



Submitted via email

July 15, 2021
Adrienne Thomas
National Oceanic and Atmospheric Administration
1401 Constitution Avenue NW, Room 5128
Washington, DC 20230
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Re: Comment Request for the Reporting of Sea Turtle Incidental Take in Virginia Chesapeake Bay Pound Net Operations, Document No. 2021-12136, 86 FR 30,918 (June 10, 2021)

Dear Ms. Thomas,

These comments are submitted on behalf of the Center for Biological Diversity (“Center”) to the National Oceanic and Atmospheric Administration (“NOAA”) on the reporting of sea turtle incidental take in Virginia Chesapeake Bay Pound Net Operations, Document No. 2021-12136. The Center is a non-profit public interest conservation organization with more than 1.4 million members and online activists dedicated to protecting imperiled species and their habitats, including efforts to limit take of endangered species, like the loggerhead, Kemp’s ridley, and green and leatherback sea turtles.

Sea turtles around the world are threatened with extinction, largely due to human activities.¹ In the Chesapeake Bay, hundreds of dead sea turtles are found washed up on beaches every year.² It’s estimated that the annual take of sea turtles by U.S. fisheries has increased, with scientists observing a North Carolina fishery increasing take of Kemp’s ridley by 318% and green sea turtles by 676% over a fifteen-year period.³ In 2004, it was estimated that globally 250,000 loggerhead and 60,000 leatherback turtles were to be snared by commercial longline fishing, with tens of thousands sea turtles dying every year.⁴

Under the Endangered Species Act (“ESA”), federal agencies have a duty to consult with the National Marine Fisheries Service (“NMFS”) to ensure that any action authorized, funded, or

¹ Santos, B. S., Kaplan, D. M., Friedrichs, M. A. M., Barco, S. G., Mansfield, K. L., and Manning, J. P. Consequences of drift and carcass decomposition for estimating sea turtle mortality hotspots. *Ecol. Indicat.* 84:319–36 (2018). doi: 10.1016/j.ecolind.2017.08.064

² *Id.*

³ Putman NF, Hawkins J, Gallaway BJ. “Managing fisheries in a world with more sea turtles.” *Proc. R. Soc. B* 287: 20200220 (2020). <http://dx.doi.org/10.1098/rspb.2020.0220>

⁴ Lewison, Rebecca L., Sloan A. Freeman, and Larry B. Crowder. “Quantifying the effects of fisheries on threatened species: the impact of pelagic longlines on loggerhead and leatherback sea turtles.” *Ecology letters* 7.3: 221-231 (2004).

carried out is not likely to jeopardize the continued existence of any threatened or endangered species.⁵ When NMFS concludes that a proposed agency action will not jeopardize the continued existence of the species, but is likely to result in incidental takings, NMFS issues an incidental take statement (“ITS”), which must specify the impact of the taking on the species, and the reasonable and prudent measures necessary or appropriate to minimize such impact.⁶ The ITS is meant to set a “trigger” that, when reached, results in an unacceptable level of incidental take and requires the parties to re-initiate consultation.⁷

Currently in Virginia pound net operations, NMFS requires fishermen to self-report the incidental catch of protected species.⁸ Self-reporting is important, as it can provide NMFS with information straight from the field. However, many fishermen may be reluctant to report, making official take reports significantly under-representative.⁹ The ESA requires that, “in order to monitor the impacts of incidental take, the Federal agency or applicant must report the process of the action and its impact on the species to the Service as specified in the incidental take statement.”¹⁰ Therefore, courts have held that take that is not appropriately monitored or ITS that fail to establish meaningful triggers are arbitrary and capricious.¹¹

To ensure NMFS is accurately monitoring take numbers, the agency must investigate ways to incentivize or independently verify the incidental catch of protected species. This is particularly important because NMFS is receiving take numbers from the field that are significantly less than anticipated take in the ITS¹²:

⁵ 16 U.S.C. § 1536(a)(2)

⁶ 16 U.S.C. § 1536(b)(4); 50 C.F.R. § 402.14(i).

⁷ *Ariz. Cattle Growers' Ass'n v. U.S. Fish & Wildlife*, 273 F.3d 1229, 1249 (9th Cir. 2001).

⁸ 50 C.F.R. § 223.206 (2018).

⁹ Cleary, N.E. “A Review of NOAA’s Incidental Take Permit (ITP) Process.” Duke University Master’s Thesis 20. https://dukespace.lib.duke.edu/dspace/bitstream/handle/10161/22643/Cleary_FinalMP.pdf?sequence=1

¹⁰ 50 C.F.R. § 402.14(i)(3)

¹¹ *Wildfish Conservancy v. Salazar*, 628 F.3d 513 (9th Cir. 2010).

¹² Endangered Species Act Section 7 Consultation on NMFS Gear Regulations in the Virginia Pound Net Fishery (Mar. 31, 2018). <https://doi.org/10.25923/5zs1-1f35>; FOIA Response to the Center for Biological Diversity, dated June 29, 2021, DOC-NOAA-2021-001675.

Species Name	Annual Anticipated Non-Lethal Take	Annual Anticipated Lethal Take	Reported Non-Lethal Take	Reported Lethal Take
NWA DPS loggerhead sea turtles	806	2	2018 – 0 2019 – 0 2020 – 2	2018 – 0 2019 – 0 2020 – 0
Kemp’s ridley sea turtles	162	2	2018 – 0 2019 – 0 2020 – 1	2018 – 0 2019 – 0 2020 – 0
North Atlantic DPS green sea turtles	17	2	2018 – 0 2019 – 0 2020 – 0	2018 – 0 2019 – 0 2020 – 0
Leatherback sea turtles	8	4	2018 – 0 2019 – 3 2020 – 0	2018 – 0 2019 – 0 2020 – 0

In conclusion, NMFS has a duty to properly monitor protected species take levels. If the take is not being monitored, then the safeguard established by the ITS to save endangered species is for naught. The agency must comply with the ESA and investigate ways to independently verify the incidental catch of protected species.

Sincerely,



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Consequences of drift and carcass decomposition for estimating sea turtle mortality hotspots

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Consequences of drift and carcass decomposition for estimating sea turtle mortality hotspots

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Abstract

Sea turtle strandings provide important mortality information, yet knowledge of turtle carcass at-sea drift and decomposition characteristics are needed to better understand and manage where these mortalities occur. We used empirical sea turtle carcass decomposition and drift experiments in the Chesapeake Bay, Virginia, USA to estimate probable carcass oceanic drift times and quantify the impact of direct wind forcing on carcass drift. Based on the time period during which free-floating turtle carcasses tethered nearshore were buoyant, we determined that oceanic drift duration of turtle carcasses was highly dependent on water temperature and varied from 2-15 days during typical late spring to early fall Bay water conditions. The importance of direct wind forcing for turtle carcass drift was assessed based on track divergence rates from multiple simultaneous deployments of three types of surface drifters: bucket drifters, artificial turtles and turtle carcass drifters. Turtle drift along-wind leeway was found to vary from 1-4% of wind speed, representing an added drift velocity of approximately 0.03-0.1 m/s for typical Bay wind conditions. This is comparable to current speeds in the Bay (0.1-0.2 m/s), suggesting wind is important for carcass drift. Estimated carcass drift parameters were integrated into a Chesapeake Bay oceanographic drift model to predict carcass drift to terrestrial stranding locations. Increased drift duration (e.g., due to low temperatures) increases mean distance between expected mortality events and stranding locations, as well as decreases overall likelihood of retention in the Bay. Probable mortality hotspots for the peak month of strandings (June) were identified off coastal southeastern Virginia and within the lower Bay, including the Bay mouth and lower James River. Overall, results support that sea turtle drift time is quite variable, and varies greatly depending on water and air temperature as well as oceanic

45 conditions. Knowledge of these parameters will improve our ability to interpret stranding events
46 around the globe.

47 **Key Words**

48 sea turtle strandings; sea turtle mortality; Chesapeake Bay; carcass decomposition; drift leeway;
49 drift simulations; endangered species; conservation

1. Introduction

Coastal strandings of deceased sea turtles provide a unique opportunity to study drivers of mortality in the world's threatened and endangered sea turtle populations (Epperly et al. 1996, Hart et al. 2006). However, interpreting coastal strandings of dead sea turtles can be challenging for a number of reasons. Level of turtle carcass decomposition and/or lack of visible injuries often make determining the cause of mortality impossible. Furthermore, although stranding events provide a general time period and region of mortality, they do not provide a specific space-time location for mortality events that can be directly related to potential causal factors (e.g., human activities, environmental conditions, etc.). Management guidelines have highlighted the need to better understand landfall patterns of stranded sea turtles to infer possible causes of mortality from mortality locations (Turtle Expert Working Group 1998).

Sea turtle carcasses typically sink upon death, until the accumulation of decomposition gases causes the body to bloat and float to the surface (Epperly et al. 1996). At this point, the body is partially submerged and acts as a drifting object. The drift of a deceased sea turtle from death at-sea to a terrestrial stranding location depends on physical forces, namely the direction and intensity of local currents and winds (Epperly et al. 1996, Hart et al. 2006). Forecast models integrating these physical forcing mechanisms can be used to predict the trajectories of drifting objects, including deceased sea turtles. However, the drift characteristics of turtle carcasses, such as the impact of direct wind forcing on carcass movements and the period of time carcasses are positively buoyant and, therefore, capable of significant horizontal movements at the ocean surface, are poorly understood. Careful interpretation of stranding observations based on detailed knowledge of these carcass drift parameters is necessary to better identify probable space-time coordinates of mortality events.

The Chesapeake Bay (Bay) and its surrounding coastal waters are critical forging and developmental habitat for the approximately 5,000 to 20,000 sea turtles (primarily juveniles) who use Bay waters seasonally (Musick and Limpus 1997, Coles 1999, Mansfield et al. 2009). However, a significant number of sea turtle strandings are recorded on local beaches each year. Approximately 100 to 300 sea turtles are found stranded on Virginia's coastline, of which the vast majority are deceased (Mansfield 2006, Swingle et al. 2016). Despite a number of management efforts aimed at reducing turtle mortality, hundreds of turtles continue to wash up every year (National Marine Fisheries Service 2006, Dealteris and Silva 2007, Swingle et al. 2016). Furthermore, as most fatalities potentially go unobserved due to low likelihood of landfall and carcass decomposition, these stranding events may considerably underestimate total at-sea mortality (Murphy and Hopkins-Murphy 1989, Epperly et al. 1996). With all sea turtles within U.S. waters classified as threatened or endangered (National Research Council 1990), there is a pressing need to understand stranding events and identify sources of mortality to ensure population recovery.

Here we address two key uncertainties when estimating mortality locations using stranding data and oceanographic drift simulations: (1) the probable amount of time dead turtles drift before stranding on shore, and (2) the correction to pure oceanic drift needed to account for direct wind forcing on turtle carcasses floating at the surface. A critical factor influencing oceanic drift times is the decomposition rate of carcasses, which controls both how long the carcass will remain buoyant and what decomposition state it will be in when it strands. Carcass decomposition studies are needed to relate the level of decomposition of observed stranded turtles to probable water drift times; however, very limited research on carcass decomposition has been conducted on sea turtles. Higgins et al. (1995) observed the complete decay of two

Kemp's ridleys to occur within 4-12 days; however, one turtle yielded unreliable results due to inconsistencies in sampling protocol between treatments. Furthermore, this study's subtropical location in the Gulf of Mexico may not be representative of the more temperate conditions in our region, the Chesapeake Bay. Intermittent observations noted in Bellmund et al. (1987) of five dead turtles entangled in a pound net in the Chesapeake Bay suggests total decay to occur on a much longer time scale, upwards of 5 weeks, yet detailed information on oceanographic conditions, time of year, or turtle sizes are not presented in the study. The discrepancies in decomposition results, limited ocean temperature range, and small sample sizes highlight the need for controlled field studies relating carcass condition to probable drift time over a range of environmental conditions.

In addition, whereas ocean circulation models are often available to assess the impact of currents, little is known about the impact of direct wind forcing on the surface transport of turtle carcasses. An object's movement through water caused by surface winds is referred to as its leeway (Allen and Plourde 1999, Breivik et al. 2011). The impact of winds on drifting objects is generally assessed in terms of leeway coefficients representing the fraction of the wind speed that must be added to the along-wind and cross-wind current components to accurately simulate drift patterns (Allen 2005). Field experiments to determine leeway coefficients have been carried out to assess drift characteristics of a variety of objects, such as watercrafts and human bodies, primarily for the purposes of search and rescue operations (Allen and Plourde 1999, Breivik et al. 2011). Some studies have investigated the drift of animal carcasses in relation to likelihood of carcass landfall (Degange et al. 1994), but few provide specific estimates of carcass leeway parameters (Bibby and Lloyd 1977, Bibby 1981). Nero et al. (2013) evaluated turtle carcass leeway from the track of a single tagged moribund turtle, providing the sole estimate of sea turtle

wind-induced drift in the literature. There is a noted need to combine experimentally obtained drifter data with oceanographic models to better understand how oceanic conditions affect the flow of carcasses at sea (Hart et al. 2006, Nero et al. 2013, Koch et al. 2013). To address this data gap, we carried out field drift experiments to better estimate the impact of winds on turtle carcass drift patterns (specifically, the along-wind and cross-wind leeway coefficients).

Results from both the decomposition study and the carcass drift experiments were used to parametrize a carcass drift model and provide initial estimates of probable mortality locations from deceased sea turtle strandings data for coastal areas in the Chesapeake Bay. Collectively, the outcomes of this study enhances our ability to infer locations of mortality from stranding events in the Bay, as well as elsewhere around the globe.

2. Materials and Methods

For simplicity in this study, we will use the term “stranding” to refer to the final beached location of a deceased sea turtle. Though stranding datasets often also include data on sick or injured sea turtles that are alive, simulation of the movements of these individuals is greatly complicated by their potential for active swimming, and, therefore, we focus exclusively on deceased individuals.

2.1 Decomposition study

When stranded turtles are found on the beach (which generally occurs within 12 hours of stranding in populated areas), carcass condition is assessed on a condition code scale from 1 (freshly deceased; we are excluding alive code 0 strandings) to 5 (bones) as per the National Oceanographic and Atmospheric Administration’s Sea Turtle Stranding Salvage Network (STSSN) stranding report forms and guidelines

(<http://www.sefsc.noaa.gov/species/turtles/strandings.htm>) (Table 1). We conducted carcass decomposition experiments to relate condition codes to probable post-mortem in-water times for a variety of environmental conditions. The decomposition rate of eight juvenile sea turtles, including two loggerheads (*Caretta caretta*), two Kemp's ridleys (*Lepidochelys kempii*) and four greens (*Chelonia mydas*), ranging in size from 26.3 to 68.0 cm straight carapace length notch to tip and 2.38 to 36.5 kg in mass, were assessed during the summers of 2015 and 2016. Carcasses were supplied by the Virginia Aquarium & Marine Science Center Stranding Response Program (VAQS) and Maryland's Department of Natural Resources Marine Mammal and Sea Turtle Stranding Program. Death was attributed to cold-stunning in all cases but one, where lacerations on the carapace of a Kemp's ridley suggested death by vessel strike. All carcasses were assessed with an initial condition code of 1 or 2. Carcasses were frozen prior to use and thawed in a fresh water bath before placement at the study site. Preliminary morphometric measurements were recorded using standard measurement protocols (Wyneken 2001).

A moored buoy system was constructed that allowed for free movement of the carcass throughout the water column and tethered in an area of 3 to 6 ft of water varying with tide in the York River, VA (Figure 1A). A 4-ft helix mooring anchor was installed into the bottom sediment and attached to a bullet buoy with rope. The turtle carcass was wrapped in 4-inch heavy duty polyethylene plastic mesh held together by carabiners and attached to the mooring system using a rope and carabiner (Figure 2). This allowed the carcass to freely move through the water column as its buoyancy changed due to decomposition processes over time. For two trials, a GoPro HERO3+ camera was attached to PVC-pipe embedded in the plastic mesh, and 3-hours of 5-second time lapse photos were recorded daily. The GoPro and PVC-pipe apparatus were adjusted to achieve neutral buoyancy so as not to impede the carcass from floating and sinking.

Approximately every 24-hours during low tide, the turtle carcass was detached from the anchor line and brought to shore where it was thoroughly photographed and qualitatively analyzed, including a detailed description of the carcass decomposition state, its associated condition code and whether it was at the surface or bottom of the water column at the time (Figure A1). As many of the codes are quite broad and can include a wide range of characteristics, early and late categories for each condition code criteria were also recorded. Code 4 is characterized as “dried carcass” by STSSN guidelines, but the turtle carcasses in this study were submerged for the entire trial and did not exhibit this type of desiccation, thus, code 4 was not observed. Temperature data were obtained from the Virginia Estuarine and Coastal Observing System Gloucester Point continuous water quality monitoring station at Gloucester Point, VA (<http://web2.vims.edu/vecos/Default.aspx>), located within 150 meters from the experimental study site. Linear regression models were performed to assess the effect of temperature on duration of positive buoyancy and total time to decay to code 5. Due to low sample size and lack of sufficient replicates across species and size classes, the effect of turtle species or size on decomposition could not be assessed, but we did not observe any obvious, large differences in decomposition between individuals of different sizes or species were observed.

2.2 Drift study

To assess the effect of wind forcing on turtle drift, three types of drifters were used: turtle carcass drifters, bucket drifters and wood-foam turtle drifters (Figure 3; Table 2). Turtle carcass drifters were constructed from the remains of deceased stranded turtles collected by VAQS (Figure 3A). Prior to use, the turtle plastron and carapace were separated during necropsy (with head and flippers still attached) and internal organs were removed. The body cavity was then

filled with insulating foam sealant spray and holes were drilled around the perimeter of the plastron and carapace pieces, which were reattached with heavy-duty zip ties and a thin 1.5 cm x 1.5 cm galvanized wire mesh on the underside of the carcass (Figure A2). The amount of foam was based on the size of the body cavity and the need to maintain positive buoyancy. When the turtle carcass drifter was floating, the majority of the shell was fully exposed with the apex of the carcass edge forming the waterline, consistent with the floating behavior of a fully bloated turtle carcass. A satellite-transmitting GPS receiver (Assetlink TrackPack transmitters) was mounted on a self-righting crab pot buoy that was attached to the turtle via a rope passing through its carapace (Figure A3). Although the impact of the buoy itself on carcass drift was not quantified, it was made as small as possible and separated from the carcass to minimize impact. The carcasses were stored prior to use in a freezer and were frozen at time of release.

The “bucket drifters” used in this study were very-near surface “Kathleen” drifters made from inverted 5-gallon plastic buckets with weights and floats inside so as to be mostly submerged when in water (Chen et al. 2009, Putman and Mansfield 2015) (Figure 3B; <http://www.nefsc.noaa.gov/epd/ocean/MainPage/lob/driftdesign.html>). These were designed to track near surface currents with movements relatively unaffected by wind. Of all the drifters launched, the buckets most closely represent the movements of water particles, thus providing an estimate of the near-surface current field to be compared with movements of the other two drifter types.

The wood-foam turtle drifters were constructed out of layers of wood and polystyrene foam in the approximate form of a juvenile loggerhead sea turtle (Figure 3C). These drifters were included as a potential (more readily available) alternative to true turtle carcass drifters, although it is worthwhile to note that the aspect ratio of the wood-foam drifter was a bit higher

than the turtle carcass drifters (e.g. whereas the difference between straight carapace length and curved carapace length for the carcass drifters ranged 5.2-7.8 cm, wood-foam drifters had a difference of 14.9 cm; Table 2). Additionally, the vertical profile of the wood-form turtle included steps whereas the profile of a true turtle carcass is rounded. Both bucket drifters and wood-foam turtle drifters were painted orange and small orange construction flags were attached on top to make the drifters more visible to boaters.

We conducted four drifter releases in the main stem of the lower Chesapeake Bay during the summer of 2016 (Figure 1A; Table 3). Each deployment included two bucket drifters and two wood-foam turtle drifters. Due to the limited number of turtle carcasses available for this study, only three loggerhead turtle carcasses were used in total. The first trial included two different carcasses, while the others used a third carcass, which was collected within 24 hours of beaching, refrozen, and redeployed for subsequent deployments. Given the large size of this third turtle carcass drifter, short deployment periods, and good initial carcass state, the multiple freeze-thaw cycles did not appear to compromise the head or flippers, all of which remained attached and essentially intact until the turtle was disposed of after the final deployment. The drifters were released by boat in the middle of the lower Chesapeake Bay and GPS locations were obtained every 30-minutes via satellite. Drifter positions were closely monitored until the objects beached, typically within 1-3 days.

Locations for all drifter types were matched in time by linearly interpolating between positions where necessary. Meteorological data (i.e., wind speed and direction) available in 6-minute intervals were obtained from the National Oceanographic and Atmospheric Administration's Center for Operational Oceanographic Products and Services (<http://tidesandcurrents.noaa.gov/>) monitoring station 8637611 York River East Rear Range

Light. Due to the presence of a weather front in the area during the second deployment, meteorological data for this trial were instead obtained from the 8638614 Willoughby Degaussing Station located in an adjacent tributary (Figures A4-A7). Wind speed was adjusted from 57 feet recorded height to the standard 10 m reference height using the methods described in Hsu et al. (1994). East-west (u) and north-south (v) wind vector components were computed and wind vector components were averaged over 30-minute intervals corresponding to the drifter data time series.

Drift leeway of the wood-foam drifters and turtle carcass drifters were computed based on the observed motion of the drifters relative to bucket drifters (most closely representing the surface current field). Leeway can be measured using a direct or indirect approach (Allen and Plourde 1999, Breivik et al. 2011). Here, drift leeway was measured indirectly by comparing the movements of the turtle and wood-foam drifters to those of the bucket drifters. The rate of change in the separation between drifters were calculated at pairs of consecutive time steps. Linear-regression analysis was used to derive leeway coefficients based on the slopes of the regression line between wind speed and along-wind leeway, cross-wind leeway or leeway speed. In addition, separation distances as a function of time since release were calculated between each combination of drifter pairs.

Due to the separation of drifters over time, movements were most comparable during the initial hours following deployment when objects were close together and likely experiencing the same physical oceanographic forces. Thus, the duration of each trial was limited from time of deployment to the next slack tide, when the tidal flow reversed direction and currents were weak and spatially incoherent (Hospital et al. 2015). This time period ranged from 2.5-8.5 hours based on deployment. Slack tide data were obtained from the National Oceanographic and

Atmospheric Administration's Tidal Current Predictions (<http://tidesandcurrents.noaa.gov/>) for station ACT5406 York River Entrance Channel (NW end).

Linear regression models used to estimate leeway coefficients for the turtle carcass drifters and wood-foam drifters included categorical variables for each deployment, (i.e. drifter release trial), turtle carcass drifter or wood-foam drifter, and the bucket being compared with a given carcass or wood-foam drifter trajectory. When estimating wood-foam drifter leeway, both bucket and wood-foam drifter were considered random nested effects inside wind speed and deployment. When estimating turtle carcass drifter leeway, bucket was a random effect nested inside wind speed, deployment and carcass drifter. The regression model included effects of categorical variables on both the intercept and slope of the relationship between wind speed and leeway. Analysis of variance was used to test for differences in wind leeway with deployment or individual carcass drifter.

Simple linear models including only wind speed as a predictor of leeway (values for which were averaged across buckets) were also run to calculate leeway coefficients for each deployment and turtle carcass drifter or wood-foam drifter combination. Both unconstrained (i.e., with a freely varying y-intercept) and constrained (i.e., y-intercept=0) linear regressions were performed. Note that p-values for constrained regression estimates are not reported because level of significance is unreliable when forcing the slope through zero.

2.3 Particle modeling

Estimated model parameters attained from the decomposition and drifter studies (i.e., likely drift duration from mortality location to stranding and along-wind leeway coefficient) were integrated into an oceanographic drift model simulating carcass drift trajectories in the Chesapeake Bay to observed stranding times and locations. The basic simulation strategy was to

“release” many surface pseudo-particles (i.e., simulated particles) throughout the domain of the oceanographic model, track these for a period of time based on wind and current estimates from atmospheric and ocean circulation models, and identify those pseudo-particles that arrived at stranding zones for each month. The initial release points for many such “stranding” forward drift trajectories were then aggregated to estimate a probability distribution for the mortality locations of stranded turtles for June, the peak month for strandings. No additional randomness was added to the model to account for sub-grid-scale variability as the oceanographic and atmospheric models themselves have errors and uncertainties that would be difficult to quantify separately from sub-grid-scale variability.

Using ocean circulation data from a Regional Ocean Modeling System (ROMS; version 3.6) physical oceanographic model of the Chesapeake Bay area (ChesROMS; Feng et al. 2015), particles were released throughout the Bay and run forward in time using the offline Lagrangian drift simulation tool Ichthyop version 3.1 (Lett et al. 2008). Simulations were conducted for the time period 2001-2005 as ChesROMS ocean currents simulation data were only available for this period at the time of this study. Computer simulations were configured to release 1,000 particles randomly throughout the Bay every 6-hours with particle tracking time ranging from 2-8 days based on results from the decomposition study. Based on observed variability in along-wind leeway results from the drifter experiment, leeway ranging from 0-4% of wind speed were added to ChesROMS currents so that pseudo-particle trajectories represent the combined effects of currents and direct wind forcing on surface transport. Wind forcing was derived from the North American Regional Reanalysis (NARR) dataset (Mesinger et al. 2006). ChesROMS, NARR and Ichthyop internal timesteps were all 3 hours. NARR winds were unavailable for 2016 at the time of the study, and thus we were unable to use them for analyses in the drifter experiments.

Sea turtle stranding data collected by the Virginia Institute of Marine Science and VAQS during 2001-2005 were analyzed to identify areas with high numbers of strandings. The years 2001-2005 was chosen to be consistent with simulations, but using a longer time period does not change the regions identified as having a high stranding rate. Target zones were created in sections of Accomack, Hampton, Norfolk, Northampton and Virginia Beach Counties (Figure 1A). Each zone has a 3-km offshore extent. Computer simulations were run targeting these specific stranding-hotspots. Simulation results for relative particle density of the origins of particles reaching target zones were mapped on a 5km x 5km square grid.

3. Results

3.1 Decomposition study

Initial assessments of all turtle carcasses indicated that the bodies were in good condition with no significant marks or lesions, with the exception of one vessel-strike turtle carcass (turtle 3). The three lacerations on the vessel strike turtle did not seem to have severally altered decomposition as results for this turtle carcass were consistent with those for the other carcasses. A summary of condition code criteria used to evaluate the carcasses can be found in Table 1 and preliminary measurements of all turtle carcasses used in the study is noted in Table 4. The majority of the turtles were a code 1 upon placement at the York River study site and sank immediately. Positive buoyancy due to the accumulation of decomposition gases occurred within the first two days in all carcasses. At time of surfacing, all turtle carcasses were observed with some degree of bloating and assessed with a condition code of 2. Turtles 2 and 8 began as an early code 2 and did not sink upon initial placement, but remained floating at the water surface.

The effect of temperature was found to be statistically significant on both the duration of positive buoyancy ($p < 0.001$, $R^2 = 0.8605$) and time to reach total decay (code 5) ($p < 0.001$, $R^2 = 0.8401$) (Figure 4A). Duration of positive buoyancy ranged from 2-15 days. By a late code 3, all turtle carcasses deteriorated to a point that the body was no longer intact enough to retain decomposition gases, causing the bodies to sink and remain at the bottom of the sea floor until reaching code 5. Duration of complete decomposition to code 5 ranged from 5-18 days (Figure 4B, Table 5). The eighth turtle, submerged in cooler water temperatures averaging 17°C, did not exhibit the same level of tissue disintegration as observed in the warmer water decomposition trials (with average water temperatures of 20-29°C). The remains from this turtle formed a mass of tissue by day 18, when the turtle reached an early code 5. Nearly all of the bones were detached from the undistinguishable mass of fat by day 20, yet the tissue remnants were observed to persist until day 23, when all remains were lost through the mesh.

Occasional observations were made of organisms scavenging within the body cavity of the turtle carcasses during sampling, including juvenile blue crabs (*Callinectes sapidus*) and mud snails (*Nassarius spp.*) In addition, a Go-Pro camera attached to the decomposition set up of two trials (turtles 3 and 4) depicted the presence of a school of fish (*Menidia menidia*) feeding on the plastron-side of turtle 3 while it was floating at the surface.

3.2 Drift study

Wind speed, deployment and individual turtle carcass drifter were found to have a significant effect on along-wind leeway ($p > 0.05$). Therefore, we conducted separate regressions for each deployment-turtle combination. Unconstrained regressions indicated that along-wind leeway was significantly related to wind speed for turtle carcass drifters 1 and 2, turtle carcass drifter 3 during deployment 3, and wood-foam drifters during deployments 1 and 3-4. Cross-

wind leeway was not found to be significant for any turtle carcass drifter, but was significant for most of the wood-foam drifter deployments (Figure 5; Table 6). The 95% confidence interval of the slope for all components of leeway were largest in deployment 1 for both the turtle carcass drifters and wood-foam drifters, which was also the deployment trial of the longest duration.

Along-wind leeway coefficients from a constrained (i.e. y-intercept=0) linear regression ranged from 1.14-3.59% of wind speed, in wind conditions ranging from 0.08-4.24 m/s. At an average wind speed of 2.85 m/s, this equates to a change in carcass movements of 0.03-0.1 m/s due to the influence of wind versus currents alone. The along-wind leeway of the wooden turtles ranged from 0.73-3.54% of wind, equating to approximately a 0.02-0.1 m/s change in movement. Along-wind leeway coefficients for turtle carcass drifters and wood-foam drifters were positively correlated, but this correlation was not statistically different from zero (Pearson's correlation coefficient=0.73, $p=0.17$ for $n=5$).

Despite being released in nearby areas, the tracks of the drift objects varied significantly across deployments (Figure 6). Upon release, drifters were noted to diverge by type fairly quickly (<1 hour), but all continued to move in the same general direction following deployment until the direction of tidal currents began to reverse. This trend is most clearly observed in the drifter tracks during deployment 2, which was the shortest deployment with objects beaching approximately 26 hours after release. The buckets in particular were noted to remain fairly close to one another throughout the majority of the drift release trials, and were the last objects to make landfall in nearly all of the deployments.

3.3 Carcass drift simulations

During 2001-2005, 1487 of the reported Virginia sea turtle strandings occurred within the model domain. The vast majority of these strandings (82%, $n=1222$) occurred in three coastal

areas of three Virginia counties: Northampton, Virginia Beach, and Norfolk (Figure 1A). Although stranding events took place throughout the spring and into the early fall, the majority of strandings occurred during late spring (May-June) and summer (Lutcavage and Musick 1985, Mansfield 2006, Barco and Swingle 2014), with nearly half of the standing events occurring during June alone (44%, n=660; Figure 1B).

The spatial distribution of location of mortality to these three top stranding zones were predicted using computer simulations applying a variety of parameter estimates covering the range of values identified in the drifter and decomposition studies. Along-wind leeway coefficients of 0%, 2% and 4% of wind speed were examined. Water temperatures in the lower Chesapeake Bay during peak times of late spring and summer strandings typically average around 20-30°C, thus drift durations of 2, 5 and 8 days were examined. Summaries of release points of particles that land in the three top zones where Virginia strandings occur during the month of June suggest that most mortalities likely originate from areas within the lower Bay, including the waters near the entrance to the Bay and the James River, as well as coastal waters off of Virginia Beach county (Figures 7 and 8). An increase in drift duration was noted to increase the distance of particle origin from the zone in all cases but one (4% leeway for zone 2 for 8 days) (Table 7). Increasing the percentage of winds consistently increased distance of particle origin from the zone for 2 days drift, but results were mixed for longer drift periods. In addition, the total number of particles making landfall increased with increasing wind forcing values across all zones, regardless of drift duration. For example, there was at least a 50% increase in the absolute number of particles reaching Zone 1 in simulations with a wind forcing value of 4% versus 0% for all drift duration values (Figure A8).

In the lower Chesapeake Bay, prevailing winds exhibit seasonal variability, with winds prevailing from the southwest during the summer months (Paraso and Valle-Levinson 1996). Summertime probability maps of particle origins reflect these dominant wind patterns, with a notable shift towards a more eastern origin with the addition of stronger wind forcing, while a north-south shift was less consistent (Figure A9).

4. Discussion

To our knowledge, our study provides the first use of extensive field experimentation to better resolve key uncertainties when modeling dead turtle drift patterns, namely, water drift time before stranding and the influence of direct wind forcing on turtle carcass drift trajectories. Model simulations of top stranding zones throughout the Chesapeake Bay with different time and wind forcing parameters highlight the sensitivity of drift patterns to parameter estimates. This research is also the first efforts to use oceanographic modeling to identify potential areas of turtle mortality in Virginia's waters.

4.1 Decomposition study

The post-mortem interval is a key element in forensic investigations. All eight turtle carcasses in this study decomposed to bones in less than 18 days, in water temperatures averaging 17-29°C. Higgins et al. (1995) observed the complete decay of two Kemp's ridley turtles from code 1 to code 5 in 4-12 days depending on water temperature, consistent with our results. These results also fit well within the range of decomposition for other aquatic animals, including an estimated drift duration for small cetaceans of 5-10 days depending on carcass state (Peltier et al. 2012).

The duration of carcass buoyancy is a key element to consider when interpreting stranding patterns. Only bloated, gas-filled carcasses with positive buoyancy can float and drift large distances. Thus, the probability of a particular turtle carcass making landfall is directly related to its buoyancy (Peltier et al. 2012). Water temperature plays a key role in the carcass surfacing time of deceased marine animals (Parker 1970, Higgins et al. 1995, Patterson et al. 2007, Peltier et al. 2012). Decay processes are initiated predominately by the activity of intestinal bacteria, which is accelerated in warmer conditions (Reisdorf et al. 2012). In this study, time period to attain buoyancy ranged from less than 24-hours in warmer water temperatures (28-29.5°C) to 2-days in cooler waters (17.5-20.5°C). Water pressure and depth can also influence carcass surfacing time, and thus decomposition rates in the shallow waters of this study may not be fully indicative of processes in deeper parts of the Bay. It is also worthwhile to note that the carcasses in this study were frozen prior to use. Studies have shown that previously frozen animals exhibit accelerated rates of disarticulation on land (Micozzi 1986), suggesting that duration to achieve buoyancy might be greater for fresh dead turtles compared to the frozen carcasses used in our study. Nonetheless, results match relatively well with Higgins et al. (1995), where fresh dead turtle carcasses surfaced in less than 24 hours after placement in 33-34°C waters, and after 4-5 days in 14-22°C waters. Sis and Landry (1992) observed red-eared pond slider carcasses to resurface in less than two days after postmortem, and some cetacean carcasses have been observed to inflate with gases within hours (Reisdorf et al. 2012). Although it is possible that bottom currents may transport carcasses from initial site of mortality, low current velocities in the bottom boundary layer, as well as contact with bottom sediments, likely lead to submerged carcasses not moving far before achieving positive buoyancy. For example, net displacement of a freshly deceased turtle prior to gaining buoyancy observed by Nero et al. 2013

was approximately 1-km over a submergence period of 4.8 days. Finally, a stratified water column with considerably lower temperatures at the bottom (e.g., as is typical of late spring) may slow decomposition processes at the bottom and thus increase the amount of time before a carcass surfaces beyond what was observed in our shallow water study.

Once a carcass surfaces, assuming it is not entangled, it will drift at the surface while continuing to gradually decompose (Reisdorf et al. 2012). The carcass will eventually decompose to a point where it is no longer intact enough to retain gases, and it will sink to the bottom of the sea floor. Thus, drift duration of carcasses is limited to only the interval of positive buoyancy, which varied with water temperature from 2 to 15 days in this study. In all trials, code 3 was the stage at which the carcasses were not intact enough to retain gases, thereby sinking and never reappearing again at the surface. These results are similar to those reported in Higgins et al. (1995), and suggests that stranded sea turtles found on beaches must land prior to reaching a late code 3. For stranded turtles found in condition code 4 or 5, it is probable that this level of decomposition occurred while on land or after reaching a shallow, nearshore environment. Uncertainty in the time component surrounding sea turtle decomposition on land can be limited by focusing on stranding events in highly populated areas, where beaches are frequently visited and strandings are likely reported and documented in a timely fashion.

Our results indicate that water temperature plays a significant role on the duration of surface drift time and thus on the probability of turtle carcasses making landfall. In particular, the timing of the annual spring peak of turtle strandings observed in the Chesapeake Bay during May and June may be partially explained by climatic conditions. Typically, sea turtles first begin entering the Chesapeake Bay around mid-May when water temperatures approach 18-20° C (Mansfield 2006, Mansfield et al. 2009). Based on the results of this study, if mortality occurs at

this time of the year when water temperatures are cooler, it is possible that turtles can drift for upwards of 15 days after surfacing. However, as the summer progresses and water temperatures rise, carcasses will likely decompose faster and thus drift for a much shorter time period (2-5 days). Therefore, increasing water temperature may decrease the likelihood of turtle carcasses beaching. Due to faster decomposition in warmer waters, it is also likely that from late summer to early fall only turtles that die close to shore will beach, as turtles dying further offshore will decompose before washing ashore.

4.2 Drift study

Our leeway drift estimates of turtle carcass drifters are among the first attempts to parameterize the drift characteristics of deceased sea turtles prior to stranding (but see Nero et al. 2013 for another recent attempt). We found that turtle carcasses drift at approximately 1.14-3.59% of the wind speed, equating to a change in movement of roughly 0.03-0.1 m/s based on typical Bay winds. With the typical currents in the Chesapeake Bay ranging from 0.1-0.2 m/s (Guo and Valle-Levinson 2007), the effect of wind on turtle carcass drift is non-negligible and must be considered when attempting to model drift trajectories.

Our use of constrained linear regressions (i.e., forcing the line of best fit to pass through the origin) should provide a more accurate estimate of leeway than an unconstrained regression assuming that objects remain at rest relative to surrounding waters in the absence of winds (Allen 2005, Breivik et al. 2011). It is also preferred over the unconstrained method when the range of wind speed is limited (Breivik et al. 2011). Notably, winds during the second deployment, for which relationships between along-wind leeway and wind speed were not significant, were the weakest and smallest in range of all deployments (Tables 3 and 6).

Our results of turtle drift between 1% and 4% of wind speed are similar to those reported for other drifting animals. The drift speed of sea birds and dolphins has been estimated to range between 2.5% and 4% of wind speed (Bibby and Lloyd 1977, Peltier et al. 2012), and Nero et al. (2013) estimated the drift leeway of a Kemp's ridley at 3.5% of wind from comparing the track of a satellite-tagged moribund turtle to simulated tracks from an ocean circulation model. Although the high aspect ratio of the wood-foam drifters may have contributed to the somewhat higher leeway values compared to the carcass drifters, the along-wind leeway for wood-foam drifters was similar in magnitude to that of turtle carcass drifters, ranging from 0.73-3.54%, suggesting that these artificial drifters may provide a good proxy for true turtle carcasses.

Given the limited number of turtle carcasses that were available to use for the drifter experiment, we cannot definitively say to what extent environmental variability between deployments and/or physical differences between turtles explain variability in along-wind leeway coefficient estimates. Nevertheless, there are suggestions in our data that both play a role. There was a positive correlation between turtle carcass drifters and wood-foam drifter leeway coefficients, suggestive of environmental differences between deployments being a source of leeway variability (because the same wood-foam drifters were used for all deployments, but carcasses differed between deployments). However, this correlation was not significantly different from zero, indicating that more data are needed to confirm this effect. Turtle size also appears to be related to leeway coefficient, but this effect is confounded with that of deployment, complicating a definitive assessment. Estimated along-wind leeway for the largest turtle carcass drifter (Carcass 2), which was used exclusively in the first deployment, was 3.59%, whereas for the smallest turtle carcass drifter (Carcass 3, used in deployments 2-4) it ranged from 1.14-

1.44%. This would suggest that larger carcasses are more heavily impacted by direct wind forcing, but again more data is needed to confirm this.

One study limitation was the limited temporal extent of leeway data due to the fast separation rate between the bucket drifters and the drift objects of interest. Here, we indirectly measured the leeway of the turtle objects by tracking its drift relative to the movements of the nearby bucket drifters, which were assumed to be representative of current conditions at the location of the turtle carcass drifter. However, this method is only effective when drifting objects are close together and in a relatively homogeneous current field, which typically only occurred over the first phase of the tidal cycle after deployment (within 5-8 hours of release). The direct method for estimating leeway coefficients, which uses a current meter attached directly to the drift object of interest, is another approach that can improve accuracy of leeway estimates (Breivik et al. 2011). In this study, the direct method was impractical due to the generally large size of current meters and/or expense of implementation. If the drift object is too small to tow a current meter, current data must be derived by some other means and thus the indirect method must be used (Breivik et al. 2011).

Future investigations should also consider the ratio of the carcass drifter's above water to below water cross sectional area. Percent exposure is important in measurements of leeway (Isobe et al. 2011) and a better understanding of percent exposure of the carcass drifters is an important avenue for additional research into leeway variability in turtle carcasses. Nevertheless, the rough consistency of our results with the few other available leeway measurements in turtles and other marine species suggests that our results are not a gross misrepresentation of reality.

4.3 Carcass drift simulations

Probability maps for starting points of stranding pseudo-particles for the three zones with the highest number of strandings in Virginia's waters during the peak stranding month of June highlight areas of the lower Bay and coastal waters immediately south of the Bay mouth as hotspots for turtle mortality in the region (Figure 8). Although the majority of area strandings wash up on the lower bayside coast of Northampton County (Zone 1), our model suggests that mortality for most of these turtles occur in waters spanning across the entire lower Chesapeake Bay channel to the vicinity of the James River mouth. These lower Bay waters, particularly near the entrance of the James, are also highlighted as a mortality hotspot for turtles washing up on Norfolk and Virginia Beach coastlines (Zones 2 and 3), in addition to oceanic waters south of the Bay mouth. Even for relatively long summer drift periods of 8 days, most stranding particles originated within waters immediately east and west of the Bay mouth. The Chesapeake Bay and Virginia's coastal waters are subject to heavy commercial and recreational public use (Terwilliger and Musick 1995), thus sea turtles in these areas are likely often subject to interactions with human activities. Although cause of death for a vast number of Virginia strandings cannot be determined from visual assessment or necropsies alone (Lutcavage and Musick 1985), results of this study provide focus areas for further investigations of potential causal mechanisms of mortality.

In addition, simulation results indicate the importance of physical processes and decomposition rates for accurately estimating mortality locations. The mean location of particle origin prior to beaching was noted to move further offshore as drift duration increased (Table 7), consistent with studies that demonstrate a negative correlation between release distance and carcass recovery (Hart et al. 2006). Importantly, this also highlights a probable bias in stranding

records. Although simulation results depict the majority of turtles as dying relatively close to stranding locations, this may not reveal a lack of turtle mortality further offshore, but rather that dead turtles have a greater likelihood of making landfall if mortality occurs closer to shore and in areas with high coastal retention (otherwise their bodies may simply be lost at sea). For example, the area off the bayside coast of southern Northampton County (Zone 1) where the most strandings and particle retention occurred is also the area of a cyclonic eddy system which has been noted to entrain particles in other studies (Hood et al. 1999). The high number of strandings observed in this area may be due to prevailing physical processes facilitating the entrainment of carcasses, further highlighting the key role physical oceanographic processes play in determining the likelihood that a sea turtle carcass strands. Improving representation of sub-grid-scale variability in the carcass drift model could increase the spread of particles and represents a possible improvement for future modeling studies.

Increasing the along-wind leeway coefficient used in the model had variable effects (depending on duration of drift period) on the distance from the target zones and spatial spread of probable points of origin for stranding particles. Nevertheless, increasing this parameter consistently increased the number of particles making landfall for all target zones (Figure A8). As currents move predominantly in an alongshore direction, the addition of winds allows for cross-shore movement of simulated particles, facilitating deposition in coastal areas. These trends were also reflected in the drift deployment experiments. The bucket drifters were the last objects to make landfall in nearly all of the deployments, highlighting the essential need to incorporate wind forcing effects in oceanographic simulations to properly represent drift of deceased turtles.

4.4 Conclusion

Although sea turtle strandings provide a unique opportunity to study turtle mortality, these events often provide little insight on causes of mortality and likely only represent a fraction of total mortality occurring at sea. Given the protected status of sea turtles, availability of turtle carcasses for research to elucidate drift patterns of turtle carcasses is extremely limited. Despite the limited sample size, our results provide the best estimate of turtle drift parameters currently available, and therefore, have significant potential for future use in modeling simulations aimed at interpreting stranding data. For example, the Sea Turtle Stranding and Salvage Network has been monitoring and collecting data on turtle strandings in the United States since 1980. With a dataset spanning several states and more than 30 years, this data potentially provides an important opportunity to apply our model to strandings in other geographic regions. Hindcasts of turtle carcass drift trajectories to final terrestrial stranding locations can be extremely useful in interpreting stranding events, and accurate information on the drift characteristics of sea turtles will result in more precise predictions of potential mortality locations.

This work is an important step for more robust analyses modeling the drift of stranded sea turtles to Chesapeake Bay beaches. Furthermore, drift information obtained from this study can be utilized in sea turtle carcass drift models to analyze strandings data from many other areas of the world. Our results indicate that sea turtle drift time may be quite short at 2-15 day in typical Bay spring-early fall conditions. We also determined that turtles drift at 1-4% of wind speed, demonstrating that direct wind forcing has a non-negligible role in determining drift trajectories. Oceanographic simulations identify potential mortality hotspots for the peak month of strandings (June) in waters of the lower Chesapeake Bay and oceanic areas off southern Virginia, providing focus areas for future investigations into likely drivers of sea turtle mortality.

591 These results are essential to improving our ability to predict mortality locations from stranding
592 events not only in the Chesapeake Bay, but around the globe, providing managers with essential
593 information to better protect vulnerable sea turtle populations worldwide.

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732 Tables

733 Table 1. Summary of condition code criteria. Descriptions are compiled from observations noted
 734 during the sea turtle decomposition study and the National Oceanographic and Atmospheric
 735 Administration's Sea Turtle Stranding Salvage Network stranding report forms and guidelines
 736 (<http://www.sefsc.noaa.gov/species/turtles/strandings.htm>).

Condition Code	Carcass State	Criteria
0	Alive	
1	Fresh dead	No odor, scutes and skin intact, no bloating, turtle may still be in rigor
2	Moderately decomposed	Mild to strong odor, slightly to very bloated, body mostly intact with skin and scutes only beginning to peel, some small cuts/scratches, internal organs still distinguishable
3	Severely decomposed	Carcass deflated, strong to no odor, moderate to significant amount of skin peeling, internal organs beginning to liquefy, hard to distinguish individual organs, large abrasions on body cavity
5	Skeleton, bones only	Carapace and plastron no longer held together, any soft tissue remains are minimal and unidentifiable, bones are clean or have minimal attached tissues

737

738 Table 2. Summary of drifter measurements. Turtle curved carapace length (CCL) and straight
 739 carapace length (SCL) measurements were taken from notch to tip. Asterisks (*) represents an
 740 estimated measurement due to the presence of epibiota.

Drifter type	Size (cm)
Bucket drifter	Height: 36.0 Diameter (bottom): 26.0
Wood-foam drifter	CCL: 88.5 SCL: 73.6
Turtle Carcass Drifter 1	CCL: 83.5* SCL: 76.7*
Turtle Carcass Drifter 2	CCL: 101.3* SCL: 93.5
Turtle Carcass Drifter 3	CCL: 72.5 SCL: 67.3

741

Table 3. Summary of drift deployments. The duration of the trial was established based on duration to slack tide, while the entire deployment was considered completed when the first object beached.

	Deployment 1	Deployment 2	Deployment 3	Deployment 4
Composition				
Number of Buckets	2	2	2	2
Number wood-foam drifters	2	2	2	2
Carcasses used	1, 2	3	3	3
Start of Deployment				
Location	37.17389, -76.2161	37.22833, -76.2161	37.22833, -76.1925	37.22232, -76.2328
Date	13-Jun-16	24-Jun-16	1-Aug-16	15-Aug-16
Time (GMT)	15:41	14:15	17:00	13:29
Water temperature (°C)	24.2	24.3	29.0	28.5
Air temperature (°C)	20.9	24.0	28.4	29.6
End of Trial				
Date	14-Jun-16	24-Jun-16	1-Aug-16	15-Aug-16
Time (GMT)	00:11	19:15	19:30	18:29
Duration (hh:mm)	8:30	5:00	2:30	5:00
10 m wind speed (m/s)	2.47 ± 0.79	2.37 ± 0.45	3.60 ± 0.55	2.73 ± 0.82
10 m wind speed range (m/s)	0.08-3.48	1.35-3.56	2.16-4.24	1.32-3.95
End of Deployment ^a				
Date	15-Jun-16	25-Jun-16	2-Aug-16	18-Aug-16 ^b
Time (GMT)	16:30	16:50	15:13	5:22 ^b
Duration (hh:mm)	48:49	26:35	22:13	63:53
10 m average wind speed	4.50 ± 1.38	3.67 ± 1.77	3.40 ± 0.86	3.76 ± 1.17
10 m wind speed range (m/s)	0.08-7.72	0.01-7.52	1.60-5.08	1.32-6.40

a. Deployment considered completed once first item beached

b. One of the buckets stopping emitting location data on 16-Aug-16 at 1:29 GMT

747 Table 4. Measurements of turtle carcasses used in the decomposition study.

Measurement (cm)	Turtle 1	Turtle 2	Turtle 3	Turtle 4	Turtle 5	Turtle 6	Turtle 7	Turtle 8
Species ^a	Cc	Cc	Cm	Lk	Cm	Cm	Cm	Lk
Weight (kg)	31.5	36.5	3.036	2.378	3.464	2.74	2.50	6.38
Straight carapace length (notch to tip)	68.0	67.2	29.3	26.3	30.4	28.6	28.9	37.4
Straight carapace width	54.0	54.3	22.8	23.9	24.2	23.3	22.9	32.6
Maximum head length	17.4	18.2	7.9	8.4	7.9	7.4	7.4	10.6
Body depth	23.1	24.2	11.6	8.8	11.7	10.6	10.2	15.3
Straight plastron length	46.5	52.6	25.7	20.2	24.9	23.6	23.3	27.8
Circumference at max width	112.8	125.0	53.3	54.0	55.3	51.6	49.9	75.4

748 a. Cc = *Caretta caretta*, Cm = *Chelonia mydas*, Lk = *Lepidochelys kempii*

749 Table 5. Summary of decomposition results for each turtle carcass.

Turtle No.	Species ^a	Study Dates		Temp (°C)	Days buoyant	Minimum days to reach condition code			
		Start	End			Code 1	Code 2	Code 3	Code 5
1	Cc	23-Jul-15	31-Jul-15	28.69±0.57	3	0	2	4	6
2	Cc	27-Aug-15	5-Sep-15	26.98±0.46	5	N/A ^b	0	3	5
3	Cm	14-Jun-16	22-Jun-16	24.32±0.56	5	0	2	4	7
4	Lk	20-Jun-16	28-Jun-16	24.62±0.82	4	0	2	5	7
5	Cm	28-Jul-16	2-Aug-16	29.54±0.61	2	0	1	3	4
6	Cm	2-Aug-16	7-Aug-16	28.55±0.41	2	0	1	3	5
7	Cm	11-Oct-16	24-Oct-16	20.37±1.24	8	0	2	6	12
8	Lk	24-Oct-16	15-Nov-16	17.03±2.62	15	N/A ^b	0	9	18

750 a. Cc = *Caretta caretta*, Cm = *Chelonia mydas*, Lk = *Lepidochelys kempii*

751 b. Turtles 2 & 8 began as an early code 2

Table 6. Unconstrained (i.e., with a freely varying y-intercept) and constrained (i.e., y-intercept=0) linear regression parameters, including the y-intercept (y-int.), slope, 95% confidence interval (C.I.), and significance (signif.), for the turtle carcass drifters and wood-foam drifters during each deployment (deploy.). Slope and standard error are represented as a percentage of wind speed. Level of significance of slope is represented by asterisks (<0.1, *<0.05, **<0.01, ***<0.001).

Along-wind component of leeway							
Drift object	Deploy.	Y-int.	Unconstrained			Constrained	
			Slope (%)	95% C.I. (%)	Signif.	Slope (%)	95% C.I. (%)
Turtle carcass drifter 1	1	-5.45	2.26	1.08-3.44	***	2.15	1.78-2.52
Turtle carcass drifter 2	1	15.72	3.26	0.85-5.67	**	3.59	2.84-4.35
Turtle carcass drifter 3	2	5.41	1.32	(-0.73)-3.37		1.44	1.13-1.76
	3	-103	2.76	0.98-4.54	*	1.14	0.83-1.44
	4	10.71	1.05	(-0.625)-2.73		1.25	0.83-1.68
Wood-foam drifters	1	-34.9	4.27	2.19-6.35	***	3.54	2.19-6.35
	2	2.94	0.66	(-1.23)-2.56		0.73	(-1.23)-2.55
	3	-59.57	2.90	0.85-4.93	*	1.95	0.85-4.93
	4	36.20	1.42	0.05-2.80	*	2.11	0.05-2.80
Cross-wind component of leeway							
Drift object		Y-int.	Unconstrained			Constrained	
			Slope (%)	95% CI (%)	Signif.	Slope (%)	95% CI (%)
Turtle carcass drifter 1	1	22.53	1.09	(-2.31)-4.49		1.56	0.50-2.63
Turtle carcass drifter 2	1	-48.92	1.34	(-1.54)-4.22		0.31	(-0.60)-1.22
Turtle carcass drifter 3	2	-20.34	0.89	(-3.25)-5.02		0.42	(-0.22)-1.05
	3	-51.31	2.94	(-1.23)-1.82		-0.52	(-0.72)-(-0.31)
	4	-28.90	2.76	(-0.76)-1.32		-0.27	(-0.54)-0.004
Wood-foam drifters	1	-11.99	3.30	0.43-6.17	*	3.05	2.14-3.95
	2	171.09	-3.40	(-5.47)-(-1.91)	***	0.25	(-0.12)-0.61
	3	-76.18	1.13	(-3.71)-5.96		-0.08	(-0.67)-0.52
	4	-78.08	1.26	0.09-2.42	*	-0.21	(-0.54)-0.12
Leeway speed							
Drift object		Y-int.	Unconstrained			Constrained	
			Slope (%)	95% CI (%)	Signif.	Slope (%)	95% CI (%)
Turtle carcass drifter 1	1	14.99	3.45	1.89-5.01	***	3.77	3.28-4.25
Turtle carcass drifter 2	1	138.01	1.53	(-0.24)-3.30	.	4.43	3.76-5.09

Turtle carcass drifter 3	2	23.16	1.39	(-0.18)-2.96	.	1.92	1.68-2.17
	3	-68.91	2.35	0.24-4.47	*	1.27	0.99-1.54
	4	16.90	1.14	(-0.28)-2.56		1.46	1.09-1.82
Wood-foam drifters	1	28.86	5.34	3.52-7.17	***	5.95	5.37-6.25
	2	51.05	0.21	(-1.05)-1.46		1.38	1.17-1.59
	3	-32.28	2.66	0.59-4.72	*	2.15	1.89-2.40
	4	52.25	1.38	0.15-2.61	*	2.37	2.03-2.70

758

759 Table 7. Mean distance (km) of particle origin 2, 5, and 8 days prior to landing in stranding zone
 760 under wind forcing conditions of 0%, 2%, and 4%. Results are compiled over 5 months of June
 761 from the years 2001-2005.

Mean distance from zone (km)									
Zone #	0% wind			2% wind			4% wind		
	2 days	5 days	8 days	2 days	5 days	8 days	2 days	5 days	8 days
1	9.78	21.80	33.77	12.14	18.34	23.36	14.35	19.12	22.35
2	10.63	24.62	37.34	11.41	19.45	23.50	14.71	22.66	22.23
3	9.47	17.82	26.95	12.86	19.36	22.79	17.05	21.87	24.33

762

Figure Legends

Figure 1. (A) Location of study sites within the Chesapeake Bay, VA, including the decomposition rate study (triangle), release points for the four drifter deployments (circles), and target zones for the oceanographic simulations (black outline). The target zones represent county-level areas which make up 95.5% of the reported 2001-2005 Virginia sea turtle strandings occurring within the model domain (n=1487). 82% of these strandings (n=1222) occur specifically within three zones (shaded in dark gray and numbered). (B) Total number of stranding events per zone (gray) and events occurring during June only (white; 44%, n=660) from the years 2001-2005. Stranding zone number corresponds to locations in Figure 1A, while “other” is composed of documented stranding events in the remaining outlined zones.

Figure 2. (A) Schematic of the decomposition study experimental design. (B) Image of a turtle carcass floating at sea. (C) Image of a turtle carcass on shore.

Figure 3. (A) Turtle carcass, (B) bucket, and (C) wood-foam drifters.

Figure 4. (A) Duration of positive buoyancy (circles, solid line) and time to total decay (triangles, dotted line) vs average water temperature (°C). (B) Boxplot of the minimum number of days to reach each condition code stage.

Figure 5. Along-wind component of leeway (10^2 m/s), cross-wind component of leeway (10^2 m/s), and leeway speed vs. wind speed (10^2 m/s) for each turtle carcass drifter and wood-foam deployment. Values are averaged over half hour periods. Solid lines represent the unconstrained linear regression mean and the shaded polygon represents the 95% confidence intervals.

Figure 6. Complete drift tracks of all individual drifters during the four deployments.

786 Figure 7. Relative particle density (%) for probability of point of origin 2, 5 and 8 days prior to
787 stranding in Zone 1, as outlined in blue. Results include 0%, 2% and 4% of direct wind
788 forcing on carcass drift. Simulation results are a composite over 5 months of June for the
789 years 2001-2005.

790 Figure 8. Relative particle density (%) for probability of point of origin 2, 5 and 8 days prior to
791 stranding in outlined zone with 2% of direct wind forcing on carcass drift. Simulation
792 results are a composite over 5 months of June for the years 2001-2005.

Appendix

Figure A1. Images of Turtle 1 at various condition code stages.

Figure A2. Schematic of sea turtle carcass drifter, including (A) carapace view, (B) plastron view, and (C) side-profile.

Figure A3. Self-righting buoy attachment with GPS for wood-foam and turtle carcass drifters.

Figure A4. NOAA National Weather Service daily weather map from July 24, 2016 depicting the presence of a weather front moving through the study site of deployment 2 (black box).

Available from: http://www.wpc.ncep.noaa.gov/dailywxmap/index_20160624.html.

Figure A5. Locations of monitoring stations 8637611 York River East Rear Range Light (red circle), 8638614 Willoughby Degaussing Station (blue circle), and deployment 2 release location (yellow triangle).

Figure A6. Reported wind speed (m/s) and wind direction (degrees from true north) from monitoring stations 8637611 York River East Rear Range Light and 8638614 Willoughby Degaussing Station. Area between the blue lines represent the full time period of deployment 2.

Figure A7. Deployment 2 results of the along-wind component of leeway for turtle carcass drifter 3 using metrological data from monitoring stations (A) 8637611 York River East Rear Range Light and (B) 8638614 Willoughby Degaussing Station. Dashed lines represent 95% confidence intervals.

Figure A8. Relative number of particles from the oceanographic model making landfall over elapsed time (days). Simulation results are a composite over 5 months of June from the years 2001-2005.

815 Figure A9. Mean starting locations 2, 5, and 8 days prior to stranding in top zones. Simulation
816 results are a composite over 5 months of June from the years 2001-2005.

Research



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Managing fisheries in a world with more sea turtles

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For decades, fisheries have been managed to limit the accidental capture of vulnerable species and many of these populations are now rebounding. While encouraging from a conservation perspective, as populations of protected species increase so will bycatch, triggering management actions that limit fishing. Here, we show that despite extensive regulations to limit sea turtle bycatch in a coastal gillnet fishery on the eastern United States, the catch per trip of Kemp's ridley has increased by more than 300% and green turtles by more than 650% (2001–2016). These bycatch rates closely track regional indices of turtle abundance, which are a function of increased reproductive output at distant nesting sites and the oceanic dispersal of juveniles to near shore habitats. The regulations imposed to help protect turtles have decreased fishing effort and harvest by more than 50%. Given uncertainty in the population status of sea turtles, however, simply removing protections is unwarranted. Stock-assessment models for sea turtles must be developed to determine what level of mortality can be sustained while balancing continued turtle population growth and fishing opportunity. Implementation of management targets should involve federal and state managers partnering with specific fisheries to develop bycatch reduction plans that are proportional to their impact on turtles.

1. Introduction

The successful management of wide-ranging marine species with complex life cycles and long times to maturity is confronted by numerous challenges [1–3]. The environmental and anthropogenic drivers of population dynamics can be highly uncertain and predicting (or even assessing) the effectiveness of management actions can be confounded by many variables [4,5]. These issues are exemplified in sea turtle conservation [6–8]. Hatchling sea turtles emerge from nests laid on sandy beaches and quickly swim offshore. For many populations, major nesting areas are situated near ocean current systems that facilitate movement to distant developmental habitats. As turtles grow, most species tend to shift from oceanic to coastal foraging grounds. After a decade or more, turtles reach maturity and return to the vicinity of their natal site to reproduce and nest, after which adults depart to their foraging grounds [8]. Owing to fisheries bycatch, direct harvest of adults and eggs, habitat loss or alterations and a suite of life-history traits that make sea turtles susceptible to extinction, six of the seven sea turtle species are considered vulnerable, endangered or critically endangered [9].

Despite a grim outlook in the early decades of sea turtle conservation, many turtle populations across the globe are now rebounding [9–11]. Particularly in the western Atlantic, extensive protections for turtles (eliminating direct harvest on nesting beaches and reducing fishery bycatch through gear modification, fishing closures and declining fishing effort) appear successful [9]. Nest counts (a proxy of both female abundance and reproductive output) are increasing in many populations [9] and in-water surveys show similar trends at foraging grounds [12–14]. These successes present a new challenge: how do

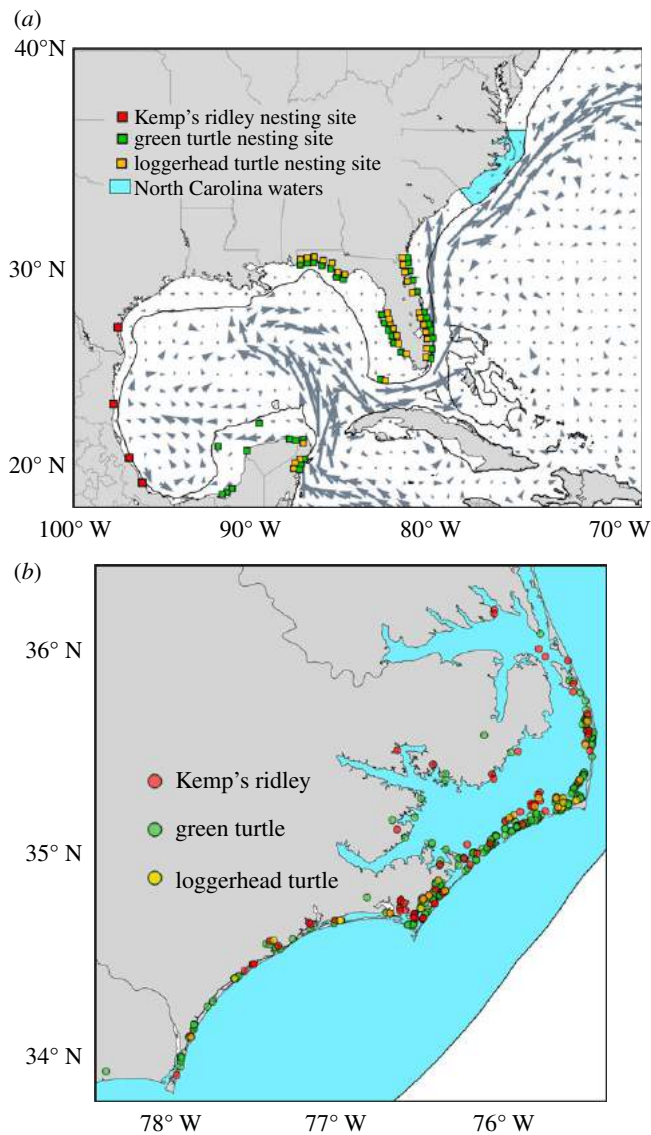


Figure 1. (a) Map of the western Atlantic. Arrows indicate average ocean current velocity (based on Global Hybrid Coordinate Ocean Model (HYCOM) surface layer for the year 2015). The thin black line indicates the 75 m isobath. Squares show nesting sites of Kemp's ridley (red = Tamaulipas, Mexico; Veracruz, Mexico and Texas, USA), green turtles (green = Florida, USA; Quintana Roo, Mexico; Yucatan, Mexico; and Campeche, Mexico), and loggerhead turtles (orange = Florida, USA and Quintana Roo, Mexico). Annual hatchling production data from these sites, ICHTHYOP (v.2) particle tracking software and surface velocity fields from Global HYCOM predict annual number of juvenile turtles that move into North Carolina's waters (blue shading) [16]. (b) Map of coastal North Carolina showing locations of large-mesh gillnet fisheries interactions with turtles. Colour conventions as in (a).

we protect species that are susceptible to negative impacts by anthropogenic activities, but whose growing abundance increases the probability that those interactions will occur? In the United States, these issues are further complicated by precautionary governance policy, which prohibits interactions with sea turtles through the Endangered Species Act (ESA) [15]. Here, we illustrate the importance of raising this question by examining sea turtle bycatch in the inshore/estuarine gillnet fishery of North Carolina, USA (figure 1).

The gillnet fishery is one of North Carolina's most important commercial fisheries operating in inshore/estuarine waters, landing between 4.5 and 13.6 million kg annually over the last 25 years. The value (price paid the fishers) of the anchored gillnet (the most common technique of deploying

this gear) has ranged between \$8.2 and \$12.9 million over the same period, consistently ranking it among the top fisheries for North Carolina. Annually, the gillnet fishery has had the most participants of any commercial finfish fishery in the state, ranging from approximately 1000 to 2300 individuals, indicating its importance to the local culture and economy [17].

North Carolina Division of Marine Fisheries (NCDMF), the agency responsible for managing the state's coastal fisheries, has worked to reduce sea turtle interactions by closing certain areas to gillnet fishing when turtles are likely to be present in high numbers, shortening gillnet lengths, requiring observers on a specified percentage of gillnet fishing trips (funded by commercial fisheries), requiring gillnet attendance by fishers and limiting the number of hours gillnets can be left in place [18,19] (electronic supplementary material, table S1). Presently, NCDMF manages turtle-gillnet interactions through an Incidental Take Permit (ITP) from the National Marine Fisheries Service (NMFS) by closing areas to gillnets once a threshold number of sea turtle interactions is reached for any species, in addition to the aforementioned actions [18,20–22].

North Carolina's geography and proximity to the Gulf Stream, a warm northward flowing ocean current, provides foraging habitat for Kemp's ridley (*Lepidochelys kempii*), green (*Chelonia mydas*) and loggerhead (*Caretta caretta*) turtles [13] (figure 1). Sea turtle bycatch in the North Carolina gillnet fishery primarily involves juvenile Kemp's ridley and green turtles at sizes that suggest recent recruitment to coastal waters from oceanic habitats (less than 40 cm curved carapace length (CCL) [23–26]). By contrast, loggerhead bycatch is relatively rare (management actions in the late 1990s and early 2000s preclude gillnet fisheries from operating in the species's preferred habitat in the deep waters of Pamlico Sound) and involves older turtles, probably with established foraging grounds [27,28].

We examined trends in bycatch rates of these species to test whether reducing gillnet lengths or soak times were particularly important for limiting bycatch (in which case a decrease in bycatch rate would be detected) or if growing populations of sea turtles have resulted in an increase in bycatch rate through time. For the latter possibility, we more directly assessed whether changes in gillnet bycatch rates were correlated with indices of turtle abundance that were derived from fishery-independent surveys and strandings. We further determined whether temporal variation in turtle abundance could be accounted for by a recently developed model that predicts the recruitment dynamics of oceanic-stage juvenile turtles to coastal waters based on reproductive output from distant nesting beaches [16]. Finally, we examine the implications of growing sea turtle populations for fisheries and discuss management approaches that can ensure protections to sea turtle populations and allow fisheries to operate.

2. Methods

(a) Fishery data

Data associated with the North Carolina inshore gillnet fishery were provided by NCDMF. The inshore waters of North Carolina's extensive estuarine systems are divided into six management units (A, B, C, D-1, D-2, E), which are designated based on geographical boundaries, similarities of fisheries and knowledge of protected species interactions. For the purposes of this study, we consolidated data on catch and effort that were initially reported by each management unit into statewide totals. We aggregated

catch data into statewide, annual values of total kg of fish landed (irrespective of species composition) for small (less than 10 cm ISM) and large (≥ 10 cm ISM) mesh gillnet fisheries, separately. The small- and large-mesh gillnet fisheries are known to differ in regard to potential sea turtle interactions, and management responses are usually separated using the respective mesh sizes [18,20]. We compiled effort data into the annual number of inshore trips by management unit, using the NCDMF 'trip tickets' system. Commercial fishermen in North Carolina are required by law to fill out a ticket of what is caught for each fishing trip, with other information such as gear, date and location. If no marketable catch occurs or if the catch is not sold a 'trip ticket' will not exist, thus these values should be considered an index of the minimum number of trips within a year. To provide further context for changes in fishing effort, we compiled information on management actions that restricted soak time and length of gillnets (electronic supplementary material, table S1). Fish catch (kg) and effort data (number of trips) were available for the North Carolina gillnet fishery from 1994 through 2016 (electronic supplementary material, tables S2 and S3).

NCDMF provided data for the number of turtle interactions in the large- and small-mesh gillnet fisheries from 2001 through 2016 (programmes 466 and 467) (electronic supplementary material, table S2). The sea turtle ITP requires the observer programme to have at least 7% coverage of large-mesh trips and 1% coverage for small-mesh trips (though NCDMF aims for 10% and 2% observer coverage for large- and small-mesh gillnet fisheries, respectively) [20]. Details on the amount of observer coverage across the state of North Carolina could not be determined for all years in which observed takes were reported. We therefore chose to calculate an annual index of turtle catch per trip based on the number of turtles observed in the large-mesh gillnet fishery divided by the total number of large-mesh gillnet trips. We adopted this approach because we were interested in producing an annual index of turtle interactions for trend analysis, not computing total bycatch.

(b) Turtle data

Abundance indices for loggerhead, green and Kemp's ridley turtles in North Carolina were obtained from two sources, each of which provides information on different aspects of turtle abundance. The years chosen for analysis correspond to the longest possible time series that overlaps with the fisheries data described above. The first source was NCDMF's Gillnet Fisheries Independent Sampling Program (programme 915) for the years 2000 through 2016 (electronic supplementary material, table S4). This programme is designed to sample inshore habitat and has used relatively consistent methodology/effort to supplement age, growth and reproduction studies, to evaluate catch rates and species distribution for use in management plans of coastal fishes [29]. However, over the years, grid and area modifications have been made to reduce turtle interactions. Thus, while this time series provides an annual index of turtles that are susceptible to capture by gillnets in the estuarine waters of North Carolina, the values are likely biased low.

The second source of abundance indices were statewide counts of stranded turtles from <http://www.seaturtle.org/strand>, as reported by the North Carolina Wildlife Resources Commission's Division of Wildlife Management. We used annual counts spanning 1998 through 2016 that include estuarine and oceanic areas (electronic supplementary material, table S4). While some sea turtle strandings might be linked to gillnet interactions or other fishing activities, they are also shaped by environmental conditions that influence mortality, the probability of washing ashore and the probability of being reported [30]. Our aim was not to ascertain cause, but to use these data as an index of abundance across the state, assuming that the more turtles that are

present in an area, the more likely it is that one will wash ashore (for whatever reason) and be reported [16]. This index of turtle abundance may be biased high, because the dataset includes sea turtle that strand outside of estuarine waters, where turtles are not susceptible to gillnet interactions.

In addition to observed indices of turtle abundance, we used a recently developed model that predicts the distribution and abundance of juvenile Kemp's ridley, green and loggerhead sea turtles during their oceanic stage [16]. The approach has been described in detail and appears to accurately depict environmental drivers that contribute to annual variation in turtle distributions [31]. Moreover, the model shows good agreement in predicting spatio-temporal variation in the recruitment of oceanic-stage Kemp's ridley and green turtles to coastal waters in the Gulf of Mexico [16]. For this analysis, we computed the number of 0.5- to 3.5-year-old green and loggerhead turtles, and 0.5- to 2.5-year-old Kemp's ridley that crossed shoreward of the 75 m isobath near the coast of North Carolina (33.8–36.5 N; figure 1; electronic supplementary material, table S4). All age classes of a given species were summed each year for the period 1996–2016.

(c) Analyses

We examined time-series trends in gillnet trips, catch, catch per trip, reported turtle bycatch per trip and abundance indices of turtles in North Carolina's waters using linear and polynomial (quadratic and cubic) regressions. Higher-order equations necessarily produce better fits to the data (higher R^2 values), thus we determined whether increasing the complexity of the regression equation produced a higher R^2 than would be expected by chance ($p \leq 0.05$) [32]. Reported p -values are for the slopes of the regression lines. Pearson's correlation tests were used to compare modelled juvenile recruitment of each species to bycatch and in-water metrics of turtle abundance. We log-transformed observed and modelled turtle abundance data (adding 1 to all values and then computing the logarithm to the base of 10) so that data would conform to the assumption of normality and relationships detected would not be driven by an uncharacteristically high or low data point.

3. Results

In North Carolina's large-mesh gillnet fishery, reported catch per trip of Kemp's ridley and green turtles have increased through time (Kemp's ridley: linear fit $R^2 = 0.306$, $p = 0.026$, $n = 16$; green turtle: quadratic fit $R^2 = 0.770$, $p = 0.000072$, $n = 16$), but loggerhead catch per trip shows no trend (linear fit $R^2 = 0.004$, $p = 0.815$, $n = 16$) (figure 2). Comparing the first 5 years of the dataset (2001–2005) to the last 5 years (2012–2016), Kemp's ridley catch per trip has increased by 318%, and green turtle catch per trip has increased by 676%. Log-transformed Kemp's ridley and green turtle catch per gillnet trip and indices of turtle abundance (fishery-independent gillnet survey and strandings) did not differ from a normal distribution (Kolmogorov–Smirnov test $D \leq 0.26$, $p \geq 0.19$, $n \geq 16$, for each) and were strongly correlated (figure 2, table 1). Log-transformed loggerhead catch per gillnet trip and strandings data did not differ from a normal distribution (Kolmogorov–Smirnov test $D \leq 0.22$, $p \geq 0.38$, $n \geq 16$, for both); though the fishery-independent gillnet survey significantly differed (Kolmogorov–Smirnov test $D = 0.41$, $p = 0.004$, $n = 17$) no relationships were detected between any indices of loggerhead turtle abundance and bycatch rate (table 1).

The trends detected in sea turtle abundance indices in North Carolina (figure 2) correspond to basin-wide patterns apparent in the models of juvenile, oceanic-stage sea turtle

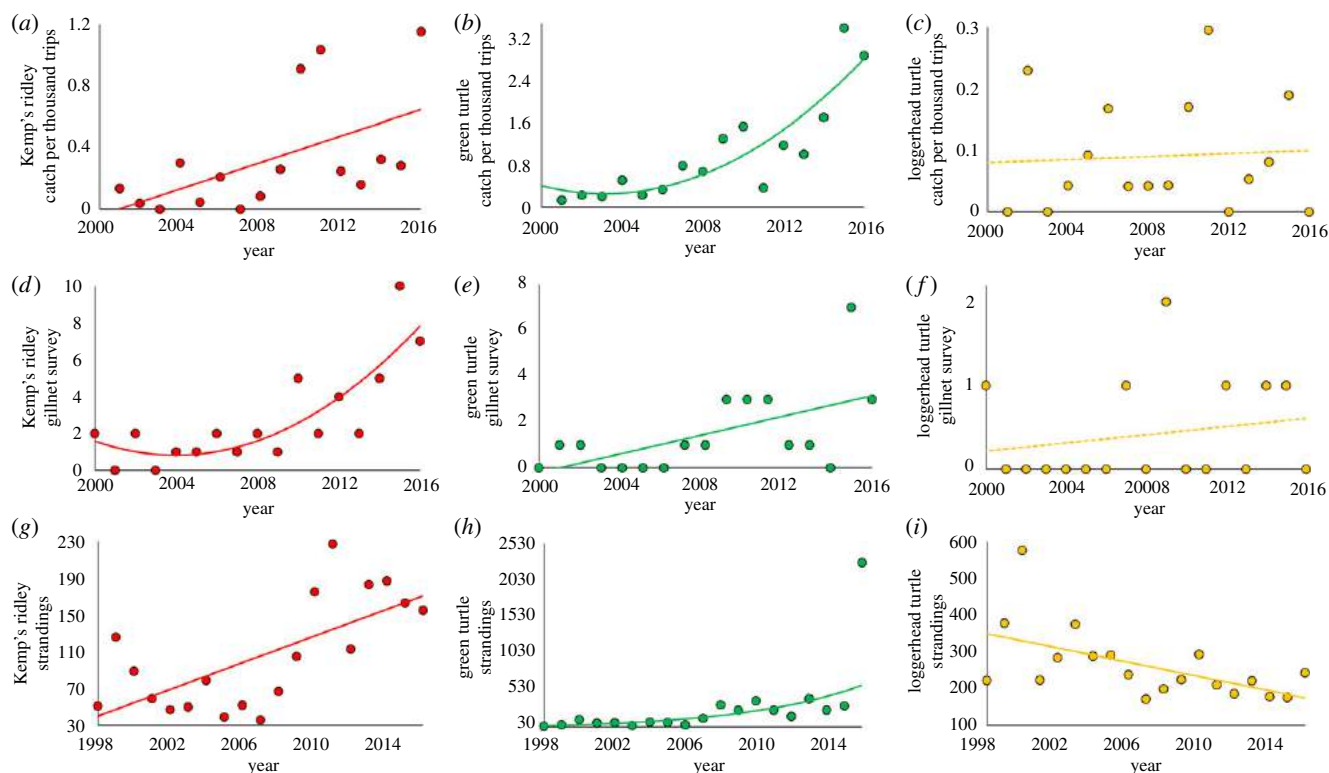


Figure 2. Trends in gillnet fishery bycatch and in-water indices of sea turtle abundance in North Carolina. Statistically significant trends are shown with solid lines, dashed lines denote no detectable trend through time. (a) Kemp's ridley bycatch rates (observed turtles in the large-mesh gillnet fishery divided by the annual number of large-mesh gillnet trips) have significantly increased (linear fit, $R^2 = 0.306$, $p = 0.026$, $n = 16$). (b) Green turtle bycatch rates have sharply risen (quadratic fit, $R^2 = 0.770$, $p = 0.000072$, $n = 16$). (c) Loggerhead turtle bycatch rates show no trend (linear fit, $R^2 = 0.004$, $p = 0.815$, $n = 16$). Within the fisheries-independent gillnet survey the number of turtles caught each year has increased for (d) Kemp's ridley (quadratic fit $R^2 = 0.71$, $p = 0.00017$, $n = 17$) and (e) green turtles (linear fit $R^2 = 0.33$, $p = 0.015$, $n = 17$), but not (f) loggerhead turtles (linear fit $R^2 = 0.04$, $p = 0.441$, $n = 17$). Statewide strandings have increased for (g) Kemp's ridley (linear fit $R^2 = 0.464$, $p = 0.00132$, $n = 19$) and (h) green turtles (quadratic fit $R^2 = 0.478$, $p = 0.00552$, $n = 19$), but have decreased for (i) loggerhead turtles (linear fit $R^2 = 0.316$, $p = 0.0122$, $n = 19$).

abundance (figure 3). Increases in Kemp's ridley and green turtle abundance along the eastern US coast, particularly off-shore of North Carolina, are likely to be indicative of increased potential for coastal recruitment in these regions and an increase in the number of turtles susceptible to bycatch (figure 3). The modelled abundance of juvenile Kemp's ridley entering the waters around North Carolina was positively correlated to the number of turtles caught in the NCDMF fishery-independent gillnet survey and strandings, but not bycatch rates (table 1). For green turtles, modelled juvenile abundance was positively correlated to the number of turtles caught in the NCDMF fishery-independent gillnet survey, strandings and bycatch rates (table 1). Predicted juvenile abundance of loggerheads was unrelated to the number of turtles caught in the NCDMF gillnet survey, strandings or bycatch rates (table 1).

For fisheries, the implications of growing sea turtle populations are an increased rate of bycatch and increased regulations (electronic supplementary material, table S1). In the North Carolina gillnet fishery, this has resulted in annual fish catches declining sharply (large mesh: quadratic fit $R^2 = 0.848$, $p = 6.7 \times 10^{-9}$, $n = 23$; small mesh: linear fit $R^2 = 0.47$, $p = 0.0003$, $n = 23$) (figure 4a). In the large-mesh gillnet fishery, catches were around 1.36 million kg in the 1990s to early 2000s and decreased by 57% to <0.57 million kg in 2016. The small-mesh gillnet fisheries have seen catches drop 55%, from 1.72 million kg in 2001 to 0.77 million kg in 2016. The number of large-mesh trips in 2016 decreased 66% from their peak number in 1997, with the decline accelerating in recent years (quadratic fit $R^2 = 0.891$, $p = 2.27 \times 10^{-10}$, $n = 23$). Small-mesh

gillnet trips have steadily declined over this period (linear fit $R^2 = 0.814$, $p = 4.07 \times 10^{-9}$, $n = 23$) and in 2016 had fallen 57% from their high in 1995 (figure 4b). Interestingly, catch per trip data for both small- and large-mesh fisheries exhibited no obvious trend (linear fit $R^2 < 0.148$, $p > 0.069$, $n = 23$, for both fisheries) (figure 4c). In the small-mesh fishery, total catch was positively related to the number of trips taken (linear fit $R^2 = 0.57$, $p = 2.9 \times 10^{-5}$, $n = 23$) and total catch in the large-mesh fishery was nearly entirely a function of the number of trips taken (linear fit $R^2 = 0.92$, $p = 5.4 \times 10^{-13}$, $n = 23$). Thus, reduction in fish caught through time does not appear to be attributable to regulations that have shortened net lengths and soak times; rather, closing areas to fishing after a certain number of turtle are caught has restricted the number of trips taken and resulted in reduced harvest.

4. Discussion

The steady increase in catch per trip of Kemp's ridley and the sharper increase of green turtles in the large-mesh gillnet fishery of North Carolina both closely track species-specific abundance indices (table 1), suggesting that bycatch of these species is largely dependent upon how many turtles are within the area. Furthermore, the increasing abundance of Kemp's ridley and green turtles is not unique to North Carolina but is a function of increases in reproductive output at distant nesting sites and the recruitment of juveniles to coastal foraging grounds throughout the region (table 1, figure 3). Interestingly, loggerhead bycatch rate did not increase, and the largest population of loggerhead turtles shows no evidence of growth during

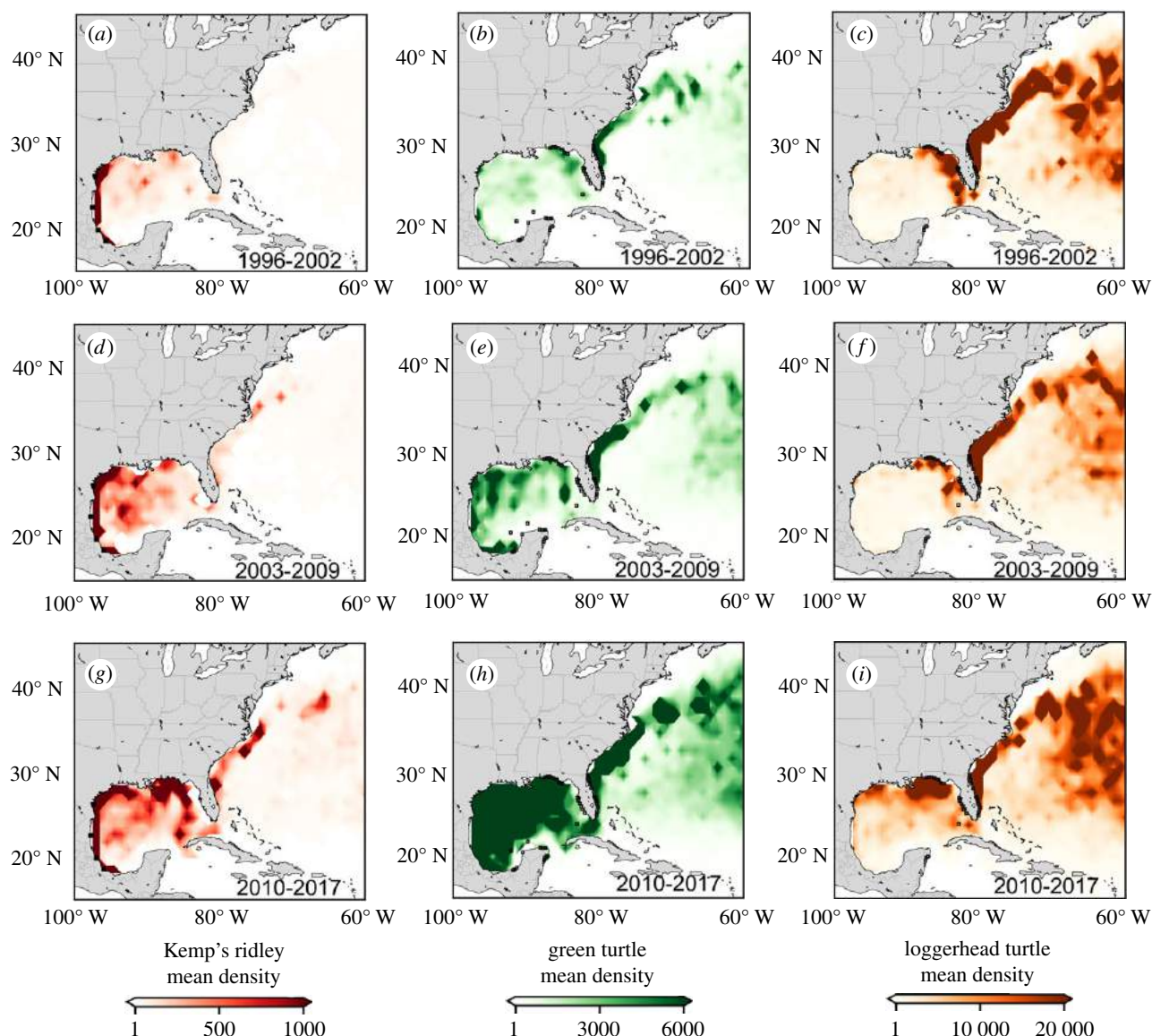


Figure 3. Predictions of oceanic-stage sea turtle abundance across the western North Atlantic for years 1996–2017. Maps show the mean number of predicted turtles within 1° latitude $\times$ 1° longitude grid cells across the North Atlantic for turtles aged 0.5 years, 1.5 years, 2.5 years and 3.5 years (owing to the shorter oceanic stage for Kemp's ridley the 3.5-year age class was not computed for that species) [16]. Mean annual abundance summed across age classes is shown for (a–c) 1996–2002, (d–f) 2003–2009 and (g–i) 2010–2017. Large increases in the abundance of Kemp's ridley (red shading) and green turtles (green shading) are predicted in the Gulf of Mexico and off the eastern US coast. Loggerhead turtle (orange shading) abundance appears more stable, though in recent years increased abundance is also predicted across the Gulf of Mexico.

Table 1. Results of statistical tests to relate changes in turtle bycatch rates to metrics of in-water turtle abundance. Values indicate Pearson's correlation coefficient (r), p -values shown in parentheses below. Significant relationships ($p < 0.05$) are highlighted in *italics*.

species	bycatch versus survey ($n = 16$)	bycatch versus strandings ($n = 16$)	bycatch versus model ($n = 16$)	survey versus model ($n = 17$)	strandings versus model ($n = 19$)
Kemp's ridley	<i>0.55 (0.026)</i>	<i>0.74 (0.001)</i>	0.38 (0.15)	<i>0.61 (0.009)</i>	<i>0.52 (0.022)</i>
green turtle	<i>0.63 (0.0086)</i>	<i>0.79 (0.0003)</i>	<i>0.88 (<0.00001)</i>	<i>0.49 (0.046)</i>	<i>0.79 (0.00006)</i>
loggerhead turtle	−0.16 (0.55)	−0.02 (0.94)	−0.02 (0.95)	0.22 (0.42)	0.045 (0.85)

this period [33]. Thus, for all three species of turtles bycatch rates appear to follow broad-scale population-level trends and regulations aimed at reducing turtle bycatch do not appear to have kept pace with Kemp's ridley or green turtle population growth.

State fisheries managers and commercial fishers now find themselves in a difficult position. The current strategy of stopping gillnet fishing to ensure only an acceptable number of 'takes' [18] will necessarily result in reduced fishing

opportunity and increased regulatory burden because, ironically, conservation efforts have been successful and turtle populations have begun to rebound. It is noteworthy that simply capping bycatch would also be problematic if turtle populations were in decline, as fishing effort could increase as fewer turtles were available to catch and further drive the population toward extinction. Indeed, the management approach is only logical if turtle population abundance is stable.

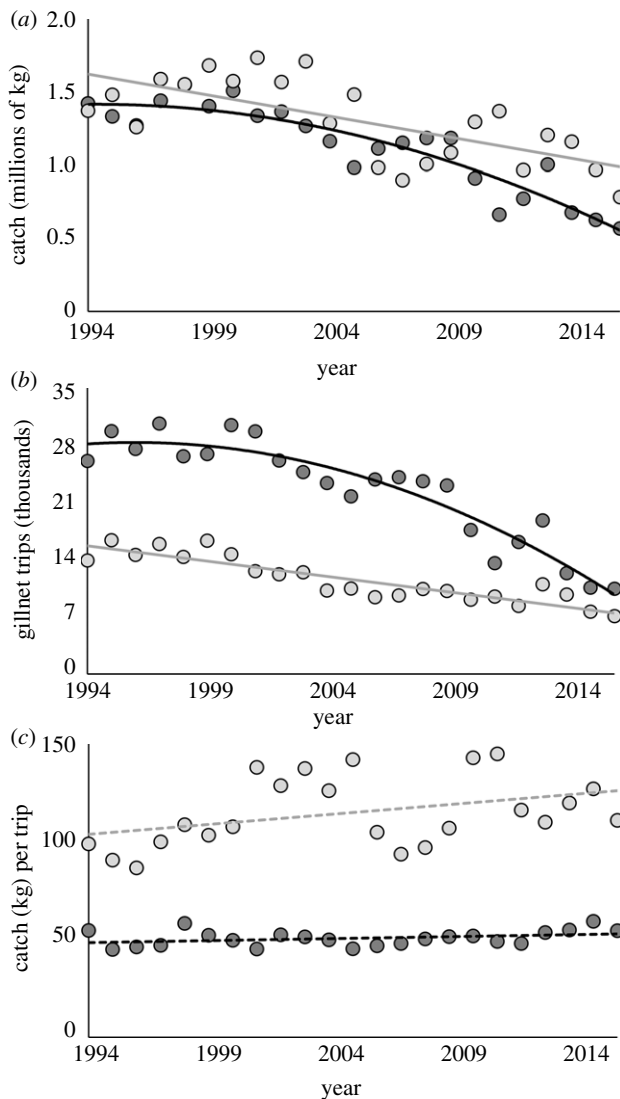


Figure 4. Trends in gillnet fishery effort, productivity. (a) Annual catch in the large-mesh (darker grey) and small-mesh (lighter grey symbols) gillnet fisheries. Catch in the large-mesh gillnet fishery has declined sharply (quadratic fit) and steadily declined in the small-mesh fishery (linear fit). (b) The number of large-mesh gillnet trips have decreased sharply (quadratic fit) and small-mesh gillnet trips have decreased steadily (linear fit). (c) Catch per trip in both fisheries shows no obvious trend (linear fits).

There are mechanisms for North Carolina fisheries managers to request changes in the amount of sea turtle bycatch allowed by the ITP from NMFS [18]. It may be tempting to suggest that fishing opportunity could be sustained if the state annually requests increases that track the per cent increase in reproductive output from nesting populations that use state waters as foraging habitat (figure 1). Formal consultations using §7 of the Endangered Species Act by NMFS with the US Fish and Wildlife Service involving affected fisheries have likewise been used to address sea turtle interactions with fisheries and have prevented extensive or episodic closures for specific fishing gear. However, while reproductive output may be higher now than in previous years, considerable uncertainty remains in the status of these populations [33,34]. Thus, to follow either option in a scientifically meaningful way will require regular population assessments on sea turtles that include estimating reproductive output and natural and anthropogenic mortality across life-stages and throughout their range. Such a comprehensive assessment seems outside of the scope and capacity of state

fisheries managers. Given that sea turtles are federally protected in the USA, this responsibility should fall to NMFS. A stock-assessment framework is well suited to generate the needed information and is already commonly applied to commercially harvested marine fishes by NMFS scientists and managers.

NMFS should develop species-specific stock-assessment models for sea turtles that occur within US waters that are annually updated based on reproductive output of relevant populations and the cumulative impacts experienced in the USA and elsewhere. These stock assessments should determine the amount of mortality that can be sustained while maintaining a desirable amount of population growth [35–37]. Within this framework, a better understanding of the population-level implications of management actions would emerge and, in tandem, the ability to make regulations among different resource users proportional to each group's impact on sea turtles. Similarly, this framework would help determine what research to prioritize that could best reduce uncertainty in such a model [38,39].

Developing a framework to conduct annual stock assessments on sea turtles will require considerable interjurisdictional coordination to obtain data on anthropogenic activities that impact sea turtles and an investment in basic research on sea turtle ecology [16,37]. To obtain the needed information, the direct involvement of other government agencies, fisheries, industries, conservation groups, academia and the private sector should be encouraged. A key benefit of developing the stock assessments with an internationally diverse and participatory group is the mutual exchange of information, greater potential for stakeholders to accept regulations and removing the perception of *ad hoc* and arbitrary limits on turtle interactions that differ from one state or sector to another. For implementation, federal and state managers would partner with specific fisheries to determine how to achieve the target reduction in sea turtle bycatch [40].

In the interim, while stock assessments are organized, we recommend establishing working groups for specific fisheries to develop standards for 'compliance based' management [40]. This approach has been successfully implemented in other US fisheries to limit sea turtle bycatch, including shrimp trawls, the summer flounder trawl fishery, the pound net fishery in Chesapeake Bay, the pelagic longline fishery in the Exclusive Economic Zone (EEZ) of the Atlantic and Gulf of Mexico and the gillnet fishery in the EEZ in the Mid-Atlantic regions [41]. In the case of the North Carolina gillnet fishery, such an approach is promising for several reasons. First, the greatly lower amount of turtle bycatch in small-mesh compared with large-mesh gillnets (electronic supplementary material, tables S2 and S3) indicates that gillnets are not, necessarily, always a major threat to sea turtles. Likewise, bycatch in gillnets tends not to be fatal (>60% Kemp's ridley and green turtles released alive; >90% of loggerheads released alive) [18–22]. In other regions, hanging longline light-sticks from gillnets reduces sea turtle interactions by 40% to 60%, with minimal impact to target catch [42–44]. Though in open ocean habitat these lights probably attract turtles to hooks [45], illumination may help turtles see gillnets and avoid entanglement [43]. Thus, if given the opportunity, innovative approaches to reduce bycatch and limit its lethality by simple modifications to fishing practices and gear might be achieved with joint participation between fisheries managers and the fishing industry [46–50]. The possible solutions tested in such programmes across the southeastern US would contribute to more sustainable fisheries, the recovery of sea turtles, and provide a valuable indication of

how to meet the management targets that are determined once sea turtle stock assessments have been conducted.

Data accessibility. All data used in this paper are provided in the electronic supplementary material.

Authors' contributions. All authors contributed to the study design, interpretation of results, scholarship and writing of this paper. N.F.P. performed the analyses and wrote the initial draft.

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REPORT

Quantifying the effects of fisheries on threatened species: the impact of pelagic longlines on loggerhead and leatherback sea turtles

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Abstract

The depletion of fish stocks from global fisheries has been a long-standing concern. More recently, incidental catch of non-target (termed bycatch) vertebrates also has been proposed as a serious conservation issue. Here we present a bycatch assessment for loggerhead and leatherback sea turtles that are incidentally caught by global pelagic longlines. We integrate catch data from over 40 nations and bycatch data from 13 international observer programmes. Despite infrequent rates of encounter, our analyses show that more than 200 000 loggerheads and 50 000 leatherbacks were likely taken as pelagic longline bycatch in 2000. Our analyses suggest that thousands of these turtles die each year from longline gear in the Pacific Ocean alone. Given 80–95% declines for Pacific loggerhead and leatherback populations over the last 20 years, this bycatch level is not sustainable. Adopting a large-scale, synthetic approach is critical to accurately characterize the influence of global fisheries bycatch on globally distributed and imperilled pelagic vertebrates.

Keywords

Bycatch, global fisheries, leatherback, loggerhead, pelagic longlines, pelagic vertebrates, sea turtle.

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INTRODUCTION

Recent research has pointed to significant declines in targeted fish stocks from global industrial fisheries (Pauly *et al.* 1998; Myers & Worm 2003). Although not commercial targets, other pelagic species can also become entangled or hooked by the same fishing gear (Hall 1996); this incidental catch is termed 'bycatch' and is a management issue for all fishing fleets (Hall *et al.* 2000). Large marine vertebrates (e.g. sea turtles, seabirds, marine mammals, sharks) are among those most vulnerable to the negative effects of bycatch because of their late age at maturity and low reproductive rates (Heppell *et al.* 1999; Fujiwara & Caswell 2001; Baum *et al.* 2003; Lewison & Crowder 2003). Whereas fishing pressure on a target stock responds to target abundance, fishing pressure on bycatch species is likely to continue irrespective of bycatch abundance if the effects of bycatch are not assessed (Crowder & Murawski 1998).

Despite the existence of bycatch in all fishing fleets, there have been few attempts to quantify the magnitude and extent of protected species bycatch even for fisheries in

which bycatch is perceived as a pressing concern. This is, in part, a consequence of limited data. Although international fishery commissions request voluntary reporting of the catch of target species over entire ocean basins, they have no regulatory authority over non-fish bycatch and few commissions have paid close attention to bycatch of threatened pelagic species. Unlike landing records for target species, bycatch monitoring must rely solely on onboard observers or on fishers' logbooks. Several nations employ observers to record bycatch of vulnerable species, but total observer effort is low. Another limitation of existing bycatch assessments has been a single nation or regional perspective, which constrains the applicability of such findings for globally distributed bycatch species. Whereas some research has addressed national bycatch issues and estimated regional fishing effort (Klaer & Polacheck 1997; Caswell *et al.* 1998; Gales *et al.* 1998; Tuck *et al.* 2001), these analyses have been limited in scale and data synthesis.

One fishery currently receiving considerable attention with respect to bycatch is the pelagic longline fishery. This gear's mainline stretches for tens of kilometres and dangles

thousands of individually hooked lines; sea turtle bycatch is the result of turtles attempting to swallow bait or becoming entangled in gear. Pelagic longline bycatch has been implicated as a proximate cause for regional declines in two threatened sea turtle populations – loggerhead and leatherback sea turtles in the Pacific (Spotila *et al.* 2000). Despite these claims, the magnitude and extent of sea turtle bycatch from pelagic longlines has not been assessed, primarily because of the limitations of small-scale analyses to address this global issue. Here we present an integrated approach to fisheries bycatch assessment, synthesizing existing data at a spatial scale relevant to imperilled sea turtle populations and the global pelagic longline fishery.

PELAGIC LONGLINES AND SEA TURTLES

Pelagic longlines are used to catch tunas and swordfish around the world, with fishing effort extending across the Pacific, Atlantic and Indian oceans. Targeted species include bigeye (*Thunnus obesus*), albacore (*T. alalunga*), yellowfin (*T. albacares*) and bluefin tuna (*T. thynnus*), as well as swordfish (*Xiphus gladius*). Pelagic longlines catch 85% of the total landings of swordfish and more than 60% of bigeye and albacore tuna – totalling more than 680 000 metric tonnes (MT) of swordfish and tuna per year. Although many fishing nations contribute to the reported landings, a few fishing nations account for the majority of this catch, i.e. Japan and Taiwan account for more than half of this total (31 and 26% respectively) while no other single nation catches more than 7% of the total longline landings. In addition to reported landings, illegal, unregistered or unreported (IUU) vessels are believed to catch another 85 000 MT of tuna and swordfish [International Commission for the Conservation of Atlantic Tunas (ICCAT 2001; SPC 2002; IOTC 2003; IATTC 2003)].

Six of the seven extant sea turtle populations worldwide are listed in the IUCN Red List of Threatened Species (<http://www.redlist.org/>). In our analyses, we considered the two species caught most frequently by pelagic longlines – leatherbacks (*Dermochelys coriacea*) and loggerheads (*Caretta caretta*). The most dramatic declines for these two species have occurred in the Pacific Ocean, where nesting populations of leatherback turtles have declined over 95% in the last 20 years (Crowder 2000; Spotila *et al.* 2000), and nesting populations of loggerheads have suffered an 80–86% decline over a similar time period (Kamezaki *et al.* 2003; Limpus & Limpus 2003).

METHODS

Fishing effort

To accurately characterize pelagic longline fishing effort, we compiled the most recent public domain data reported to

fishery commissions in the Atlantic, Pacific and Indian oceans. We used three primary public domain data sources: ICCAT, Indian Ocean Tuna Commission, and the Secretariat for the Pacific Community Oceanic Fisheries Programme (ICCAT 2001; SPC 2002; IOTC 2003). All data were entered and mapped in ArcGIS 8.1 (ESRI, Inc. Redlands, CA, USA). All ocean regions were divided into $5 \times 5^\circ$ grid cells. Locations, described by latitude and longitude, were binned into grid cells by aggregating finer ($1 \times 1^\circ$) or parsing larger ($10 \times 10^\circ$ or $20 \times 20^\circ$) cells evenly. Where fleet nationality was provided (Atlantic and Indian Ocean records), fleet information was retained. Data included in this analysis reflect fishing effort for 2000, the most recent year for which data have been released from all commissions. Although some regions contain no pelagic fishing effort (e.g. the Southern Ocean, Gulf of Alaska and Pacific coast of South America), they may contain demersal (bottom-set) longline effort. As demersal longlines have not been implicated as a source of sea turtle bycatch, we did not include this gear type in our analysis.

Data from the Pacific and Indian oceans included information on catch (measured in MT) and effort (numbers of hooks set) per fishing location (latitude and longitude) per quarter. We binned this information according to $5 \times 5^\circ$ grid cell and calculated catch per unit effort (CPUE) per grid cell (i.e. catch of target species in MT per 1000 hooks). However, Atlantic (including Mediterranean) data were released in several forms. The majority of nations fishing in the Atlantic (70% of data) report catch, effort and fishing location; these data were binned and CPUEs were calculated as described above. Approximately 2% of the Atlantic data came from nations that reported catch and fishing location, but no information regarding effort. We converted these catches to effort using weighted CPUEs from reported effort data in the same $5 \times 5^\circ$ grid cell. CPUEs were weighted by number of hooks to account for differences in hooks per estimate. If no CPUE was reported for a particular grid cell, we used the weighted average CPUE from all contiguous grid cells. The remaining 28% of Atlantic data included all other countries that were known to have caught ≥ 100 MT of tuna or swordfish, but reported neither catch nor effort to ICCAT. For these data, we based fishing location on a public domain 1997 ICCAT spatial database (CATDIS; ICCAT 2001) and rescaled each nation's 1997 catch per grid cell to reflect 2000 catch levels. This catch was then converted to effort using the weighted average CPUE method described above.

Previous research has revealed that longline sets that target swordfish have turtle bycatch rates *c.* 10 times higher than bycatch rates in tuna sets (Crowder & Myers 2001). To maintain this distinction, fishing effort was categorized into two target categories (tuna or swordfish). If target was not reported, we defined the target as the fish species with the

largest catch. All effort data were stratified by target (swordfish or tuna), by season (quarterly) and by location ($5 \times 5^\circ$ grid cell).

Sea turtle bycatch

We compiled all available bycatch rate information (Fig 1, see Supplementary Information for data sources). This included raw observer data, observer data summaries and bycatch assessments from other methods (e.g. questionnaires) from 13 countries. Bycatch data were stratified by species (loggerhead or leatherback), by target (swordfish or tuna), by season (quarterly) and by location ($5 \times 5^\circ$ grid cell).

To calculate an initial estimate of the number of turtles caught in 2000, we accounted for target-specific fishing effort that overlapped a recorded bycatch rate directly in space ($5 \times 5^\circ$ grid square) and time (yearly quarter). We refer to this as our minimum documented bycatch estimate. As the minimum documented estimate, by definition, does not account for all pelagic fishing effort in 2000, we used this estimate to extrapolate bycatch from all reported pelagic longline effort by scaling the estimates by the percentage of remaining hooks. We also estimated bycatch from all reported pelagic longline effort using basin-specific average bycatch rates for each turtle species, with fishing effort and bycatch data stratified by target. These basin averages were the mean of per country means by target within a basin, multiplied by the total effort within that basin. Although no bycatch rates have been released for the Indian Ocean, this ocean supports a relatively high level of pelagic longline effort (>140 million hooks per year). To include this region in our global turtle bycatch estimate, we therefore applied the median of the Atlantic and Pacific bycatch rate averages to Indian Ocean effort. We compared results between the two extrapolation methods (minimum estimate and basin averages) as an indication of estimate stability.

To minimize the effect of any one bycatch event, we divided all observed bycatch by all observed effort in each grid cell with multiple data records. We accounted for temporal and spatial variability in bycatch rates (and thus in bycatch estimates) by calculating the standard deviation of bycatch per unit effort from the US observer data in the Atlantic and Pacific. We used the US National Marine Fisheries Service (NMFS) data to characterize variability because it was the only raw data set available to us. We calculated the standard deviation for all $5 \times 5^\circ$ grid cells for all quarters that had more than one bycatch data record in the Atlantic and Pacific. From this distribution of standard deviations, we used a bootstrapping procedure (1000 replications of sampling with replacement) to identify the mean standard deviation for each basin. We used the mean standard deviations to calculate a one-tailed 95% confidence

interval for the basin-average extrapolation method. We truncated the interval to reflect positive bycatch rates and thus to yield positive bycatch estimates. Throughout the analysis, we selected the lower values of estimated intervals in calculating and reporting bycatch and bycatch effects.

Probability of a bycatch event and mortality

To put our derived bycatch estimates into a population context, we relied on published demographic information for loggerheads and leatherbacks, and focused our attention on populations in the Pacific where the most dramatic population declines have been reported. The reported declines in the Pacific are based on extensive beach survey efforts that have recorded the total number of nests and nesting turtles over the past 15–20 years for both species (Spotila *et al.* 2000; Kamezaki *et al.* 2003; Limpus & Limpus 2003).

Using our bycatch estimates for the Pacific, we calculated the probability of an individual Pacific loggerhead or leatherback being caught as bycatch. To do this, we defined the annual bycatch probability, P_{bycatch} , for each turtle species as the probability that a turtle would get caught in pelagic longline gear as

$$P_{\text{bycatch}} = T_{\text{bycatch}} / T_v \quad (1)$$

where P_{bycatch} was calculated as T_{bycatch} , the number of turtles caught as bycatch (see 'Sea turtle bycatch') divided by T_v , the number of turtles vulnerable to being caught by pelagic longline gear in each population. We calculated the number of Pacific loggerheads and leatherbacks vulnerable to longline gear, T_v , as:

$$T_v = V \times T \quad (2)$$

$$T = [(N_f / P_{Nf}) \times 2] \quad (3)$$

where V is the proportion of turtles vulnerable to longline gear based on body size distribution of observed bycatch and T is the total population size. N_f is the total number of nesting-aged females, and P_{Nf} is the total proportion of nesting-aged females relative to the total population. V was calculated as 20% based on the size distribution of turtles recorded by the US NMFS observer programme, and the estimated age distributions (Heppell *et al.* 2004; M. Snover personal communication). N_f was based on nesting females observed annually from all major rookeries multiplied by 2 to represent the fact that a given female nests on average every 2 years. Recent estimates put the number of nesting females at *c.* 1500 for both loggerheads and leatherbacks (Spotila *et al.* 2000; Kamezaki *et al.* 2003; Limpus & Limpus 2003). For loggerheads, P_{Nf} is 1.8%, based on the stable age distribution for Atlantic loggerheads (M. Snover personal communication). Age distribution data is not available for

Spatial Coverage of Sea Turtle Bycatch Rates

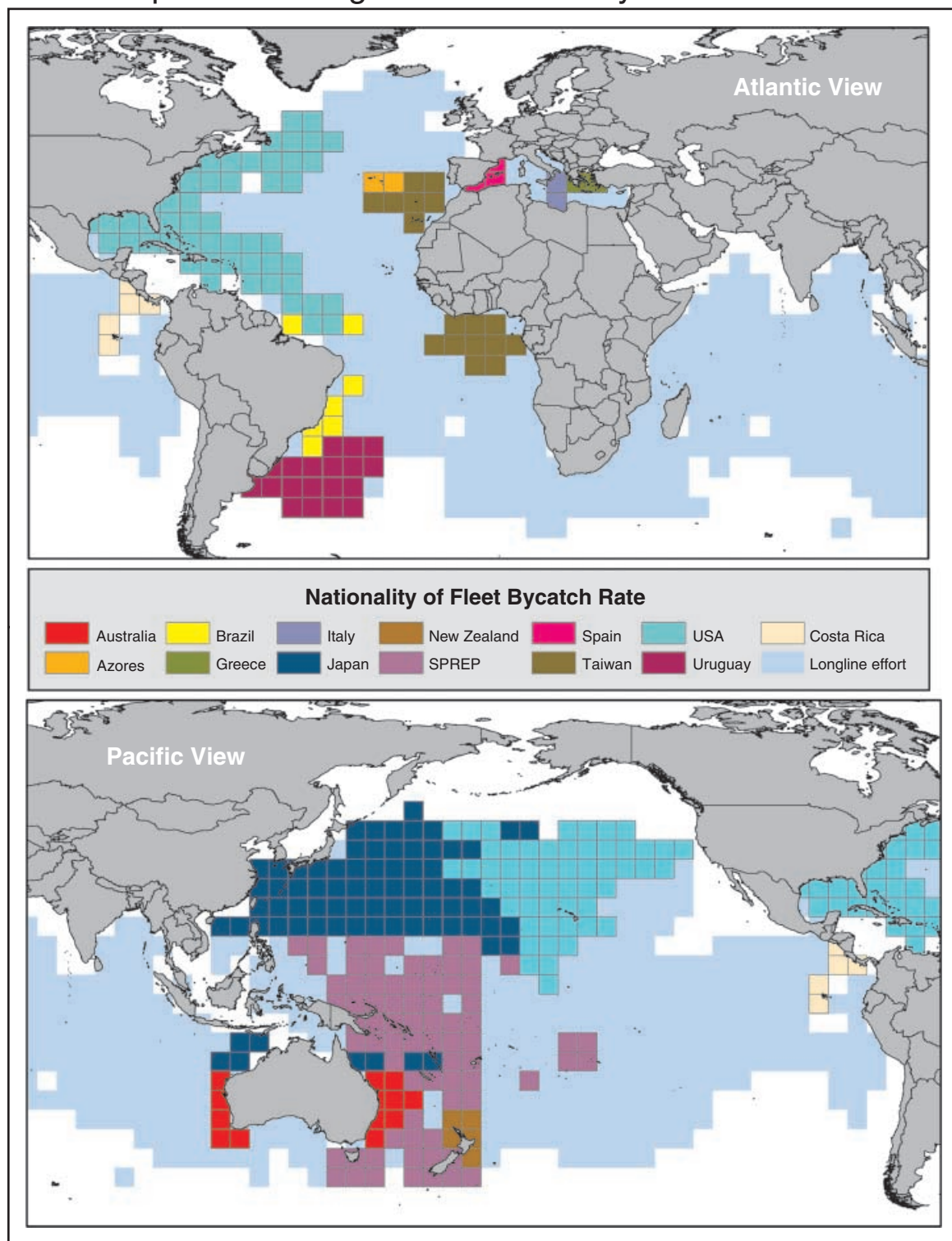


Figure 1 Map of all available bycatch rates includes in the estimate. Bycatch rates were derived from observer data, observer data summaries and assessments for other methods, including questionnaires. *SPREP, South Pacific Regional Environment Programme, including Cook Islands, Fiji, Guam, Kiribati, Mariana Islands, Marshall Islands, Micronesia, New Caledonia, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga, and Vanuatu.

leatherbacks; we assumed that P_{Nf} for leatherbacks was 3.75%, the value for Kemp's ridley (*Lepidochelys kempii*) turtles, a species with a comparable age of first reproduction (Heppell *et al.* 2003). We multiplied the total number of females by 2, assuming a 50–50 sex ratio, to calculate the total population (T).

As pelagic longlines have been documented to cause selective mortality among older age classes, deviations from a stable age distribution are plausible. To consider the affect of deviating from a stable age distribution on the calculated annual bycatch probability, we considered a range of values for the two parameters derived from the stable age distribution – P_{Nf} , the proportion of nesting-aged females in the population and V , the proportion of turtles vulnerable to longline gear. As these two parameters are linked (nesting-aged females are a subset of vulnerable turtles), we varied the parameters to account for the relative proportional change between them.

Although not every turtle interaction with longline gear is lethal, the probability of mortality per take remains uncertain. To estimate the approximate level of mortality from longline bycatch, we calculated the proportion of hooked turtles that die from gear interactions. This number is the product of the bycatch probability and the post-hooking mortality estimates. These mortality estimates reflect immediate and delayed mortality as a result of interaction with longline gear, and were estimated by the US NMFS as 17–42% for loggerheads, and 8–27% for leatherbacks (NMFS 2001a). These estimates are based on the largest bycatch data set available that accounts for immediate and delayed mortality. To calculate the number of turtles that were likely to be killed by pelagic longlines in the Pacific in 2000, we multiplied our lowest estimate of the number of loggerheads and leatherbacks caught annually in the Pacific by the probability of capture and the species-specific mortality rates.

RESULTS

Fishing effort

We estimate that pelagic longline fleets from 40 nations set $\approx$ 1.4 billion hooks in the water in one year (2000), which is equivalent to $\approx$ 3.8 million hooks every day (Fig. 2). Over half (52%) of the total fishing effort occurred in the Pacific Ocean (the largest by area), while the remaining effort was in the Atlantic (37%) and the Indian Ocean (11%). Six times more fishing effort targeted tunas (1.2 billion hooks) than swordfish (200 million hooks).

Four primary hotspots of pelagic longline effort emerge: the area south of Kiribati in the central Pacific Ocean, the region between Indonesia and the Philippines, the Mediterranean Sea and the central southern Atlantic Ocean.

Although the data from the Pacific Ocean are not nation specific, global landings suggest that Japan and Taiwan are primary fleets in this region. Indonesian fleets also report significant longline landings (45 000 MT per year), likely from artisanal fisheries in the same area. Intense longline effort in the Mediterranean primarily comes from European and African fishing nations (i.e. Spain, Italy, Greece, Libya), while the south Atlantic hotspot reflects heavy fishing by China, Equatorial Guinea and several Central American fleets (i.e. Belize, Honduras, Panama).

Sea turtle bycatch

Turtle bycatch rates from swordfish and tuna vessels ranged from 0 to 14 loggerheads, and 0 to 2.4 leatherbacks per 1000 hooks. There were no clear trends in bycatch rates by latitude, although there were significant differences between ocean basins. Atlantic and Mediterranean bycatch rates were higher than Pacific rates across tuna and swordfish fleets for both turtle species (Kolmogorov–Smirnov, $P < 0.01$). These differences may be the result of higher rates of encounter in the Atlantic, which may reflect different fishing practices regarding the use of oceanographic or bathymetric features, or different population sizes or trends between ocean regions.

Our minimum documented estimate of bycatch accounted for 26% (349 million hooks) of the total annual hooks for loggerheads, 22% for leatherbacks (288 million hooks), and yielded a minimum bycatch estimate of $\approx$ 60 000 loggerheads and 9000 leatherbacks. Extrapolating to account for the remaining hooks, this yielded an estimate of 220 000 loggerheads and 50 000 leatherbacks caught globally as bycatch in 2000. A second extrapolation method based on the basin-wide average bycatch rates yielded similar estimates of $\approx$ 250 000 loggerheads and 60 000 leatherbacks caught globally as bycatch in 2000. The concurrence of the estimates from the two extrapolation methods suggests estimate stability.

Bycatch per each ocean basin was calculated using the basin-average extrapolation method (Fig. 3). The estimate intervals are in large part determined by the amount of observer coverage in each basin; basins with low observer coverage have larger standard deviations. For example, we estimated 60 000–80 000 loggerheads are caught in the Mediterranean, based on bycatch data that were applicable to 80% of reported fishing effort. In contrast, the estimate for leatherbacks in the Mediterranean covers two orders of magnitude. However, even accounting for the varying extent of observer coverage, there are still differences between basins. Although observer coverage is greater for the Pacific than the Atlantic, there appears to be higher variability in the Pacific, either because of fewer turtle encounters, different fishing practices or a combination of factors.

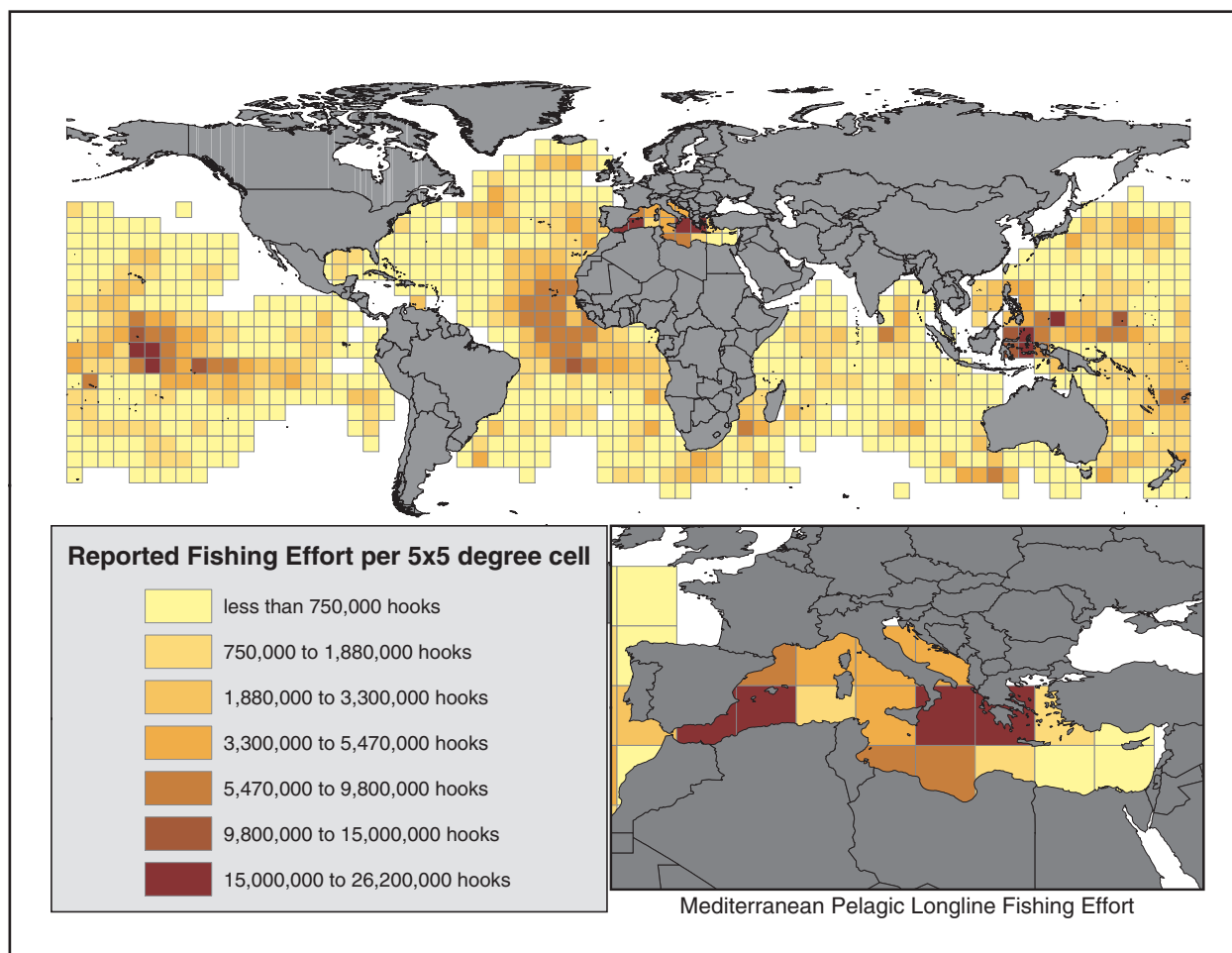


Figure 2 Map of reported pelagic longline effort, including all tuna and swordfish directed effort for 2000. Hotspots of high fishing effort are shown in brown.

Probability of a bycatch event and mortality

Based on eqn 3, total population sizes in the Pacific were calculated to be $\approx$ 335 000 loggerheads and 160 000 leatherbacks. Of these, an estimated 67 000 loggerheads and 32 000 leatherbacks are in size classes vulnerable to pelagic longline bycatch. From the Pacific fishing effort and bycatch rate data, we estimated that 30 000 loggerheads and 20 000 leatherbacks were caught in 2000 as bycatch by pelagic longlines throughout the Pacific. This yielded annual bycatch probabilities of 0.45 and 0.63 for Pacific loggerheads and leatherbacks respectively, and suggests that vulnerable loggerheads and leatherbacks in this region are taken as bycatch on average once every 2 years. Combining these bycatch probabilities and NMFS mortality estimates, we estimate that between 2600 and 6000 loggerheads and between 1000 and 3200 leatherback turtles were killed by pelagic longline gear in 2000 in the Pacific alone.

Although the annual bycatch probabilities were derived using parameters associated with a stable age distribution, the calculated probabilities were robust to deviations from that distribution (Fig. 4a and b). Even assuming the lowest (and unlikely) percentage of nesting-aged females in each population, 0.6 and 2.25% for loggerheads and leatherbacks, respectively, the resulting annual bycatch probabilities in the Pacific are still high enough to warrant management action under protected species legislation.

DISCUSSION

Fisheries management faces the growing problem of reducing the bycatch of protected pelagic species, namely sea turtles, sea birds, marine mammals and sharks. Despite the concerns of the public about declining populations of these species, bycatch assessments have been limited in temporal and spatial scale, and, thus, in applicability to this

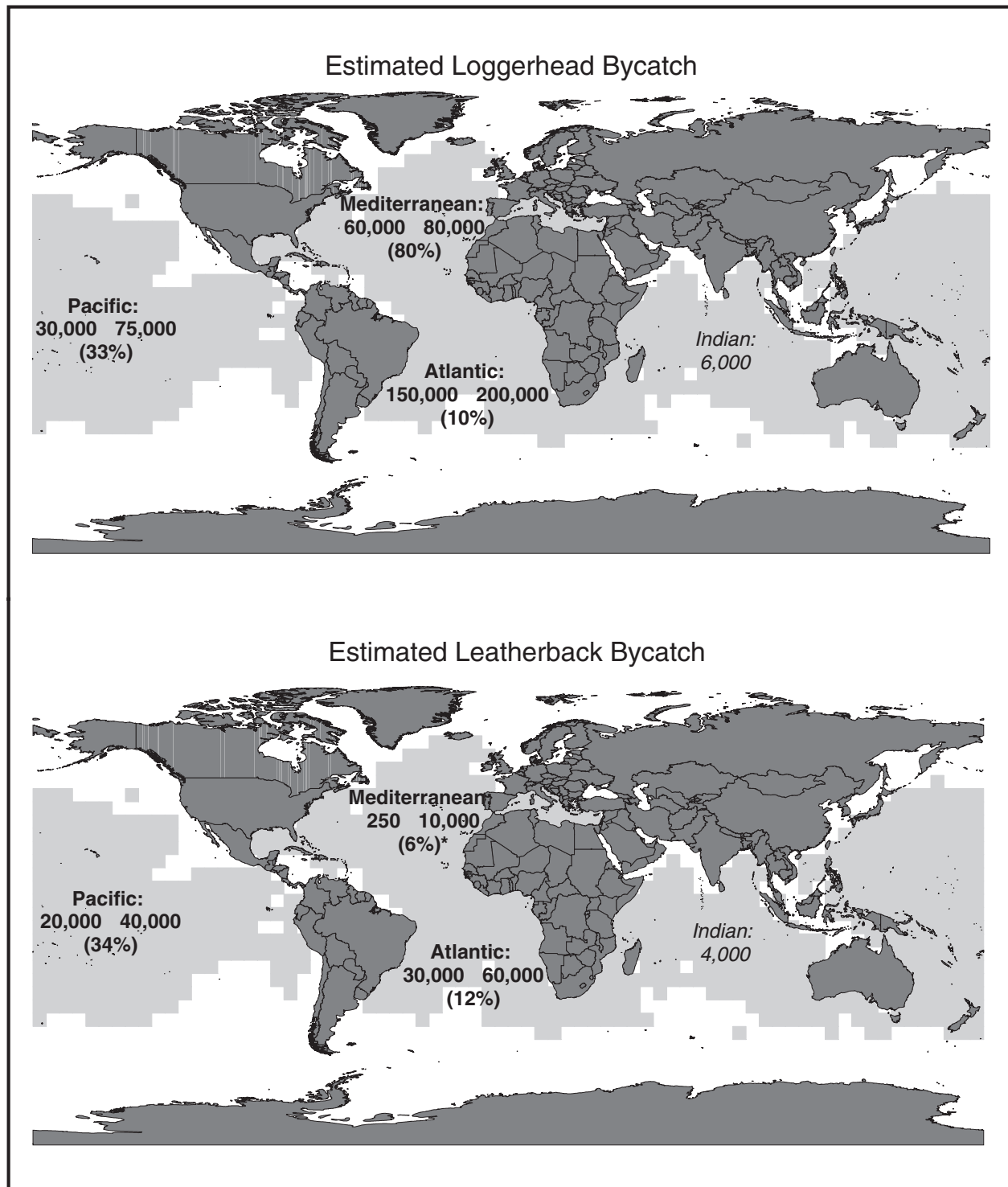


Figure 3 Estimates of loggerhead and leatherback turtles caught as bycatch by the pelagic longline fishery in 2000 in the Atlantic, Pacific and Mediterranean. The range of values is based on a one-tailed 95% confidence interval. The number in parentheses represents the observer coverage for the basin – the percentage of fishing effort that occurred in grid cells with measured bycatch rates. Estimates for the Indian Ocean are shown in italics to indicate that no bycatch data has been published or released for this region. Indian Ocean estimates are based on median bycatch rates from the Atlantic and Pacific. *Lack of recorded zeros for leatherbacks may contribute to the low level of observer coverage for this species in the Mediterranean.

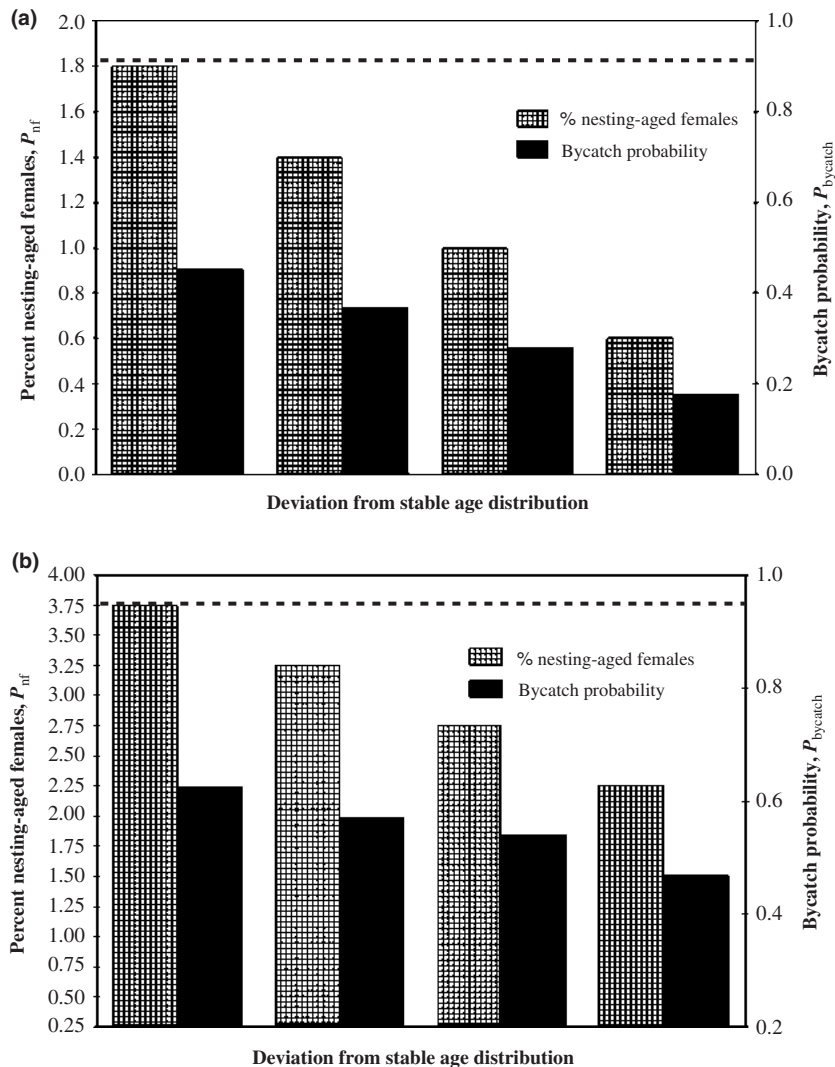


Figure 4 The influence of deviating from the stable age distribution P_{nf} , where P_{nf} is the percent of nesting-aged females in the total population, on the estimates of the annual bycatch probability ($P_{bycatch}$) for (a) loggerheads and (b) leatherbacks. Annual bycatch probability is calculated as the ratio of the number of turtles caught ($T_{bycatch}$) to the number of turtles vulnerable to being caught (T_v). Dashed line represents stable age distribution value for P_{nf} .

global conservation problem. Here we present an assessment framework that integrates data at relevant spatial scales for two protected and globally distributed pelagic sea turtle species. Although sea turtles are the focus of this paper, the large-scale, synthetic approach presented here is applicable to other globally distributed taxa (e.g. seabirds, marine mammals and sharks) caught by pelagic longlines and other global fisheries. Beyond the basic question of what impact a fishery has on species taken as bycatch, large-scale bycatch assessments may also point to important regional differences in how bycatch species and fishing vessels interact. The significant differences in bycatch rates between the Atlantic, Mediterranean and Pacific may result from different fishing gear, fishing practices or simply reflect divergent trends in abundance of bycatch species among regions. These differences have yet to be explicitly considered.

Worldwide pelagic longline fisheries were likely to have caught at least 200 000 loggerheads and 50 000 leatherbacks turtles in 2000. Based on the estimates of mortality from NMFS, tens of thousands of turtles die from these encounters around the world. In the Pacific, where regional nest surveys record the majority of nesting activity, precipitous declines in nesting females on all major Pacific rookeries (Fig. 5) suggest that unmitigated longline bycatch will have serious consequences for both loggerheads and leatherbacks in the Pacific. Population projections calculated from Costa Rican leatherback nesting data in 1995, when nesting counts were higher than today, suggested adult leatherback mortality from fisheries greater than 1% would lead to population collapse (Spotila *et al.* 1996). Our analyses suggest this mortality threshold is likely being exceeded for both loggerheads and leatherbacks in the Pacific. Other sources of mortality may also be contributing to regional loggerhead or leatherback

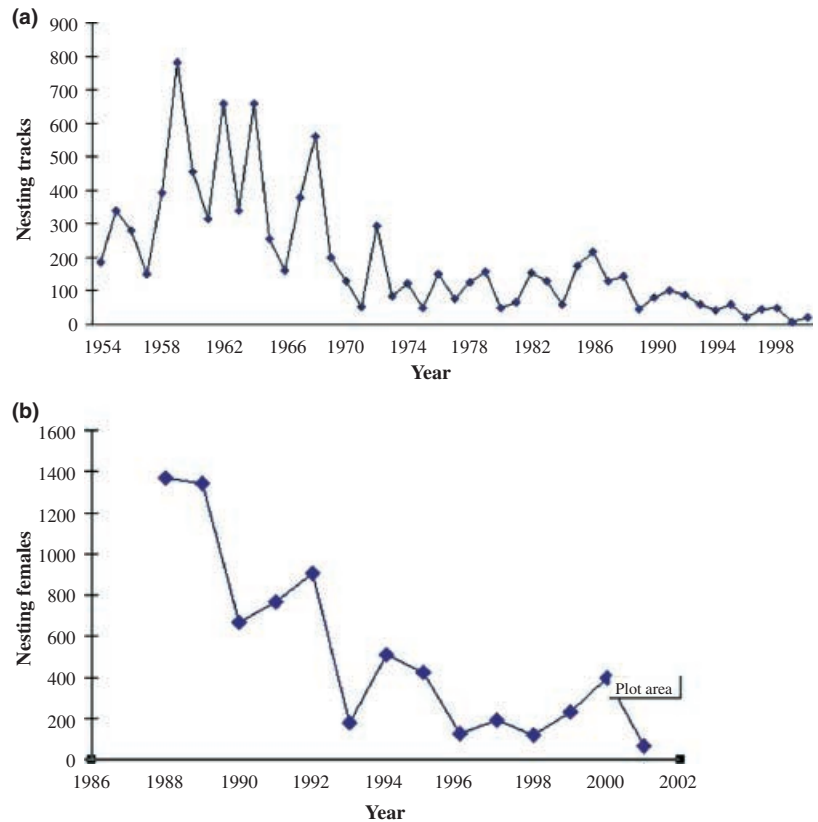


Figure 5 Trends of nesting activity from major nesting beaches in the Pacific for (a) loggerheads in Kamouda Beach, Japan (Kamezaki *et al.* 2003) and (b) leatherbacks in Playa Grande, Costa Rica (Spotila *et al.* 2000). Similar trends have been reported for other nesting beaches (Limpus & Limpus 2003, L. Sarti and S. Eckert personal communication).

declines: egg mortality from human and other predators, loss of beach habitat, and bycatch from other fisheries, such as gillnets and trawls (NMFS 2001b; Lewison *et al.* 2003). Like pelagic longlines, gillnets and trawl nets catch large subadults and adults, age classes that are sensitive to perturbation and can strongly affect population growth rates (Crowder *et al.* 1994; NMFS 2001b; Bolten 2003). These additional mortality sources must also be assessed and mitigated.

Just as bycatch assessments must be made at relevant spatial scales, so too must management actions that are designed to reduce or eliminate turtle bycatch. The United States has implemented both temporary and permanent fishery closures to reduce turtle bycatch and protect turtle populations (NMFS 2000a,b). However, the basin-wide distributions of both pelagic longline effort and sea turtles, coupled with the relatively small US contribution to total pelagic longline effort (*c.* 2% of worldwide landings), suggest that effective protection for loggerheads and leatherbacks will require coordinated international action (Crowder 2000). Experimental fisheries have identified some gear modifications and fishing practices that reduce sea turtle bycatch (e.g. circle hooks, mackerel bait, leaded swivels; Watson *et al.* 2003), but multinational efforts are needed immediately to continue to develop and implement

mitigation measures that can reduce or eliminate turtle bycatch across fleets and basins.

Of necessity, our analysis relies on fishing statistics voluntarily reported by member states in the international fishing commissions, and on published or released bycatch rates from individual nations. Thus, our calculations are subject to error from data limitations. Although the quality of the data available may limit the precision of our estimates, we believe our calculations of longline effort and turtle bycatch are reasonable assessments of the magnitude of actual effects. Our estimates were robust to deviations in demographic assumptions and were all based on the lowest values from estimate intervals. The precautionary principle as applied to endangered species management suggests that we should seek to reduce mortality for sea turtles, particularly in the Pacific, both on land and at sea.

The large bycatch estimate ranges found in ocean areas where observer coverage is low demonstrate that widespread observer coverage is critical to precisely characterize the extent and magnitude of fisheries bycatch. Despite data limitations and uncertainties, the non-trivial risk of extinction for some populations of sea turtles warrants the use of the best available data to provide bracketed estimates of the magnitude of current bycatch problems and, if demographic information is available, to place

bycatch into a population context. As long as bycatch assessments use transparent and defensible methodologies that can be replicated and revised once higher quality or more data become available, these assessments can provide a meaningful management tool. Although more data collection may always be warranted, there is currently sufficient data available to inform resource managers on the need for intervention, particularly in the Pacific. An integrated approach that replaces the single nation or regional perspective with a global one, and synthesizes data from fishery commissions and data on protected species can provide critical insights to those interested in managing oceanic pelagic organisms at the appropriate scale. Actions of individual nations may do little to prevent wide-ranging pelagic organisms such as sea turtles from sliding to extinction. Conserving sea turtles, and other global bycatch species, will require ocean-scale assessments in conjunction with international action.

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REMAND for re-sentencing consistent with this opinion.



**ARIZONA CATTLE GROWERS' ASSO-
CIATION, Jeff Menges, Plaintiffs–
Appellees–Cross–Appellants,**

v.

**UNITED STATES FISH AND WILD-
LIFE, Bureau of Land Management,
Defendants–Appellants–Cross–Appel-
lees,**

and

**Southwest Center for Biological
Diversity, Defendant–Inter-
venor–Appellant.**

**Nos. 99–16102, 99–16103, 00–
15322 and 00–15511.**

United States Court of Appeals,
Ninth Circuit.

Argued and Submitted March 14, 2001

Filed Dec. 17, 2001

Ranchers' association challenged United States Fish and Wildlife Service's (FWS) issuance of incidental taking statements (ITS) that precluded ranchers from grazing cattle in certain areas on basis that potential habitat modification by cattle might harm endangered species. The United States District Court for the District of Arizona, David Alan Ezra, Chief District Judge, granted judgment for ranchers (ACGA I), 63 F.Supp.2d 1034. FWS appealed. In a separate case against the United States Forest Service (USFS), on similar issues in the same district, Robert C. Broomfield, Chief District Judge, granted judgment for ranchers in part and judgment for USFS in part (ACGA II) and an appeal was taken. The cases were consolidated on appeal. The Court of Appeals,

Wardlaw, Circuit Judge, held that: (1) ITS was required to be predicated on finding of incidental take; (2) FWS acted in arbitrary and capricious manner by issuing ITS; and (3) failure by FWS to properly specify amount of anticipated take, and to provide clear standard for determining when authorized level of take had been exceeded, was arbitrary and capricious.

ACGA I affirmed; ACGA II affirmed in part and reversed in part.

1. Fish ⇨12

Game ⇨3.5

The issuance of a Biological Opinion as well as an accompanying Incidental Take Statement under the Endangered Species Act (ITS) are considered final agency actions. Endangered Species Act of 1973, § 7(b), as amended, 16 U.S.C.A. § 1536(b); 50 C.F.R. § 402.14.

2. Administrative Law and Procedure ⇨704

Final agency actions are reviewable by federal courts under the Administrative Procedure Act (APA). 5 U.S.C.A. §§ 551–559, 701–706.

3. Federal Civil Procedure ⇨103.2

Federal Courts ⇨30

Federal courts are under an independent obligation to examine their own jurisdiction, and standing is perhaps the most important of the jurisdictional doctrines.

4. Fish ⇨12

Game ⇨3.5

Judicial review of administrative decisions involving the Endangered Species Act (ESA) is governed by the Administrative Procedures Act (APA). 5 U.S.C.A. § 706; Endangered Species Act of 1973, § 2 et seq., as amended, 16 U.S.C.A. § 1531 et seq.

5. Administrative Law and Procedure
⌘763

The arbitrary and capricious test under the Administrative Procedures Act (APA) is a narrow scope of review of agency factfinding. 5 U.S.C.A. § 706(2)(A).

6. Administrative Law and Procedure
⌘760, 763

To determine whether an agency violated the arbitrary and capricious standard under the Administrative Procedures Act (APA), a court must determine whether the agency articulated a rational connection between the facts found and the choice made; a court is not empowered to substitute its judgment for that of the agency. 5 U.S.C.A. § 706(2)(A).

7. Administrative Law and Procedure
⌘753, 763

As long as an agency decision is based on a consideration of relevant factors, and there is no clear error of judgment, a reviewing court may not overturn an agency's action as arbitrary and capricious; however, the basis for the decision must come from the agency because a reviewing court may not substitute reasons for agency action that are not in the record. 5 U.S.C.A. § 706(2)(A).

8. Administrative Law and Procedure
⌘760, 784.1

The Court of Appeals is deferential to an agency's expertise in situations where resolution of a dispute primarily involves issues of fact; deference is particularly important when the agency is making predictions, within its area of special expertise, at the frontiers of science; consequently, a reviewing court may set aside only those conclusions that do not have a basis in fact, not those with which it disagrees. 5 U.S.C.A. § 706(2)(A).

9. Administrative Law and Procedure
⌘763**Statutes** ⌘219(4)

Judicial review of agency action is meaningless unless a reviewing court carefully reviews the record to ensure that agency decisions are founded on a reasoned evaluation of the relevant factors; accordingly, while reviewing courts should uphold reasonable and defensible constructions of an agency's enabling act, they must not rubber stamp administrative decisions that they deem inconsistent with a statutory mandate or that frustrate the congressional policy underlying a statute. 5 U.S.C.A. § 706(2)(A).

10. Statutes ⌘219(1)

Generally, courts review agency interpretation of a statute under a two part test, where, under step one, the court decides independently whether Congress has directly spoken to the precise question at issue, and if the court is unable to conclude that Congress has precisely spoken, it is to defer to any permissible or reasonable interpretation of the agency.

11. Statutes ⌘219(4)

Ultimately, the judiciary is the final authority on issues of statutory construction and must reject administrative constructions that are contrary to clear congressional intent.

12. Fish ⌘12**Game** ⌘3.5

Although an action agency is technically free to disregard a Biological Opinion and proceed with its proposed action, it does so at its own peril; consequently, if the terms and conditions of an Incidental Take Statement (ITS) are disregarded, and a taking does occur, the action agency or the applicant may be subject to potentially severe civil and criminal penalties. Endangered Species Act of 1973, §§ 2-18,

7(o), as amended, 16 U.S.C.A. §§ 1531–1544, 1536(o).

13. Fish ⇌12

Game ⇌3.5

An Incidental Take Statement (ITS) under the Endangered Species Act (ESA) must be predicated on a finding of an incidental take. Endangered Species Act of 1973, § 7(a)(2), (o), as amended, 16 U.S.C.A. § 1536(a)(2), (o).

14. Fish ⇌12

Game ⇌3.5

The Endangered Species Act (ESA) does not dictate that the Fish and Wildlife Service (FWS) must issue an Incidental Take Statement (ITS) irrespective of whether any incidental takings will occur. Endangered Species Act of 1973, § 7(b)(4), as amended, 16 U.S.C.A. § 1536(b)(4).

15. Federal Courts ⇌612.1

The Court of Appeals has discretion to review a purely legal issue, including the interpretation of a statute, that is made for the first time on appeal unless the other party would be prejudiced by the failure to raise the issue at the district court.

16. Statutes ⇌205, 208

The words of a statute must be read in their context and with a view to their place in the overall statutory scheme; a court must therefore interpret the statute as a symmetrical and coherent regulatory scheme and fit, if possible, all parts into an harmonious whole.

17. Statutes ⇌219(4)

An agency's construction of the laws it administers is accorded considerable weight; however, the judiciary is the final authority on issues of statutory construction and must reject administrative constructions which are contrary to clear congressional intent.

18. Fish ⇌12

Game ⇌3.5

Absent rare circumstances, such as those involving migratory species, it is arbitrary and capricious to issue an Incidental Take Statement (ITS) when the Fish and Wildlife Service (FWS) has no rational basis to conclude that a take will occur incident to the otherwise lawful activity. Endangered Species Act of 1973, § 7(b)(4), as amended, 16 U.S.C.A. § 1536(b)(4).

19. Fish ⇌12

Game ⇌3.5

The Fish and Wildlife Service is not required to provide an Incidental Take Statement (ITS) whenever it issues a Biological Opinion. Endangered Species Act of 1973, § 7(b)(4), as amended, 16 U.S.C.A. § 1536(b)(4); 50 C.F.R. § 402.14.

20. Fish ⇌12

Fish and Wildlife Service (FWS) acted in arbitrary and capricious manner by issuing Incidental Take Statements (ITS) imposing terms and conditions on land use permits, where there either was no evidence that endangered species existed on land or no evidence that a take would occur if permit were issued. 5 U.S.C.A. § 706; Endangered Species Act of 1973, § 7(b)(4), as amended, 16 U.S.C.A. § 1536(b)(4); 50 C.F.R. § 402.14.

21. Fish ⇌12

Game ⇌3.5

The Endangered Species Act (ESA) provides for the designation of critical habitat outside a geographic area currently occupied by a species when such areas are essential for the conservation of the species. Endangered Species Act of 1973, § 3(5)(A)(ii), as amended, 16 U.S.C.A. § 1532(5)(A)(ii).

22. Game ⇌3.5

When an agency purports to impose conditions on the lawful use of land under

the Endangered Species Act (ESA) without showing that a species exists on it, it acts beyond its authority. 5 U.S.C.A. § 706; Endangered Species Act of 1973, § 2 et seq., as amended, 16 U.S.C.A. § 1531 et seq.

23. Fish ⇌12

Issuance of Incidental Take Statements (ITS) relating to loach minnow in particular area was not arbitrary and capricious, on basis that Fish and Wildlife Service (FWS) articulated rational connection between harm to species and land grazing activities, since loach minnow could have been harmed when livestock entered river and FWS provided extensive site-specific information that discussed not only topography of relevant allotment, but indirect effects of grazing on species due to topography. 5 U.S.C.A. § 706; Endangered Species Act of 1973, § 7(b)(4), as amended, 16 U.S.C.A. § 1536(b)(4); 50 C.F.R. § 402.14.

24. Fish ⇌12

Failure by Fish and Wildlife Service (FWS) to properly specify amount of anticipated take and to provide clear standard for determining when authorized level of take had been exceeded, was arbitrary and capricious, in lawsuit brought by ranchers' association challenging issuance of incidental taking statements (ITS) that precluded ranchers from grazing cattle in certain areas on basis that potential habitat modification by cattle might harm endangered species, since issuance of such terms and conditions were so vague as to preclude compliance therewith. 5 U.S.C.A. § 706; Endangered Species Act of 1973, § 7(b)(4), as amended, 16 U.S.C.A. § 1536(b)(4); 50 C.F.R. § 402.14.

25. Fish ⇌12

Game ⇌3.5

For the purpose of application of the Endangered Species Act (ESA), in the absence of a specific numerical value in an

Incidental Take Statement (ITS), the Fish and Wildlife Service must establish that no such numerical value can be practically obtained. Endangered Species Act of 1973, § 7(b)(4), as amended, 16 U.S.C.A. § 1536(b)(4); 50 C.F.R. § 402.14.

26. Fish ⇌12

Game ⇌3.5

For the purpose of application of the Endangered Species Act (ESA), the Fish and Wildlife Service (FWS) must establish a link between the activity and the taking of species before setting forth specific conditions, not that the FWS must demonstrate a specific number of takings. Endangered Species Act of 1973, § 7(b)(4), as amended, 16 U.S.C.A. § 1536(b)(4); 50 C.F.R. § 402.14.

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M. Reed Hopper (on brief), Pacific Legal Foundation, for the amicus curiae.

Appeal from the United States District Court for the District of Arizona; Robert C. Broomfield and David Alan Ezra, District Court Judges, Presiding. D.C. Nos. CV-97-02416-DAE, CV-99-0673-RCB.

Before: NOONAN, McKEOWN, and WARDLAW, Circuit Judges.

WARDLAW, Circuit Judge:

At issue in these consolidated cross-appeals is whether the United States Fish and Wildlife Service's provision of Incidental Take Statements pursuant to the Endangered Species Act was arbitrary and capricious under Section 706 of the Administrative Procedure Act. In separate actions, the Arizona Cattle Growers' Association ("ACGA") challenged the Incidental Take Statements set forth in the Biological Opinions issued by the Fish and Wildlife Service in consultation with the Bureau of Land Management (ACGA I) and the United States Forest Service (ACGA II) in response to ACGA's application for cattle grazing permits in Southeastern Arizona. In the district courts, each of the Incidental Take Statements was set aside, with one exception, as arbitrary and capricious actions by the Fish and Wildlife Service, due to insufficient evidence of a take.

We hold, based on the legislative history, case law, prior agency representations, and the plain language of the Endangered Species Act, that an Incidental Take Statement must be predicated on a finding of an incidental take. Further, the Fish and Wildlife Service acted in an arbitrary and capricious manner by issuing Incidental Take Statements imposing terms and conditions on land use permits, where there either was no evidence that the endangered species existed on the land or no evidence that a take would occur if the permit were issued. We also find that it was arbitrary and capricious for the Fish

and Wildlife Service to issue terms and conditions so vague as to preclude compliance therewith.

I. Background

A. ACGA I

Arizona Cattle Growers' Association and Jeff Menges, a rancher seeking a grazing permit on the lands at issue (collectively "ACGA"), sued the Fish and Wildlife Service and the Bureau of Land Management to challenge Incidental Take Statements issued by the Fish and Wildlife Service in a Biological Opinion for certain grazing lands. *Ariz. Cattle Growers' Ass'n v. U.S. Fish & Wildlife Serv.*, 63 F.Supp.2d 1034 (D.Ariz.1998) (Ezra, C.J., presiding) ("ACGA I"). Menges sought livestock grazing permits for land within the area supervised by the Bureau of Land Management's Safford and Tucson, Arizona field offices, and the Association represented members who claimed to be harmed by the government action. The Bureau of Land Management's livestock grazing program for this area affects 288 separate grazing allotments that in total comprise nearly 1.6 million acres of land. The Fish and Wildlife Service's Biological Opinion, issued on September 26, 1997, analyzes twenty species of plants and animals and concludes that the livestock grazing program was not likely to jeopardize the continued existence of the species affected nor was likely to result in destruction or adverse modification of the designated or proposed critical habitat. The Fish and Wildlife Service did, however, issue Incidental Take Statements for various species of fish and wildlife listed or proposed as endangered.

ACGA's suit challenged both the Incidental Take Statements and their terms and conditions. The matter was adjudicated by way of cross-motions for summary judgment. ACGA's summary judgment

motion focused on two of the ten Incidental Take Statements, those for the razorback sucker and the cactus ferruginous pygmy-owl. The district court first determined that ACGA enjoyed representational standing to sue for injuries relating to all allotments affected by the Incidental Take Statements. It then held that the Fish and Wildlife Service's issuance of an Incidental Take Statement for both the razorback sucker and the pygmy-owl was arbitrary and capricious, reasoning that the Fish and Wildlife Service "failed to provide sufficient reason to believe that listed species exist in the allotments in question." *Id.* at 1045. In light of this holding, the court did not reach ACGA's objections to the terms and conditions of the Incidental Take Statements. It therefore granted ACGA's motion for partial summary judgment, following which ACGA stipulated to dismissal without prejudice of the other claims. A final judgment setting aside the Incidental Take Statements for the pygmy-owl and razorback sucker was entered. The Fish and Wildlife Service, together with the Bureau of Land Management, timely filed its notice of appeal. At the request of the Bureau of Land Management and the Fish and Wildlife Service, the parties agreed to stay the appeal pending judgment in the second action, ACGA II.

B. ACGA II

In ACGA II, ACGA¹ challenged Incidental Take Statements set forth in a second Biological Opinion issued by the Fish and Wildlife Service that concerns livestock grazing on public lands administered by the United States Forest Service. *Ariz. Cattle Growers' Ass'n v. U.S. Fish & Wildlife Serv.*, No. 99-0673 (D.Ariz. Dec. 14, 1999) (Broomfield, J., presiding) ("ACGA II"). The Fish and Wildlife Service examined 962 allotments, determining

that grazing would have no effect on listed species for 619 of those allotments and cause no adverse effects for 321 of the remaining allotments, leaving 22 allotments. These allotments were each roughly 30,000 acres, but several of the allotments were significantly larger. In its Biological Opinion, the Fish and Wildlife Service concluded that ongoing grazing activities on 21 out of the 22 allotments at issue would not jeopardize the continued existence of any protected species or result in the destruction or adverse modification of any critical habitat. It determined, however, that ongoing grazing activities would incidentally take members of one or more protected species in each of the 22 allotments, and it issued Incidental Take Statements for each of those allotments. ACGA contested the issuance of Incidental Take Statements for six of the allotments: Cow Flat, East Eagle, Montana, Sears-Club/Chalk Mountain, Sheep Springs, and Wildbunch.

The parties filed cross-motions for summary judgment. Rejecting the government's arguments that the term "taking" should be interpreted more broadly in a Section 7 consultation case than in a Section 9 injunctive relief case, the district court held that the "the term 'take' as used in Section 7(b)(4) of the Endangered Species Act ('ESA') has an identical meaning as when used in Section 9." With that interpretation in mind, the district court examined the Biological Opinion to determine whether the evidence relied upon by the Fish and Wildlife Service was rationally connected to its decision to issue Incidental Take Statements for the six allotments at issue. With respect to all but the Cow Flat Allotment, the district court held that the Fish and Wildlife Service acted arbitrarily and capriciously in issuing an Incidental Take Statement based on a Bio-

1. Menges was not a party to this litigation.

logical Opinion that fails to show a take was reasonably certain to occur. As to the Cow Flat Allotment, the district court found that based upon the evidence in the Biological Opinion, the Fish and Wildlife Service could reasonably determine that takings were likely to occur when livestock entered the river, and therefore upheld the Incidental Take Statement for that allotment. The court then ruled that neither the specificity of the anticipated take provision nor the "reasonable and prudent measures" condition was arbitrary and capricious. It therefore granted the Fish and Wildlife Service's motion for summary judgment as to the Cow Flat Allotment and ACGA's motion for summary judgment as to the East Eagle, Montana, Sears-Club/Chalk Mountain, Sheep Springs, and Wildbunch allotments.

The Fish and Wildlife Service appealed the district court's rulings only as they concerned the East Eagle, Montana, Sears-Club/Chalk Mountain and Wildbunch allotments. ACGA cross-appealed the district court's Cow Flat Allotment rulings.

II. Jurisdiction and Standing

[1,2] Final agency actions are reviewable by federal courts under section 704 of the Administrative Procedure Act ("APA"), 5 U.S.C. §§ 551-559, 701-706 (1994 & Supp. IV 1998). The issuance of a Biological Opinion as well as an accompanying Incidental Take Statement are considered final agency actions. *Bennett v. Spear*, 520 U.S. 154, 178, 117 S.Ct. 1154, 137 L.Ed.2d 281 (1997) (holding that the Biological Opinion is a final agency action because it has "direct and appreciable legal consequences"); *Southwest Ctr. for Biological Diversity v. U.S. Bureau of Reclamation*, 143 F.3d 515, 522 (9th Cir.1998).

[3] In ACGA I, the district court considered at length the question of ACGA's standing to challenge a majority of the

Incidental Take Statements at issue, and found that ACGA possessed representational standing to sue for injuries relating to all allotments affected by the Biological Opinion and not just those allotments that affect co-appellee and ACGA member Menges. *See ACGA I*, 63 F.Supp.2d at 1038-42. Although the Fish and Wildlife Service did not attempt to resurrect the issue of standing on appeal, "federal courts are under an independent obligation to examine their own jurisdiction, and standing 'is perhaps the most important of [the jurisdictional] doctrines.'" *FW/PBS Inc. v. Dallas*, 493 U.S. 215, 231, 110 S.Ct. 596, 107 L.Ed.2d 603 (1990) (quoting *Allen v. Wright*, 468 U.S. 737, 750, 104 S.Ct. 3315, 82 L.Ed.2d 556 (1984)). We have considered therefore the question of standing anew and agree with the district court's analysis and conclusion that ACGA enjoys standing to maintain these appeals.

III. Standard of Review

These cases arise as a challenge to the Fish and Wildlife Service's interpretation of the mandates of the ESA and its subsequent actions in issuing Incidental Take Statements. Although the parties agree that the agency action must be reviewed under the APA § 706 arbitrary and capricious standard, the Fish and Wildlife Service strenuously objects both to the ACGA I district court's requirement that it provide some evidence that the species existed, and could therefore be harmed by the regulated land use, and to the ACGA II district court's use of a "reasonable certainty" standard to evaluate whether the agency acted in an arbitrary and capricious manner.

A. Judicial Review of Agency Action

[4,5] Judicial review of administrative decisions involving the ESA is governed by section 706 of the APA. 5 U.S.C. § 706; *Pyramid Lake Paiute Tribe of Indians v.*

U.S. Dep't of the Navy, 898 F.2d 1410, 1414 (9th Cir.1990). Under section 706, the reviewing court must determine that agency decisions are not "arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law." 5 U.S.C. § 706(2)(A); *Pyramid Lake Paiute Tribe of Indians*, 898 F.2d at 1414. The arbitrary and capricious test is a narrow scope of review of agency factfinding. *Abbott Labs. v. Gardner*, 387 U.S. 136, 87 S.Ct. 1507, 18 L.Ed.2d 681 (1967).

[6, 7] To determine whether an agency violated the arbitrary and capricious standard, this court must determine whether the agency articulated a rational connection between the facts found and the choice made. *Pyramid Lake Paiute Tribe of Indians*, 898 F.2d at 1414 (citing *Friends of Endangered Species, Inc. v. Jantzen*, 760 F.2d 976, 982 (9th Cir.1985)). The court is not empowered to substitute its judgment for that of the agency. *Citizens to Preserve Overton Park, Inc. v. Volpe*, 401 U.S. 402, 416, 91 S.Ct. 814, 28 L.Ed.2d 136 (1971). As long as the agency decision was based on a consideration of relevant factors and there is no clear error of judgment, the reviewing court may not overturn the agency's action as arbitrary and capricious. *Amer. Hosp. Ass'n v. NLRB*, 499 U.S. 606, 111 S.Ct. 1539, 113 L.Ed.2d 675 (1991); *Citizens to Preserve Overton Park, Inc.*, 401 U.S. at 402, 91 S.Ct. 814 (1971). The basis for the decision, however, must come from the agency. The reviewing court may not substitute reasons for agency action that are not in the record. See *Camp v. Pitts*, 411 U.S. 138, 142, 93 S.Ct. 1241, 36 L.Ed.2d 106 (1973) ("[T]he focal point for judicial review is the administrative record in existence....").

[8] We are deferential to the agency's expertise in situations, like that here, where "resolution of this dispute involves primarily issues of fact." *Marsh v. Or.*

Natural Res. Council, 490 U.S. 360, 377, 109 S.Ct. 1851, 104 L.Ed.2d 377 (1989) ("Because analysis of the relevant documents 'requires a high level of technical expertise,' we must defer to the informed discretion of the responsible federal agencies.") (citations omitted). Deference is particularly important "when the agency is 'making predictions, within its area of special expertise, at the frontiers of science.'" *Central Ariz. Water Conservation Dist. v. EPA*, 990 F.2d 1531, 1539-40 (9th Cir. 1993) (quoting *Balt. Gas & Elec. Co. v. Natural Res. Def. Council, Inc.*, 462 U.S. 87, 103, 103 S.Ct. 2246, 76 L.Ed.2d 437 (1983)). Therefore, the reviewing court may set aside only those conclusions that do not have a basis in fact, not those with which it disagrees. *Bureau of Indian Affairs v. FLRA*, 887 F.2d 172, 176 (9th Cir.1989); *Love v. Thomas*, 858 F.2d 1347 (9th Cir.1988).

[9] Judicial review is meaningless, however, unless we carefully review the record to "ensure that agency decisions are founded on a reasoned evaluation of the relevant factors." *Marsh*, 490 U.S. at 378, 109 S.Ct. 1851. Accordingly, while reviewing courts should uphold reasonable and defensible constructions of an agency's enabling act, cf. *NLRB v. Local 103, Int'l Ass'n of Bridge, Structural & Ornamental Iron Workers*, 434 U.S. 335, 350, 98 S.Ct. 651, 54 L.Ed.2d 586 (1978) (NLRA construction), they must not "rubber-stamp ... administrative decisions that they deem inconsistent with a statutory mandate or that frustrate the congressional policy underlying a statute." *NLRB v. Brown*, 380 U.S. 278, 291-92, 85 S.Ct. 980, 13 L.Ed.2d 839 (1965).

B. Judicial Review of Agency Interpretation of a Statute

[10, 11] Generally, courts review agency interpretation of a statute under the

two-part *Chevron* test. *Chevron, U.S.A., Inc. v. Natural Res. Def. Council, Inc.*, 467 U.S. 837, 104 S.Ct. 2778, 81 L.Ed.2d 694 (1984). Under step one of *Chevron*, the court must decide independently whether Congress “has directly spoken to the precise question at issue.” *Id.* at 842, 104 S.Ct. 2778. If the court is unable to conclude that Congress has precisely spoken, it is to defer to any “permissible” or “reasonable” interpretation of the agency. *Id.*; see also Christopher Schroeder & Robert Glicksman, *Chevron, State Farm, and EPA in the Courts of Appeals During the 1990s*, 31 *Envtl. L. Rep.* 10371, 10375–79 (documenting application of *Chevron* doctrine in EPA cases). The Supreme Court, however, has “explicitly limited” *Chevron*’s deference “to cases in which congressional intent cannot be discerned through the use of the traditional techniques of statutory interpretation.” *Chem. Mfr. Ass’n v. Natural Res. Def. Council, Inc.*, 470 U.S. 116, 152, 105 S.Ct. 1102, 84 L.Ed.2d 90 (1985). Ultimately, “[t]he judiciary is the final authority on issues of statutory construction and must reject administrative constructions which are contrary to clear congressional intent.” *Chevron*, 467 U.S. at 843 n. 9, 104 S.Ct. 2778.

IV. Defining “Taking” in Light of Section 7 and Section 9 of the ESA

In the district court, the Fish and Wildlife Service argued that the word “taking” as used in ESA Section 7(b)(4) should be interpreted more broadly than in the context of Section 9 of the ESA, relying upon the different purposes, *i.e.*, protective (Section 7) as opposed to punitive (Section 9), served by each Section. Specifically, it argued that a taking as construed in Section 7 should encompass those situations in which harm to a listed species was “possible” or “likely” in the future due to the proposed action. The district court rejected this contention, and although the Fish

and Wildlife Service states that it has abandoned this argument on appeal, it nevertheless maintains that the Section 7 incidental take definition should be interpreted more broadly than the definition of a take under Section 9. In light of our ruling that an Incidental Take Statement is appropriate only where a taking will occur, however, it is necessary to address the issue. We believe that Congress has spoken to the precise question at issue and agree with the district court that the definition of “taking” in Sections 7 and 9 of the ESA are identical in meaning and application.

A. Section 9 of the Endangered Species Act

Section 9 of the ESA, 16 U.S.C. §§ 1531–1544 (1994), prohibits, among other actions, the “take” of an animal that is listed as an endangered species. 16 U.S.C. § 1538(a)(1)(B). A species is “endangered,” and thus protected by the ESA, if it is listed by the Secretary of Fish and Wildlife Service pursuant to 16 U.S.C. § 1533. The ESA defines “taking” as “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.” 16 U.S.C. § 1532(19). The implementing regulations further define the terms “harass” and “harm.” “Harass . . . means an intentional or negligent act or omission which creates the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering.” 50 C.F.R. § 17.3. The definition of harm, upheld by the Supreme Court, is “an act which actually kills or injures wildlife. Such an act may include significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavioral patterns, including breeding, feeding or sheltering.”

50 C.F.R. § 17.3; *Babbitt v. Sweet Home Chapter of Communities for a Great Oregon*, 515 U.S. 687, 696–700, 115 S.Ct. 2407, 132 L.Ed.2d 597 (1995).

We have recently further elaborated on the question of when habitat modification will constitute harm:

Harming a species may be indirect, in that the harm may be caused by habitat modification, but habitat modification does not constitute harm unless it “actually kills or injures wildlife.” The Department of Interior’s definition of harm was upheld against a facial challenge to its validity in [*Babbitt*]. In upholding the definition of “harm” as encompassing habitat modification, the Supreme Court emphasized that “every term in the regulation’s definition of ‘harm’ is subservient to the phrase ‘an act which actually kills or injures wildlife.’”

Defenders of Wildlife v. Bernal, 204 F.3d 920, 924–25 (9th Cir.1999) (citation omitted); see also *Marbled Murrelet v. Babbitt*, 83 F.3d 1060 (9th Cir.1996) (discussing generally the propriety of projecting harm through habitat modification so long as the habitat modification will cause actual killing or injury of protected species). Other courts similarly have found that an activity may constitute “harm,” even though the harm is indirect and prospective. See, e.g., *Greenpeace v. Nat’l Marine Fisheries Serv.*, 106 F.Supp.2d 1066 (W.D.Wash.2000) (finding that Alaskan fisheries’ operations may constitute a taking of the Stellar sea lion because the fisheries are catching fish normally eaten by the sea lion); *Bensman v. U.S. Forest Serv.*, 984 F.Supp. 1242 (W.D.Mo.1997) (holding that removal of dead trees used by the Indiana bat for habitat and hibernation may constitute a taking).

In *National Wildlife Federation v. Burlington Northern Railroad*, 23 F.3d 1508 (9th Cir.1994), however, we held that mere habitat degradation is not always sufficient

to equal harm. To regulate habitat degradation that merely retards recovery of a depleted species, “[plaintiff] would have to show significant impairment of the species’ breeding or feeding habits and prove that the habitat degradation prevents, or possibly, retards, recovery of the species.” *Id.* at 1513 (emphasis in original).

Likewise, the Fish and Wildlife Service’s statement adopts this definition of “harm.” “Such act may include significant habitat modification or degradation where it actually kills or injures wildlife . . .” 50 C.F.R. § 17.3.

[T]he word “actually” before the words “kills or injures” . . . makes it clear that habitat modification or degradation, standing alone, is not a taking pursuant to section 9. To be subject to section 9, the modification or degradation must be *significant*, must *significantly impair essential* behavioral patterns, and must result in *actual* injury to a protected wildlife species.

46 FR 54748 (1981) (emphasis in original).

Violators of the ESA, including agencies and their employees, are subject to substantial civil and criminal penalties, including imprisonment, under Section 9 of the Act. Private citizens, as well as government entities, may bring suit to enjoin such violations. 16 U.S.C. § 1540(a), (b), (e), (g).

B. Section 7 of the ESA

Section 7 of the Act imposes an affirmative duty to prevent violations of Section 9 upon federal agencies, such as the Bureau of Land Management and the U.S. Forest Service. 16 U.S.C. § 1536(a)(2). This affirmative duty extends to “any action authorized, funded, or carried out by such agency,” including authorizing grazing permits on land owned by the federal government. *Id.*

To determine whether an "action may affect listed species or critical habitat," the agency may be required to create a Biological Assessment that "evaluate[s] the potential effects of the action on listed and proposed species and . . . critical habitat and determine[s] whether any such species or habitat are likely to be adversely affected by the action." 50 C.F.R. § 402.12. If the agency finds evidence of an adverse impact on any issued species, it must initiate formal consultation with the Fish and Wildlife Service. 50 C.F.R. § 402.14.

If formal consultation is necessary, the Fish and Wildlife Service will issue a Biological Opinion, summarizing the relevant findings and determining whether the proposed action is likely to jeopardize the continued existence of the species. 16 U.S.C. § 1536(b). If so, the Biological Opinion must list any "reasonable and prudent alternatives" that, if followed, would not jeopardize the continued existence of the species. 16 U.S.C. § 1536(b)(3)(A); 50 C.F.R. § 402.14.

Additionally, the Fish and Wildlife Service must specify whether any "incidental taking" of protected species will occur, specifically "any taking otherwise prohibited, if such taking is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity." 16 U.S.C. § 1536(b)(4); 50 C.F.R. § 17.3. Its determination that an incidental taking will result leads to the publication of the "Incidental Take Statement," identifying areas where members of the particular species are at risk. Contained in the Incidental Take Statement is an advisory opinion which:

- (i) specifies the impact of such incidental taking on the species,
- (ii) specifies those reasonable and prudent measures that the Secretary considers necessary or appropriate to minimize such impact [and] . . .

(iv) sets forth the terms and conditions . . . that must be complied with by the Federal agency or applicant . . . or both, to implement the measures specified under clause (ii).

16 U.S.C. § 1536(b)(4) (subsection (iii) omitted).

[12] Significantly, the Incidental Take Statement functions as a safe harbor provision immunizing persons from Section 9 liability and penalties for takings committed during activities that are otherwise lawful and in compliance with its terms and conditions. 16 U.S.C. § 1536(o). Any such incidental taking "shall not be considered to be a prohibited taking of the species concerned." *Id.* Although the action agency is "technically free to disregard the Biological Opinion and proceed with its proposed action . . . it does so at its own peril." *Bennett*, 520 U.S. at 170, 117 S.Ct. 1154. Consequently, if the terms and conditions of the Incidental Take Statement are disregarded and a taking does occur, the action agency or the applicant may be subject to potentially severe civil and criminal penalties under Section 9.

C. Reconciling "Taking" as used in Section 9 with Section 7

[13] The structure of the ESA and the legislative history clearly show Congress's intent to enact one standard for "taking" within both Section 7(b)(4), governing the creation of Incidental Take Statements, and Section 9, imposing civil and criminal penalties for violation of the ESA. In 1982, Congress amended the ESA to include Section 7(b)(4) to resolve the conflict between Sections 7 and 9. *See* H.R.Rep. No. 97-567, at 15 (1982). As noted in the legislative reports, the

purpose of Section 7(b)(4) and the amendment to Section 7(o) is to resolve the situation in which a Federal agency or a permit or license applicant has been

advised that the proposed action will not violate Section 7(a)(2) of the Act but the proposed action will result in the taking of some species incidental to that action—a clear violation of Section 9 of the Act which prohibits any taking of a species.

H.R.Rep. No. 97-567, at 26 (1982), *reprinted in* 1982 U.S.C.C.A.N. 2807, 2826. Absent an actual or prospective taking under Section 9, there is no “situation” that requires a Section 7 safe harbor provision.

We reject the argument that “taking” should be applied differently because the two sections serve different purposes. Interpreting the statutes in the manner urged by the Fish and Wildlife Service could effectively stop the proposed cattle grazing entirely. Such a broad interpretation would allow the Fish and Wildlife Service to engage in widespread land regulation even where no Section 9 liability could be imposed. This interpretation would turn the purpose behind the 1982 Amendment on its head.

This conclusion follows as a practical matter from the statutory scheme. Because of the potential liability imposed on federal agencies whose actions do not comply with conditions in the Incidental Take Statement, agencies regulating land are unlikely to permit nonconforming uses of their land. For this reason, as the Supreme Court has recognized, Biological Opinions exert a “powerful coercive effect” in shaping the policies of the federal agencies whose actions are at issue. *Bennett*, 520 U.S. at 169, 117 S.Ct. 1154 (citations omitted). Here, for example, although ACGA theoretically could choose to disregard the Incidental Take Statements without explanation, the Bureau of Land Management and the Forest Service, as the action agencies, “must not only articulate [their] reasons for disagreement (which ordinarily requires species and habitat investigations that are not within the action

agency’s expertise), but . . . [they run] a substantial risk if [their] (inexpert) reasons turn out to be wrong.” *Id.* As the *Bennett* Court noted, the action agency rarely, if ever, chooses to disregard the terms and conditions of an Incidental Take Statement. In fact, the Incidental Take Statement challenged in ACGA I began by stating, “[t]he measures described below are non-discretionary, and must be implemented by the agency so that they become binding conditions of any grant or permit issued to the applicant. . . .” As a practical matter, if ACGA’s members wish to receive grazing permits, they must comply with the terms and conditions of the Incidental Take Statements. As the district court held in ACGA II, “[i]f Fish and Wildlife Service could issue an Incidental Take Statement even when a taking in violation of Section 9 was not present, those engaging in legal activities would be subjected to the terms and conditions of such statements.” The court finds no authority for this result nor do we.

V. Determining When the Fish and Wildlife Service Must Issue an Incidental Take Statement

[14] The Fish and Wildlife Service contends that the district courts erred in scrutinizing its decision to issue Incidental Take Statements because it is statutorily required pursuant to the ESA to “issue an ITS in all no-jeopardy determinations.” In particular, it contests the ACGA I court’s requirement that it provide evidence of a listed species’ existence on the land and the ACGA II court’s holding that issuing an Incidental Take Statement is “appropriate only when a take has occurred or is reasonably certain to occur.” The Fish and Wildlife Service argues that both standards establish “an inappropriate and high burden of proof” and that it should be permitted to issue an Incidental Take Statement whenever there is any

possibility, no matter how small, that a listed species will be taken. As we believe that Congress has spoken to the precise question at issue, we must reject the agency's interpretation of the ESA as contrary to clear congressional intent. *See Chevron*, 467 U.S. at 842, 104 S.Ct. 2778.

[15] ACGA correctly states that this argument was not presented in the district courts, and urges us to decline to entertain it. We maintain the discretion to review a purely legal issue, including the interpretation of a statute, however, that is made for the first time on appeal unless the other party would be prejudiced by the failure to raise the issue at the district court. *Kimes v. Stone*, 84 F.3d 1121, 1126 (9th Cir.1996); *United States v. Patrin*, 575 F.2d 708, 712 (9th Cir.1978). Because ACGA could not have presented facts beyond those already contained in the Administrative Record, reviewing this matter now will not prejudice either party. Therefore, we exercise our discretion to consider the purely legal question whether an Incidental Take Statement is mandatory in every consultation irrespective of whether an incidental taking will occur.

The Fish and Wildlife Service argues that the plain language of the statute and implementing regulations "expressly direct" it to issue an Incidental Take Statement in every case. Section 7(b)(4) of the ESA provides:

If after consultation under subsection (a)(2) of this section, the Secretary concludes that—

(A) the agency action will not violate such subsection, or offers reasonable and prudent alternatives which the Secretary believes would not violate such subsection;

(B) the taking of an endangered species or a threatened species incidental to the agency action will not violate such subsection; and

(C) if an endangered species or threatened species of a marine mammal is involved, the taking is authorized pursuant to section 1371(a)(5) of this title; the Secretary shall provide the Federal agency and the applicant concerned, if any, with a written statement that—

(i) specifies the impact of such incidental taking on the species, . . .

16 U.S.C. § 1536(b)(4). The Fish and Wildlife Service relies on the statutory provision directing the Secretary to provide "a written statement that . . . specifies the impact of such incidental taking on the species." *Id.*

[16] It is a "fundamental canon of statutory construction that the words of a statute must be read in their context and with a view to their place in the overall statutory scheme." *Davis v. Mich. Dep't of Treasury*, 489 U.S. 803, 809, 109 S.Ct. 1500, 103 L.Ed.2d 891 (1989). "A court must therefore interpret the statute as a symmetrical and coherent regulatory scheme and fit, if possible, all parts into an harmonious whole," *Food & Drug Admin. v. Brown & Williamson Tobacco Corp.*, 529 U.S. 120, 133, 120 S.Ct. 1291, 146 L.Ed.2d 121 (2000) (citations omitted).

When read in context, it is clear that the issuance of the Incidental Take Statement is subject to the finding of the factors enumerated in the ESA. The statute explicitly provides that the written statement is subject to the consultation and the Secretary's conclusions. A contrary interpretation would render meaningless the clause stating that the Incidental Take Statement will specify "the impact of *such* incidental taking." 16 U.S.C. § 1536(b)(4)(i) (emphasis added). We therefore agree with ACGA that the plain language of the ESA does not dictate that the Fish and Wildlife Service must issue an Incidental Take Statement irrespective of whether any incidental takings will occur. *See Nat'l*

Wildlife Fed'n v. Nat'l Park Serv., 669 F.Supp. 384, 389–90 (D.Wyo.1987) (holding that a careful reading of § 1536(b) supports the defendants' contention that an Incidental Take Statement is not required if no incidental takings are foreseen).

The plain language of the implementing regulations also supports ACGA's argument. One regulation specifically instructs the Fish and Wildlife Service that its "responsibilities during formal consultation are . . . to [f]ormulate a statement concerning incidental take, if such take *may* occur." 50 C.F.R. § 402.14(g)(7) (emphasis added). Moreover, the same regulation also instructs:

(1) In those cases where the Service concludes that an action (or the implementation of any reasonable and prudent alternatives) and the resultant incidental take of listed species will not violate section 7(a)(2), . . . the Service will provide with the biological opinion a statement concerning incidental take that:

(i) Specifies the impact, i.e., the amount or extent, of such incidental taking on the species;

50 C.F.R. § 402.14(i)(1) (2001). Thus, consistent with the language of the statute, the regulations only require the issuance of an Incidental Take Statement when the "*resultant* incidental take of listed species will not violate section 7(a)(2)." *Id.* (emphasis added).

Likewise, the legislative history supports this interpretation of the statute. If the sole purpose of the Incidental Take Statement is to provide shelter from Section 9 penalties, as previously noted, it would be nonsensical to require the issuance of a Incidental Take Statement when no takings cognizable under Section 9 are to occur. *See* H.R.Rep. No. 97–567, at 26 (1982).

[17, 18] The Fish and Wildlife Service's internal handbook does not alter our con-

clusion. The 1998 version of the agency's Section 7 Consultation Handbook provides that "when no take is anticipated" the agency should include in an Incidental Take Statement the following language: "The Service does not anticipate the proposed action will incidentally take any (species)." Indeed, one of Incidental Take Statements in the ACGA II consultation that the Fish and Wildlife Service issued contains this very language. That Incidental Take Statement, however, is not before us in this appeal. It is true that "[a]n agency's construction of the laws it administers is accorded considerable weight." *Chevron*, 467 U.S. at 844, 104 S.Ct. 2778. We reiterate, however, that "[t]he judiciary is the final authority on issues of statutory construction and must reject administrative constructions which are contrary to clear congressional intent." *Id.* at 843 n. 9, 104 S.Ct. 2778. The Fish and Wildlife Service's handbook instruction to issue an Incidental Take Statement when no take will occur as a result of permitted activity is contrary to the plain meaning of the statute as well as the agency's own regulations. Accordingly, we hold that absent rare circumstances such as those involving migratory species, it is arbitrary and capricious to issue an Incidental Take Statement when the Fish and Wildlife Service has no rational basis to conclude that a take will occur incident to the otherwise lawful activity.

VI. Review of the Incidental Take Statements under the Arbitrary and Capricious Standard Pursuant to the APA

[19] Because we reject the Fish and Wildlife Service's interpretation of the ESA and hold that it is not required to provide an Incidental Take Statement whenever it issues a Biological Opinion, we must now examine each Incidental Take Statement at issue under Section 706. 5 U.S.C. § 706.

As a preliminary matter, however, we must address the ACGA II court's application of a "reasonable certainty" standard, about which the Fish and Wildlife Service has made much ado. It argues that "the predicate for issuing an ITS should not be a particular level of certainty that a take will occur, the ITS itself must only not be arbitrary and capricious." This argument misapprehends the ACGA II court's application of the arbitrary and capricious standard to the requirement that the Fish and Wildlife Service must find a take incidental to the otherwise lawful use before it may condition issuance of a permit on enumerated "reasonable and prudent" measures. ACGA II held merely that if the Fish and Wildlife Service cannot satisfy the court to a reasonable certainty that a take will occur, then it is arbitrary and capricious for it to issue an Incidental Take Statement imposing conditions on the use of the land. This is actually a more lenient standard than if the record were required to include evidence of an actual taking incident to the proposed use. Given that the Fish and Wildlife Service must have a reasonable basis to conclude that a take will occur as a result of the anticipated lawful activity, benchmarking such findings against a standard of reasonable certainty puts it to a lesser burden. Moreover, it would be unreasonable for the Fish and Wildlife Service to impose conditions on otherwise lawful land use if a take were not reasonably certain to occur as a result of that activity. And, as discussed *infra*, if an Incidental Take Statement is set aside because a take is not reasonably certain to occur, and circumstances change, the Fish and Wildlife Service or the action agency may revisit the issue. 50 C.F.R. § 402.16.

We need not definitively resolve this question, however, because regardless of the dispute over the ACGA II court's application of the arbitrary and capricious standard, we must review *de novo* the actions of the Fish and Wildlife Service

under the arbitrary and capricious standard mandated by the statute. Therefore, pursuant to Section 706 of the APA, we proceed to determine whether the Incidental Take Statements are founded on a rational connection between the facts found and the choices made by the Fish and Wildlife Service and whether it has committed a clear error of judgment. See *Motor Vehicle Manuf. Assoc. v. State Farm Mutual Auto.*, 463 U.S. 29, 43, 103 S.Ct. 2856, 77 L.Ed.2d 443 (1983); *Pyramid Lake Paiute Tribe of Indians*, 898 F.2d at 1414.

A. ACGA I

1. The Razorback Sucker

[20] In the Biological Opinion issued in response to ACGA's first request for land use permits, the Fish and Wildlife Service concluded that the direct effects of cattle grazing are infrequent to the razorback sucker, a moderately sized fish listed as endangered in November 1991. Although once abundant in the project area, the Fish and Wildlife Service admitted that there have been no reported sightings of the razorback sucker in the area since 1991 and that "effects of the livestock grazing program on individual fish or fish populations probably occur infrequently." Nevertheless, the Fish and Wildlife Service issued an Incidental Take Statement for the fish, anticipating take as a result of the direct effects of grazing in the project area, the construction of fences, the construction and existence of stock tanks for non-native fish, as well as other "activities in the watershed." Because the Fish and Wildlife Service could not directly quantify the level of incidental take, it determined that authorized take would be exceeded if range conditions in the allotment deteriorated and cattle grazing could not be ruled out as a cause of the deterioration.

[21] Despite the lack of evidence that the razorback sucker exists on the allot-

ment in question, the Fish and Wildlife Service argues that it should be able to issue an Incidental Take Statement based upon prospective harm. While we recognize the importance of a prospective orientation, the regulations mandate a separate procedure for reinitiating consultation if different evidence is later developed:

Reinitiation of formal consultation is required and shall be requested by the Federal agency or by the Service, where discretionary Federal involvement or control over the action has been retained or is authorized by law and:

- (a) If the amount or extent of taking specified in the incidental take statement is exceeded;
- (b) If new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered;
- (c) If the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion; or
- (d) If a new species is listed or critical habitat designated that may be affected by the identified action.

50 C.F.R. § 402.16. Additionally, the ESA provides for the designation of critical habitat outside the geographic area currently occupied by the species when “such areas are essential for the conservation of the species.” 16 U.S.C. § 1532(5)(A)(ii). Absent this procedure, however, there is no evidence that Congress intended to allow the Fish and Wildlife Service to regulate any parcel of land that is merely capable of supporting a protected species.

The only additional evidence that the Fish and Wildlife Service offers to justify its decision is that “small numbers of the juvenile fish . . . likely survived” in an unsuccessful attempt to repopulate the

project area between 1981–1987. This speculative evidence, without more, is woefully insufficient to meet the standards imposed by the governing statute. *See* 50 C.F.R. § 402.14(g)(8) (“In formulating its biological opinion . . . the Service will use the best scientific and commercial data available. . . .”). Likewise, the Fish and Wildlife Service failed to present evidence that an indirect taking would occur absent the existence of the species on the property. Although habitat modification resulting in actual killing or injury may constitute a taking, the Fish and Wildlife Service has presented only speculative evidence that habitat modification, brought about by livestock grazing, may impact the razorback sucker. The agency has a very low bar to meet, but it must at least attain it. It would be improper to force ACGA to prove that the species does not exist on the permitted area, as the Fish and Wildlife Service urges, both because it would require ACGA to meet the burden statutorily imposed on the agency, and because it would be requiring it to prove a negative.

[22] Based on a careful review of the record, we find that it is arbitrary and capricious to issue an Incidental Take Statement for the razorback sucker when the Fish and Wildlife Service’s speculation that the species exists on the property is not supported by the record. We agree with the district court’s ruling that the Fish and Wildlife Service failed to establish an incidental taking because it did not have evidence that the razorback sucker even exists anywhere in the area. Where the agency purports to impose conditions on the lawful use of that land without showing that the species exists on it, it acts beyond its authority in violation of 5 U.S.C. § 706.

2. The Cactus Ferruginous Pygmy-owl

As with the razorback sucker, the record does not support a claim that the cactus

ferruginous pygmy-owl exists in the area of the allotment in question, and the Fish and Wildlife Service thus acted in an arbitrary and capricious manner in issuing an Incidental Take Statement for that species. The Arizona population of the cactus ferruginous pygmy-owl, a small bird measuring about 6.75 inches long, was listed as endangered in 1997. Although the owl was historically found in small numbers throughout the geographic area at issue, no pygmy-owls were detected during 1997 surveys, and there had been no recent reports of pygmy-owls in most areas within the jurisdiction. Despite this, in the Biological Opinion, the Fish and Wildlife Service issued an Incidental Take Statement stating that take was anticipated due to habitat degradation that would "significantly impair essential behavioral patterns of the pygmy-owl including breeding, feeding, and/or sheltering, leading to possible injury or death of any pygmy-owls in the allotments." Like the razorback sucker, the levels of anticipated take for the pygmy-owl could not be directly quantified, and thus, authorized take would be exceeded if habitat conditions deteriorated.

The Fish and Wildlife Service argues on appeal that subsequent surveys show that "the Service correctly anticipated that the owl was present in the areas at issue." We first note that the Fish and Wildlife Service incorrectly assumes that a reviewing court may look outside the administrative record. See *Southwest Ctr. for Biological Diversity v. U.S. Forest Serv.*, 100 F.3d 1443, 1450 (9th Cir.1996) ("Judicial review of an agency decision typically focuses on the administrative record in existence at the time of the decision and does not encompass any part of the record that is made initially in the reviewing court."). Considering evidence outside the record would render the extraordinarily complex consultation process, which includes reporting requirements and public comment periods, meaningless. It would also allow

the consulting agency to produce far reaching and unsupported Biological Opinions knowing that it could search for evidentiary support if the opinion was later challenged. Furthermore, the Fish and Wildlife Service's own regulations do not contemplate this result, but instead mandate the reinitiation of consultation if circumstances change or new facts are discovered. 50 C.F.R. § 402.16. Thus, we review the Biological Opinion based upon the evidence contained in the administrative record.

We agree with the district court that the Fish and Wildlife Service pointed to no evidence that established the existence of the pygmy-owl on the property in question. The Biological Opinion states, "[w]hile there have been no recent reports of pygmy-owls in most areas within the jurisdiction . . . the numerous records provided above indicate that pygmy-owls were at one time found at least in small numbers." Moreover, the Biological Opinion acknowledges that "[n]o pygmy-owls were detected during [1997] surveys." We also agree that the Fish and Wildlife Service failed to demonstrate how the habitat modification would "actually kill or injure" the owl given that "there have been no recent reports of pygmy-owls in most areas within the jurisdiction." We therefore affirm the district court's holding that there was no basis in fact for the Fish and Wildlife Service's decision to issue an Incidental Take Statement. Accordingly, the Incidental Take Statement, which anticipated takings of the pygmy-owl, likewise fails as arbitrary and capricious.

B. The ACGA II Consultation

1. The Issuance of Incidental Take Statements

A. The Montana Allotment (Sonora chub)

The Montana Allotment consists of 27,940 acres in the Coronado National Forest.

Although the Montana Allotment Biological Opinion addresses the impact of grazing on the Sonora chub and the lesser long-nosed bat, the Fish and Wildlife Service appealed only the district court's finding as to the Sonora chub, a stream-dwelling member of the minnow family. In a relatively terse Biological Opinion, the Fish and Wildlife Service determined that the Sonora chub are present on the Montana Allotment, but that they are essentially confined to the California Gulch, an area from which livestock are excluded. Nonetheless, the Fish and Wildlife Service found that take "of Sonora chub is expected to result from the ongoing grazing activities on the Montana Allotment." The Biological Opinion projects both direct harm to individual fish that disperse into areas accessible to cattle and indirect harm stemming from habitat modification. With respect to direct harm, it concludes that, "during periods of high instream flow and fish dispersal, livestock may directly impact fish in the stream channel."

The Biological Opinion is similarly sparse with respect to projected indirect harms. It notes that the watershed is "naturally fragile and highly sensitive to disturbance . . . [and][t]he effects of livestock grazing activities can be additive, exacerbating the naturally fragile and highly sensitive watershed conditions." The Biological Opinion also reports, however, that there are "improved soil and riparian area conditions" and that "range condition is generally good with an upward trend." Although the Biological Opinion states that "[l]ivestock currently have direct access to the stream channel immediately upstream of the enclosure" and "[h]arm occurs through the effects to habitat that alter the suitability of the habitat to support Sonora chub," there is no information about how far upstream the enclosure is nor is there site specific data that connects grazing in the enclosure and sedimentation.

The Biological Opinion also notes under "Cumulative Effects" that stray cattle could cross the Mexican-American border and access the area that the Sonora chub is thought to inhabit, thereby causing a direct taking. The Biological Opinion does not present any evidence that this has occurred either in the Montana Allotment or on similar properties.

Because the Biological Opinion provides little factual support for its conclusion that an incidental taking is anticipated, we agree with the district court that the issuance of the Incidental Take Statement for the Sonora chub on the Montana Allotment was based only on the very speculative "potential" for these fish to move upstream and on the "potential" downstream effects of grazing. We affirm the district court's holding that "the mere potential for harm, however, is insufficient." Without evidence that a take would occur as a result of livestock grazing, issuing an Incidental Take Statement imposing conditions on the otherwise lawful use of the land was arbitrary and capricious.

B. The Sears-Club/Chalk Mountain Allotment (Gila topminnow)

The Fish and Wildlife Service has not documented the existence of Gila topminnow, a small fish that prefers shallow water, in the upper portion of Dutchman Grave Spring, located on the Sears-Club/Chalk Mountain Allotment. The topminnow are found, however, in the nearby lower reaches of Dutchman Grave Spring, on the Red Creek Allotment. Although the upper portion of the spring is separated from the lower portion by 1,000 feet of dry streambed and a partial barrier restricting upstream movement, the Fish and Wildlife Service concluded that upstream fish movement could be possible during some flows. Likewise, the Service recognized that grazing activities are un-

likely to jeopardize the continued existence of the topminnow, but found that grazing on the upper spring could affect its suitability for any possible future reintroduction of Gila topminnow or any recolonization from the lower spring.

As with the Montana Allotment, we find that the Incidental Take Statement is based on the mere potential of harm to the Gila topminnow, not on any harm that would occur. The Fish and Wildlife Service provided only speculative evidence as to how these two-inch fish could travel upstream across 1,000 feet of dry streambed and over waterfalls (up to three feet high) to recolonize the area contained on the allotment. Such speculation is not a sufficient rational connection to survive judicial review. Accordingly, we agree with the district court's determination that the Fish and Wildlife Service's decision to issue an Incidental Take Statement for Gila topminnow on the Sears-Club/Chalk Mountain Allotment was arbitrary and capricious.

C. The East Eagle Allotment (loach minnow and spikedace)

The East Eagle Allotment consists of 37,259 acres in the Apache-Sitgreaves National Forest. The East Eagle Biological Opinion notes that neither the loach minnow, a small fish that inhabits shallow, swift waters, nor the spikedace, a small river-dwelling fish that rarely exceeds 2.95 inches in length, have been documented in any portion of Eagle Creek located in this allotment. Surveys in 1994, 1995, 1996, and 1997, however, recorded the presence of the loach minnow in Eagle Creek approximately three miles downstream from the allotment, and in Middle Prong Eagle Creek, approximately one mile downstream. The nearest known spikedace habitat is twelve miles from the allotment.

Although there is no current documentation that either species exists on the East

Eagle Allotment, the Fish and Wildlife Service concluded that trailing livestock along and across creeks could potentially step on fish, larvae, and eggs, remove vegetation that could influence water temperature, or trample streambanks that could lead to changes in stream morphology. Again, the Fish and Wildlife Service defined the incidental take in terms of habitat characteristics, finding that take will be exceeded if several conditions are not met, including if "[e]cological conditions do not continue to improve or maintain good or better status."

We find that the Fish and Wildlife Service did not have sufficient evidence of a take of either species to issue an Incidental Take Statement for the East Eagle Allotment. Because the only evidence contained in the Biological Opinion shows that neither species exists on the allotment, the Fish and Wildlife Service could not rationally conclude that a take would occur.

D. The Wildbunch Allotment (loach minnow)

The Wildbunch Allotment consists of 23,085 acres in the Apache-Sitgreaves National Forest, bordered by the Blue River on the west and by the San Francisco River on the south. The Biological Opinion here addresses the effects of grazing on the loach minnow that exist in the Blue River and also are sporadically present in the San Francisco River. Livestock are geographically excluded from the portion of the Blue River that is within the allotment, and the San Francisco River is adjacent to, but not actually part of, the allotment. According to the Biological Opinion, although "[l]ivestock do not have direct access to any known occupied or potential loach minnow habitat on the Wildbunch Allotment . . . [i]ncreases in sedimentation into the Blue and San Francisco rivers from the allotment are expected as

a result of ongoing livestock grazing and alterations of runoff patterns.” The Fish and Wildlife Service issued an Incidental Take Statement anticipating takings through “effects to habitat” and found that “incidental take of loach minnow associated with the proposed action cannot be directly quantified.” As with the East Eagle Allotment, the Incidental Take Statement here concludes that incidental take will be exceeded if, among other things, “[e]cological conditions do not improve under the proposed livestock management.”

We affirm the district court’s finding that the Fish and Wildlife Service acted arbitrarily and capriciously in issuing the Incidental Take Statement for loach minnow on the Wildbunch Allotment. As with the allotments we previously addressed, the Fish and Wildlife Service considered only general evidence of the possible effects of livestock grazing on aquatic habitats. It proffered no basis to conclude that these negative effects were occurring on the aquatic habitats located on the Wildbunch Allotment or that such habitat modification would actually kill or injure the loach minnow.

E. The Cow Flat Allotment (loach minnow and spikedace)

[23] According to the Biological Opinion, the Blue River passes through or adjacent to approximately 3.5 miles of the Cow Flat Allotment, made up of 22,592 acres in the Apache–Sitgreaves National Forest. Surveys conducted in 1994, 1995, and 1996 found loach minnow throughout the Blue River. The Fish and Wildlife Service concluded that the segment of the Blue River that passes through or adjacent to the Cow Flat Allotment is considered occupied loach minnow habitat.

Having determined that loach minnow exist on the allotment, Fish and Wildlife Service determined that the loach minnow

are vulnerable to direct harms resulting from cattle crossings, such as trampling. Moreover, because the fish use the spaces between large substrates for resting and spawning, sedimentation resulting from grazing in pastures that settles in these spaces can adversely affect loach minnow habitat. The Biological Opinion determines that this indirect effect, along with the direct crushing of loach minnow eggs and the reduction in food availability, will result in take of the loach minnow. The Incidental Take Statement, however, does not directly quantify the incidental takings of loach minnow and determines that such takings “will be difficult to detect.” Defining the incidental take in terms of habitat characteristics, the Fish and Wildlife Service found that take will be exceeded if several conditions are not met. One such condition was if “[e]cological conditions do not improve under the proposed livestock management” plan.

We agree with the district court that the issuance of the Cow Flat Incidental Take Statement was not arbitrary and capricious. Unlike the other allotments in question, the Fish and Wildlife Service provided evidence that the listed species exist on the land in question and that the cattle have access to the endangered species’ habitat. Accordingly, the Fish and Wildlife Service could reasonably conclude that the loach minnow could be harmed when the livestock entered the river. Additionally, the Fish and Wildlife Service provided extensive site-specific information that discussed not only the topography of the relevant allotment, but the indirect effects of grazing on the species due to the topography. The specificity of the Service’s data, as well as the articulated causal connections between the activity and the “actual killing or injury” of a protected species distinguishes the Fish and Wildlife Service’s treatment of this allotment from the other allotments at issue in the two

consultations. Thus, we hold that because the Fish and Wildlife Service articulated a rational connection between harm to the species and the land grazing activities at issue, the issuance of the Incidental Take Statements for the Cow Flat Allotment was not arbitrary and capricious.

2. The Anticipated Take Provisions

[24] We now turn to the question whether the Service acted arbitrarily and capriciously by failing to properly specify the amount of anticipated take in the Incidental Take Statement for the Cow Flat Allotment and by failing to provide a clear standard for determining when the authorized level of take has been exceeded. The district court upheld the Cow Flat take provision, including its conditions on the land use, issued by the Fish and Wildlife Service, finding that it was rationally connected to the proposed action of cattle grazing and thus did not violate the arbitrary and capricious standard.

In general, Incidental Take Statements set forth a "trigger" that, when reached, results in an unacceptable level of incidental take, invalidating the safe harbor provision, and requiring the parties to re-initiate consultation. Ideally, this "trigger" should be a specific number. *See, e.g., Mausolf v. Babbitt*, 125 F.3d 661 (8th Cir. 1997) (snowmobiling activity may take no more than two wolves); *Fund for Animals v. Rice*, 85 F.3d 535 (11th Cir.1996) (municipal landfill may take fifty-two snakes during construction and an additional two snakes per year thereafter); *Mt. Graham Red Squirrel v. Madigan*, 954 F.2d 1441 (9th Cir.1992) (telescope construction may take six red squirrels per year); *Ctr. for Marine Conservation v. Brown*, 917 F.Supp. 1128 (S.D.Tex.1996) (shrimping operation may take four hawksbill turtles, four leatherback turtles, ten Kemp's ridley turtles, ten green turtles, or 370 loggerhead turtles). Here, however, the "trigger" took the form of several conditions.

We must therefore determine whether the linking of the level of permissible take to the conditions set forth in the various Incidental Take Statements was arbitrary and capricious.

ACGA argues that the Incidental Take Statements fail to specify the amount or extent of authorized take with the required degree of exactness. Specifically, ACGA objected to the first condition:

The service concludes that incidental take of loach minnow from the proposed action will be considered to be exceeded if any of the following conditions are met:

[Condition 1] Ecological conditions do not improve under the proposed livestock management. Improving conditions can be defined through improvements in watershed, soil condition, trend and condition of rangelands (e.g., vegetative litter, plant vigor, and native species diversity), riparian conditions (e.g., vegetative and geomorphologic: bank, terrace, and flood plain conditions), and stream channel conditions (e.g., channel profile, embeddedness, water temperature, and base flow) within the natural capabilities of the landscape in all pastures on the allotment within the Blue River watershed.

We have never held that a numerical limit is required. Indeed, we have upheld Incidental Take Statements that used a combination of numbers and estimates. *See Ramsey v. Kantor*, 96 F.3d 434, 441 n. 12 (9th Cir.1996) (utilizing both harvesting rates and estimated numbers of fish to reach a permitted take); *Southwest Ctr. for Biological Diversity v. U.S. Bureau of Reclamation*, 6 F.Supp.2d 1119 (D.Ariz. 1997) (concluding that an Incidental Take Statement that indexes the permissible take to successful completion of the reasonable and prudent measures as well as

the terms and conditions is valid); *Pac. Northwest Generating Coop. v. Brown*, 822 F.Supp. 1479, 1510 (D.Or.1993) (ruling that an Incidental Take Statement that defines the allotted take in percentage terms is valid).

[25] Moreover, while Congress indicated its preference for a numerical value, it anticipated situations in which impact could not be contemplated in terms of a precise number. See H.R.Rep. No. 97-567, at 27 (1982), reprinted in 1982 U.S.C.C.A.N. at 2827 ("The Committee does not intend that the Secretary will, in every instance, interpret the word impact to be a precise number. Where possible, the impact should be specified in terms of a numerical limitation."); see also 50 C.F.R. § 402.14 (defining impact as "the amount or extent, of such incidental taking on the species."). In the absence of a specific numerical value, however, the Fish and Wildlife Service must establish that no such numerical value could be practically obtained.

[26] We agree with the ACGA II court's conclusion that, "the use of ecological conditions as a surrogate for defining the amount or extent of incidental take is reasonable so long as these conditions are linked to the take of the protected species." Indeed, this finding is consistent with the Fish and Wildlife Service's Section 7 Consultation Handbook:

When preparing an incidental take statement, a specific number (for some species, expressed as an amount or extent, e.g., all turtle nests not found and moved by the approved relocation technique) or level of disturbance to habitat must be described. Take can be expressed also as a change in habitat characteristics affecting the species (e.g., for an aquatic species, changes in water temperature or chemistry, flows, or sediment loads) where data or information exists which links such changes to the

take of the listed species. In some situations, the species itself or the effect on the species may be difficult to detect. However, some detectable measure of effect should be provided . . . [I]f a sufficient causal link is demonstrated (i.e., the number of burrows affected or a quantitative loss of cover, food, water quality, or symbionts), then this can establish a measure of the impact on the species or its habitat and provide the yardstick for reinitiation.

Final ESA Section 7 Consultation Handbook, March 1998 at 4-47 to 4-48. By "causal link" we do not mean that the Fish and Wildlife Service must demonstrate a specific number of takings; only that it must establish a link between the activity and the taking of species before setting forth specific conditions.

ACGA argues that it is entitled to more certainty than "vague and undetectable criteria such as changes in a 22,000 acre allotment's 'ecological condition.'" In response, the Fish and Wildlife Service argues that "the [Incidental Take Statement] provides for those studies necessary to provide the quantification of impacts which the Cattle Growers claim is lacking."

We disagree with the government's position. The Incidental Take Statements at issue here do not sufficiently discuss the causal connection between Condition 1 and the taking of the species at issue. Based on the Incidental Take Statement, if "[e]cological conditions do not improve," takings will occur. This vague analysis, however, cannot be what Congress contemplated when it anticipated that surrogate indices might be used in place of specific numbers. Moreover, whether there has been compliance with this vague directive is within the unfettered discretion of the Fish and Wildlife Service, leaving no method by which the applicant or the action agency can gauge their performance.

Finally, Condition 1 leaves ACGA and the United States Forest Service responsible for the general ecological improvement of the approximately 22,000 acres that comprise the Cow Flat Allotment.

Based upon the lack of an articulated, rational connection between Condition 1 and the taking of species, as well as the vagueness of the condition itself, we hold that its implementation was arbitrary and capricious. The terms of an Incidental Take Statement do not operate in a vacuum. To the contrary, they are integral parts of the statutory scheme, determining, among other things, when consultation must be reinitiated.

Thus, even though the Fish and Wildlife Service was not arbitrary and capricious in issuing Incidental Take Statements for the Cow Flat Allotment, its failure to properly specify the amount of anticipated take and to provide a clear standard for determining when the authorized level of take has been exceeded is arbitrary and capricious. As with the Incidental Take Statements for the other allotments, we therefore conclude that the issuance of the Cow Flat Allotment Incidental Take Statement was arbitrary and capricious.

VII. Conclusion

For the foregoing reasons, the decision of the ACGA I district court is AFFIRMED, and the decision of the ACGA II district court is AFFIRMED in part, and REVERSED in part.



Rossitza Koleva POPOVA and Nadejda Petrova, Petitioners,

v.

**IMMIGRATION AND
NATURALIZATION SERVICE,
Respondent.**

No. 00-70429.

United States Court of Appeals,
Ninth Circuit.

Argued and Submitted Oct. 11, 2001

Filed Nov. 28, 2001

Alien petitioned for review of decision by Board of Immigration Appeals (BIA) to deny her request for asylum and withholding of deportation. The Court of Appeals, Pregerson, Circuit Judge, held that: (1) alien demonstrated well founded fear of future persecution “on account of” her religion and political opinion; (2) Immigration and Naturalization Service (INS) failed to rebut the presumption of future persecution afforded alien on account of her past persecution; and (3) alien was entitled to withholding of deportation on basis that her life and freedom were threatened.

Petition granted, BIA order vacated, and remanded.

1. Aliens ⇐54.3(1)

The review by the Court of Appeals of a final order of deportation is limited to the decision of the Board of Immigration Appeals, except to the extent that an opinion of an immigration judge is expressly adopted. Immigration and Nationality Act, § 106(a), as amended, 8 U.S.C.(1994 Ed.) § 1105a(a).

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§223.206 Exceptions to prohibitions relating to sea turtles.

[Link to an amendment published at 84 FR 70063, Dec. 20, 2019.](#)

[This amendment was delayed until Aug. 1, 2021, at 86 FR 16676, Mar. 31, 2021.](#)

(a) *Permits*—(1) *Scientific research, education, zoological exhibition, or species enhancement permits.* The Assistant Administrator may issue permits authorizing activities which would otherwise be prohibited under §223.205(a) for scientific or educational purposes, for zoological exhibition, or to enhance the propagation or survival of threatened species of sea turtles, in accordance with and subject to the conditions of part 222, subpart C—General Permit Procedures.

(2) *Incidental-take permits.* The Assistant Administrator may issue permits authorizing activities that would otherwise be prohibited under §223.205(a) in accordance with section 10(a)(1)(B) of the Act (16 U.S.C. 1539(a)(1)(B)), and in accordance with, and subject to, the implementing regulations in part 222 of this chapter. Such permits may be issued for the incidental taking of threatened and endangered species of sea turtles.

(b) *Exception for injured, dead, or stranded specimens.* If any member of any threatened species of sea turtle is found injured, dead, or stranded, any agent or employee of the National Marine Fisheries Service, the Fish and Wildlife Service, the U.S. Coast Guard, or any other Federal land or water management agency, or any agent or employee of a state agency responsible for fish and wildlife who is designated by his or her agency for such purposes, may, when acting in the course of his or her official duties, take such specimens without a permit if such taking is necessary to aid a sick, injured, or stranded specimen or dispose of a dead specimen or salvage a dead specimen which may be useful for scientific study. Whenever possible, live specimens shall be returned to their aquatic environment as soon as possible. Every action shall be reported in writing to the Assistant Administrator within 30 days, and reports of further occurrence shall be made as deemed appropriate by the Assistant Administrator until the specimen is either returned to its environment or disposed of. Reports shall be mailed by registered or certified mail, return receipt requested, to the Assistant Administrator and shall contain the following information:

(1) Name and position of the official or employee involved;

(2) Description of the specimen(s) involved;

(3) Date and location of disposal;

(4) Circumstances requiring the action;

(5) Method of disposal;

(6) Disposition of the specimen(s), including, where the specimen(s) has been retained in captivity, a description of the place and means of confinement, and the measures taken for

its maintenance and care; and

(7) Such other information as the Assistant Administrator may require.

(c) *Exception for research or conservation.* Any employee or agent of the National Marine Fisheries Service, the Fish and Wildlife Service, or a state fish and wildlife agency operating a conservation program pursuant to the terms of a Cooperative Agreement with the National Marine Fisheries Service or the Fish and Wildlife Service in accordance with section 6(c) of the Act, designated by his or her agency for such purposes, may, when acting in the course of his or her official duties, take any threatened species to carry out scientific research or conservation programs. All such takings shall be reported within 30 days of the taking to the Assistant Administrator who may request additional reports of the taking and research at the Assistant Administrator's discretion.

(d) *Exception for incidental taking.* The prohibitions against taking in §223.205(a) do not apply to the incidental take of any member of a threatened species of sea turtle (i.e., a take not directed towards such member) during fishing or scientific research activities, to the extent that those involved are in compliance with all applicable requirements of paragraphs (d)(1) through (d)(11) of this section, or in compliance with the terms and conditions of an incidental take permit issued pursuant to paragraph (a)(2) of this section.

(1) *Handling and resuscitation requirements.* (i) Any specimen taken incidentally during the course of fishing or scientific research activities must be handled with due care to prevent injury to live specimens, observed for activity, and returned to the water according to the following procedures:

(A) Sea turtles that are actively moving or determined to be dead as described in paragraph (d)(1)(i)(C) of this section must be released over the stern of the boat. In addition, they must be released only when fishing or scientific collection gear is not in use, when the engine gears are in neutral position, and in areas where they are unlikely to be recaptured or injured by vessels.

(B) Resuscitation must be attempted on sea turtles that are comatose, or inactive, as determined in paragraph (d)(1) of this section, by:

(1) Placing the turtle on its bottom shell (plastron) so that the turtle is right side up and elevating its hindquarters at least 6 inches (15.2 cm) for a period of 4 up to 24 hours. The amount of the elevation depends on the size of the turtle; greater elevations are needed for larger turtles. Periodically, rock the turtle gently left to right and right to left by holding the outer edge of the shell (carapace) and lifting one side about 3 inches (7.6 cm) then alternate to the other side. Gently touch the eye and pinch the tail (reflex test) periodically to see if there is a response.

(2) Sea turtles being resuscitated must be shaded and kept damp or moist but under no circumstance be placed into a container holding water. A water-soaked towel placed over the head, carapace, and flippers is the most effective method in keeping a turtle moist.

(3) Sea turtles that revive and become active must be released over the stern of the boat only when fishing or scientific collection gear is not in use, when the engine gears are in neutral position, and in areas where they are unlikely to be recaptured or injured by vessels. Sea turtles that fail to respond to the reflex test or fail to move within 4 hours (up to 24, if possible) must be returned to the water in the same manner as that for actively moving turtles.

(C) A turtle is determined to be dead if the muscles are stiff (rigor mortis) and/or the flesh has begun to rot; otherwise the turtle is determined to be comatose or inactive and resuscitation attempts are necessary.

(ii) In addition to the provisions of paragraph (d)(1)(i) of this section, a person aboard a vessel in the Atlantic, including the Caribbean Sea and the Gulf of Mexico, that has pelagic or bottom longline gear on board and that has been issued, or is required to have, a limited access permit for highly migratory species under §635.4 of this title, must comply with the handling and release requirements specified in §635.21 of this title.

(iii) Any specimen taken incidentally during the course of fishing or scientific research activities must not be consumed, sold, landed, offloaded, transshipped, or kept below deck.

(2) *Gear requirements for trawlers—(i) TED requirement for shrimp trawlers.* Any shrimp trawler that is in the Atlantic Area or Gulf Area must have an approved TED installed in each net that is rigged for fishing. A net is rigged for fishing if it is in the water, or if it is shackled, tied, or otherwise connected to any trawl door or board, or to any tow rope, cable, pole or extension, either on board or attached in any manner to the shrimp trawler. Exceptions to the TED requirement for shrimp trawlers are provided in paragraph (d)(2)(ii) of this section.

(ii) *Exemptions from the TED requirement—(A) Alternative tow-time restrictions.* A shrimp trawler is exempt from the TED requirements of paragraph (d)(2)(i) of this section if it complies with the alternative tow-time restrictions in paragraph (d)(3)(i) of this section and if it:

(1) Has on board no power or mechanical-advantage trawl retrieval system (i.e., any device used to haul any part of the net aboard);

(2) Is a bait shrimper that retains all live shrimp on board with a circulating seawater system, if it does not possess more than 32 lb. (14.5 kg) of dead shrimp on board, if it has a valid original state bait-shrimp license, and if the state license allows the licensed vessel to participate in the bait shrimp fishery exclusively;

(3) Has only a pusher-head trawl, skimmer trawl, or wing net rigged for fishing;

(4) Is in an area during a period for which tow-time restrictions apply under paragraphs (d)(3)(ii) or (iii) of this section, if it complies with all applicable provisions imposed under those paragraphs; or

(5) Is using a single test net (try net) with a headrope length of 12 ft (3.6 m) or less and with a footrope length of 15 ft (4.6 m) or less, if it is pulled immediately in front of another net

or is not connected to another net in any way, if no more than one test net is used at a time, and if it is not towed as a primary net, in which case the exemption under this paragraph (d)(2)(ii)(A) applies to the test net.

(B) *Exempted gear or activities.* The following fishing gear or activities are exempted from the TED requirements of paragraph (d)(2)(i) of this section:

(1) A beam or roller trawl, if the frame is outfitted with rigid vertical bars, and if none of the spaces between the bars, or between the bars and the frame, exceeds 4 inches (10.2 cm); and

(2) A shrimp trawler fishing for, or possessing, royal red shrimp, if royal red shrimp constitutes at least 90 percent (by weight) of all shrimp either found on board, or offloaded from that shrimp trawler.

(iii) *Gear requirement—summer flounder trawlers—(A) TED requirement.* (1) Any summer flounder trawler in the summer flounder fishery-sea turtle protection area must have an approved TED installed in each net that is rigged for fishing. A net is rigged for fishing if it is in the water, or if it is shackled, tied, or otherwise connected to any trawl door or board, or to any tow rope, cable, pole or extension, either on board or attached in any manner to the summer flounder trawler. Exceptions to the TED requirement for summer flounder trawlers are provided in paragraph (d)(2)(iii)(B) of this section.

(2) Any approved hard TED or special hard TED installed in a summer flounder trawl must be installed in a TED extension. The TED extension is a cylindrical piece of webbing distinct from the main trawl's body, wings, codend, and any other net extension(s). The TED extension must be constructed of webbing no larger than 3.5 inch (8.9 cm) stretched mesh. The TED extension must extend at least 24 inches (61.0 cm) but not more than 36 inches (91.4 cm) forward of the leading edge of the TED and aft of the trailing edge of the grid.

(B) *Exemptions from the TED requirement.* Any summer flounder trawler north of 35°46.1' N. lat. (Oregon Inlet, NC) from January 15 through March 15 annually is exempt from the TED requirement of paragraph (d)(2)(iii)(A) of this section, unless the Assistant Administrator determines that TED use is necessary to protect sea turtles or ensure compliance, pursuant to the procedures of paragraph (d)(4) of this section.

(C) *Monitoring.* Summer flounder trawlers must carry onboard a NMFS-approved observer if requested by the Southeast Regional Administrator or the Northeast Regional Administrator. A written notification will be sent to the address specified for the vessel in either the NMFS or state fishing permit application, or to the address specified for registration or documentation purposes, or upon written notification otherwise served on the owner or operator of the vessel. Owners and operators must comply with the terms and conditions specified in such written notification. All NMFS-approved observers will report any violations of this section, or other applicable regulations and laws. Information collected by observers may be used for enforcement purposes.

(D) *Additional sea turtle conservation measures.* The Assistant Administrator may impose other such restrictions upon summer flounder trawlers as the Assistant Administrator deems necessary or appropriate to protect sea turtles and ensure compliance, pursuant to the procedures of paragraph (d)(4) of this section. Such measures may include, but are not limited to, a requirement to use TEDs in areas other than summer flounder fishery-sea turtle protection area, a requirement to use limited tow-times, and closure of the fishery.

(3) *Tow-time restrictions*—(i) *Duration of tows.* If tow-time restrictions are utilized pursuant to paragraph (d)(2)(ii), (d)(3)(ii), or (d)(3)(iii) of this section, a shrimp trawler must limit tow times. The tow time is measured from the time that the trawl door enters the water until it is removed from the water. For a trawl that is not attached to a door, the tow time is measured from the time the codend enters the water until it is removed from the water. Tow times may not exceed:

(A) 55 minutes from April 1 through October 31; and

(B) 75 minutes from November 1 through March 31.

(ii) *Alternative—special environmental conditions.* The Assistant Administrator may allow compliance with tow-time restrictions, as an alternative to the TED requirement of paragraph (d)(2)(i) of this section, if the Assistant Administrator determines that the presence of algae, seaweed, debris or other special environmental conditions in a particular area makes trawling with TED-equipped nets impracticable.

(iii) *Substitute—ineffectiveness of TEDs.* The Assistant Administrator may require compliance with tow-time restrictions, as a substitute for the TED requirement of paragraph (d)(2)(i) of this section, if the Assistant Administrator determines that TEDs are ineffective in protecting sea turtles.

(iv) *Notice; applicability; conditions.* The Assistant Administrator will publish notification concerning any tow-time restriction imposed under paragraph (d)(3)(ii) or (iii) of this section in the FEDERAL REGISTER and will announce it in summary form on channel 16 of the marine VHF radio. A notification of tow-time restrictions will include findings in support of these restrictions as an alternative to, or as substitute for, the TED requirements. The notification will specify the effective dates, the geographic area where tow-time restrictions apply, and any applicable conditions or restrictions that the Assistant Administrator determines are necessary or appropriate to protect sea turtles and ensure compliance, including, but not limited to, a requirement to carry observers, to register vessels in accordance with procedures at paragraph (d)(5) of this section, or for all shrimp trawlers in the area to synchronize their tow times so that all trawl gear remains out of the water during certain times. A notification withdrawing tow-time restrictions will include findings in support of that action.

(v) *Procedures.* The Assistant Administrator will consult with the appropriate fishery officials (state or Federal) where the affected shrimp fishery is located in issuing a notification concerning tow-time restrictions. An emergency notification can be effective for a period of up to 30 days and may be renewed for additional periods of up to 30 days each if the Assistant Administrator finds that the conditions necessitating the imposition of tow-time restrictions

continue to exist. The Assistant Administrator may invite comments on such an action, and may withdraw or modify the action by following procedures similar to those for implementation. The Assistant Administrator will implement any permanent tow-time restriction through rulemaking.

(4) *Limitations on incidental takings during fishing activities*—(i) *Limitations*. The exemption for incidental takings of sea turtles in paragraph (d) of this section does not authorize incidental takings during fishing activities if the takings:

(A) Would violate the restrictions, terms, or conditions of an incidental take statement or biological opinion;

(B) Would violate the restrictions, terms, or conditions of an incidental take permit; or

(C) May be likely to jeopardize the continued existence of a species listed under the Act.

(ii) *Determination; restrictions on fishing activities*. The Assistant Administrator may issue a determination that incidental takings during fishing activities are unauthorized. Pursuant thereto, the Assistant Administrator may restrict fishing activities in order to conserve a species listed under the Act, including, but not limited to, restrictions on the fishing activities of vessels subject to paragraph (d)(2) of this section. The Assistant Administrator will take such action if the Assistant Administrator determines that restrictions are necessary to avoid unauthorized takings that may be likely to jeopardize the continued existence of a listed species. The Assistant Administrator may withdraw or modify a determination concerning unauthorized takings or any restriction on fishing activities if the Assistant Administrator determines that such action is warranted.

(iii) *Notice; applicability; conditions*. The Assistant Administrator will publish a notification of a determination concerning unauthorized takings or a notification concerning the restriction of fishing activities in the *FEDERAL REGISTER*. The Assistant Administrator will provide as much advance notice as possible, consistent with the requirements of the Act, and will announce the notification in summary form on channel 16 of the marine VHF radio. Notification of a determination concerning unauthorized takings will include findings in support of that determination; specify the fishery, including the target species and gear used by the fishery, the area, and the times, for which incidental takings are not authorized; and include such other conditions and restrictions as the Assistant Administrator determines are necessary or appropriate to protect sea turtles and ensure compliance. Notification of restriction of fishing activities will include findings in support of the restriction, will specify the time and area where the restriction is applicable, and will specify any applicable conditions or restrictions that the Assistant Administrator determines are necessary or appropriate to protect sea turtles and ensure compliance. Such conditions and restrictions may include, but are not limited to, limitations on the types of fishing gear that may be used, tow-time restrictions, alteration or extension of the periods of time during which particular tow-time requirements apply, requirements to use TEDs, registration of vessels in accordance with procedures at paragraph (d)(5) of this section, and requirements to provide observers. Notification of withdrawal or modification will include findings in support of that action.

(iv) *Procedures.* The Assistant Administrator will consult with the appropriate fisheries officials (state or Federal) where the fishing activities are located in issuing notification of a determination concerning unauthorized takings or notification concerning the restriction of fishing activities. An emergency notification will be effective for a period of up to 30 days and may be renewed for additional periods of up to 30 days each, except that emergency placement of observers will be effective for a period of up to 180 days and may be renewed for an additional period of 60 days. The Assistant Administrator may invite comments on such action, and may withdraw or modify the action by following procedures similar to those for implementation. The Assistant Administrator will implement any permanent determination or restriction through rulemaking.

(5)-(6) [Reserved]

(7) Restrictions applicable to gillnet fisheries in North Carolina. No person may fish with gillnet fishing gear which has a stretched mesh size larger than 4 $\frac{1}{4}$ inches (10.8 cm), annually from September 1 through December 15, in the inshore waters of Pamlico Sound, North Carolina, and all contiguous tidal waters, bounded on the north by 35°46.3' N. lat., on the south by 35°00' N. lat., and on the west by 76°30' W. long.

(8) *Restrictions applicable to large mesh gillnet fisheries in the mid-Atlantic region.* No person may fish with or possess on board a boat, any gillnet with a stretched mesh size 7-inches (17.8 cm) or larger, unless such gillnets are covered with canvas or other similar material and lashed or otherwise securely fastened to the deck or the rail, and all buoys larger than 6-inches (15.2 cm) in diameter, high flyers, and anchors are disconnected. This restriction applies in the Atlantic Exclusive Economic Zone (as defined in 50 CFR 600.10) during the following time periods and in the following area:

(i) Waters north of 33°51.0' N. (North Carolina/South Carolina border at the coast) and south of 35°46.0' N. (Oregon Inlet) at any time;

(ii) Waters north of 35°46.0' N. (Oregon Inlet) and south of 3°22.5' N. (Currituck Beach Light, NC) from March 16 through January 14;

(iii) Waters north of 36°22.5' N. (Currituck Beach Light, NC) and south of 37°34.6' N. (Wachapreague Inlet, VA) from April 1 through January 14; and

(iv) Waters north of 37°34.6' N. (Wachapreague Inlet, VA) and south of 37°56.0' N. (Chincoteague, VA) from April 16 through January 14.

(9) *Restrictions applicable to Pacific pelagic longline vessels.* In addition to the general prohibitions specified in §600.725 of chapter VI of this title, it is unlawful for any person who is not operating under a western Pacific longline permit under §665.801 of this title to do any of the following on the high seas of the Pacific Ocean east of 150° W. long. and north of the Equator (0° N. lat.):

(i) Direct fishing effort toward the harvest of swordfish (*Xiphias gladius*) using longline near

(ii) Possess a light stick on board a longline vessel. A light stick as used in this paragraph is any type of light emitting device, including any fluorescent *glow bead*, chemical, or electrically powered light that is affixed underwater to the longline gear.

(iii) An operator of a longline vessel subject to this section may land or possess no more than 10 swordfish from a fishing trip where any part of the trip included fishing east of 150° W. long. and north of the equator (0° N. lat.).

(iv) Fail to employ basket-style longline gear such that the mainline is deployed slack when fishing.

(v) When a conventional monofilament longline is deployed by a vessel, no fewer than 15 branch lines may be set between any two floats. Vessel operators using basket-style longline gear must set a minimum of 10 branch lines between any 2 floats.

(vi) Longline gear must be deployed such that the deepest point of the main longline between any two floats, i.e., the deepest point in each sag of the main line, is at a depth greater than 100 m (328.1 ft or 54.6 fm) below the sea surface.

(10) *Restrictions applicable to pound nets in Virginia*—(i) *Offshore pound net leaders in Pound Net Regulated Area I.* During the time period of May 6 through July 15 each year, any offshore pound net leader in Pound Net Regulated Area I must meet the definition of a modified pound net leader. Any offshore pound net leader in Pound Net Regulated Area I that does not meet the definition of a modified pound net leader must be removed from the water prior to May 6 and may not be reset until July 16.

(ii) *Nearshore pound net leaders in Pound Net Regulated Area I and all pound net leaders in Pound Net Regulated Area II.* During the time period of May 6 to July 15 each year, any nearshore pound net leader in Pound Net Regulated Area I and any pound net leader in Pound Net Regulated Area II must have only mesh size less than 12 inches (30.5 cm) stretched mesh and may not employ stringers. Any nearshore pound net leader in Pound Net Regulated Area I or any pound net leader in Pound Net Regulated Area II with stretched mesh measuring 12 inches (30.5 cm) or greater, or with stringers, must be removed from the water prior to May 6 and may not be reset until July 16. A pound net leader is exempt from these measures only if it meets the definition of a modified pound net leader.

(iii) *Protocol for measuring mesh size.* This protocol applies to measuring mesh size in leaders described in 50 CFR 223.206(d)(10)(i) and 223.206(d)(10)(ii). Mesh sizes are measured by a wedge-shaped gauge having a taper of 0.79 in. (2 cm) in 3.15 in. (8 cm) and a thickness of 0.09 in. (2.3 mm) inserted into the meshes under a pressure or pull of 11.02 lb. (5 kg). The mesh size is the average of the measurement of any series of 20 consecutive meshes. The mesh in the leader is measured at or near the horizontal and vertical center of a leader panel.

(iv) *Reporting requirement.* At any time during the year, if a sea turtle is taken live and uninjured in a pound net operation, the operator of the vessel must report the incident to the NMFS Northeast Regional Office, (978) 281-9328 or fax (978) 281-9394, within 24 hours of returning from the trip in which the incidental take was discovered. The report shall include a

returning from the trip in which the incidental take was discovered. The report shall include a description of the sea turtles condition at the time of release and the measures taken as required in paragraph (d)(1) of this section. At any time during the year, if a sea turtle is taken in a pound net operation, and is determined to be injured, or if a turtle is captured dead, the operator of the vessel shall immediately notify NMFS Northeast Regional Office and the appropriate rehabilitation or stranding network, as determined by NMFS Northeast Regional Office.

(v) *Monitoring.* Owners or operators of pound net fishing operations must allow access to the pound net gear so it may be observed by a NMFS-approved observer if requested by the Northeast Regional Administrator. All NMFS-approved observers will report any violations of this section, or other applicable regulations and laws. Information collected by observers may be used for law enforcement purposes.

(vi) *Expedited modification of restrictions and effective dates.* From May 6 to July 15 of each year, if NMFS receives information that one sea turtle is entangled alive or that one sea turtle is entangled dead, and NMFS determines that the entanglement contributed to its death, in pound net leaders that are in compliance with the restrictions described in paragraph (d)(10)(ii) of this section, NMFS may issue a final rule modifying the restrictions on pound net leaders as necessary to protect threatened sea turtles. Such modifications may include, but are not limited to, reducing the maximum allowable mesh size of pound net leaders and prohibiting the use of pound net leaders regardless of mesh size. In addition, if information indicates that a significant level of sea turtle entanglements, impingements or strandings will likely continue beyond July 15, NMFS may issue a final rule extending the effective date of the restrictions, including any additional restrictions imposed under this paragraph (d)(10)(vi), for an additional 15 days, but not beyond July 30, to protect threatened sea turtles.

(vii) *Modified pound net leader compliance training.* Any pound net licensee and any vessel operator who have modified pound net leaders set in Pound Net Regulated Area I or Pound Net Regulated Area II at any time from May 6 through July 15 must have completed modified pound net leader compliance training and possess on board the vessel a valid modified pound net leader compliance training certificate issued by NMFS. NMFS retains discretion to provide exemptions in limited circumstances where appropriate. Notice will be given by NMFS announcing the times and locations of modified pound net leader compliance training.

(11) *Restrictions applicable to sea scallop dredges in the mid-Atlantic—(i) Gear Modification.* During the time period of May 1 through November 30, any vessel with a sea scallop dredge and required to have a Federal Atlantic sea scallop fishery permit, regardless of dredge size or vessel permit category, that enters waters west of 71° W. long., from the shoreline to the outer boundary of the Exclusive Economic Zone must have on each dredge a chain mat described as follows. The chain mat must be composed of horizontal (“tickler”) chains and vertical (“up-and-down”) chains that are configured such that the openings formed by the intersecting chains have no more than four sides. The vertical and horizontal chains must be hung to cover the opening of the dredge bag such that the vertical chains extend from the back of the cutting bar to the sweep. The horizontal chains must intersect the vertical chains such that the length of each side of the openings formed by the intersecting

chains is less than or equal to 14 inches (35.5 cm) with the exception of the side of any individual opening created by the sweep. The chains must be connected to each other with a shackle or link at each intersection point. The measurement must be taken along the chain, with the chain held taut, and include one shackle or link at the intersection point and all links in the chain up to, but excluding, the shackle or link at the other intersection point.

(ii) Any vessel that enters the waters described in paragraph (d)(11)(i) of this section and that is required to have a Federal Atlantic sea scallop fishery permit must have the chain mat configuration installed on all dredges for the duration of the trip.

(iii) Vessels subject to the requirements in paragraphs (d)(11)(i) and (ii) of this section transiting waters west of 71° W. long., from the shoreline to the outer boundary of the Exclusive Economic Zone, will be exempted from the chain-mat requirements provided the dredge gear is not available for immediate use as defined by §648.2 of this title and there are no scallops on-board.

[64 FR 14070, Mar. 23, 1999]

EDITORIAL NOTE: For FEDERAL REGISTER citations affecting §223.206, see the List of CFR Sections Affected, which appears in the Finding Aids section of the printed volume and at www.govinfo.gov.

EFFECTIVE DATE NOTES: 1. At 64 FR 14070, Mar. 23, 1999, §223.206 was revised. Paragraph (d)(5) contains information collection and recordkeeping requirements and will not become effective until approval has been given by the Office of Management and Budget.

2. At 67 FR 41203, June 17, 2002, §223.206 was amended by adding paragraph (d)(2)(v). This paragraph contains information collection and recordkeeping requirements and will not become effective until approval has been given by the Office of Management and Budget.

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§223.207 Approved TEDs.

[Link to an amendment published at 84 FR 70063, Dec. 20, 2019.](#)

[Link to a correction published at 85 FR 59199, Sept. 21, 2020.](#)

[This amendment was delayed until Aug. 1, 2021 at 86 FR 16676, Mar. 31, 2021.](#)

Any netting, webbing, or mesh that may be measured to determine compliance with this section is subject to measurement, regardless of whether it is wet or dry. Any such measurement will be of the stretched mesh size.

(a) *Hard TEDs.* Hard TEDs are TEDs with rigid deflector grids and are categorized as “hooped hard TEDs” and “single-grid hard TEDs” such as the Matagorda and Georgia TED (Figures 3 & 4 to this part). Hard TEDs complying with the following generic design criteria are approved TEDs:

(1) *Construction materials*—(i) *Single-grid and inshore hooped hard TED.* A single-grid hard TED or an inshore hooped hard TED must be constructed of one or a combination of

A Review of NOAA's Incidental Take Permit (ITP) Process

by

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A Review of NOAA's Incidental Take Permit (ITP) Process

Executive Summary

The Endangered Species Act is often considered to be the world's most powerful piece of legislation. The purpose of the Act is to protect and recover imperiled species and the ecosystems they depend on. To achieve these objectives, the U.S. Fish and Wildlife Service and NOAA's National Marine Fisheries Service implement a large number of regulations, including one Section of the Act which prohibits almost all 'takes' of listed species. One highly controversial aspect of the statute is the Section 10 provision which allows non-federal entities to apply for an incidental take permit (ITP). ITPs authorize the incidental taking of protected species during otherwise legal activities, such as construction projects or commercial fishing.

This Master's Project examines the ITP implementation process of listed marine species under NOAA's jurisdiction. To analyze this process, I conducted a literature review to compare the information that exists for both marine and terrestrial based ITPs, examined the application process and timeline for the ITP issued to the North Carolina Division of Marine Fisheries for sea turtles, and created and implemented stakeholder interviews to gain perspective from people who have been involved with an ITP. This project aims to identify the shortcomings that exist in the ESA Section 10 ITP process, so that management agencies can address these issues. Addressing these problems will help to improve the ITP process for involved stakeholders and ensure compliance with the ESA to provide the best protections possible for endangered and threatened species.

I. Introduction

Establishment of the Endangered Species Act

The Endangered Species Act (“the ESA”, “the Act”) of 1973 (16 U.S.C. § 1531 *et seq.*) is one of the nation’s most significant, but controversial laws (Bean, 2009). Although heavily questioned and critiqued now, the Act held little controversy at its inception and was approved by the House and Senate with overwhelming margins (Bean, 2009). Many have labeled the Act as one of the world’s most powerful pieces of legislation (Schwartz, 2008; Petersen, 1999), but it certainly was not the first attempt in the U.S. to regulate and protect wildlife. The first direct step taken toward national wildlife regulation occurred in 1900 when Congress passed the Lacey Act (Petersen, 1999). The Lacey Act was the first piece of legislation that enabled federal involvement in species preservation and recognized the growing, national problem of species protection (Petersen, 1999). It prohibited the interstate commerce of animals, birds and their products killed in violation of state law, in addition to requiring the Secretary of Agriculture to work toward the preservation and restoration of game birds and animals (Petersen, 1999). Following the Lacey Act of 1900, President Roosevelt established the first national wildlife refuge on Pelican Island in FL in 1903, which created the National Wildlife Refuge System (USDOI, 2018). After the implementation of these efforts geared toward habitat and species protection, the general public desired further wildlife protection when the last remaining passenger pigeon passed away in a zoo in 1914 (Petersen, 1999). This event led to the signing of the Migratory Bird Treaty in 1916, later ratified by Congress as the Migratory Bird Treaty Act (MBTA) in 1918 (Petersen, 1999). In 1962, Rachel Carson published her famous work *Silent Spring*, which was another major contribution to a national push toward environmental protection (Petersen, 1999).

The ESA was actually the third law in a series of statutes passed in attempts to avoid species extinctions (Bean, 2009). Prior to passage of the first law, efforts were led by the U.S. Fish and Wildlife Service (USFWS) to prevent the extinction of the whooping crane and California condor (Bean, 2009). The Department of the Interior (DOI) pursued federal legislation that would enable USFWS to create a program to conserve endangered species; Congress responded by passing the Endangered Species Prevention Act of 1966, the first law in this series (Bean, 2009). The 1966 Act did not provide any regulatory consequences, meaning that one could still kill a particular species or destroy its habitat, but it led to the creation of a formal list of species threatened with extinction and a program to aid in species conservation (Bean, 2009). In 1967, USFWS published the first formal list of 78 endangered species (Bean, 2009). Shortly after enacting the 1966 Act, the lack of legal protections became a clear liability, due to declines in whale populations and international trade of spotted cats (Bean, 2009). This led to the Endangered Species Conservation Act of 1969, which provided some regulatory prohibitions (Bean, 2009). The 1969 Act prohibited the import or export of listed species, in an attempt to

regulate international commercial trade (Bean, 2009). It also required the negotiation of an international treaty to address international trade, which led to the 1972 Convention on International Trade in Endangered Species of Fauna and Flora (CITES) (Bean, 2009). As concern for endangered species continued to grow, so did general concern for the environment. The first Earth Day, held in 1970, led to the creation of other notable environmental acts, such as the Clean Air Act, Clean Water Act, and Marine Mammal Protection Act. In 1973, President Nixon strengthened protections for listed species and their habitats even further by signing the ESA (Bean, 2009). The ESA passed in the Senate 92 - 0, and in the House 355 - 4 (Schwartz, 2008).

Overview of the Act

The ESA contained a variety of significant changes from the two laws that preceded it (Bean, 1999). The first was that every animal and plant now had the potential to be listed if need be; the first two laws only enabled the listing of vertebrates, mollusks, and crustaceans (Bean, 1999). Another significant adjustment was that subspecies and discrete populations were now eligible for protection; previous statutes applied only to entire species (Bean, 1999). The ESA also created the category of a threatened species, a species likely to become endangered; the first two laws did not include this listing category (Bean, 1999). There have been a few notable amendments, in 1978, 1982 and 1988, to the ESA since it was enacted, but its general framework and purpose has remained intact (Bean, 2009).

The ESA is considered one of the nation's most significant laws. It can be argued that its most notable success is that the status of many listed species has improved over time (Schwartz, 2008). However, the Act is also controversial. Some of its controversy stems from its failure to truly empower its agencies to implement the law (Schwartz, 2008). Two federal agencies are responsible for administering the Act: the USFWS service, under the DOI, and the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS), under the U.S. Department of Commerce (DOC) (Bean, 1999). USFWS is responsible for terrestrial and freshwater species, and NMFS is responsible for marine and anadromous species (Bean, 1999).

The entire framework of the ESA is important and contributes to its many successes, but many argue that most of its power rests in Section 4 (16 U.S.C. §§ 1533), Section 7, (16 U.S.C. §§ 1536) and Section 9 (16 U.S.C. §§ 1539) (Petersen, 1999). Section 4(b) of the ESA enables any person or entity, outside of the federal government, to file a petition to add or remove any species to and from listed endangered or threatened status (Ward, 2019). If a petition is presented, the Secretary of the Interior or the Secretary of Commerce, dependent on the species in question, decides whether or not the species should be listed based solely on the best available scientific and commercial data (Ward, 2019). Sections 4(a) and (c) of the Act allow the Secretary

to list a species if it is threatened or endangered due to habitat destruction, disease or predation, overutilization, or other factors that may affect its current existence (Ward, 2019). Sections 4(a)(3) and 4(f) require the Secretary to designate critical habitat and develop recovery plans for listed species (Ward, 2019). Another extremely important aspect of the ESA is Section 7, which outlines the consultation process USFWS and NMFS must follow to ensure that federal activities do not jeopardize the existence of any listed species (USFWS, 2020). If a federal entity proposes to conduct, permit, or fund an activity that has the potential to adversely affect a listed species or its critical habitat, that entity must submit a Biological Assessment (BA) to USFWS or NMFS (personal correspondence: Jeff Murphy. Feb. 23, 2021). The acting agency will then review the BA and publish a Biological Opinion (BO) (personal correspondence: Jeff Murphy. Feb. 23, 2021). The BO will indicate whether the acting agency believes the proposed activity will jeopardize the continued existence of a listed species by impacting their distribution or reducing its abundance, or whether the activity will adversely modify the species designated critical habitat (personal correspondence: Jeff Murphy. Feb. 23, 2021). If the proposed activity does either, the acting agency must publish reasonable alternatives to the activity (personal correspondence: Jeff Murphy. Feb. 23, 2021). Section 9 of the ESA prohibits the ‘taking’ of a listed species. The Act defines take as “means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct” (16 U.S.C. §§ 1532(19)).

Section 10 of the Act

In 1982 the ESA was amended to include Section 10 (16 U.S.C. §§ 1540). Section 10 enables entities to obtain permits that authorize the incidental take of listed species during other otherwise lawful and legal activities (NOAA, 2020; USFWS, 2021). This amendment was enacted to address the concerns of private landowners who were not eligible to use Section 7 of the ESA to obtain federal permits to conduct activities that could adversely affect listed species (Webster, 1987). Prior to Section 10, private landowners had no means to participate in legal activities that had the potential to take listed species, because they would have been in violation of the take prohibitions in Section 9 (Webster, 1987).

There are three permit types that private landowners can apply for under Section 10 of the Act, which include recovery and interstate commerce permits (16 U.S.C. §§ 1540(a)(1)(a)), incidental take permits (ITPs) (16 U.S.C. §§ 1540(a)(1)(b)), and enhancement of survival permits (16 U.S.C. §§ 1540(a)(1)(c) (USFWS, 2021). Recovery and interstate commerce permits are issued for activities that are intended to foster the recovery of listed species, such as scientific research projects that include species abundance surveys, genetic research, or relocations (USFWS, 2021). Such permits also allow for the sale or transport of listed species across state lines, for the purpose of activities such as breeding programs (USFWS, 2021).

ITPs are issued for legal activities that do not fall under the categories of scientific research or species recovery, such as construction projects or state-run commercial fisheries (USFWS, 2021). If an applicant wishes to receive an ITP issued by USFWS or NMFS they must also submit a habitat conservation plan (HCP), a detailed, extensive plan that demonstrates how the applicant will minimize and mitigate the effects of the permitted activity on the listed species (USFWS, 2019).

Enhancement of survival permits are used in conjunction with Safe Harbor Agreements and Candidate Conservation Agreements with Assurances that allow private landowners to improve habitat areas for listed species without receiving additional restrictions on their land in the future, if the species should start to increase their occupied area (USFWS, 2020). All three permit options available for private landowners under Section 10 of the ESA allow them to incidentally take listed species without being in violation of the Act, as federal agencies have been able to do under Section 7 consultation processes.

II. Project Purpose

The purpose of this project is to analyze the ESA section 10 ITP application and implementation process. More specifically, this work will review the process as it occurs for marine based ITPs under NOAA/NMFS's jurisdiction, as opposed to terrestrial based ITPs under USFWS's jurisdiction. This work will begin to fill a knowledge gap, as little research has been conducted to evaluate marine based ITPs. Throughout this work I hope to determine potential areas of improvement throughout the application and implementation process that can improve the experience for involved stakeholders and the ability of an ITP to protect listed species.

III. Methodology

Literature Review

I conducted an initial literature review to gain background knowledge and identify literature that described, reviewed, analyzed, or criticized specific ITPs. In this review I aimed to collect literature pertaining to both terrestrial and marine based ITPs to compare the breadth and extent of information for ITPs in the two environments. I used three scientific databases to complete this review: Web of Science, Scopus, and Earth, Atmospheric & Aquatic Science. When searching in each database, I simply used the term "incidental take permit." When I attempted to narrow and specify the search by adding words such as "review," "effective," "efficacy," etc., too few results were returned. When broadening the search to pertain to "incidental take," as opposed to ITPs specifically, there were too many results unrelated to ESA Section 10. I manually reviewed each

search return from each database and analyzed those that proved relevant to collect and extract information.

Case Study Analysis: North Carolina Division of Marine Fisheries for Sea Turtles

I reviewed all available documents in the Federal Register for all current, active ITPs issued by NMFS. There are currently nine active ITPs under NMFS's jurisdiction. Originally, I had anticipated to conduct three case study analyses on ITPs that are issued to different regions, allow for the take of different protected species, and are issued to different entities (i.e. state fisheries and industrial facilities). However, during the stakeholder interviews I conducted (methodology described below), I was unable to contact anyone involved in two of the ITPs I had intended to review. Instead, I focused on an in-depth case study analysis of the ITP issued to the North Carolina Division of Marine Fisheries (NCDMF) to regulate sea turtle bycatch in the state's gillnet fishery. To conduct this review, I analyzed and extracted information from permit applications, the environment assessment, public comments, the final permit document, news articles, etc.

Interviews with Stakeholders

To gain a variety of perspectives of the marine ITP implementation process, I conducted interviews with a variety of stakeholders. The purpose of these interviews was to engage in formal conversations with federal and state employees and industry members about their experiences with the ITP process. I created a list of ten questions to ask in each interview (Appendix A). Generally, these questions were constructed to gain an understanding of how stakeholders were involved in the process, whether they experienced difficulties within the process, and whether they believed the process had room for improvement. All participants consented to the interview, as well as to being audio recorded. Participants had the option to remain anonymous, or to opt out of the potential to be quoted directly. All interviews were analyzed using NVivo software to identify common themes and shared and contradictory opinions amongst participants.

IV. Results

Literature Review

The literature review produced 212 returns from the three scientific databases. Web of Science returned four resources, Scopus returned 89, and Earth, Atmospheric, and Aquatic Science returned 119. After manually reviewing each return, I selected 62 resources for further analysis, as they contained information relevant to Section 10 ITPs. Of the final 62

selected resources, only 12 were related to the marine environment; the other 50 resources were related to ITPs issued in terrestrial environments.

Nearly half of the resources related to ITPs in the marine environment discussed the ITP issued to NCDMF for sea turtle takes in the NC gillnet fishery (Putman et al., 2020; Boucquey, 2019; May, 2015; May, 2012; Santora, 2003). A study conducted by May (2012) examined the choice of NC commercial fishers to practice active non-participation, which is an active choice to not involve themselves in formal political activities. In 2015, May took to this case study once again and examined the campaign that recreational fishers and conservationists completed in an attempt to ban commercial gillnet use in the state. Boucquey (2019) and Santora (2003) also utilized the NCDMF sea turtle ITP as a case study. Boucquey explored how fishers perceive the politics of fisheries management and who they believed actually held the power to make management decisions. While exploring this issue, Boucquey noted that greater participation from political ecologists was needed to successfully manage these conflicts. Santora explored the feasibility of achieving social and biological goals and discussed solutions that could legally operate under the ESA and uphold social values. Putman et al. (2020) examined the issue of protected species bycatch increasing as their populations begin to rise. These authors noted that bycatch within the NC gillnet fishery had increased by 300 percent and 650 percent for Kemp's ridley and green sea turtles, even though fishing effort had significantly decreased. They suggested that stock assessment models should be utilized more to determine a sustained level of mortality for the protected species.

Additional returns that mentioned ITPs in the marine environment discussed the Dungeness crab fishery in CA, ME's lobster fishery, U.S. Naval sonar use, the NC sturgeon ITP, and the Marine Mammal Protection Act (Hathaway, 2020; French, 2019; Rahaim, 2019; Hathaway and Moore, 2020; Calvez, 2000; Donald, 2017; Hofman, 2009). Three resources that discussed CA's Dungeness crab fishery, which is in the process of applying for an ITP to permit whale entanglements, were published in the fisheries trade journal *National Fishermen*. Each article noted that fishermen felt as though they were being "singled-out," as the shipping industry harms many whales on the west coast of the United States, but fishermen are being regulated and having their livelihoods affected (Hathaway, 2020; French, 2019; Rahaim, 2019).

Most resources in this literature review were related to terrestrial ITPs and covered a wide variety of topics. Many studies systematically reviewed the ITP and, more specifically, the Habitat Conservation Plan (HCP) planning process. Most of these studies noted how the number of HCPs rose dramatically after 1983 (Harding et al., 2001; Watchman et al., 2001; Opperman and Bernazzani, 2003). Only 14 HCPs existed in 1992, compared to 225 in 1997 (Harding et al., 2001) and more than 330 by the end of 2000 (Watchman et al., 2001). In 1999, HCPs encompassed close to 12 million acres of threatened and endangered species habitat (Bidwell et al., 1999). This dramatic rise in ITPs and HCPs appears to have sparked many researchers to

review these planning processes, because HCPs had become the primary mechanism in which the ESA was implemented on private land (Opperman and Bernazzani, 2003).

Throughout the first 18 years of HCPs, few studies attempted to quantitatively assess the scientific foundation underlying HCP documents (Harding et al., 2001). Harding et al. (2001) helped to fill this knowledge gap by conducting case study assessments on 43 HCPs; their main goal was to evaluate the availability and use of scientific data. Overall, the authors concluded that HCP planners did a good job using relevant and available scientific information, even though only 60% of the plans they reviewed were not missing any data that the authors deemed as necessary. Additionally, biological and status data simply did not exist for many of the species involved in the HCPs they reviewed. Population estimates only existed for 10 percent of the covered species, and 42 percent of the species lacked the data needed to accurately determine how predicted take levels could affect the population.

Watchman et al. (2001) also sought to review HCPs and reflected on the adequacy of their use of scientific information. The authors reviewed 43 HCPs and determined that data gaps generated and propagated uncertainty throughout the planning process. They also found that abundance trends were unknown for 49 percent of the species covered in the HCPs. Opperman and Bernazzani (2003) noted that a variety of HCP reviews shared similar themes, and that all had concerns related to data adequacy. These authors sought to review those common themes by analyzing interview responses from 121 participants from 31 different HCPs. In general, they found that HCP participants felt that the scientific data used were adequate. Participants appeared to be more concerned with social, economic, political and logistical issues, in addition to the time it takes to develop an HCP. Many participants also expressed frustration with the lack of guidance they received from USFWS. A separate review also analyzed HCP participant interviews and created summaries of how 31 different HCPs were created (Bidewell et al., 1999). These authors identified five planning process components and determined that there were conflicts within each process for every HCP they reviewed. One particular study demonstrated that the presence of species in the planning areas for 22 multispecies HCPs was not even confirmed for 41% of the covered species (Rahn et al., 2006).

In addition to literature review returns being related to strategic reviews of terrestrial based HCPs, a variety of resources sought to critique Section 10 of the ESA. Some reviews were aggressively critical (Brown and Oliver, 1997; Beneville, 1995), but others aimed to demonstrate why HCPs had potential room for improvement (Shilling, 1997; Thomas 2000; Wilhere, 2009). According to Brown and Oliver (1997), ITPs are nothing more than “kill an endangered species free card” for various landowners and corporations. Beneville (1995) shared a similar sentiment, claiming that ESA Section 10 is a “back-door attempt to thwart enforcement of the act and make it more ‘user friendly’ to those who are no friend to endangered plants and critters.” This author boiled down the ITP and HCP process even further by stating that they simply allow private

landowners to be approved to destroy habitat when they are faced with a problem related to endangered species. Other articles questioned the validity of whether or not HCPs really protect threatened and endangered species, due to the fact that HCPs do not actually require a species recovery plan and only require that the approved activities do not deplete the protected species below a particular limit (Shilling, 1997; Thomas, 2000). Some authors believed that HCPs can provide solutions, as they provide a vehicle to solve conflicts that occur between economically important activities on non-federal lands and protected species (Thomas, 2000). HCPs were created with this good intention, but many believe they suffer from drawbacks (Thomas, 2000; Wilhere, 2009). Wilhere (2009) categorized perceived shortcomings of ESA Section 10 into three paradoxes: the Trainwreck Paradox, the Jeopardy Paradox, and the Maximum Mitigation Paradox. The Trainwreck Paradox refers to the conflict of HCPs needing to be created to prevent species from being listed, while simultaneously needing federal listings to motivate landowners to create HCPs. The Jeopardy Paradox refers to the vague language of ESA Section 10 and the Maximum Mitigation Paradox outlines the issue of a landowner balancing financial resources to provide maximum mitigation at the present or in the future. In general, these articles critiquing ESA Section 10 ITPs and HCPs believe there are better solutions, and that the HCP process and setup often contradicts itself and the purpose of the ESA.

Many literature returns sought to criticize ESA Section 10, but a variety of returns aimed to introduce concepts that could be used in lieu of, or prior to, ITP implementation. Some of these alternatives included concepts such as habitat conservation banking (HCB), candidate conservation agreements with assurances (CCAA), pre-listing conservation (PLC), and recovery credit systems (RCS). HCB is a concept that allows landowners to profit off of endangered species if they partake in a process to preserve certain habitats and receive credits in return (Hay, 2010). Essentially, landowners would be allowed to continue their activities on one piece of land, if they completely protect another area. HCB may be able to streamline the Section 10 permitting process, due to the fact that ITPs are not always feasible because of their costs and the extensive application process (Hay, 2010). CCAAs provide incentives for landowners to partake in activities that are beneficial for species that have potential to become candidates for ESA listing in the future (Schuler and Corbin, 2020). CCAAs are binding agreements, and an ITP can be pre-setup during the planning process (Schuler and Corbin, 2020). This would allow an ITP to become effective immediately, if the species is eventually listed (Schuler and Corbin, 2020). CCAAs have the potential to prevent species from needing to be listed and are a proactive measure that can be taken before ITPs must be implemented. PLC is a concept similar to CCAAs in the sense that it encourages landowners to voluntarily partake in conservation initiatives that would benefit at-risk species (Donlan et al., 2013). If USFWS approved a landowner's property for a PLC, the landowner could seek financial assistance from a project developer to initiate the approved conservation measures. (Donlan et al., 2013). If the landowner earns enough credit from USFWS throughout the conservation project, they would be able to use the credits in the future to offset anticipated impacts from their activities (Donlan et al., 2013). PLCs would

complement a few current ESA programs and, once again, help species before they are listed. An RCS was created for the Fort Hood Military Reservation, which needed to find a way to mitigate their impacts on the endangered golden-cheeked warbler population located on this military base (Wolfe et al., 2012). The RCS allowed Fort Hood to buy permanent and temporary credits from private landowners, who then initiated conservation measures on their property to mitigate the impacts caused by Fort Hood's activities (Wolfe et al., 2012). All of these alternatives provided effective measures to protect at-risk species, and potentially prevent the need for an ITP altogether.

The literature review also revealed a current hot topic related to terrestrial based ITPs and the issue of species protection, particularly bird protections, and renewable wind energy development. A variety of returns discussed the environmental importance of supporting growth within the wind energy sector, but noted how difficult this has been due to species protections laid out in the ESA and MBTA (Glen et al., 2013; Yung and Sanders, 2014; George 2015). Due to protections provided by the MBTA, it is almost impossible for wind farms not to be in direct violation of the statute (Glen et al., 2013). Some authors believed the MBTA should be amended to include its own ITP process (Obrecht, 2013; Brooks, 2015), as bird takes should be covered in the wind industry (Obrecht, 2013). Others believed the MBTA needs an ITP process to allow the wind industry to grow (Lonsdorf et al., 2018), but some were critical of the length of the ITP process (Glen et al., 2013). Testa (2011) described the process one wind company, Energy Northwest, went through to receive an ITP and how they felt the USFWS goals were unrealistic and impossible to meet. To combat the conflict that currently exists between wind energy development and bird takes, many resources also sought to explore alternative mitigation options. For example, Lonsdorf et al. (2018) suggested that energy companies should look toward mitigation strategies outside of their wind farms to offset the takes allotted in an ITP. The authors used the golden eagle as an example, as many are killed in vehicle collisions. Energy companies could potentially find ways to mitigate golden eagle vehicle collisions, if they run out of options at their wind facility, to remain within the number of takes they are legally allotted. Hallingstad et al. (2018) also worked to develop new observation-based methods on wind farms, to hopefully reduce take and remain within authorized limits. The optimal solution to this conflict remains unclear, but it is evident from the literature that wind energy development is being stalled in many cases, due to protected species protections.

Case Study Analysis: North Carolina Division of Marine Fisheries for Sea Turtles

The diverse nature of North Carolina's commercial fisheries make the state one of the top seafood-producing areas in the U.S. (Byrd et al., 2011). North Carolina fishers are adaptive and dynamic, and typically use a variety of gear types in different seasons (Byrd et al., 2011). The southern flounder fishery is one of the most economically important fisheries in the state (Byrd et al., 2011) and commercial landing records that date back to the 1960's demonstrate that

southern flounder had the highest value of all other finfish species (NCDEQ, n.d.). Over the past ten years, commercial southern flounder landings have averaged 1.7 million pounds (NCDEQ, n.d.). Prior to the 1990's, the commercial pound net fishery was the primary gear used to harvest southern flounder, but landings from gillnets began to drastically increase in the 1980's and 1990's and eventually surpassed pound net landings in 1994 (NCDEQ, n.d.). In 2011, 93% of southern flounder landings were caught in gillnets (Byrd et al., 2011), and in 2017 commercial gillnet vessels were the third ranked gear type by ex-vessel value of landings in NC, generating \$9,256,629 in ex-vessel value (NCDMF, 2019).

A gillnet is a wall of netting suspended in the water column, made with monofilament or multifilament nylon (NOAA Fisheries, 2021). Mesh size varies with the size of the target species, as the nets are designed to allow a fish's head to fit through the net, but not their body (NOAA Fisheries, 2021). This results in fish becoming entangled in the net at the level of their gills, preventing them from freeing themselves when they attempt to back out (NOAA Fisheries, 2021). Gillnets are effective in capturing target species but, unfortunately, also result in the incidental capture of many non-target species (BMIS, n.d.). Gillnet entanglement is a common source of mortality for sea turtles, as their heads or flippers can be easily entangled in the mesh (BMIS, n.d.). Once entangled, a sea turtle suffers the risk of drowning if it is unable to reach the surface to breathe (BMIS, n.d.). Sea turtles may also suffer from lacerations if the net tightens around their bodies, which can injure the turtle or cause an infection if the turtle survives the actual entanglement (BMIS, n.d.).

As the use of gillnets in the North Carolina fishery began to increase in the 1980's, fishing practices began to change as well. Gillnets had been typically set in shallow, estuarine waters, but in the 1990's a deep-water gillnet fishery emerged in Pamlico Sound (Byrd et al., 2011). The emergence of this fishery imposed a significantly increased risk to local sea turtle populations (Byrd et al., 2011). In the fall of 1999, high levels of sea turtle strandings were linked to entanglement in gillnets used in Pamlico Sound (NOAA-NMFS, 2013b). The incidental take of sea turtles in this gillnet fishery was not covered under an ESA Section 10 ITP at the time, thus placing the state fishery in violation of the ESA. As a result, NMFS issued an emergency 30-day rule and closed the fishery before the end of the season, citing lack of authorization for the incidental take of the listed loggerhead sea turtles, *Caretta caretta* (NOAA-NMFS, 2013b). In 2000, the first ESA Section 10 ITP was issued to NCDMF to enable the shallow water commercial fishery to operate within the closed area while managing sea turtle interactions in the southeastern Pamlico Sound (NOAA-NMFS, 2013b). Three additional ITPs were issued to NCDMF in 2001, 2002, and 2005, to continue to monitor sea turtle interactions in the fall large mesh gillnet fishery in the Pamlico Sound (NOAA-NMFS, 2013b). The objective of all four ITPs was to reduce sea turtle mortality by 50% between September 15 and December 15, compared to the 1999 stranding levels (NOAA-NMFS, 2013b). The final ITP issued in 2005 had a duration of six years.

In February 2010, as the expiration date for NCDMF's permit began to approach, the state's inshore commercial gillnet fishery was sued by the Duke Environmental Law and Policy Clinic ("the Clinic") on behalf of the Karen Beasley Sea Turtle Rescue and Rehabilitation Center (KBSTRRC) (Duke Law News, 2010a). The KBSTRRC alleged that NCDMF and the North Carolina Marine Fisheries Commission (NCMFC) had been issuing fishing permits and licenses that resulted in the illegal taking of ESA listed sea turtles (Duke Law News, 2010a) in waters not covered under an ITP. The lawsuit cited a number of resources from NOAA, NMFS, and NCDMF which demonstrated that the gillnet fisheries in NC often caused death or injury to sea turtles (Duke Law News, 2010a). The lawsuit also made it clear that KBSTRRC was simply asking NCDMF to enforce the ESA to aid in the recovery of sea turtles. Jean Beasley, Director of KBSTRRC, noted that she valued the history of commercial fishing in the state, but wanted to halt the decline of sea turtle populations (Duke Law News, 2010a), while allowing fishermen to continue to fish.

In September 2010, the KBSTRRC, NCDMF and NCMFC came to a settlement agreement (Duke Law News, 2010b). This agreement created new laws to govern gillnet fishing practices in NC in-shore waters to reduce the number of gillnet interactions with sea turtles (Duke Law News, 2010b). There were four main components of the settlement agreement (Duke Law News, 2010b):

1. implement new rules regarding the size and type of gillnets allowed, and the time frame in which they can be deployed
2. adopt an enhanced "observer" program, with more observers on the water and a new certification program for volunteer observers
3. expand the geographic scope of its regulatory program for gillnet fishing
4. adopt an "adaptive management" protocol based on observer data

As part of the settlement agreement, NCDMF was required to acquire an ESA Section 10 ITP, in which it would address the four components listed above, and discuss, via an HCP, how it would monitor, minimize, and mitigate the take of ESA listed sea turtles in the state's gillnet fishery.

In June 2010, NCDMF submitted their initial application, for ITP No. 16230, to NMFS to address sea turtle takes in the flounder gillnet fishery (78 FR 42508). After receiving comments and suggestions from NMFS, NCDMF submitted a revised application in August 2011 (76 FR 61670). The revised permit included loggerhead (*Caretta caretta*), green (*Chelonia mydas*), leatherback (*Dermochelys coriacea*), hawksbill (*Eretmochelys imbricata*), and Kemp's ridley (*Lepidochelys kempii*) sea turtles in the conservation plan and NCDMF proposed a permit duration of three years (76 FR 61670). The application proposed that the inshore gillnet fisheries be divided into five management areas to be monitored seasonally (76 FR 61670). To account for

the first major component of the settlement agreement, NCDMF proposed that it would prohibit the use of gillnets from one hour after sunrise on Friday, through one hour before sunset on Monday (76 FR 61670). In addition, the conservation plan also included a requirement for large mesh nets to be low profile, with a series of net length restrictions (76 FR 61670). To account for the second major component of the settlement agreement, NCDMF proposed the use of alternative platform and traditional fisheries observers to monitor sea turtle interactions; a minimum of 7% of annual large mesh gillnet trips were to be observed (76 FR 61670). NCDMF estimated in its revised application that the anticipated annual incidental takes of sea turtles would be 295 lethal and 607 non-lethal takes (76 FR 61670).

In October 2011, NMFS published their receipt of NCDMF's application in the Federal Register, making it available for public comment. Thirteen public comments were received during the allotted 60-day comment period, many of which were multipage documents that encompassed a variety of questions, support, and concerns (NOAA-NMFS, 2011). Comments were received from representatives of environmental organizations, public citizens, and researchers (NOAA-NMFS, 2011). Most comments expressed general support for the ITP application, but the submissions also raised further questions and concerns. These included, but were not limited to, the low percentage of large mesh gillnet trips that would be observed, a claim that the HCP was missing information, and a failure to fully address some terms from the settlement agreement. NMFS reviewed all public comments and provided feedback to NCDMF to revise their application to address the necessary questions and concerns (NOAA-NMFS, 2011).

In September 2012, NCDMF submitted their amended ITP application, which was revised based on the previous public comments and feedback from NMFS (78 FR 42508). The most significant change to the updated application was the newly requested permit duration of ten years, compared to the original request of three years (77 FR 65864). The new application also proposed the implementation of six management areas, to manage and monitor the inshore gillnet fisheries seasonally and by fishery (77 FR 65864). NCDMF did not increase the minimum percentage of annual observed fishing trips for large mesh gillnets, but did add a requirement for 1-2% of annual observed fishing trips for small mesh gillnets as well (77 FR 65864). NMFS published the updated ITP application for review to the Federal Register in October 2012 and a 30-day public comment period ensued (77 FR 65864). Twelve, multipage public comments were received, and they once again expressed general support in addition to voicing a series of remaining concerns (NOAA-NMFS, 2012). A few public commenters were unsure of the rationale for the number of sea turtle takes NCDMF was requesting, as these levels were based from historic estimated take levels, as opposed to potentially available take levels (NOAA-NMFS, 2012).

Following the completion of the second public comment period, NMFS summarized all of the comments received during both periods in the Environmental Assessment (EA) (78 FR 42508).

In July 2013, NMFS published the draft EA, thus beginning another comment period (78 FR 42508). The purpose of the required EA was to analyze “the effects to the human and natural environment caused by the issuance of ITP No. 16230 to NCDMF for the incidental take of threatened and endangered sea turtles during management of North Carolina inshore gillnet fisheries” (78 FR 42508). During the EA comment period, 54 comments were received (NOAA-NMFS, 2013a). Many of these comments were from the general public, and there were once again comments from representatives of environmental organizations and researchers. The comments demonstrated a variety of opinions, but some commonly shared concerns were related to the number of sea turtle takes being allotted, how those numbers were actually determined, and the lack of any recent sea turtle stock assessment updates (NOAA-NMFS, 2013a).

After the EA public comment period closed and NMFS reviewed all comments, they approved and issued ITP No. 16230 to NCDMF for the incidental take of various sea turtle species in the state’s inshore commercial gillnet fishery in September 2013 (78 FR 57132). In the final conservation plan, it details that the estuarine waters would be divided into six management areas and each would be monitored seasonally and by fishery (78 FR 57132). There are also restricted soak times for large mesh gillnets, maximum net length restrictions, the implementation of the monitoring program, and adaptive management strategies, amongst a few other things, in the conservation plan (78 FR 57132). The application process for ITP No. 16230 was over three years long, from the initial application in June 2010 to the final permit issuance in September 2013. This permit was also approved for a duration of 10 years, so it will be expiring in 2023.

Interviews with Stakeholders

I formally interviewed 13 participants for this project, 10 of whom were directly involved with the ITP issued to NCDMF. Of the other three participants, one is a federal employee and two are state employees from outside North Carolina. The 10 interview participants involved with the NCDMF ITP include:

- 1 federal employee
- 2 state employees
- 2 commercial fishermen
- 3 recreational fishermen and conservationists
- 1 Sea Turtle Advisory Committee (STAC) member
- 1 Duke Environmental Law and Policy Clinic employee

Interviews ranged from 15 to 40 minutes in length and revealed a diverse set of opinions which varied considerably among participants. Generally, participants within the same stakeholder group expressed similar opinions. Common themes discussed during interviews included: (1)

ESA and ITP purpose and application, (2) stakeholder engagement, (3) communication, (4) ITP implementation and scientific data use, collection, and reporting, (5) the HCP handbook, and (6) resources.

When asked to describe the purpose of an ITP, all participants used language that was parallel to the ESA. Each respondent noted that the purpose of an ITP is to authorize the incidental taking of a listed species, to allow certain activities to continue operations. One recreational fisherman, however, expressed that ITPs “make no sense” and “are just a contradiction” to the ESA, alluding to the fact that they are unevenly issued because some takes are authorized while others ignored. One commercial fisherman, who is a representative of the North Carolina Fisheries Association and often represents this stakeholder group stated that it was “a result of someone trying to weaponize the Endangered Species Act, trying to get rid of commercial gears. In this case it happened to be gillnets, specifically large mesh gillnets.” He also made sure to note that the commercial fishermen do not feel this was Jean Beasley’s intention when she filed the lawsuit, but it was likely others’ who pushed her to file. He noted that the commercial industry believes that, if the ESA is going to be applied, it should be applied evenly. Referencing stranding data, he noted that sea turtle incidental takes also occur with recreation hook and line, boat strikes, and other activities in NC waters. No other participants mentioned the idea of the ESA being used to target a particular group, but it is clear that commercial fishermen feel their industry was targeted in NC.

One of the most frequent interview themes was stakeholder engagement throughout the ITP application process. One NC state employee, who was heavily involved with the sea turtle ITP, noted that NCDMF was engaged with commercial fishermen, NGO’s, recreational fishers, and the Sea Turtle Advisory Committee (STAC) throughout the application process. He stated that the “bulk of the stakeholder engagement [was] just as informal phone calls and in person meetings, mostly occurring with commercial stakeholders.” This state employee also felt that the STAC likely felt left out of the process, especially toward the end when NCDMF needed to make decisions that did not agree with the STAC’s input. The Duke Environmental Law and Policy Clinic employee I interviewed echoed the state employee’s thoughts regarding commercial fisher involvement throughout the process, stating that “they had...quite sufficient access to regulatory officials and lawmakers, just like any...important and powerful economic group in the state [would],” and that their “interests were well represented and well protected throughout [the ITP] process.” Commercial fishers, however, disagree. Commercial fishermen were able to have conversations with NCDMF and attend Marine Fisheries Commission meetings, but “they were on the outside looking in.” They did not have the input they would have loved to have, as NCDMF drafted the initial ITP and included what *they* wanted to see out of the permit and then just worked with NMFS to make adjustments until the permit was granted. The fishermen felt they were being told what they would have to do, as opposed to helping with the decision-making process. A federal employee that worked on the NC sea turtle ITP felt that

engaging with NCDMF was often difficult, as “they were fairly unorganized...[and] ended up submitting a lot of incomplete applications.” She believes the state had an unwillingness to include a substantial amount of mitigation and monitoring measures into their application, which resulted in a lot of back-and-forth that could have been avoided.

Another heavily discussed topic was communication between stakeholders throughout the ITP process. Most participants felt there were barriers to communication among the parties. An NC state employee felt that one major barrier to communication was the fact that NCDMF was the permit holder for the sea turtle ITP, but the commercial fishery carried out the activity. He noted that NMFS was in communication with NCDMF, not the fishery, so communication between parties did become difficult, especially when NCDMF had to make quick decisions with NMFS. Commercial fishers expressed a similar sentiment and felt that NCDMF could have been much more transparent with their decisions in each permit application. The STAC member described the whole ITP process as cumbersome and that “there was a lot of communication, but [it was a lot of] cross talk” and not a lot of actual communication about what stakeholders were thinking. State employees also noted that there was inconsistent information and guidance provided by federal employees at NMFS, and that responses often contradicted one another. To provide an example, the federal employee involved with the NC sea turtle ITP stated that:

“It's really helpful if the applicant has some idea of [the] actions they might take to minimize and monitor take before coming to the table, [they can come to] NMFS and say, ‘hey, I want an ITP but I have no idea how I would meet any of these requirements.’...we're happy to provide assistance to applicants...helping them understand what those requirements are, and educating them on what's involved in the process, so they can get their ducks in a row.”

However, another NC state employee shared that, when reaching out to NMFS for advice on how to analyze data for an ITP application, she was told, “we can't tell you how to analyze the data, we can only comment on it after [it] has [been] done.” While seeking advice on how data should be analyzed for an ITP application may be different than seeking general advice about the application process itself, the interaction between NMFS and the NC state employee seems to contradict what the federal employee shared with me about application assistance. The response this state employee received from NMFS does not appear to be application assistance and may make state employees wonder what communication can actually occur between them and the federal agency. In a different scenario, a state employee from outside NC, who is currently beginning an ITP application, agrees that communication with NMFS is difficult. He noted that NMFS responds to all inquiries and provides helpful information, but conversations feel contentious due to the subject matter of the ITP. He also felt that there was another major barrier to communication with the fishing industry, as it is difficult to explain the legal requirements of the ESA and why particular mitigation measures are chosen.

ITP implementation and the collection, reporting and use of scientific data came up frequently when participants were asked about ITP successes and failures. An NC state employee believes the successful implementation of the NC sea turtle ITP was a result of having adaptive management strategies built into the application. He noted that this management strategy has, for the most part, enabled the gillnet fishery to continue to operate with as few closures as possible. The Duke Environmental Law and Policy Clinic member felt that the ITP application was successful “based on the solid scientific and robust modeling [that was used to] extrapolate takes.” She felt that the NC sea turtle ITP fails in its implementation, as requirements in the ITP are not being properly followed or enforced. She specifically mentioned the failure of fishers to self-report takes when observers are not onboard and noted that this damages the collection of scientific data that should be helping us to better understand what is occurring in the fishery. The recreational fishermen and conservationists also expressed this same sentiment, claiming that it is quite obvious that commercial fishermen are not following the ITP’s reporting rules. The STAC member mentioned that he “still can’t figure out exactly how [NCDMF is] coming up with their [take] numbers. [He’s] never really figured out their reports” and believes there must be an easier, or more simplistic, way to present the data they are collecting.

Two state employees, one from NC and one from another state, also discussed the HCP Handbook, which is the guide used when writing an ITP application. The non-NC employee stated that the handbook is “very general and it doesn’t necessarily provide a great roadmap for specifically dealing with marine mammals.” He also noted that it does not provide examples for how to deal with migratory or transboundary animals. The NC state employee expressed that no handbook should be two-inches thick when printed, and that there must be ways to streamline the application process by providing something other than this massive handbook. She suggested that ITP training, or some type of webinar series, conducted by NMFS could potentially be useful tools to speed up the process and avoid confusion.

A final theme and topic of discussion that came up throughout interviews was the availability of resources and how that specifically contributed to an ITP applications time frame. Nearly all participants expressed that they feel the entire ITP application process is too long and could somehow be shortened. However, the federal employee did not believe the length of the process was too much of an ask. She noted that a lot of information must go into an application, in addition to rounds of public comment periods and ensuring compliance with the National Environmental Policy Act (NEPA). She believed that applicants need to recognize there are some aspects of the process that simply cannot be accelerated. State employees noted that they believe the process can be faster, but they also recognized that NMFS has a limited number of employees to review ITP applications, and the state has a limited number of employees to devote to the application. Many participants expressed that, unfortunately, an ITP application was a

huge resource draw, as employees had to be pulled away from their typical duties and projects for extended periods of time to assist with the ITP.

V. Discussion

The results of my project clearly demonstrate the need to revisit the application and implementation process for ITPs under NOAA's jurisdiction. Criticisms and perceived shortcomings of the process were evident in both the literature review and stakeholder interviews, and the case study analysis demonstrated that the process can be complicated and lengthy.

The lack of existing literature on marine-based ITPs suggests a limited knowledge base of the application and implementation process, and a lack of understanding regarding how effective these permits are in protecting ESA listed species. Previous attempts to analyze such permits are limited to the NCDMF sea turtle ITP case study, demonstrating the need for further research to gain a base understanding of more marine permits. It is also important to note that most of the literature I reviewed on terrestrial ITPs criticized the permits and suggested potential alternatives. These review articles noted that many HCPs were missing critical data on the status and presence of listed species in permitted areas. The ITP planning process, in the terrestrial realm, has been criticized since the 1990's but little has been changed in response to these critiques. The same process is being used for marine environments, but the process may not be entirely applicable to oceans and estuaries.

Interview participants expressed a variety of opinions regarding the process, indicating that there is no consensus on how this process could be improved. Applying for an ITP can be complicated with many stakeholders involved in the decision-making process, but the stakeholders who are being regulated must be brought to the table. In the case of the NCDMF sea turtle ITP, I believe that representatives of commercial fishermen should have been included in the communications between NMFS and NCDMF. This would have enabled fishermen to provide their input on suggested mitigation measures and reduced the clarifications required when NCDMF attempted to pass information along to the fishermen. Additionally, if the commercial fishermen felt that their input was being valued and considered they may have been more likely to comply with the final mitigation measures, such as self-reporting sea turtle interactions. This may not be true for all fishermen, as many may still be reluctant to self-report, but it could help to encourage a few. Conflict amongst stakeholders, especially when dealing with a complex process, often leads to a lack of participation further down the road. To prevent this phenomenon, and thereby increase the potential for stakeholders to comply with implemented ITP guidelines, required stakeholder engagement meetings should be added to the application process. A required meeting prior to an ITP application submission where selected representatives from each stakeholder group can meet

to discuss what it being submitted may help reduce conflict. While some may think that a required meeting would lengthen the process, it may actually have the potential to shorten it. If stakeholders know, understand, and have the opportunity to discuss what is present in an application package it may result in fewer public comments that must be reviewed, or prevent comments that would require another revised application. It would also provide an opportunity for aspects of the application to be discussed with all stakeholders, and adjusted if need be, prior to submitting the application, which could once again prevent the need for an additional revised application down the road.

In addition to determining how all stakeholders can be thoughtfully engaged, the ITP application process could be improved by revising the HCP Handbook. The handbook was last revised in 2016, but it is incredibly long and is not particularly applicable to marine species. It should either be revised and shortened and provide marine based examples, or a new handbook should be created to detail the process specifically for NMFS. Variation should be allowed within the process between terrestrial and marine based ITPs, as management strategies are different in the two environments. In particular, it is often difficult to generate accurate stock assessments for marine species, which can complicate how takes should be allocated. Revising or creating a new handbook may also help to improve the length of the application process. If the directions are more succinct, and the examples more concrete and applicable, there will likely be fewer questions from the applicant. This will help them to put together an acceptable application with fewer revisions and will thereby save time and resources for federal employees and the applicant. An ITP application seminar, run by NMFS once or twice a year, could also help to alleviate confusion about the process. A seminar may also encourage more entities to apply for an ITP, as the resources to understand the process would be more readily available and straight forward.

There are only nine active ITPs currently under NOAA's jurisdiction, so many activities that result in the take of listed marine species are not legally authorized to do so. Many entities are hesitant to apply for an ITP, due to the complicated and lengthy application process, even though they are aware that they are violating the ESA. If the application process was not as difficult, more entities may be willing to apply, even if they are not threatened by legal action. This will help to protect listed species, and result in further scientific data collection for these species. Ensuring compliance with the ESA is necessary to provide the best protections possible for endangered and threatened species. Management agencies should make it a priority to address the shortcomings in this ESA process identified in this review.

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VIII. Appendices

Appendix A: List of established interview questions each participant responded to.

1. What is your current profession/job title? Can you please provide a brief description of what your work generally entails on a day-to-day basis?
2. In your own words, what do you believe is the purpose of an incidental take permit?
3. Which incidental take permit(s) have you been involved in? Can you please explain how and why you were involved?
4. During your involvement, did you engage with any other stakeholders? If yes, how and with who?
5. Do you think there were any barriers to communication during the process? Do you think any stakeholders were too involved, or not involved enough?
6. How do you think successful incidental take permit implementation should be defined?
7. Do you believe the incidental take permit you have been involved with is successful? Why or why not?
8. If you believe the incidental take permit has been successful, what do you think made it so? If you think the process and permit were unsuccessful, why?
9. Do you think there are ways in which the incidental take permit process can be improved? If yes, what are they?
10. Are there any other thoughts regarding the incidental take permit process that you would like to share today?

(i) *Completion time.* The Federal agency or the designated non-Federal representative shall complete the biological assessment within 180 days after its initiation (receipt of or concurrence with the species list) unless a different period of time is agreed to by the Director and the Federal agency. If a permit or license applicant is involved, the 180-day period may not be extended unless the agency provides the applicant, before the close of the 180-day period, with a written statement setting forth the estimated length of the proposed extension and the reasons why such an extension is necessary.

(j) *Submission of biological assessment.* The Federal agency shall submit the completed biological assessment to the Director for review. The Director will respond in writing within 30 days as to whether or not he concurs with the findings of the biological assessment. At the option of the Federal agency, formal consultation may be initiated under § 402.14(c) concurrently with the submission of the assessment.

(k) *Use of the biological assessment.* (1) The Federal agency shall use the biological assessment in determining whether formal consultation or a conference is required under § 402.14 or § 402.10, respectively. If the biological assessment indicates that there are no listed species or critical habitat present that are likely to be adversely affected by the action and the Director concurs as specified in paragraph (j) of this section, then formal consultation is not required. If the biological assessment indicates that the action is not likely to jeopardize the continued existence of proposed species or result in the destruction or adverse modification of proposed critical habitat, and the Director concurs, then a conference is not required.

(2) The Director may use the results of the biological assessment in (i) determining whether to request the Federal agency to initiate formal consultation or a conference, (ii) formulating a biological opinion, or (iii) formulating a preliminary biological opinion.

§ 402.13 Informal consultation.

(a) Informal consultation is an optional process that includes all discus-

sions, correspondence, etc., between the Service and the Federal agency or the designated non-Federal representative, designed to assist the Federal agency in determining whether formal consultation or a conference is required. If during informal consultation it is determined by the Federal agency, with the written concurrence of the Service, that the action is not likely to adversely affect listed species or critical habitat, the consultation process is terminated, and no further action is necessary.

(b) During informal consultation, the Service may suggest modifications to the action that the Federal agency and any applicant could implement to avoid the likelihood of adverse effects to listed species or critical habitat.

§ 402.14 Formal consultation.

(a) *Requirement for formal consultation.* Each Federal agency shall review its actions at the earliest possible time to determine whether any action may affect listed species or critical habitat. If such a determination is made, formal consultation is required, except as noted in paragraph (b) of this section. The Director may request a Federal agency to enter into consultation if he identifies any action of that agency that may affect listed species or critical habitat and for which there has been no consultation. When such a request is made, the Director shall forward to the Federal agency a written explanation of the basis for the request.

(b) *Exceptions.* (1) A Federal agency need not initiate formal consultation if, as a result of the preparation of a biological assessment under § 402.12 or as a result of informal consultation with the Service under § 402.13, the Federal agency determines, with the written concurrence of the Director, that the proposed action is not likely to adversely affect any listed species or critical habitat.

(2) A Federal agency need not initiate formal consultation if a preliminary biological opinion, issued after early consultation under § 402.11, is confirmed as the final biological opinion.

(c) *Initiation of formal consultation.* A written request to initiate formal consultation shall be submitted to the Director and shall include:

- (1) A description of the action to be considered;
- (2) A description of the specific area that may be affected by the action;
- (3) A description of any listed species or critical habitat that may be affected by the action;
- (4) A description of the manner in which the action may affect any listed species or critical habitat and an analysis of any cumulative effects;
- (5) Relevant reports, including any environmental impact statement, environmental assessment, or biological assessment prepared; and
- (6) Any other relevant available information on the action, the affected listed species, or critical habitat.

Formal consultation shall not be initiated by the Federal agency until any required biological assessment has been completed and submitted to the Director in accordance with § 402.12. Any request for formal consultation may encompass, subject to the approval of the Director, a number of similar individual actions within a given geographical area or a segment of a comprehensive plan. This does not relieve the Federal agency of the requirements for considering the effects of the action as a whole.

(d) *Responsibility to provide best scientific and commercial data available.* The Federal agency requesting formal consultation shall provide the Service with the best scientific and commercial data available or which can be obtained during the consultation for an adequate review of the effects that an action may have upon listed species or critical habitat. This information may include the results of studies or surveys conducted by the Federal agency or the designated non-Federal representative. The Federal agency shall provide any applicant with the opportunity to submit information for consideration during the consultation.

(e) *Duration and extension of formal consultation.* Formal consultation concludes within 90 days after its initiation unless extended as provided below. If an applicant is not involved, the Service and the Federal agency

may mutually agree to extend the consultation for a specific time period. If an applicant is involved, the Service and the Federal agency may mutually agree to extend the consultation provided that the Service submits to the applicant, before the close of the 90 days, a written statement setting forth:

- (1) The reasons why a longer period is required,
- (2) The information that is required to complete the consultation, and
- (3) The estimated date on which the consultation will be completed.

A consultation involving an applicant cannot be extended for more than 60 days without the consent of the applicant. Within 45 days after concluding formal consultation, the Service shall deliver a biological opinion to the Federal agency and any applicant.

(f) *Additional data.* When the Service determines that additional data would provide a better information base from which to formulate a biological opinion, the Director may request an extension of formal consultation and request that the Federal agency obtain additional data to determine how or to what extent the action may affect listed species or critical habitat. If formal consultation is extended by mutual agreement according to § 402.14(e), the Federal agency shall obtain, to the extent practicable, that data which can be developed within the scope of the extension. The responsibility for conducting and funding any studies belongs to the Federal agency and the applicant, not the Service. The Service's request for additional data is not to be construed as the Service's opinion that the Federal agency has failed to satisfy the information standard of section 7(a)(2) of the Act. If no extension of formal consultation is agreed to, the Director will issue a biological opinion using the best scientific and commercial data available.

(g) *Service responsibilities.* Service responsibilities during formal consultation are as follows:

- (1) Review all relevant information provided by the Federal agency or otherwise available. Such review may include an on-site inspection of the action area with representatives of the Federal agency and the applicant.

(2) Evaluate the current status of the listed species or critical habitat.

(3) Evaluate the effects of the action and cumulative effects on the listed species or critical habitat.

(4) Formulate its biological opinion as to whether the action, taken together with cumulative effects, is likely to jeopardize the continued existence of listed species or result in the destruction or adverse modification of critical habitat.

(5) Discuss with the Federal agency and any applicant the Service's review and evaluation conducted under paragraphs (g)(1) through (3) of this section, the basis for any finding in the biological opinion, and the availability of reasonable and prudent alternatives (if a jeopardy opinion is to be issued) that the agency and the applicant can take to avoid violation of section 7(a)(2). The Service will utilize the expertise of the Federal agency and any applicant in identifying these alternatives. If requested, the Service shall make available to the Federal agency the draft biological opinion for the purpose of analyzing the reasonable and prudent alternatives. The 45-day period in which the biological opinion must be delivered will not be suspended unless the Federal agency secures the written consent of the applicant to an extension to a specific date. The applicant may request a copy of the draft opinion from the Federal agency. All comments on the draft biological opinion must be submitted to the Service through the Federal agency, although the applicant may send a copy of its comments directly to the Service. The Service will not issue its biological opinion prior to the 45-day or extended deadline while the draft is under review by the Federal agency. However, if the Federal agency submits comments to the Service regarding the draft biological opinion within 10 days of the deadline for issuing the opinion, the Service is entitled to an automatic 10-day extension on the deadline.

(6) Formulate discretionary conservation recommendations, if any, which will assist the Federal agency in reducing or eliminating the impacts that its proposed action may have on listed species or critical habitat.

(7) Formulate a statement concerning incidental take, if such take may occur.

(8) In formulating its biological opinion, any reasonable and prudent alternatives, and any reasonable and prudent measures, the Service will use the best scientific and commercial data available and will give appropriate consideration to any beneficial actions taken by the Federal agency or applicant, including any actions taken prior to the initiation of consultation.

(h) *Biological opinions.* The biological opinion shall include:

(1) A summary of the information on which the opinion is based;

(2) A detailed discussion of the effects of the action on listed species or critical habitat; and

(3) The Service's opinion on whether the action is likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of critical habitat (a "jeopardy biological opinion"); or, the action is not likely to jeopardize the continued existence of a listed species or result in the destruction or adverse modification of critical habitat (a "no jeopardy" biological opinion). A "jeopardy" biological opinion shall include reasonable and prudent alternatives, if any. If the Service is unable to develop such alternatives, it will indicate that to the best of its knowledge there are no reasonable and prudent alternatives.

(i) *Incidental take.* (1) In those cases where the Service concludes that an action (or the implementation of any reasonable and prudent alternatives) and the resultant incidental take of listed species will not violate section 7(a)(2), and, in the case of marine mammals, where the taking is authorized pursuant to section 101(a)(5) of the Marine Mammal Protection Act of 1972, the Service will provide with the biological opinion a statement concerning incidental take that:

(i) Specifies the impact, i.e., the amount or extent, of such incidental taking on the species;

(ii) Specifies those reasonable and prudent measures that the Director considers necessary or appropriate to minimize such impact;

(iii) In the case of marine mammals, specifies those measures that are necessary to comply with section 101(a)(5) of the Marine Mammal Protection Act of 1972 and applicable regulations with regard to such taking;

(iv) Sets forth the terms and conditions (including, but not limited to, reporting requirements) that must be complied with by the Federal agency or any applicant to implement the measures specified under paragraphs (i)(1)(ii) and (i)(1)(iii) of this section; and

(v) Specifies the procedures to be used to handle or dispose of any individuals of a species actually taken.

(2) Reasonable and prudent measures, along with the terms and conditions that implement them, cannot alter the basic design, location, scope, duration, or timing of the action and may involve only minor changes.

(3) In order to monitor the impacts of incidental take, the Federal agency or any applicant must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement. The reporting requirements will be established in accordance with 50 CFR 13.45 and 18.27 for FWS and 50 CFR 220.45 and 228.5 for NMFS.

(4) If during the course of the action the amount or extent of incidental taking, as specified under paragraph (i)(1)(i) of this Section, is exceeded, the Federal agency must reinstate consultation immediately.

(5) Any taking which is subject to a statement as specified in paragraph (i)(1) of this section and which is in compliance with the terms and conditions of that statement is not a prohibited taking under the Act, and no other authorization or permit under the Act is required.

(j) *Conservation recommendations.* The Service may provide with the biological opinion a statement containing discretionary conservation recommendations. Conservation recommendations are advisory and are not intended to carry any binding legal force.

(k) *Incremental steps.* When the action is authorized by a statute that allows the agency to take incremental steps toward the completion of the action, the Service shall, if requested by the

Federal agency, issue a biological opinion on the incremental step being considered, including its views on the entire action. Upon the issuance of such a biological opinion, the Federal agency may proceed with or authorize the incremental steps of the action if:

(1) The biological opinion does not conclude that the incremental step would violate section 7(a)(2);

(2) The Federal agency continues consultation with respect to the entire action and obtains biological opinions, as required, for each incremental step;

(3) The Federal agency fulfills its continuing obligation to obtain sufficient data upon which to base the final biological opinion on the entire action;

(4) The incremental step does not violate section 7(d) of the Act concerning irreversible or irretrievable commitment of resources; and

(5) There is a reasonable likelihood that the entire action will not violate section 7(a)(2) of the Act.

(1) *Termination of consultation.* (1) Formal consultation is terminated with the issuance of the biological opinion.

(2) If during any stage of consultation a Federal agency determines that its proposed action is not likely to occur, the consultation may be terminated by written notice to the Service.

(3) If during any stage of consultation a Federal agency determines, with the concurrence of the Director, that its proposed action is not likely to adversely affect any listed species or critical habitat, the consultation is terminated.

[51 FR 19957, June 3, 1986, as amended at 54 FR 40350, Sept. 29, 1989]

§ 402.15 Responsibilities of Federal agency following issuance of a biological opinion.

(a) Following the issuance of a biological opinion, the Federal agency shall determine whether and in what manner to proceed with the action in light of its section 7 obligations and the Service's biological opinion.

(b) If a jeopardy biological opinion is issued, the Federal agency shall notify the Service of its final decision on the action.

VI. Conclusion

Storch was one of the most infamous jailhouse informants in Los Angeles history. In particular, as confirmed by Kryniak's and Markus's testimony, Storch had a propensity to go after high profile cases. The "Skid Row Stabber" case would have been just such a case, and Storch's testimony at Maxwell's trial is a textbook example of the "booking" method that Storch helped make famous. Based on the evidence brought to light during the lengthy evidentiary hearing, we conclude that the state court's finding that Storch did not give false testimony was an unreasonable determination of the facts in light of the evidence. We further conclude that there is a reasonable probability that this false testimony affected the jury's verdict. Because the State convicted Maxwell on the basis of false and material evidence in violation of his due process rights, we direct the district court to grant Maxwell habeas relief on this claim. We further conclude that the prosecution withheld material evidence in violation of *Brady*.

We reverse the district court's judgment and remand with directions to grant a writ of habeas corpus directing the state to provide Maxwell with a new trial in a reasonable amount of time or to release him.

REVERSED AND REMANDED.



WILD FISH CONSERVANCY,
Plaintiff–Appellant,

v.

Kenneth L. SALAZAR, in his official capacity as Secretary of the Interior; United States Fish and Wildlife Service; Rowan W. Gould, in his official capacity as Acting Director of the United States Fish & Wildlife Service; Julie Collins, in her official capacity as Complex Manager for the Leavenworth National Fish Hatchery Complex, Defendants–Appellees.

No. 09–35531.

United States Court of Appeals,
Ninth Circuit.

Argued and Submitted March 4, 2010.

Filed Dec. 7, 2010.

Background: Non-profit environmental organization brought action challenging the operation of fish hatchery, specifically alleging that Fish and Wildlife Service (FWS) had improperly determined that hatchery's newly adopted operation and management plan would not jeopardize threatened bull trout. The United States District Court for the Eastern District of Washington, Lonny R. Suko, Chief Judge, 613 F.Supp.2d 1209, granted summary judgment for defendants. Plaintiff appealed.

Holdings: The Court of Appeals, Berzon, Circuit Judge, held that:

- (1) decision to limit analysis in biological opinion to five-year term of operations and management of hatchery was arbitrary and capricious;
- (2) FWS failed to articulate rational connection between facts found and conclusions made;

- (3) biological opinion on bull trout adequately had considered effects of pollution runoff from abatement pond;
- (4) FWS reasonably did not attribute take of bull trout by tribal anglers in Icicle Creek to salmon hatchery;
- (5) incidental take statement that lacked adequate monitoring and reporting requirements to establish meaningful trigger for renewed consultation after take exceeded authorized levels was arbitrary and capricious; and
- (6) hatchery violated its substantive duty under ESA to ensure that its operations and maintenance did not jeopardize continued existence of bull trout.

Reversed and remanded.

Fisher, Circuit Judge, filed opinion concurring in part and dissenting in part.

1. Environmental Law ⚖️537

Under the ESA, the duty to consult applies to ongoing agency actions, which exists if the action comes within the agency's decisionmaking authority and remains so, as well as future actions. Endangered Species Act of 1973, § 7(a)(2), 16 U.S.C.A. § 1536(a)(2).

2. Environmental Law ⚖️537

The jeopardy regulation under the ESA requires the consulting agency to consider both recovery and survival impacts. Endangered Species Act of 1973, § 7(a)(2), 16 U.S.C.A. § 1536(a)(2); 50 C.F.R. § 402.14(g).

3. Environmental Law ⚖️537

Salmon hatchery project was obligated under ESA to consult with United States Fish and Wildlife Service (FWS) to ensure that its operations were not jeopardizing continued existence of bull trout, and also for authorization of any incidental takings, once that species was listed as threatened. Endangered Species Act of

1973, § 7(a)(2), 16 U.S.C.A. § 1536(a)(2); 50 C.F.R. § 402.14(g).

4. Environmental Law ⚖️537

Fish and Wildlife Service (FWS) was required to issue comprehensive biological opinion taking long view of effects of salmon hatchery on bull trout, or to explain adequately why any such effort would have been unproductive when assessing long-term impact of hatchery's operations on bull trout, and therefore decision to limit analysis in biological opinion to five-year term of operations and management of hatchery was arbitrary and capricious with regard to agency action of operation and maintenance of hatchery, particularly given 70 year existence of hatchery and absence of any indication that it might close down altogether in foreseeable future. Endangered Species Act of 1973, § 7(a)(2), 16 U.S.C.A. § 1536(a)(2); 50 C.F.R. §§ 402.02, 402.14(g).

5. Environmental Law ⚖️537

Under the ESA, agency action can "jeopardize" the existence of a species only if that agency action causes some deterioration in the species' preaction condition; in other words, an agency jeopardizes a species only if it causes some new jeopardy. Endangered Species Act of 1973, § 7(a)(2), 16 U.S.C.A. § 1536(a)(2); 50 C.F.R. § 402.14(g).

6. Environmental Law ⚖️537

Conclusion by United States Fish and Wildlife Service (FWS), that action of maintenance and operation of salmon hatchery was "not likely to change the current distribution and abundance of the bull trout in the action area," was arbitrary and capricious for failure to articulate rational connection between facts found and conclusions made, even if action could have been defined by five-year period, where FWS had found that action

would “at least reduce, and in some years preclude” migratory bull trout spawning and that the local bull trout population would continue to decline. Endangered Species Act of 1973, § 7(a)(2), 16 U.S.C.A. § 1536(a)(2); 50 C.F.R. § 402.02.

7. Environmental Law ⚖️537

Biological opinion on bull trout adequately had considered effects of pollution runoff from abatement pond with regard to operation and management of salmon hatchery, where United States Fish and Wildlife Service (FWS) in section entitled “Release of Effluent into Icicle Creek” had described operation of pollution abatement pond and noted that it was last cleaned one year previously and concluded that “hatchery effluent release into Icicle Creek is unlikely to cause adverse effects to the bull trout” and there was no indication that runoff issue was important aspect of jeopardy determination. Endangered Species Act of 1973, § 7(a)(2), 16 U.S.C.A. § 1536(a)(2); 50 C.F.R. § 402.02.

8. Environmental Law ⚖️537

In context of “incidental take statement” issued with biological opinion as part of consultation with United States Fish and Wildlife Service (FWS) under ESA, FWS reasonably did not attribute take of bull trout by tribal anglers in Icicle Creek to salmon hatchery, since tribal fishing rights in Icicle Creek had been guaranteed by treaties and other agreements; although hatchery’s operations likely did increase numbers of bull trout lingering in spillway pool, take of bull trout by tribal anglers was exempt from ESA wherever it occurred, as long as tribal regulations were followed, and holding hatchery responsible for take by tribal anglers would have been incongruent with special rule exempting tribal fishing from ESA’s take prohibition. Endangered Species Act of 1973, § 7(b)(4), 16 U.S.C.A. § 1536(b)(4); 50 C.F.R. § 402.14(i).

9. Environmental Law ⚖️537

Incidental take statement in biological opinion issued by United States Fish and Wildlife Service (FWS) on bull trout that set clear numerical cap, but lacked adequate monitoring and reporting requirements to establish meaningful trigger for renewed consultation after take exceeded authorized levels, was arbitrary and capricious under ESA, since FWS was responsible for specifying in statement how action agency was to monitor and report effects of action on listed species. Endangered Species Act of 1973, § 7(b)(4), 16 U.S.C.A. § 1536(b)(4); 50 C.F.R. § 402.14(i).

10. Environmental Law ⚖️537

Under the ESA, incidental take statements set forth a “trigger” that, when reached, results in an unacceptable level of incidental take, invalidating the safe harbor provision, and requiring the parties to re-initiate consultation; preferably, the trigger is numerical, but a surrogate may be used, such as changes in ecological conditions affecting the species, but if a surrogate is used, the agency must articulate a rational connection between the surrogate and the taking of the species. Endangered Species Act of 1973, § 7(b)(4), 16 U.S.C.A. § 1536(b)(4); 50 C.F.R. § 402.14(i)(3).

11. Environmental Law ⚖️537

Salmon hatchery, as action agency that requested biological opinion on bull trout with regard to its operation and maintenance of hatchery over five year period of time, violated its substantive duty under ESA to ensure that its operations and maintenance did not jeopardize continued existence of bull trout by relying on legally flawed biological opinion from United States Fish and Wildlife Service (FWS). Endangered Species Act of 1973, § 7(a)(2), 16 U.S.C.A. § 1536(a)(2).

12. Environmental Law ⚡537

An agency's reliance on a biological opinion based on "admittedly weak" information satisfies its ESA obligations as long as the challenging party can point to no new information undercutting the opinion's conclusions; however, where the opinion's flaws are legal in nature, discerning them requires no technical or scientific expertise, and the failure to do so may result in an action based on reasoning not in accordance with law, and thus arbitrary and capricious. Endangered Species Act of 1973, § 7(b)(4), 16 U.S.C.A. § 1536(b)(4).

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John C. Cruden, Acting Assistant Attorney General, Thekla Hansen-Young, Ellen Durkee, J. Brett Grosko, and David C. Shilton, Attorneys, Environment & Natural Resources Division, Department of Justice, Washington, DC, Nolan Shishido, of Counsel, Office of Regional Solicitor, Department of the Interior, for the defendants-appellees.

Appeal from the United States District Court for the Eastern District of Washington, Lonny R. Suko, Chief District Judge, Presiding. D.C. No. 2:05-cv-00181-LRS.

Before: A. WALLACE TASHIMA,
RAYMOND C. FISHER and MARSHA S.
BERZON, Circuit Judges.

Opinion by Judge BERZON; Partial
Concurrence and Partial Dissent by Judge
FISHER.

OPINION

BERZON, Circuit Judge:

We are faced once again with the far-reaching effects of federal hydroelectric projects in the Columbia River Basin on the region's native fish species. *See, e.g., Nat'l Wildlife Fed'n v. Nat'l Marine Fisheries Serv.*, 524 F.3d 917 (9th Cir.2008); *Nw. Res. Info. Ctr., Inc. v. Nw. Power Planning Council*, 35 F.3d 1371 (9th Cir. 1994). The fish at the heart of this particular controversy is not salmon, as in most of the earlier cases, and the potential threat to its survival and recovery is not a hydroelectric dam but a hatchery project intended to mitigate a dam's impact.

This action, brought by the Wild Fish Conservancy ("the Conservancy"), centers on a biological opinion ("BiOp") addressing the effects of the operations of the Leavenworth National Fish Hatchery ("the Hatchery") on the bull trout. *See* U.S. Fish & Wildlife Serv., Biological Opinion for the Operation and Maintenance of the Leavenworth National Fish Hatchery Through 2011 (2008) [hereinafter "2008 BiOp"]. The bull trout is listed under the Endangered Species Act ("ESA"), 16 U.S.C. §§ 1531–44, as threatened throughout its range. *See* Determination of Threatened Status for Bull Trout in the Coterminous United States, 64 Fed.Reg. 58,910 (Nov. 1, 1999). The 2008 BiOp, prepared by the U.S. Fish and Wildlife Service ("the Service"), concluded that the Hatchery's operations from 2006 to 2011 were not likely to jeopardize the continued existence of the bull trout. Because the Service in several respects failed to articulate a rational connection between the facts found and the "no jeopardy" conclusion, we reverse and remand.

I.

A.

In 1938, Congress authorized the establishment of several salmon hatcheries to

replace spawning grounds in the upper Columbia River made inaccessible by the completion of the Grand Coulee Dam, which blocks fish migration. *See* Mitchell Act, ch. 193, 52 Stat. 345 (1938); 83 Cong. Rec. H6075 (May 2, 1938) (statement of Rep. Rich). The Leavenworth National Fish Hatchery was built on Icicle Creek, just south of Leavenworth, Washington, beginning in 1939. Although funding responsibility for the Hatchery has shifted among federal agencies and now rests with the Bureau of Reclamation, the Service has managed and operated the Hatchery continuously since its construction. Currently, the Hatchery operates as a single-species facility, rearing only spring-run Chinook salmon.¹ Initially, salmon were trapped in the Columbia River and hauled to the Hatchery to spawn. The Hatchery no longer imports salmon into Icicle Creek, relying entirely on returning adult salmon to meet its production targets.

Unfortunately, and somewhat ironically, the Hatchery itself blocks fish passage in Icicle Creek (the “Creek”). When the Hatchery was constructed, a canal was built alongside the Creek; the Creek’s natural channel is now called the “historic channel.” The canal culminates in a concrete spillway; fish can travel downstream over the spillway but not upstream. Fish whose upstream passage is blocked by the spillway gather in a deep pool at its base (the “spillway pool”), and from there the returning salmon, as well as the occasional interloper, ascend a fish ladder to the Hatchery’s holding ponds. Adult salmon in the holding ponds are killed and the females’ eggs removed and incubated. The offspring are reared in the holding

ponds and eventually released into Icicle Creek.

Unimpeded, the Creek’s historic channel would allow fish to circumvent the spillway and swim upstream. Passage through the historic channel is blocked, however, at the two points at which the historic channel meets the canal: At the top of the historic channel, radial gates, known as “dam 2,” divert water from the historic channel to the canal, and, when closed, also block fish passage through the historic channel. At the bottom, a weir, or fence, known as “dam 5,” prevents fish from entering the historic channel; boards can be removed from the weir to allow fish passage.

How does this configuration affect bull trout, the species with which we are concerned? Here’s how:

Bull trout exhibit either resident or migratory behavior. Resident bull trout live out their lives in the streams in which they were spawned. They are significantly smaller than migratory bull trout, measuring only six to twelve inches at maturity, and produce fewer eggs. Migratory bull trout, in contrast, migrate as juveniles to larger bodies of water and return to their hatching place to spawn. They regularly reach twenty-four inches or more. Both resident and migratory bull trout can produce offspring that exhibit either resident or migratory behavior.

The Hatchery’s barriers have seriously disrupted the migratory trout’s migration and spawning activity. Between 1940 and 2001, migratory bull trout that hatched in the tributaries upstream of the Hatchery were able to migrate downstream over the Hatchery’s spillway but were blocked entirely from returning upstream to spawn.

1. Although naturally spawned spring-run Chinook salmon in the upper Columbia River as well as some artificially propagated stocks are listed as endangered or threatened under the ESA, the Hatchery population is excluded

from the listing because it is significantly divergent from the local natural populations. *See* Final Listing Determinations for 16 ESUs of West Coast Salmon, 70 Fed.Reg. 37,160, 37,175 (June 28, 2005).

Beginning in 2001, the Hatchery started adjusting its dams sporadically to allow occasional upstream fish passage for short periods of time. It also completed an environmental impact statement on a proposed habitat restoration project, a project that would include modifying dams 2 and 5 to allow for increased fish passage. That project has been delayed, however, and, according to the government, “is likely to take some time to implement.”

Starting in 2006, after the Conservancy initiated this litigation, the Hatchery implemented two main measures to facilitate upstream passage for bull trout and other native fish. First, it began opening dams 2 and 5 at least partway for about ten months out of the year; passage remains blocked from approximately May 15 to July 7, during the salmon collection period. It also plans to use adaptive management approaches to open the dams early if enough salmon have been collected. Second, the Hatchery installed a trap near the fish ladder for the purpose of collecting bull trout and releasing them above the dams; any bull trout found in the salmon holding ponds will also be transported upstream.

B.

[1] Section 7(a)(2) of the ESA requires federal agencies to consult with either the Fish and Wildlife Service or the National Marine Fisheries Service to “insure that any action authorized, funded, or carried out by [the] agency . . . is not likely to jeopardize the continued existence of any endangered species or threatened species.” 16 U.S.C. § 1536(a)(2). The duty to consult applies to “ongoing agency action[s],” *Pac. Rivers Council v. Thomas*, 30 F.3d 1050, 1053 (9th Cir.1994), as well as future actions. An “ongoing agency action” exists if the action “comes within the agency’s decisionmaking authority and remains

so.” *W. Watersheds Project v. Matejko*, 468 F.3d 1099, 1109 (9th Cir.2006) (internal quotation omitted).

[2] Formal section 7 consultation begins when the “action agency” (here, the Service in its capacity as the operator of the Hatchery) transmits a written request to the “consulting agency” (here, the Service in its consulting capacity). *See* 50 C.F.R. § 402.14(c); *Salmon Spawning & Recovery Alliance v. Gutierrez*, 545 F.3d 1220, 1223 (9th Cir.2008). The consulting agency then issues a biological opinion evaluating the “current status of the listed species” and the “effects of the action and cumulative effects on the listed species,” and offering a conclusion “as to whether the action, taken together with cumulative effects, is likely to jeopardize the continued existence of listed species.” 50 C.F.R. § 402.14(g). To “jeopardize the continued existence” of a species is to “engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species.” *Id.* § 402.02. “[T]he jeopardy regulation requires [the Service] to consider both recovery and survival impacts.” *Nat’l Wildlife Fed’n*, 524 F.3d at 931.

Aside from making a jeopardy determination, the consulting agency must also consider whether the action will implicate another ESA provision, the general prohibition on “tak[ing]” of endangered species. ESA § 9, 16 U.S.C. § 1538. The ESA defines “take” as “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.” 16 U.S.C. § 1532(19). As authorized by ESA section 4(d), 16 U.S.C. § 1533(d), the Service has issued regulations extending the take prohibition to threatened species, with certain excep-

tions. *See* 50 C.F.R. § 17.31. The take prohibition applies generally to bull trout in Washington, although fishing activities authorized under state, federal, or tribal laws and regulations are exempted. *See id.* § 17.44(w).

If the consulting agency concludes that an action is likely to jeopardize a listed species, it must recommend any “reasonable and prudent alternatives” that will avoid jeopardy. 16 U.S.C. § 1536(b)(3)(A); 50 C.F.R. § 402.14(h)(3). Also, if the consulting agency concludes that the action will not jeopardize the continued existence of a listed species but is likely to result in incidental takings, then it must issue an “incidental take statement” with the biological opinion. 16 U.S.C. § 1536(b)(4); 50 C.F.R. § 402.14(i). An incidental take statement exempts a specified number of incidental takings from the take prohibition of section 9.

[3] Given this statutory structure, once the bull trout was listed as threatened, the Hatchery was obligated to consult with the Service to ensure that its operations were not jeopardizing the continued existence of the species, and also for authorization of any incidental takings. *See Pac. Rivers Council*, 30 F.3d at 1053. In its request for consultation, the Hatchery defined the agency action as the operation and maintenance of the Hatchery from 2006 through 2011. According to the 2008 BiOp, the Hatchery selected a five-year period because it planned two modifications to Hatchery operations during and soon after that period that would require it to reinitiate formal consultation: (1) replacement of the water intake system, expected to be completed by 2010, and (2) the habitat

restoration project, projected to begin in 2013.²

As to the Service’s scheme for evaluating the impact of an action on the survival and recovery of the bull trout, the Service recognizes five bull trout population segments, which it terms “interim recovery units.” Each unit contains several local populations, grouped into geographic “core areas.” The Icicle Creek bull trout population is one of seven local populations in the Wenatchee River core area. This core area, in turn, is part of the Columbia River interim recovery unit, which contains about 90 core areas and 500 local populations, making it the largest by far of the five recovery units. The Service conducts its jeopardy determinations for the bull trout at the interim recovery unit level. *See Determination of Threatened Status for Bull Trout*, 64 Fed.Reg. at 58,930.

The 2008 BiOp found that the Icicle Creek bull trout population “has been and remains in decline.” 2008 BiOp at 49. As the 2008 BiOp explained, for most of the time since 1940, all reproduction in the Icicle Creek bull trout population has depended on the smaller, less fecund resident bull trout that live out their lives upstream of the Hatchery, because the Hatchery structures have prevented migratory bull trout from returning upstream to spawn. *See id.* at 31–32. There is no spawning habitat downstream of the Hatchery, and migratory bull trout attempting unsuccessfully to return upstream do not appear to spawn elsewhere once their progress has been impeded. *See id.* at 40, 48.

Since 2002, very small numbers of adult migratory bull trout have occasionally been observed upstream of the Hatchery

2. The Service filed a 28(j) letter with this court on February 18, 2010, reporting that the replacement of the water intake system had been delayed as a result of engineering

difficulties; the Service now anticipates issuing a new biological opinion “before the close of 2011 at the latest.”

in Icicle Creek, suggesting that at least a few bull trout have been able to pass through the Hatchery dams during the periods they have been open. *See id.* at 43. The 2008 BiOp identifies several factors, however, that likely limit the effectiveness of the 2006–2011 operations and management in providing upstream fish passage: First, the approximately two-month period during which the dams are closed for salmon collection largely coincides with the period during which bull trout attempt to migrate upstream. *See id.* at 45–47. Second, although the bull trout migration period may extend somewhat beyond the salmon collection period, migrating bull trout successful in traversing the historic channel face additional hurdles before they can reach the spawning habitat farther upstream. Most notably, another Hatchery structure, the intake dam, as well as a group of boulders, is in the way. *See id.* at 55–56. Although the intake dam is equipped with a fish ladder, the ladder location is “suboptimal.”³ *Id.* at 55. The boulders, and possibly the intake dam, are passable only during high flows, which typically occur in late spring and early summer. *See id.* at 56. Beginning in July, flow decreases and the boulder area becomes a barrier. The salmon collection period is scheduled to end on July 7 but may be extended for up to two weeks depending on salmon numbers. *See id.* at 10. Thus, in normal years, there is only a brief window during which migratory bull trout can pass the Hatchery structures and the boulders to spawn upstream, and in some years there may be no window at all.⁴ *See id.* at 69.

3. The water intake system also presents a hazard to bull trout because it is inadequately screened. *See id.* at 79.

4. Even if migratory bull trout are able to reach the spawning habitat, they will be able to spawn only if they can find a mate. Although migratory females can mate with resi-

Finally, the Hatchery’s efforts to remove migratory bull trout from the spillway pool and salmon holding ponds and transport them upstream have not been successful. *See id.* at 72–73. Bull trout appear to avoid the fish trap and the salmon ladder. *See id.*

As a result of these factors, the Service expects “long-term negative [population] trends [within Icicle Creek] . . . to continue.” *Id.* at 85. The 2008 BiOp found that “in the short-term the risk of extirpation for the Icicle Creek population is moderately low. . . . [I]n the long-term that risk is higher, although not as high as it was before formal [operations and maintenance] changes were made at the [Hatchery] in 2006.” *Id.* at 50. Despite the continued negative population trend for bull trout in Icicle Creek, the 2008 BiOp concluded that “the effect of improved upstream passage conditions caused by the proposed action . . . when added to the environmental baseline should improve, albeit in only a small way, the contribution of the Icicle Creek local population to the survival of the bull trout.” *Id.* at 86. Finally, the Service concluded that the action was “not likely to appreciably reduce the likelihood of both the survival and recovery of the bull trout in the wild.” *Id.* at 87.

C.

The Conservancy, then known as “Washington Trout,” filed this action in 2005, seeking declaratory and injunctive relief for alleged violations of the ESA and

dent males, migratory males apparently cannot mate with resident females. *See id.* at 71. Thus, if only small numbers of migratory bull trout pass the barriers, there may be a skewed sex ratio among them, which could prevent them from spawning. *See id.*

the National Environmental Policy Act (“NEPA”). Pursuant to a partial settlement, the Hatchery engaged in formal ESA section 7 consultation with the Service, resulting, in 2006, in a biological opinion (“2006 BiOp”). When the Conservancy challenged the 2006 BiOp in an amended complaint, the Service moved for and was granted a voluntary remand. In 2008, the Service issued the 2008 BiOp under review here, thereby superseding the 2006 BiOp. The Conservancy, still concerned that the Icicle Creek bull trout population was being adversely affected, challenged the 2008 BiOp in a second supplemental complaint.

Both parties moved for summary judgment. The district court granted the Service’s motion and denied the Conservancy’s. It concluded that the 2008 BiOp was “sufficiently well-documented and explained”; that the Service “appropriately defined and justified the 5-year term of the proposed action”; that the “no jeopardy” conclusion was not arbitrary and capricious. The Conservancy timely appealed.

II.

We review the district court’s decision and analysis on summary judgment de novo. *See Nat’l Wildlife Fed’n*, 524 F.3d at 927. We must affirm the district court’s grant of summary judgment to the Service unless the agency’s action is “arbitrary, capricious, an abuse of discretion, or otherwise not in accordance with law.” 5 U.S.C. § 706(2)(A). Although we cannot substitute our own judgment for that of the agency, we must “engage in a careful, searching review to ensure that the agency has made a rational analysis and decision on the record before it.” *Nat’l Wildlife Fed’n*, 524 F.3d at 927.

5. The 2008 BiOp cites another upcoming project, the habitat restoration project, for which construction is projected to begin in “approximately 2013,” as an additional reason for the

A.

[4] We consider first whether the Service permissibly defined the scope of the action as the operations and management of the Hatchery for a period of five years. The Conservancy objects to framing the operation of an ongoing project as a short-term action, arguing that the Service’s choice of the action’s scope allowed it to avoid considering whether the operations of the Hatchery would lead to the extirpation of the Icicle Creek bull trout population at some point beyond the five-year period, as well as whether that loss, if it occurred, would compromise the interim recovery unit. The Service maintains that its choice of the five-year term was not arbitrary and capricious because, as the 2008 BiOp states, the Hatchery anticipated that the replacement of its water intake system in 2010 (now delayed, as we have noted) would require it to reinitiate section 7 consultation.⁵

Evaluating the scope of an agency action can be significant in determining the adequacy of a biological opinion. “[T]he scope of the agency action is crucial because the ESA requires the biological opinion to analyze the effect of the *entire* agency action.” *Conner v. Burford*, 848 F.2d 1441, 1453 (9th Cir.1988). We “interpret the term ‘agency action’ broadly,” because “caution can only be exercised if the agency takes a look at all the possible ramifications of the agency action.” *Id.* (internal quotation marks and alterations omitted).

Conner rejected biological opinions addressing only the first, preliminary stage in a multistage project. The case involved the federal government’s issuance of more

2011 end date, *see* 2008 BiOp at 15, but the Service does not mention this reason in its brief.

than 700 leases for oil and gas exploration in two national forests. Before the leases were issued, the Service prepared a biological opinion for each forest. Concluding that there was “insufficient information available to render a comprehensive biological opinion beyond the initial lease phase,” *id.* at 1452, the Service considered the effects only of the leases themselves, not of the oil and gas activity to follow on the leased land. *Id.* at 1453. Instead of comprehensive biological opinions at the leasing stage, the Service included in the leases stipulations requiring additional environmental consultation prior to any “surface-disturbing activities.” *Id.* at 1455.

We held that the limited scope of the biological opinions violated the ESA. The Service’s obligation, we said, was “to analyze the effect of the *entire* agency action.” *Id.* at 1453. Because “[p]umping oil and not leasing tracts is the aim of congressional mineral leasing policy,” the agency action necessarily encompassed “not only leasing but leasing and all post-leasing activities through production and abandonment.” *Id.* (internal quotation marks and alterations omitted). The Service’s proposal to conduct “incremental-step consultation” was an inadequate alternative. That approach might result, for example, in the “piecemeal chipping away of habitat” for endangered species. *Id.* at 1454. The Service was thus “required to prepare, at the leasing stage, a comprehensive biological opinion” considering “all phases of the agency action.” *Id.* Because it had not done so, the biological opinions were invalid.

The Service contends that *Conner* is inapposite because the five-year term of operations and management *is* the entire

agency action.⁶ What the Service’s argument does not acknowledge is that the Hatchery has been operating for seventy years and is expected to continue operating into the future. The Hatchery simply made a decision, endorsed by the Service, to define the action as a five-year term of operations, when it might as easily have chosen a thirty-year term or a one-year term.

The delineation of the scope of an action can have a determinative effect on the ability of a biological opinion fully to describe the impact of the action on the viability of the threatened species, here the bull trout. For example, limiting the analysis of the Hatchery’s impact on the bull trout to a one-month term of operations would almost certainly be arbitrary and capricious. The time period under study would likely be too short to capture *any* effects on the bull trout, even though, as the 2008 BiOp under review recognizes, the Hatchery will have a negative impact over a five-year period.

The Hatchery must ensure that it does not “engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery” of the bull trout in the Columbia River interim recovery unit. 50 C.F.R. § 402.02. The artificial division of a continuing operation into short terms can undermine the consulting agency’s ability to determine accurately the species’ likelihood of survival and recovery, as the example just given illustrates.

This problem is exacerbated by the fact that the ESA regulation requires consideration of whether the action will “reduce *appreciably* the likelihood of both the sur-

6. The Service relies primarily on *Cabinet Mountains Wilderness v. Peterson*, 685 F.2d 678 (D.C.Cir.1982), a case we regarded as inapposite in *Conner*. See 848 F.2d at 1457.

As in *Conner*, *Cabinet Mountains* is not pertinent because it did not address whether the agency correctly determined the time-limited scope of the action covered by the BiOp.

vival and recovery” of the affected species. *Id.* (emphasis added). There could be some impact, but not an appreciable impact, in each of several subdivided periods of operation that, in cumulation, have an undeniably appreciable impact. For instance, if the Service were to analyze ongoing Hatchery operations as a series of ten five-year actions, it might find a likely net decrease of five to ten bull trout over each five-year period, and might conclude that an incremental reduction in the local population of that magnitude would not *appreciably* reduce the likelihood of survival and recovery of the interim recovery unit. But if instead the Service were to consider the *entire* reduction in the local population over fifty years, it might then find an appreciable impact on the interim recovery unit.⁷

[5] One reason for the potential discrepancy in outcomes depending on the temporal scope of the analysis is that, in conducting its jeopardy analysis, the Service considers the effects of the action “that will be added to the environmental baseline.” *Id.* The baseline includes “the past and present impacts of all Federal, State, or private actions and other human activities in the action area.” *Id.* Thus, if the Service conducts a series of short-term analyses, the baseline effectively resets at the beginning of each period. While the Service must consider the baseline in its analysis, “[a]gency action can only ‘jeopardize’ a species’ existence if that agency action causes some deterioration in the species’ preaction condition.” *Nat’l Wildlife Fed’n*, 524 F.3d at 930. In other words, “an agency only ‘jeopardize[s]’ a

species if it causes some new jeopardy.” *Id.*

To illustrate the problem: If the Service were to project that Hatchery operations over a fifty-year term would result in the extirpation of the Icicle Creek bull trout population, the loss of that local population, depending on the role it played in the larger interim recovery unit, might be significant enough to “reduce appreciably the likelihood of both the survival and recovery” of the interim recovery unit. A series of short-term analyses, on the other hand, could mask the long-term impact of Hatchery operations. If the Service were to determine in year 45, for example, that Hatchery operations over the next five years would eradicate the local bull trout population, the local population in year 45—the baseline year—might already have become so small, and its role in the interim recovery unit therefore so diminished, that its loss could not be said to *reduce appreciably* the likelihood of survival and recovery of the interim recovery unit.

As we observed in other circumstances in *National Wildlife Federation*, “[u]nder this approach, a listed species could be gradually destroyed, so long as each step on the path to destruction is sufficiently modest. This type of slow slide into oblivion is one of the very ills the ESA seeks to prevent.” *Id.*; see also *Am. Rivers v. U.S. Army Corps of Eng’rs*, 271 F.Supp.2d 230, 255 (D.D.C.2003) (“If FWS were allowed to apply such a limited scope of consultation”—in that case, one year—“to all agency activities, any course of agency action could ultimately be divided into multiple small actions, none of which, in and of themselves, would cause jeopardy.”).⁸ Al-

7. If the downward trend grew steeper as the population got smaller, as could be the case if the same proportion of individuals was prevented from reproducing each year, the overall exponential decline in the population might be all the more likely to appear “appre-

ciable” when considered from a longer-term perspective.

8. Serial short-term biological opinions also present another problem: If the period of operations concerned is short, a BiOp may

though it is not for us to dictate precisely how long the term of the analysis should be in this case, it must be long enough for the Service to make a meaningful determination as to whether the *ongoing* operation of the Hatchery “reasonably would be expected . . . to reduce *appreciably* the likelihood of both the survival and recovery” of the Columbia River interim recovery unit. 50 C.F.R. § 402.02 (emphasis added). Particularly given the long life of this facility and the absence of any indication that the Hatchery might close down altogether in the foreseeable future, five years is not sufficient.

The Service maintains that the choice of a five-year term of operations was justified in this case because the Hatchery plans to reinitiate Section 7 consultation after replacing its water intake system sometime in the near future. But the 2008 BiOp does not explain why the Hatchery’s proposed infrastructure improvement project should relieve the Service of the obligation to prepare a “comprehensive biological opinion[] considering all stages of the agency action.” *Conner*, 848 F.2d at 1454. The 2008 BiOp estimates that the current water intake system, which is poorly screened, is likely to kill one bull trout per

year and injure another. *See* 2008 BiOp at 92. Additionally, the intake dam—along with the boulder field—is one of two barriers encountered by bull trout who successfully pass upstream of dams 2 and 5. Thus, the water intake system has a comparatively minor effect on bull trout. The far greater threat is the closure of dams 2 and 5, which is expected to injure as many as twenty migratory bull trout per year by “significantly disrupting their breeding behavior,” in turn preventing an indeterminate number of births. 2008 BiOp at 92; *see also id.* at 67–68. Although the 2008 BiOp asserts that the new water intake system “will result in major changes to [operations and maintenance],” *id.* at 14, it makes no suggestion as to what those changes will entail, including whether there will be any effects on fish passage.⁹

Additionally, although the Service suggests that including the effects of the new water intake system in the 2008 BiOp would have been entirely speculative because there was no “concrete proposal” to consider, that suggestion is not accurate. On the contrary, the 2008 BiOp states that the Service and the Bureau of Reclamation had already approved a “preferred alterna-

become moot before judicial review occurs, or, as here, may be reviewed relatively late in the period covered. *See Am. Rivers v. Nat’l Marine Fisheries Serv.*, 126 F.3d 1118, 1123–24 (9th Cir.1997) (holding that a new biological opinion generally renders moot any challenges to the validity of the previous one).

9. We recognize that an agency managing an ongoing facility could conceivably plan to change its infrastructure so substantially that it would ultimately have to overhaul its entire operating regime. In such a situation, there might be so little continuity between the way the facility operated in the present and the way it would operate in the future, and its future operations might be so unpredictable, that the consulting agency would be justified in preparing a short-term biological opinion. That is not the case here.

The fact that an agency must reinitiate formal consultation “[i]f the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the biological opinion” does not, standing alone, justify preparing a short-term biological opinion. 50 C.F.R. § 402.16(c). To avoid the need for further consultations, an agency can address any already planned subsequent modifications in its BiOp, something that the Service failed to do, as discussed in more detail below. Moreover, any renewed consultation and BiOp with regard specifically to relatively minor subsequent modifications can be accomplished considerably more expeditiously if there is an existing BiOp covering the operations for that period than if there is not.

tive design for the new water intake system” and set aside funding “for implementation of this alternative.” *Id.* at 14. Thus, the Service had enough information about the proposed new system to include a meaningful analysis of its potential effects, including any anticipated changes in the operation of dams 2 and 5 as a result of the new system, in the 2008 BiOp.

Moreover, regardless of any uncertainty regarding the proposed infrastructure improvement, it was incumbent on the Service “to use the best information available to prepare [a] comprehensive biological opinion[] considering all stages of the agency action.” *Conner*, 848 F.2d at 1454. We concluded in *Conner* that “incomplete information about post-leasing activities does not excuse the failure to comply with the statutory requirement of a comprehensive biological opinion using the best information available.” *Id.* (citing 16 U.S.C. § 1536(a)(2)). We held that the Service was required to “develop projections of oil and gas activities which may indicate potential conflicts between development and the preservation of protected species.” *Id.* Likewise, in this case, the Service was required to use the best information available, including information about future infrastructure improvements, to consider the effects of the Hatchery’s ongoing operations on the bull trout.

The Hatchery and the Service remain under a continuing duty to reinitiate consultation “[i]f new information reveals effects of the action that may affect listed species . . . in a manner or to an extent not previously considered,” or “[i]f the . . . action is subsequently modified in a manner that causes an effect to the listed species . . . that was not considered in the biological opinion.” 50 C.F.R. § 402.16(b), (c); see *Conner*, 848 F.2d at 1458 n. 42; see also *N. Alaska Envtl. Ctr. v. Kempthorne*, 457 F.3d 969, 981 (9th Cir.2006) (upholding

a biological opinion relying on a “reasonable and foreseeable oil development scenario” and noting that “[i]f future actions differ from the 2008 BiOp assumptions, BLM must reinitiate consultation with the FWS” (citing 50 C.F.R. § 402.16(b))). The duty to reinitiate consultation in the future, however, does not diminish the Service’s obligation to prepare a comprehensive biological opinion now.

To give meaning to the ESA’s exhortation that agencies ensure that their actions are “not likely to jeopardize the continued existence of any endangered species or threatened species,” 16 U.S.C. § 1536(a)(2), the Service was required to issue a comprehensive biological opinion taking a long view of the Hatchery’s effects on the bull trout, or to explain adequately why any such effort would be unproductive in assessing the long-term impact of the Hatchery’s operations on the bull trout. Here, the Service did neither. The decision to limit the analysis in the 2008 BiOp to a five-year term of operations and management was therefore arbitrary and capricious.

B.

[6] Even if the Service had been justified in defining the action as a five-year period, it still had to consider the immediate and long-term effects of the action and “articulate[] a rational connection between the facts found and the conclusions made.” *Pac. Coast Fed’n of Fishermen’s Ass’ns v. Bureau of Reclamation*, 426 F.3d 1082, 1090 (9th Cir.2005). The ESA’s implementing regulations define the “effects of the action” as the “direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline.” 50 C.F.R. § 402.02. Indirect effects are

“those that are caused by the proposed action and are later in time, but still are reasonably certain to occur.” *Id.*

The 2008 BiOp found that the Icicle Creek bull trout population is the smallest local population in the Wenatchee River core area and the most vulnerable to extirpation. *See* 2008 BiOp at 66. The population trend has been negative for nearly 70 years, since the Hatchery was constructed. *See id.* Between 1940 and 2001, only the smaller and less fecund resident bull trout had access to the spawning areas upstream of the Hatchery; emigrating migratory bull trout were unable to return. Although there is little data on the size of the resident bull trout population, the number of spawning individuals is assumed to be fewer than twenty. As a result, according to the 2008 BiOp, “[i]nbreeding depression, genetic drift, and other consequences of very small population size are a significant concern for this population.” *Id.* at 66.

The survival and recovery of the Icicle Creek bull trout population is “largely dependent on” the ability of migratory bull trout to reach the historically accessible spawning areas upstream of the Hatchery. *Id.* Because they are larger and more prolific, returning migratory bull trout would contribute to the local population by “reducing competition, demographic, distributional, and genetic risks.” *Id.* The Service estimates that 100 to 200 migratory bull trout would visit the spawning grounds annually “if unimpeded passage were provided over a time period long enough for the population to respond.” *Id.* at 50.

During the 2006–2011 period of operations, the Service expects “low numbers” of migratory bull trout to travel upstream past the Hatchery’s barriers. *Id.* at 71. “[T]hese fish . . . have the potential to migrate to and possibly spawn in upper Icicle Creek.” *Id.* Over the two-year period from 2006 to 2007, a total of six migratory

bull trout were seen upstream of the Hatchery within ten miles or less of spawning areas, but it is unknown what gender they were (and so whether they were able to mate with each other or resident bull trout) or whether they spawned. *Id.* “If only a small number of migratory bull trout can pass the [Hatchery], the probability that the group has a skewed sex ratio is greater, simply due to random chance and a small sample size.” *Id.* The 2008 BiOp found that “[i]n order to stabilize or achieve a positive population growth trajectory in Icicle Creek, at least a few pairs of male and female migratory bull trout would probably need to successfully spawn in Icicle Creek annually.” *Id.* at 49 (emphasis added). And, the 2008 BiOp also concluded that “the proposed action is still likely to at least reduce, and in some years preclude, demographic and genetic contributions by migratory bull trout to the small resident bull trout population in Icicle Creek.” *Id.* at 71 (emphasis added). If the action would prevent any migratory bull trout from spawning successfully in some years and would permit only six trout of unknown gender to make it upstream in two years, then there is no way the population could meet the minimum requirements to stabilize: “at least a few pairs of male and female migratory bull trout . . . successfully spawn[ing] in Icicle Creek annually.” *Id.* at 49. Thus, as the 2008 BiOp projected, “long-term negative [population] trends [within Icicle Creek] are likely to continue.” *Id.* at 85.

The Service failed adequately to explain how this conclusion can be squared with its ultimate determination that the 2006–2011 operations and maintenance “reasonably would [not] be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery” of the Columbia River interim recovery unit. 50

C.F.R. § 402.02. Contrary to the dissent's repeated assertions, we make no determination regarding whether the Service could have issued a rational no jeopardy conclusion in light of continuing negative population trends. *See* Dissent at 19625–27. It is not our role to decide whether the findings in the 2008 BiOp require a jeopardy conclusion. Instead, as noted, we must determine whether the agency “articulated a rational connection between the facts found and the conclusions made.” *Pac. Coast Fed’n*, 426 F.3d at 1090. We must hold that it did not.

To begin with, although the Service found that the action would “at least reduce, and in some years preclude” migratory bull trout spawning and that the local bull trout population would continue to decline, it concluded inexplicably that the action was “not likely to change the current distribution and abundance of the bull trout in the action area.” 2008 BiOp at 84. If the population trend is “negative,” as the Service found, *id.* at 85, then, in ordinary English, there will be fewer fish in 2011 than there were in 2006. Yet the Service concluded that the “current distribution and abundance of the bull trout in the action area” is “not likely to change.” Translating again into ordinary English, that means there *won't* be fewer fish in 2011 than there were in 2006. How can that be, given the negative population trend? It cannot.

The 2008 BiOp offered two reasons for its dubious conclusion that the “current distribution and abundance of the bull trout in the action area” is “not likely to change”: (1) the persistence of the Icicle Creek bull trout population since 1940; and (2) the detection of six migratory bull trout upstream of the Hatchery in 2006 and 2007. *See id.* at 84. Elaborating on the second reason, the 2008 BiOp asserted that the periodic breeding of migratory

and resident bull trout that would “potentially” occur during the term of the action “is likely to contribute to maintaining and improving the viability of this local population and its contribution to the viability of the core area and interim recovery unit populations of the bull trout.” *Id.*

Neither reason adequately explains the contradiction between the Service's findings and its conclusion. First, the fact that the local population has survived since 1940 does not provide any information about how much longer it can hold on. If there are now fewer than twenty spawning individuals and the population continues to decline, then, absent some intervention, the population will eventually reach zero, its long prior existence notwithstanding. Moreover, even before a population is extinguished, it may reach a point at which it is no longer recoverable: “a species can often cling to survival even when recovery is far out of reach.” *Nat'l Wildlife Fed.*, 524 F.3d at 931. The Service has not determined when the tipping point precluding recovery of the Icicle Creek bull trout population is likely to be reached, nor, necessarily, whether it will be reached as a result of the 2006–2011 operations and maintenance of the Hatchery.

Second, the discovery of a small number of migratory bull trout upstream of the Hatchery in 2006 and 2007 does not, in light of the 2008 BiOp's other findings, support the Service's conclusion that the 2006–2011 action will not affect bull trout distribution and abundance in Icicle Creek. The Service found that the action was likely to “reduce, and in some years preclude, demographic and genetic contributions by migratory bull trout to the small resident bull trout population.” 2008 BiOp at 71 (emphasis added). True, before 2001, there were no migratory bull trout spawning successfully, and under the 2006–2011 operations and maintenance

there may—possibly—be a very few, although that is far from certain. But any positive impact from the small number of migratory bull trout upstream can only occur if that impact is not offset by the number of bull trout who are not born or die because the Hatchery impairs upstream migration.

The Service found that between 2001, the first year the Hatchery began adjusting its dams to allow some upstream migration, and 2007, the second year of the action period, there was *no* net gain: “Not enough migratory bull trout are likely to have passed upstream of the [Hatchery] and successfully spawned between 2001 and 2007, to fully offset the reduced [bull trout] B[ir]ths and I[m]migration], plus increased D[eath]s], caused by [operations and maintenance] at [the Hatchery].” *Id.* at 49. Moreover, the 2008 BiOp found that stabilizing the local population would require “at least a few pairs of male and female migratory bull trout . . . successfully spawn[ing] in Icicle Creek annually,” *id.*, but the action would likely preclude *any* spawning by migratory bull trout in some years. That is why, presumably, the bottom line of the Service’s findings is that as a result of the 2006–2011 action, the local bull trout population will continue to decline. As noted, the Service failed to draw a rational link between that finding and its conclusion that the action would not affect the “current distribution and abundance of the bull trout in the action area.”

Nor did the Service articulate a rational connection between its findings and its ultimate conclusion—that the action would not cause jeopardy at the recovery unit scale. The Service has identified the following “survival and recovery needs” for the Columbia River unit: “maintain or expand the current distribution of the bull trout within core areas; maintain stable or increasing trends in bull trout abun-

dance; maintain/restore suitable habitat conditions for all bull trout life history stages and strategies; and conserve genetic diversity and provide opportunities for genetic exchange.” *Id.* at 84. In considering the impact of the action on the Columbia River interim recovery unit, the Service concluded:

[T]he proposed action is likely to contribute to the survival of the bull trout by providing some upstream passage opportunities for migratory bull trout in Icicle Creek, but is not likely to appreciably increase its recovery at the action area, core area, interim recovery unit, and range-wide scales because it will impair upstream passage of migratory bull trout during the optimal period of in-stream flows However, the effect of improved upstream passage conditions caused by the proposed action . . . should improve, albeit in only a small way, the contribution of the Icicle Creek local population to the survival of the bull trout.

For the above reasons, the effects of implementing the proposed [Hatchery] operations from May 2006 through December 2011, are not likely to substantively change the capacity of the Columbia River interim recovery unit to provide both the survival and recovery functions assigned to it. For that reason, the proposed action is not likely to appreciably reduce the likelihood of both the survival and recovery of the bull trout in the wild.

Id. at 86–87. This conclusion simply does not account for the finding that the number of bull trout in Icicle Creek would continue to decrease over the action period. The 2008 BiOp does not explain how a “negative” population trend in Icicle Creek could “improve . . . the contribution of the Icicle Creek bull trout population to the survival of the bull trout.” It may be that,

as we conjectured in the preceding section, the decrease in the local population over the five-year period under study would not have an “appreciable” negative impact on the interim recovery unit. But how it could have a *positive* impact remains unclear.

The Service might also have found that even if the Icicle Creek bull trout population *were* extirpated, its loss would not jeopardize the survival or recovery of the Columbia Creek interim recovery unit. But it did not make that finding, and it is far from obvious that the extirpation of the Icicle Creek population would be harmless. The 2008 BiOp reports that bull trout populations in the Columbia River interim recovery unit are generally declining and are strong in only 6 to 24 percent of the occupied range. *See id.* at 19. The Wenatchee River core area is particularly important to the recovery unit because it is a “relative stronghold” for bull trout in the upper Columbia River area. *Id.* at 36. Further, the Icicle Creek local population is important to the core area because its location in the lower basin “could insulate this population from disturbances in the upper basin that would affect most of the others.” *Id.* at 50. At oral argument, the Service emphasized the buffer function the Icicle Creek population might play if other local populations in the core area were threatened.

In sum, the Service was “obligated to articulate a rational connection between the facts found and the conclusions made.” *Pac. Coast Fed.*, 426 F.3d at 1091 (internal quotation marks and alteration omitted). It did not do so. Because “an agency’s action must be upheld, if at all, on the basis articulated by the agency itself,” *id.*, we must reverse and remand on this basis as well.

C.

[7] The 2008 BiOp was also required to consider the effects of activities interrelated with the proposed agency action. *See* 50 C.F.R. § 402.02. The Hatchery uses about 100,000 pounds of fish food to feed the salmon it rears each year, resulting in 30,000 pounds of solid wastes. *See* 2008 BiOp at 80. The Hatchery uses a pollution abatement pond to collect these wastes. Periodically, waste is removed from the pond and spread out on dry ground at the Hatchery.

The Conservancy contends that the Service did not address the effects of cleaning the pollution abatement pond. In particular, the Conservancy is concerned about the effects of runoff from the wastes spread on land at the Hatchery. The 2008 BiOp reports that the fish food used at the Hatchery “is a source of very small amounts of PCBs [polychlorinated biphenyls],” although samples collected from the top layer of sediments in the pollution abatement pond “did not have significantly elevated levels of PCBs.” *Id.* at 66. The Conservancy worries that runoff associated with the cleaning of the pollution abatement pond may contain PCBs and pesticides that could adversely affect bull trout.

We agree with the Service that the 2008 BiOp adequately considered the effects of runoff. In the section entitled “Release of Effluent into Icicle Creek,” the Service described the operation of the pollution abatement pond and noted that it was last cleaned in 2007. *Id.* at 80. It concluded that “hatchery effluent release into Icicle Creek is unlikely to cause adverse effects to the bull trout.” *Id.* at 81.

Although the Service’s discussion of the effects of the pollution abatement pond could have been more detailed, we are satisfied that the agency did not “entirely fail[] to consider an important aspect of the problem,” as it did give the matter

some consideration. *Lands Council v. McNair*, 537 F.3d 981, 987 (9th Cir.2008) (en banc), *abrogated in part on other grounds*, *Winter v. Nat. Res. Def. Council*, 555 U.S. 7, 129 S.Ct. 365, 375, 172 L.Ed.2d 249 (2008). Moreover, there is no indication that the runoff issue is an important aspect of the jeopardy determination. The Service points to the results of a 2005 study of PCB and pesticide concentrations in Icicle Creek, the pollution abatement pond, and Hatchery salmon, reported in the Biological Assessment for Operation and Maintenance of the Leavenworth National Fish Hatchery. According to the Biological Assessment, “[d]ata show that [the Hatchery] is not adversely impacting the PCB or pesticide concentrations in Icicle Creek below the hatchery and hatchery fish are not accumulating PCB or pesticides to levels of concern.” U.S. Fish & Wildlife Serv., Biological Assessment for Operation and Maintenance of Leavenworth National Fish Hatchery 61 (2006).

We therefore reject the Conservancy’s contention that the 2008 BiOp is invalid because it did not adequately address the effects of the pollution abatement pond.

D.

[8] When the Service concludes that a proposed agency action will not jeopardize the continued existence of the species but is likely to result in incidental takings, it issues an “incidental take statement” with the biological opinion. 16 U.S.C. § 1536(b)(4); 50 C.F.R. § 402.14(i). The statement must “specif[y] the impact of such incidental taking on the species,” as well as “those reasonable and prudent measures . . . necessary or appropriate to minimize such impact.” 16 U.S.C. § 1536(b)(4). The statement acts as a safe harbor, exempting the specified amount of incidental taking from the take prohibition of ESA section 9. “If during the course of

the action the amount or extent of incidental taking, as specified [in the statement], is exceeded, the Federal agency must reinstate consultation immediately.” 50 C.F.R. § 402.14(i)(4).

Here, the Service issued an incidental take statement (“Statement”) setting the following annual limits on incidental take: (1) one bull trout killed and one harmed by the water intake system; and (2) twenty migratory bull trout injured because their access to historically accessible spawning habitat is impaired, significantly disrupting their breeding behavior. *See* 2008 BiOp at 92. The Conservancy challenges the adequacy of the Statement on two separate grounds.

1.

First, the Conservancy contends that the Statement does not account for the full extent of incidental take. The Hatchery facilitates an active tribal Chinook salmon fishery at the base of its spillway pool, and the 2008 BiOp estimated that some bull trout would be harvested incidentally by tribal anglers. *See* 2008 BiOp at 73. Take of bull trout in accordance with state and tribal fishing regulations is exempt from the ESA’s take prohibition. *See* 50 C.F.R. § 17.44(w)(2). Nonetheless, the Conservancy maintains that the Hatchery takes bull trout by closing dam 5 during the bull trout’s spring migration, which results in large numbers of bull trout lingering in the spillway pool, where they may fall prey to tribal anglers fishing for Chinook salmon. If this “take” were included in the Statement, then the Hatchery would be required to comply with reasonable and prudent measures to minimize the take. *See* 16 U.S.C. § 1536(b)(4).

We conclude that it was reasonable for the Service not to attribute to the Hatchery the take of bull trout by tribal anglers. Tribal fishing rights in Icicle Creek are

guaranteed by treaties and other agreements. See *United States v. Confederated Tribes of Colville Indian Reservation*, 606 F.3d 698(9th Cir.2010). Although the Hatchery's operations likely do increase the numbers of bull trout lingering in the spillway pool, were the Hatchery to change its operations with the result that the spillway pool became less productive as a Chinook salmon fishing area, the Service might very well be obligated to provide alternative locations for the tribal fishery—which might also result in the taking of bull trout. Take of bull trout by tribal anglers is exempt from the ESA wherever it occurs, as long as tribal regulations are followed. Holding the Hatchery responsible for take by tribal anglers would be incongruent with the special rule exempting tribal fishing from the ESA's take prohibition. It was therefore not arbitrary and capricious for the Service to exclude take associated with the tribal fishery from the Statement.

2.

[9] Second, the Conservancy argues that the Statement does not include adequate monitoring requirements. The Statement anticipates that up to twenty migratory bull trout will be injured each year, because Hatchery operations will significantly disrupt their breeding behavior by preventing or delaying their spawning migration. Yet, the Statement does not require the Hatchery to monitor and report the actual number of bull trout so harmed.

[10] "Incidental Take Statements set forth a 'trigger' that, when reached, results in an unacceptable level of incidental take, invalidating the safe harbor provision, and requiring the parties to re-initiate consultation." *Ariz. Cattle Growers' Ass'n v. U.S. Fish & Wildlife*, 273 F.3d 1229, 1249(9th Cir.2001). Preferably, the trig-

ger is numerical, but the Service may use a surrogate—for example, changes in ecological conditions affecting the species. *Id.* at 1250. If a surrogate is used, the agency must articulate a rational connection between the surrogate and the taking of the species. *Id.* at 1250–51. This court has rejected a surrogate trigger so vague that it failed to "provide a clear standard for determining when the authorized level of take has been exceeded," *id.* at 1251, and a surrogate so broad—"all spotted owls" associated with the project—that it "could not adequately trigger reinitiation of consultation." *Or. Natural Res. Council v. Allen*, 476 F.3d 1031, 1038 (9th Cir. 2007).

The Service contends that the Statement is adequate because it provides a clear numerical cap on take—twenty bull trout prevented from spawning—beyond which consultation must be reinitiated. Unlike the other anticipated takings discussed in the Statement, however, the twenty-bull trout limit is not accompanied by a monitoring and reporting requirement. For example, the Statement requires the Hatchery to monitor and report the number and types of fish caught in the water intake system. See 2008 BiOp at 94–95. The question, then, is whether the consulting agency is responsible only for providing a clear cap, leaving it up to the action agency to monitor take and reinitiate consultation when the trigger is met, or whether the consulting agency must also set out monitoring and reporting requirements.

The ESA's implementing regulations provide that "[i]n order to monitor the impacts of incidental take, the Federal agency or any applicant must report the progress of the action and its impact on the species to the Service as specified in the incidental take statement." 50 C.F.R. § 402.14(i)(3) (emphasis added). The reg-

ulation makes clear that the Service is responsible for specifying in the statement how the action agency is to monitor and report the effects of the action on listed species.

Here, the Service has set a clear numerical cap, but a numerical cap is useful only insofar as the action agency is capable of quantifying take to determine when the trigger has been met. *See Or. Natural Res. Council*, 476 F.3d at 1039 (explaining that the incidental take statement must “set a clear standard for determining when the authorized level of take ha[s] been exceeded”); *Natural Res. Def. Council, Inc. v. Evans*, 279 F.Supp.2d 1129, 1187 (N.D.Cal.2003), cited with approval in *Or. Natural Res. Council*, 476 F.3d at 1038 (“It is arbitrary and capricious to set the trigger at one animal unless defendants can adequately detect the taking of a single animal.”). Thus, the Service must either specify monitoring and reporting requirements with respect to the twenty-bull trout limit or, if appropriate, select a surrogate trigger that *can* be monitored. Therefore, we hold that the ITS failed to establish a meaningful trigger for renewed consultation after the take exceeded authorized levels.

E.

[11, 12] Finally, ESA section 7 also imposes on the Hatchery a substantive duty to ensure that its operations are not likely to jeopardize the continued existence of the bull trout. “Arbitrarily and capriciously relying on a faulty Biological Opinion violates this duty.” *Defenders of Wildlife v. EPA*, 420 F.3d 946, 976 (9th Cir.2005), *rev’d on other grounds, Nat’l Ass’n of Home Builders v. Defenders of Wildlife*, 551 U.S. 644, 127 S.Ct. 2518, 168 L.Ed.2d 467 (2007). An agency’s reliance on a biological opinion based on “admittedly weak” information satisfies its ESA obli-

gations as long as the challenging party can point to no new information undercutting the opinion’s conclusions. *Pyramid Lake Paiute Tribe of Indians v. U.S. Dep’t of Navy*, 898 F.2d 1410, 1415 (9th Cir. 1990). Where the opinion’s flaws are “*legal* in nature,” however, “[d]iscerning them requires no technical or scientific expertise,” and the failure to do so may result in “an action based on reasoning ‘not in accordance with law’ and . . . thus arbitrary and capricious.” *Defenders of Wildlife*, 420 F.3d at 976.

Here, the Service committed legal error by limiting the scope of the action to five years; failing to articulate a rational connection between its findings in the 2008 BiOp and its no jeopardy conclusion; and issuing an inadequate incidental take statement. The Hatchery’s reliance on a legally flawed biological opinion was arbitrary and capricious. The Hatchery therefore violated its substantive duty to ensure that its operations and maintenance did not jeopardize the continued existence of the bull trout.

III.

We conclude that the 2008 BiOp is arbitrary and capricious because the Service limited the analysis to a five-year period, failed to articulate a rational connection between the facts found and the conclusions made, and issued an incidental take statement lacking adequate monitoring and reporting requirements. Additionally, the Hatchery violated its substantive duty to ensure that its operations did not jeopardize the continued existence of the bull trout. We reverse and remand to the district court with directions to grant the Conservancy’s motion for summary judgment and to grant injunctive relief until the Service complies with its obligations under the ESA.

REVERSED and REMANDED.

FISHER, Circuit Judge, concurring in part and dissenting in part:

Prompted by this litigation, the U.S. Fish and Wildlife Service has attempted to minimize the effect of the Leavenworth National Fish Hatchery (“the Hatchery”) on the small population of bull trout in Icicle Creek. My colleagues in the majority find these efforts insufficient to meet the strictures of the Endangered Species Act (“ESA”) and place two substantial burdens on the Fish and Wildlife Service (“the Service”) that the ESA does not require. First, the majority requires the Service to address operations and maintenance on an unlimited time horizon, despite planned modifications that will further reduce the Hatchery’s impact on the bull trout. Second, the majority requires the Service to attribute continuation of a 70-year population decline to planned Hatchery operations, rather than recognizing that trend and the structures that caused it as the environmental baseline. I respectfully dissent from these aspects of the majority’s opinion.

I.

The majority first concludes that the Service acted arbitrarily or capriciously by limiting its analysis to the five-year term of the 2006 to 2011 Operations and Maintenance Plan (“the O&M Plan”). *See* Op. at 521–25. As the majority notes, Section 7 of the ESA requires consultation concerning any agency action that may “jeopardize the continued existence of an endangered species or threatened species or result in the destruction or adverse modification of habitat of such species.” 16 U.S.C. § 1536(a)(2). The ESA defines agency action as “any action authorized, funded, or carried out by such agency.” *Id.* The applicable regulation further defines “action” as

all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies in the United States or upon the high seas. Examples include, but are not limited to . . . actions directly or indirectly causing modifications to the land, water, or air. 50 C.F.R. § 402.02.

Here the Service had a reasonable rationale to limit the scope of the agency action considered in the 2008 Biological Opinion to a five-year period: the projected completion of a new water intake system in 2011 that will reduce annual adverse impacts on the bull trout when completed. *See* U.S. Fish & Wildlife Serv., *Biological Opinion for the Operation and Maintenance of the Leavenworth National Fish Hatchery Through 2011*, at 14–15 (2008) (“2008 BiOp.”). As both the 2008 BiOp and the accompanying Incidental Take Statement (“ITS”) acknowledge, the current water intake system harms bull trout annually, and the majority recognizes that improving this system will require a new BiOp. *See* Op. at 519 n. 2. The Service also intends to undertake a broader habitat restoration project at the Hatchery. Although this project cannot begin until adequate funding has been secured and further consultation has occurred, *see* 2008 BiOp at 15, it demonstrates the significant differences between the environmental impacts during the period covered by the O&M Plan and future operations. Perhaps most importantly, allowing the Service in these circumstances to define an action as the multi-year operation of an ongoing program promotes renewed analysis based on a growing foundation of data, analysis and mitigation experiments. The majority’s contention that the Service “might as easily have chosen a thirty-year term or a one-year term,” Op. at 522, is unfairly dismissive of the agency’s reasonable response to the facts on the ground (and in the river).

It seems quite reasonable for the Service to assess the present and future impacts of a fixed period of operations rather than to assess operations on an indefinite time horizon, which would require the demonstrably false assumption that the Service will never meaningfully change Hatchery operations. *Cf. Pac. Coast Fed'n of Fishermen's Ass'ns v. U.S. Bureau of Reclamation*, 426 F.3d 1082, 1088–92 (9th Cir. 2005) (faulting a 10-year BiOp for failing to explain why mitigating action was delayed until year nine, not for being limited to 10 years). The majority's repeated assertion that a BiOp addressing five years of operation and management is not a "comprehensive biological opinion[] considering all stages of the agency action," Op. at 524, 524–25 (quoting *Conner v. Burford*, 848 F.2d 1441, 1454 (9th Cir.1988)), begs the question and fails to afford the Service appropriate flexibility to define the scope of its action. The majority guarantees that an ongoing program that fails to remedy immediately a slowly declining population will be found to jeopardize the existence of a threatened or endangered species.

A BiOp addressing a fixed term of operations can and must address long-term implications. However, ESA consultation need address only long-term effects of the agency action at issue, rather than additional agency actions that may or may not occur in the future. *See* 50 C.F.R. § 402.02 (defining "indirect effects" as "those that are caused by the proposed action and are later in time, but are still reasonably certain to occur" (emphasis added)); *Nat'l Wildlife Fed'n v. Nat'l Marine Fisheries Serv.*, 524 F.3d 917, 930 (9th Cir.2008) ("[T]he proper baseline analysis is . . . what jeopardy might result from the agency's proposed actions in the present and future human and natural contexts." (internal quotation marks and citations omitted)). The 2008 BiOp expressly con-

sidered these "indirect effects." 2008 BiOp at 67. Although the BiOp acknowledged that the proposed action is unlikely "to prevent the number of migratory spawners from being large enough to cause an increasing population trend, or to fully alleviate long-term genetic risks to the population," *id.* at 85, given that the population has persisted for over 70 years without access to migratory spawners, it was not irrational for the Service to conclude that five additional years of limited access would not "reduce appreciably the likelihood of both the survival and recovery" of the local population, let alone the interim recovery unit. 50 C.F.R. § 402.02; *cf. Am. Rivers v. U.S. Army Corps of Engrs.*, 271 F.Supp.2d 230, 254–55 (D.D.C. 2003) (finding that plaintiffs were likely to succeed on the merits because the Army Corps "narrowly focus[ed] its analysis on the impacts of the 2003 high summer flows on . . . this year only, instead of evaluating both the present and future effects of the 2003 low summer flows" (emphasis added)). Future BiOps may find that continued operation of the Hatchery will push the Icicle Creek population to a tipping point, but the 2008 BiOp provides a rational explanation why this particular O&M Plan will not appreciably increase the likelihood that such a point will be reached.

Rejecting appellant's challenge to the 2008 BiOp would not, as the majority envisions, authorize death of the bull trout by a thousand cuts. A short-term BiOp is reasonable in this case because the Service plans major improvements in the near term that will significantly alleviate the bull trout take. Should the Service continue to resort to short-term BiOps in the future, however, that approach would be increasingly unlikely to satisfy the ESA, regardless of the justification. Allowing this short-term BiOp would not foreclose future analysis of any period of time in

which the agency's action would reduce "appreciably the likelihood" of survival and recovery. *Contra* Op. 522–23 (emphasis in original). Indeed, a reasonable definition of an appreciable effect surely would include "a likely net decrease of five to ten bull trout over [a] five-year period", *id.*, when the starting population is believed to number fewer than 20 spawning individuals. See 2008 BiOp at 66. There is, however, no support in the record for the notion that such a decline is likely during the period addressed by the 2008 BiOp, let alone that the Service would continue to reach no-jeopardy conclusions if similar, cumulative decreases were to occur a second or third time.

Finally, the majority fears that the Service would permit serial reductions in the Icicle Creek population until its "role in the interim recovery unit [is] so diminished, that its loss could not be said to reduce appreciably the likelihood of survival and recovery of the interim recovery unit." Op. 523 (emphasis in original). But, if the small Icicle Creek population plays a significant role, that importance must be based on genetic and geographic diversity, not the population's contribution to gross numbers. Even if one or more short-term assessments permitted small further reductions in the Icicle Creek population, its genetic and geographic importance to the interim recovery unit would remain unchanged, and the loss of this diversity would have to be taken into account in future jeopardy assessments.

The majority tries to shoehorn this case into the rule we established in *Conner v. Burford*, 848 F.2d 1441 (9th Cir.1988). See Op. at 521–22. *Conner* is not on point. There we held that an incremental approach to a BiOp was not permissible when the scope of the planned agency action—a lease of federal land for oil exploration, development and production—

included activity beyond the exploration phase reviewed in the BiOp. See *id.* at 1443–44, 1452. Unlike *Conner*, the O&M Plan does not authorize activity beyond the duration or scope of the BiOp; the purpose of the planned activities is complete at the end of the authorized agency action. Cf. *id.* at 1453 ("'[P]umping oil' and not 'leasing tracts' is the aim of congressional [mineral leasing].") (quoting *North Slope Borough v. Andrus*, 642 F.2d 589, 608 (D.C.Cir.1980) (alterations in original))).

The D.C. Circuit's decision in *Cabinet Mountains Wilderness v. Peterson*, 685 F.2d 678, 681 (D.C.Cir.1982), provides a more apt analysis. *Cabinet Mountains Wilderness* approved a BiOp that addressed only a three-year exploration plan because "[a]pproval was expressly limited to the proposed exploratory drilling activities[, and] further activities such as developmental exploration or mineral extraction would require a comprehensive examination of environmental effects." *Id.* at 681. Although the D.C. Circuit did not place its express imprimatur on the duration of the drilling plan, it rejected the plaintiffs' contention that the BiOp failed to account for cumulative impacts to grizzly habitat and determined that only concurrent "timber sales and roads were relevant in addressing the problem of cumulative impacts." *Id.* at 683–84. The majority's dismissal of *Cabinet Mountains Wilderness* in a footnote, see Op. at 522 n. 6, fails to grapple with the decision. I recognize that *Cabinet Mountains Wilderness* did not expressly hold that an agency may segregate a fixed period of operations in a BiOp, but *Conner* did not expressly hold that an agency may not do so. *Cabinet Mountains Wilderness* remains the more analogous authority.

We are faced with a BiOp addressing a distinct five-year plan for operations and

management, using existing infrastructure prior to planned improvements. Unlike *Conner*, the BiOp addresses the approved agency action in its entirety. And like *Cabinet Mountains Wilderness*, the O&M Plan is expressly limited to a limited period and range of activities; any further operation will require renewed environmental review. I therefore part company with my colleagues' conclusion that the decision to address only five years of management activities was arbitrary and capricious.

II.

The majority holds that it is impossible to issue a rational no jeopardy conclusion in light of the Service's finding that "long-term negative [population] trends[within Icicle Creek] are likely to continue." Op. at 526 (quoting 2008 BiOp at 85) (modifications in original). The majority, however, fails to address the appropriate environmental baseline and merely assumes that the long-term trend is attributable to the current action. See Op. at 525–29. The 2008 BiOp includes the Hatchery's historical structures and operations in the environmental baseline, see 2008 BiOp at 66, and Wild Fish Conservancy has abandoned on appeal its argument that this inclusion was improper.

Department of the Interior regulations define the environmental baseline as including

the past and present impacts of all Federal, State, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of State or private actions which are contemporaneous with the consultation in process.

50 C.F.R. § 402.02. Of course planned operation and maintenance of the Hatchery cannot be included in the baseline. See *Nat'l Wildlife Fed'n*, 524 F.3d at 930–31 ("Although we acknowledge that the existence of the dams must be included in the environmental baseline, the operation of the dams is within the federal agencies' discretion . . ."). The 2008 BiOp correctly determined that the O&M Plan will harm the Icicle Creek bull trout population. See, e.g., 2008 BiOp at 85 ("The proposed action is likely to cause impaired passage conditions for the bull trout in Icicle Creek each year . . ."). The BiOp, however, included the continued presence of Hatchery facilities, including obstructions to bull trout migration put in place during past operations, as components of the environmental baseline. See 2008 BiOp at 32; *Nat'l Wildlife Fed'n*, 524 F.3d at 930 ("The current existence of the [federal] dams constitutes an 'existing human activity' which is already endangering the fishes' survival and recovery." (quoting *Alcoa v. Administrator, Bonneville Power Admin.*, 175 F.3d 1156, 1162 n. 6 (9th Cir.1999))). Similarly, the BiOp included in the baseline a 70-year population decline and the risks that accompany a small remaining population. See BiOp at 66.

With the scope of both the proposed agency action and the environmental baseline in mind, the Service successfully "articulated a rational connection between the facts found and the [no jeopardy] conclusions made." *Pac. Coast*, 426 F.3d at 1090 (citing *Motor Vehicle Mfrs. Ass'n v. State Farm Mutual Auto. Ins. Co.*, 463 U.S. 29, 43, 103 S.Ct. 2856, 77 L.Ed.2d 443 (1983)). The continuation of long-term negative population trends results from the continuing presence of obstacles to fish passage through Icicle Creek, and the Service's inaction—its failure to remove those obstacles—is not a part of activity whose effects are considered in the BiOp. There is no

contradiction between the remaining effects and the Service's conclusion that the present and long-term effects of the O&M Plan are not likely to reduce appreciably the bull trout's likelihood of survival and recovery of the interim recovery unit.

Nor was it irrational for the Service to conclude that the O&M Plan, in concert with the environmental baseline, was "not likely to change the current distribution and abundance of the bull trout in the action area." 2008 BiOp at 84. By reducing the period in which preexisting obstacles bar passage of bull trout to spawning grounds, the O&M Plan reduced the rate of decline, and we have no reason to disbelieve the Service's conclusion that the marginal decline over a five year period—while improvements are made to the intake system and plans are laid for habitat rehabilitation—would affect distribution and abundance in an ecologically meaningful manner. This does not guarantee that there "won't be fewer fish in 2011 than there were in 2006." Op. at 527. But that claim was never made by the Service and is not necessary to its no-jeopardy conclusion.

The majority also contends that the 2008 BiOp fails to "explain how a 'negative' population trend in Icicle Creek could 'improve . . . the contribution of the Icicle Creek bull trout population to the survival of the bull trout.'" Op. at 528 (quoting 2008 BiOp 86–87). The majority, however, omits a crucial phrase from the quoted text. The BiOp states in full:

However, the effect of improved upstream passage conditions caused by the proposed action, as evidenced by some migratory bull trout observations in spawning habitat within Icicle Creek

above the [Hatchery] in 2006 and 2007, *when added to the environmental baseline* should improve, albeit in only a small way, the contribution of the Icicle Creek local population to the survival of the bull trout.

Slowing a localized decline improves a population's contribution to the broader survival of the species, both by preserving genetic diversity in the short term and widening the time frame in which further improvements can be made to reverse the trend entirely. More importantly, any contradiction in this analysis is irrelevant to the Service's broader conclusion that "the proposed action . . . is not likely to appreciably increase [the Bull Trout's] recovery at the action area, core area, interim recovery unit, and range-wide scales." 2008 BiOp at 86.

* * * * *

In sum, the Service provided a rational basis for its no jeopardy conclusion. To conclude otherwise requires neglecting the environmental baseline and distrusting agency experts' analysis of the scope and relevance of continued population decline, mitigated by remedial agency action. I therefore disagree with my colleague's conclusion that the Service's analysis in the 2008 BiOp is irrational. For these reasons, I respectfully dissent from Parts II.A, II.B, II.E and III. of the majority opinion, but otherwise concur.



**ENDANGERED SPECIES ACT SECTION 7 CONSULTATION
BIOLOGICAL OPINION**

Action Agency: National Marine Fisheries Service

Activity: Endangered Species Act Section 7 Consultation on NMFS Gear
Regulations in the Virginia Pound Net Fishery
PCTS ID: NER-2017-14025
ECO ID: GARFO-2017-01032

Consulting Agency: National Marine Fisheries Service, Greater Atlantic Regional Office,
Protected Resources Division

Date Issued: MAR 31 2018

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1.0 INTRODUCTION

Section 7(a)(2) of the Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. 1531 *et seq.*), requires each Federal agency to insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of the designated critical habitat of such species. When the action of a Federal agency may affect a species or critical habitat that is protected under the ESA, that agency is required to consult with either the National Oceanic and Atmospheric Administration's (NOAA) National Marine Fisheries Service (NMFS) or the U.S. Fish and Wildlife Service (U.S. FWS), depending upon the species and/or critical habitats that may be affected. In instances where the NMFS or U.S. FWS authorizes, funds, or carries out an action that may affect ESA-listed species or critical habitat under their respective jurisdictions, the agency in question must conduct intra-service consultation.

The Federal actions described in this document are gear regulations that our agency, NMFS, has enacted for the pound net fishery operating in nearshore coastal and estuarine waters of Virginia, including waters inside Chesapeake Bay, since 2002. These gear regulations take the form of protected species conservation measures pursuant to the ESA as well as the Marine Mammal Protection Act (MMPA). Because of these federal actions, we are required to perform an intra-service section 7 consultation to assess their impacts on ESA-listed species and critical habitats under our jurisdiction, across the full range of fishing activities and locations where they occur.

We, the NMFS Greater Atlantic Regional Fisheries Office, Protected Resources Division (GARFO PRD), most recently completed formal consultation and issued a biological opinion (Opinion) pursuant to section 7 of the ESA for the NMFS gear regulations on the Virginia pound net fishery on April 16, 2004. In the 2004 Opinion, we concluded that the federal gear regulations governing the fishery may adversely affect, but are not likely to jeopardize the continued existence of ESA-listed species. We also concluded in the 2004 Opinion that the federal gear regulations are not likely to destroy or adversely modify designated critical habitat for ESA-listed species. This new Opinion replaces the existing 2004 Opinion and provides an updated analysis of the effects of the Federal gear regulations on ESA-listed species, including the Northwest Atlantic distinct population segment (DPS) of loggerhead sea turtles, the North Atlantic DPS of green sea turtles, and the five DPSs of Atlantic sturgeon which have been listed subsequent to the 2004 Opinion. In addition, this new Opinion will consider the best available scientific information on the incidental take of sea turtles and Atlantic sturgeon in components of the Virginia pound net fishery affected by gear regulations under both the ESA and MMPA. Finally, we will assess the impacts of the federal gear regulations on critical habitat for Atlantic sturgeon, which is designated in several rivers of the Chesapeake Bay estuary and may overlap with Virginia pound net fishing operations.

This Opinion is based on information contained in a 2015 final rule that amended the regulations and definitions for Virginia pound nets under both the Bottlenose Dolphin Take Reduction Plan (BDTRP) and the ESA for sea turtle conservation (80 FR 6925; February 9, 2015). It is also based on information from and correspondence with the Virginia Marine Resources Commission (VMRC; the state agency responsible for marine fisheries management in Virginia), information on past interactions with ESA-listed species in the Virginia and other Atlantic pound net

fisheries, and other scientific data and reports cited throughout this document. In addition, we used information from past consultations on the fishery dating back to 2002. A complete administrative record of this formal ESA consultation will be kept on file at GARFO PRD.

2.0 CONSULTATION HISTORY

On May 14, 2002, we completed our first Opinion on sea turtle conservation measures for the Virginia pound net fishery pursuant to section 7 of the ESA. This consultation addressed a proposed rule that prohibited the use of all pound net leaders measuring 12 inches and greater stretched mesh and all pound net leaders with stringers in the Virginia waters of the mainstem Chesapeake Bay and portions of Virginia tributaries from May 8 to June 30 each year (67 FR 15160; March 29, 2002). An interim final rule for this action was published on June 17, 2002 (67 FR 41196). It required fishermen to report all pound net-sea turtle interactions within 24 hours of returning from trips and included a year-round requirement for fishermen to utilize NMFS-approved observers if requested by the Northeast (now Greater Atlantic) Regional Administrator.

We most recently completed formal consultation on sea turtle conservation measures for the Virginia pound net fishery on April 16, 2004. This was in response to new information on the effects of the fishery on ESA-listed sea turtles subsequent to the original 2002 Opinion as well as the issuance of a 2004 proposed rule prohibiting the use of offshore pound net leaders. In both the 2002 and 2004 Opinions, we considered the effects of the implementation of sea turtle conservation measures as well as the continued operation of the Virginia pound net fishery and its gear components (leaders, pounds, etc.). As the proposed action is our agency's regulation of gears utilized in the fishery, and because the regulations provide an exception to the prohibition on incidental take of ESA-listed sea turtles, we consider the impacts to both ESA-listed species and designated critical habitat under our jurisdiction from the continued operation of the Virginia pound net fishery inclusive of all its gear components, as fishing of the gear components are interrelated/interdependent actions resulting from the protected species conservation measures.

In the 2004 Opinion, we concluded that the implementation of sea turtle conservation regulations for the Virginia pound net fishery under the 2004 rule (which prohibited the use of offshore pound net leaders), and the continued operation of the fishery following implementation of the rule, was not likely to jeopardize the continued existence of any ESA-listed species or result in the destruction or adverse modification of any designated critical habitats under our jurisdiction. We provided an incidental take statement (ITS) in the 2004 Opinion for the anticipated incidental take of loggerhead, leatherback, Kemp's ridley, and green sea turtles in the fishery operating in compliance with the proposed measures and provided several reasonable and prudent measures and accompanying terms and conditions to minimize the impacts of incidental take. Although also assessed in the 2004 Opinion as "may be affected," shortnose sturgeon were not anticipated to be incidentally taken (or adversely affected) as a result of the proposed measures and continuation of the fishery.

In both 2006 and 2007, we conducted section 7 reviews of additional Virginia pound net related rulemaking. On June 5, 2006, we performed a section 7 review of new modified pound net leader regulations for Virginia pound nets under the ESA. The 2006 proposed rule required that any offshore pound net leader set in Pound Net Regulated Area I (see Figure 1) during the period of

May 6 - July 15 be a modified leader, and allowed the use of modified leaders in the remainder of the Virginia portion of Chesapeake Bay. We determined that reinitiation of consultation was not necessary because the proposed action provided a level of protection to listed sea turtles similar to or better than that of the restrictions already in place. The final rule for that action was published on June 23, 2006 (71 FR 36024). On January 27, 2007, we performed a section 7 review of a modified leader inspection program for Virginia pound nets. The proposed rule established an inspection program for pound net fishermen who intended to use modified pound net leaders in the Virginia portion of Chesapeake Bay at any time during the period from May 6 to July 15. We determined that the proposed action would have no effect on ESA-listed species because it would be conducted entirely on land. The final rule for that action was published on November 18, 2008 (73 FR 68348).

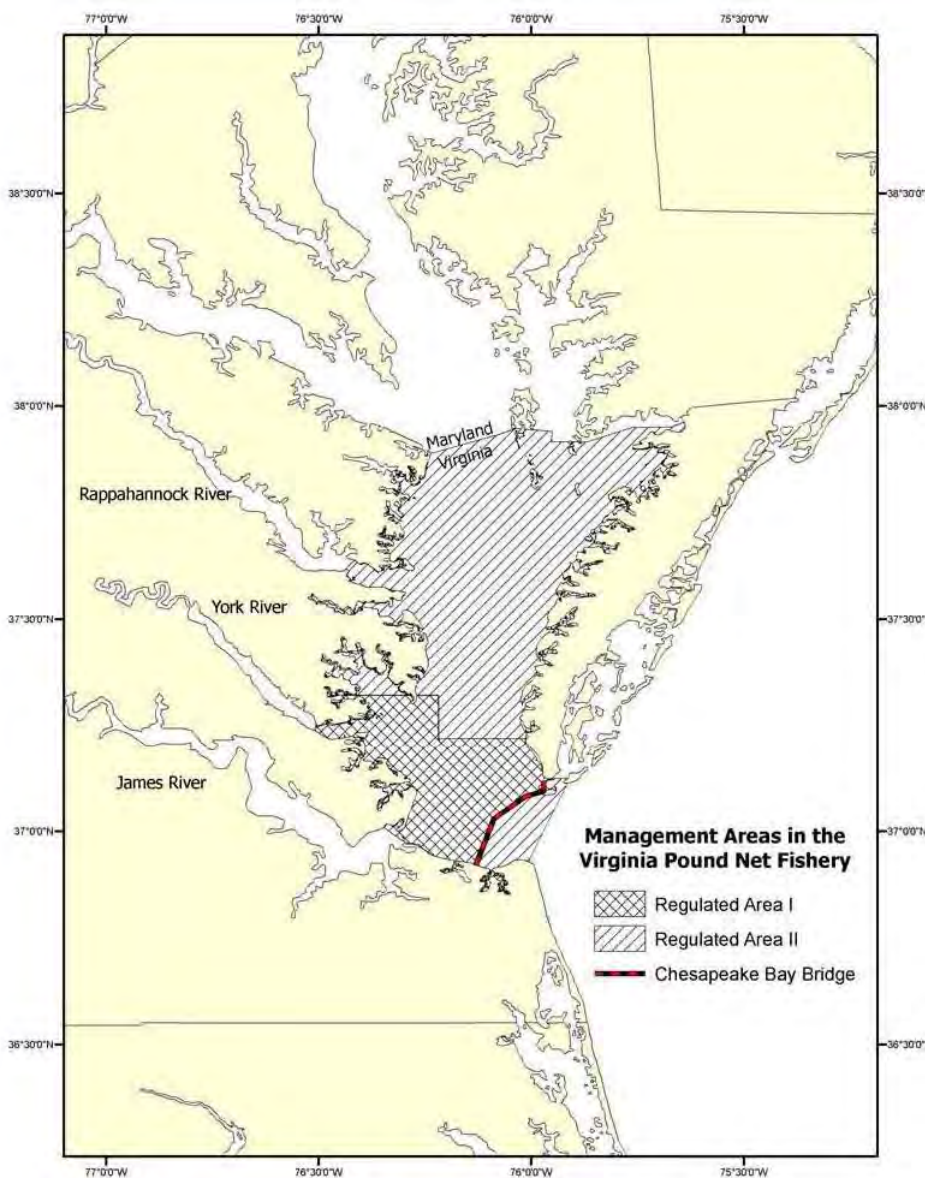


Figure 1. Pound Net Regulated Areas I and II in the Chesapeake Bay, Virginia.

On February 9, 2015, we published a final rule in the *Federal Register* amending the BDTRP and its implementing regulations under the MMPA to require year-round use of modified leaders for offshore Virginia pound nets in specified waters of the lower mainstem Chesapeake Bay and coastal state waters (80 FR 6925; Figure 2). Seasonality of modified leader use as previously required under the ESA regulations remains in place. Under both the MMPA and ESA, the final rule also included a one-time compliance training for fishermen using modified leaders, new and revised Virginia pound net-related definitions, and requirements to fish all sections of the gear at the same time. The final rule became effective on March 11, 2015, and represents a modification to the NMFS gear regulations assessed in the 2004 Opinion. In addition to these new MMPA and ESA regulations, new information is available on the effects of federally regulated gear in the Virginia pound net fishery on ESA-listed species. In light of the recent changes to the fishery, the availability of new information on the effects of the fishery on sea turtles, and the recent listing of Atlantic sturgeon, reinitiation of consultation was appropriate. This consultation will also consider effects of the action on critical habitat designated for the five DPSs of Atlantic sturgeon.

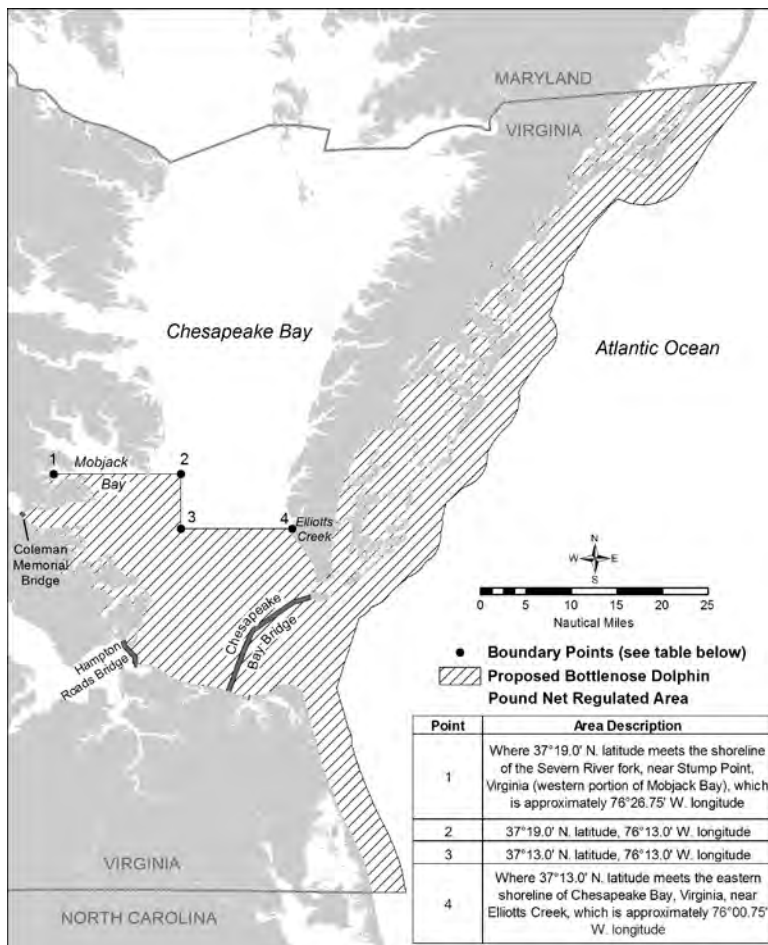


Figure 2. Bottlenose Dolphin Pound Net Regulated Area in Virginia state waters.

3.0 DESCRIPTION OF THE PROPOSED ACTION

The proposed action is NMFS's implementation of gear regulations for the Virginia pound net fishery, in the form of protected species conservation measures pursuant to the ESA and MMPA. Because the proposed action is NMFS's regulation of the fishery, and because the regulations provide an exemption to the prohibition on incidental take of listed species, we will consider the impacts to listed species from the continued operation of the pound net fishery as a whole.

3.1 Description of NMFS Gear Regulations and the Virginia Pound Net Fishery

Based upon documented sea turtle interactions with pound net leaders, NMFS issued a final rule on May 5, 2004 (69 FR 24997), that prohibited the use of offshore pound net leaders from May 6 to July 15 in an area referred to as "Pound Net Regulated Area I." Pound Net Regulated Area I is defined under the 2015 final rule (as shown in Figure 1) as the Virginia waters of the mainstem Chesapeake Bay and the portion of the James River seaward of the Hampton Roads Bridge Tunnel (Interstate Highway-64) and the York River seaward of the Coleman Memorial Bridge (Route 17), bounded to the south and east by the Chesapeake Bay Bridge Tunnel (Route 13; extending from approximately 37°07' N. lat., 75°58' W. long. to 36°55' N. lat., 76°08' W. long.), and to the north by the following points connected by straight lines and in the order listed:

<u>Point Area</u>	<u>Description</u>
1	Where 37°19.0' N. lat. meets the shoreline of the Severn River fork, near Stump Point, Virginia (western portion of Mobjack Bay), which is approximately 76°26.75' W. long.
2	37°19.0' N. lat., 76°13.0' W. long.
3	37°13.0' N. lat., 76°13.0' W. long.
4	Where 37°13.0' N. lat. meets the eastern shoreline of Chesapeake Bay, Virginia, near Elliotts Creek, which is approximately 76°00.75' W. long.

Under the 2015 final rule, an offshore pound net leader or offshore pound net means a pound net with any part of the leader (from the most offshore pole at the pound end of the leader to the most inshore pole of the leader) in water greater than or equal to 14 feet (4.3 meters) at any tidal condition.

The May 2004 rule also placed restrictions on nearshore pound net leaders in Pound Net Regulated Area I and on all pound net leaders employed in "Pound Net Regulated Area II." Pound Net Regulated Area II, as currently defined in the 2015 final rule, refers to Virginia waters of the Chesapeake Bay outside of Pound Net Regulated Area I, bounded by the Maryland-Virginia State line to the north and by the COLREGS line at the mouth of the Chesapeake Bay and 37°07' N. lat. between Kiptopeke and Smith Island, Northampton County, Virginia to the south and east. This area includes the Great Wicomico River seaward of the Jessie Dupont Memorial Highway Bridge (Route 200), the Rappahannock River downstream of the Robert Opie Norris Jr. Bridge (Route 3), the Piankatank River downstream of the Route 3 Bridge, and all other tributaries within these boundaries (Figure 1). Under the 2015 final rule, a nearshore pound net leader or nearshore pound net means a pound net with every part of the leader (from the most offshore pole at the pound end of the leader to the most inshore pole of the leader) in

less than 14 feet (4.3 meters) of water at any tidal condition. Pursuant to the 2004 rule, nearshore pound net leaders in Pound Net Regulated Area I and all pound net leaders in Pound Net Regulated Area II must have mesh size less than 12 inches (30.5 centimeters) stretched mesh and may not employ stringers.

In 2004 and 2005, NMFS implemented a coordinated research program with pound net industry participants and other interested parties to develop and test a modified pound net leader design with the goal of eliminating or reducing sea turtle interactions while retaining an acceptable level of fish catch. Based upon these results, on June 23, 2006, NMFS issued a final rule (71 FR 36024) that required any offshore pound net leader in Pound Net Regulated Area I during the period from May 6 through July 15 to meet the definition of a modified pound net leader. A modified pound net leader, as defined under the 2015 final rule, is a pound net leader that is affixed to or resting on the sea floor and made of a lower portion of mesh and an upper portion of only vertical lines such that the mesh size is equal to or less than 8 inches (20.3 centimeters) stretched mesh; at any particular point along the leader, the height of the mesh from the seafloor to the top of the mesh must be no more than one-third the depth of the water at mean lower low water directly above that particular point; the mesh is held in place by a bottom chain that forms the lowermost part of the pound net leader; the vertical lines extend from the top of the mesh up to a top line, which is a line that forms the uppermost part of the pound net leader; the vertical lines are equal to or greater than 5/16 inch (0.8 centimeters) in diameter and strung vertically at a minimum of every 2 feet (61 centimeters); and the vertical lines are hard lay lines.

Existing mesh size and stringer restrictions on nearshore pound net leaders in Pound Net Regulated Area I and all pound net leaders in Pound Net Regulated Area II remained in place from May 6 through July 15 of each year. However, the June 2006 rule created an exception to those restrictions by allowing the use of modified pound net leaders during that period in nearshore pound net leaders in Pound Net Regulated Area I and all pound net leaders in Pound Net Regulated Area II. The year-round reporting and monitoring requirements for this fishery and the framework mechanism under the existing regulations (50 CFR 223.206(d)(10)) also remained in effect. After the 2006 final rule was published, NMFS determined that an onshore inspection program that examines a modified leader ready for deployment would help ensure the protection of sea turtles, while limiting the difficulties of and potential costs to fishermen associated with post-deployment inspections at-sea.

In the February 2015 final rule, NMFS amended: (1) the BDTRP and its implementing regulations at 50 CFR 229.2, 229.3, and 229.35, in accordance with section 118(f) of the MMPA; and (2) current definitions and regulations issued under the ESA for sea turtle conservation at 50 CFR 222.102, 223.205, and 223.206 (d)(10). NMFS further amended the BDTRP to meet its MMPA-mandated goal of reducing incidental mortality and serious injury of strategic stocks of bottlenose dolphins from the Virginia pound net fishery. Regulations for this amendment were based on the BDTRT's consensus recommendations, which were generally consistent with existing regulations enacted under the ESA for sea turtle conservation, with some revisions and updates. Amendments to the ESA sea turtle conservation regulations for the Virginia pound net fishery were finalized within the same rulemaking for consistency in definitions and regulations.

The final rule required the year-round use of modified pound net leaders for offshore Virginia pound nets within the Bottlenose Dolphin Pound Net Regulated Area (Figure 2). It removed the land-based inspection program for modified pound net leaders under the ESA. Instead, under both the MMPA and ESA, it required fishermen to attend a one-time compliance training before setting modified pound net leaders and to keep on board the vessel a valid modified pound net leader compliance training certificate issued by NMFS. The rule also required that all three sections of pound net gear (leader, heart, and pound) be fished at the same time with the exception of a continuous 10-day period to deploy, remove, and/or repair gear. Virginia pound net-related definitions were added/revised for effective implementation of the regulatory measures, including hard lay lines, modified pound net leader, nearshore pound net, offshore pound net, and pound net. Lastly, non-regulatory measures were finalized under the BDTRP including outreach and coordination to help with compliance and monitoring of regulatory measures for the Virginia pound net fishery.

Virginia pound net fishery

The Virginia pound net fishery is described in various documents (Mansfield *et al.* 2001; NMFS 2004a; Silva *et al.* 2011; Magnusson *et al.* 2012), and the following is a brief summary. A pound net is a fixed entrapment gear consisting of an arrangement of fiber netting supported upon stakes or pilings with the head ropes or lines above the water. Typically, there are three distinct segments: (1) the pound, which is the enclosed end with a netting floor where the fish entrapment takes place; (2) the heart, which is a net in the shape of a heart that aids in funneling the fish into the pound; and (3) the leader, which is a long straight net that leads the fish offshore towards the pound (Figure 3). There may also be an outer compartment or second heart, and pound nets fished in deeper water may have a middle compartment (round pound). Pound nets are oriented perpendicular to the shoreline, with the leader being the closest component to shore. Fish swimming along shore are turned towards the pound by the leader, guided into the heart(s), and then into the pound where they are removed periodically. Pound net leaders may consist of mesh, stringers, and/or buoys. Some pound net leaders are all mesh, while others have stringers and mesh. Stringers, also known as vertical lines, are spaced a regular distance apart and are not crossed by other lines to form mesh (Figure 4). We consider a pound net leader with stretched mesh greater than 12 inches to be a large mesh leader.

Pound nets are passive fishing devices, as they will trap the fish that swim into the pound. Pound nets have low selectivity for size, but are selective for fishes that occur in nearshore areas. The majority of pound nets are set and fished between April and November in relatively shallow water (<6 meters) and target many gamefishes (Welsh *et al.* 2002a). In order to fish the pound net, watermen will routinely use a smaller skiff to untie the crib from the poles, and begin bunting the net onto the skiff. As the bunting process continues, fish are confined to an ever decreasing space until it is easy for the watermen to remove the fish with a large, hydraulically operated dip net or small, manual one. From this point, the catch is culled. Species of fish that are caught within a net depend upon a variety of factors, including the season and the location of the pound net. Bait fish, Atlantic croaker, and menhaden often comprise the majority of the total catch by pound nets. As a result, the fishery is managed by the Atlantic States Marine Fisheries Commission (ASMFC) under the Interstate Fishery Management Plans for Atlantic Croaker and Spot. As mentioned above, gear used in the fishery is also regulated under the ESA as well as the BDTRP and its implementing regulations under the MMPA.

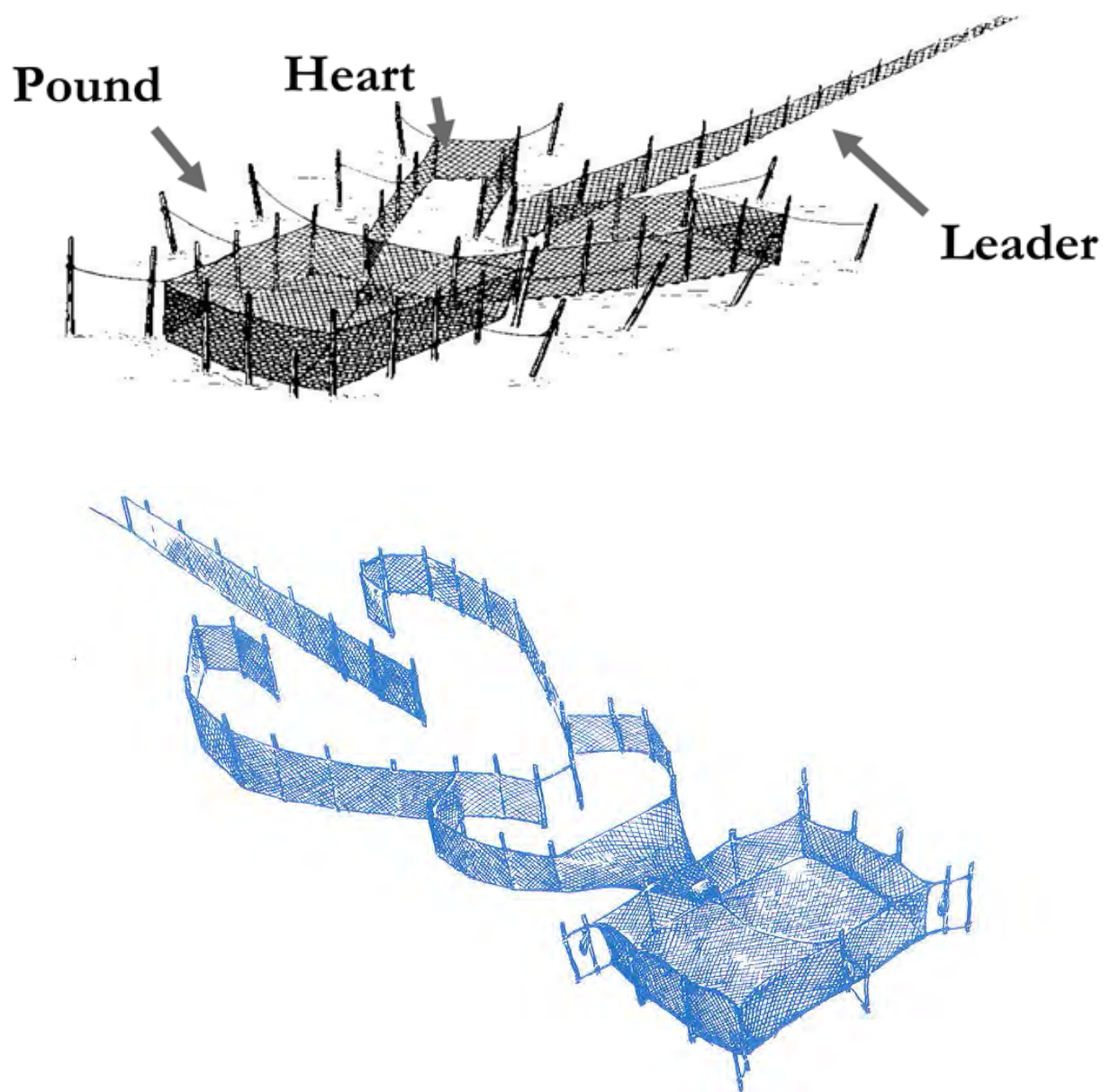
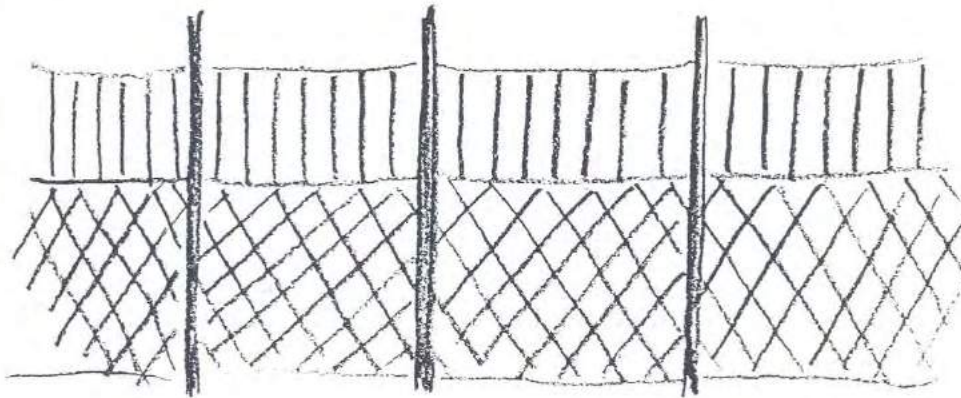


Figure 3. Generalized designs of a Virginia pound net. Adapted from Mansfield *et al.* (2001) and Silva *et al.* (2011).

Mesh:



Stringer:



Buoy:

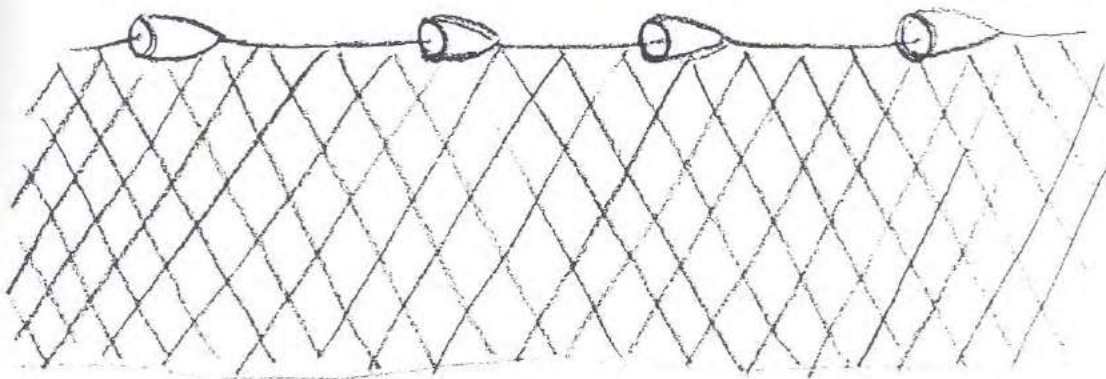


Figure 4. Pound net leader types: mesh, stringer, and buoy. Adapted from Mansfield *et al.* (2001).

Effort in this fishery occurs in nearshore coastal and estuarine waters of Virginia. This fishery includes all pound net effort in Virginia state waters, including waters inside Chesapeake Bay. Virginia has maintained a limited entry system for pound nets in the mainstem Chesapeake Bay and near reaches of the tributaries since 1994. At present, the number of available licenses in Virginia is capped at 161 (Regulation 4 VAC 20-600-10 et seq. “Limits the Sale of Pound Net Licenses”). According to the VMRC website, 158 pound net licenses are currently in effect in Virginia, where one license is assigned to each pound net that can be set (https://webapps.mrc.virginia.gov/public/maps/virginia_poundnets.php). In 2017, there were 26 participants in the fishery possessing the 158 total licenses (average ~6 per participant). Annual attrition occasionally results in licenses being transferred to new participants, so it appears that the number of licenses has been relatively stable for the past twenty plus years. Separate from active nets, several of the 158 licensed pound nets are currently noted by VMRC as forfeited and therefore cannot be fished at present. Also, not all Virginia pound net fishermen hang their nets in the action area where NMFS regulations apply; therefore, we expect fewer than 158 nets in the action area.

According to VMRC, pound nets are set almost exclusively offshore of the county in which the license was purchased. In Virginia, the majority of pound net stands are located around the southern Virginia shore of the mouth of the Potomac River (south of Smith Point), around the mouth of the Rappahannock River to the mouth of the York River/Mobjack Bay, and along the Eastern shore of Virginia (https://webapps.mrc.virginia.gov/public/maps/virginia_poundnets.php and https://webapps.mrc.virginia.gov/public/maps/chesapeakebay_map.php). This geographical distribution of sites is consistent with those observed during past monitoring efforts and studies.

The choice of leader mesh size depends heavily on the currents where the nets are located. Large mesh leaders are utilized in areas of strong tidal currents to prevent flotsam from washing into the leaders and causing the overburdened nets to drift away, while small mesh leaders (approximately 6-8 inch mesh) are set closer to shore in up to 15 feet of water. Stringer leaders, which are prohibited from May 6 to July 15, have also historically been used in locations with high currents. The pounds for those stringer leaders are set in about 12-30 feet of water. Nets in shallower protected areas are usually equipped with smaller mesh leaders (<8 inches stretched mesh). Only a few pound nets are set upriver of the first bridge in the Virginia Chesapeake Bay tributaries or outside the Bay Bridge/COLREGS line.

3.2 Action Area

The action area is defined as “all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action” (50 CFR 402.02). We anticipate that the effects on ESA-listed species and their habitats as a result of the NMFS gear regulations in the Virginia pound net fishery include the direct effects of interactions between listed species and pound net fishing gear as well as the effects on other marine organisms (i.e., prey) on or very near to the sea floor that may result from placement/hauling of the gear or direct capture/entanglement in it. In addition, indirect effects from the operation of fishing vessels on ESA-listed species, their prey, and habitats are possible. Therefore, for the purpose of this consultation, the action area is defined by the area in which Virginia pound net fishing activities

and vessel-based operations occur within nearshore coastal and estuarine waters of Virginia, including waters inside Chesapeake Bay.

Specifically, the action area for this consultation includes the Virginia waters of the mainstem Chesapeake Bay from the Maryland-Virginia state line (approximately 37° 55' N. lat., 75° 55' W. long.) to the COLREGS line at the mouth of the Chesapeake Bay; the James River downstream of the Hampton Roads Bridge Tunnel (I-64); the York River downstream of the Coleman Memorial Bridge (Route 17); the Great Wicomico River downstream of the Jessie Dupont Memorial Highway Bridge (Route 200); the Rappahannock River downstream of the Robert Opie Norris Jr. Bridge (Route 3); and the Piankatank River downstream of the Route 3 Bridge (Figure 1). The action area also includes the Bottlenose Dolphin Pound Net Regulated Area which is the southern Virginia waters of the mainstem Chesapeake Bay (i.e., Pound Net Regulated Area I) and state coastal waters to the Maryland/Virginia line and Virginia/North Carolina line (Figure 2).

4.0 STATUS OF LISTED SPECIES AND CRITICAL HABITAT

4.1 Species and Critical Habitat Not Likely to be Adversely Affected by the Proposed Action

Federally endangered sei, sperm, and blue whales do not occur in the action area. Federally endangered North Atlantic right whales and fin whales are expected to occasionally occur in Virginia nearshore and coastal waters of the action area, including Chesapeake Bay. Pound net gear is typically set in shallow, nearshore waters at depths that are often not deep enough for these two species of large whales to enter. As a result, it is extremely unlikely that any right or fin whales would interact with pound net gear; therefore, effects are discountable.

We have also determined that the proposed action is not likely to have any adverse effects on the availability of prey for right and fin whales. Right whales feed on copepods. Pound net gear will not affect the availability of copepods for foraging right whales because copepods are very small organisms that will pass through the gear rather than being captured in it. Fin whales feed on pelagic krill as well as small schooling fish (e.g., sand lance, herring, mackerel) (Aguilar 2002). Pound net fishing gear operates on or near the bottom in shallow waters. Fish species caught in pound net gear are typically shallow water species that live in benthic habitat (on or very near the bottom) versus schooling fish and invertebrates that occur within the water column in deeper waters. As a result, the pound net fishery will not affect the availability of the pelagic prey of foraging fin whales. Since the proposed action is not likely to adversely affect right or fin whales or their prey, we will not assess them further in this Opinion.

The hawksbill sea turtle is listed as endangered. This species is uncommon in the waters of the continental U.S. Hawksbills prefer coral reef habitats, such as those found in the Caribbean and Central America. Mona Island (Puerto Rico) and Buck Island (St. Croix, U.S. Virgin Islands) contain especially important foraging and nesting habitat for hawksbills. Within the continental U.S., nesting is restricted to the southeast coast of Florida and the Florida Keys, but nesting is rare in these areas. Hawksbills have been recorded from all Gulf of Mexico states and along the U.S. east coast as far north as Massachusetts, but sightings north of Florida are rare. Many of the

strandings in states north of Florida have been observed after hurricanes or offshore storms. Aside from Florida, Texas is the only other U.S. state where hawksbills are sighted with any regularity. Since hawksbill sea turtles are extremely unlikely to be present in the action area, effects to this species as a result of the proposed action are extremely unlikely and therefore, discountable. The lack of any captures of hawksbill sea turtles in Virginia pound net gear to date supports this determination.

Shortnose sturgeon are benthic fish that occur in large coastal rivers of eastern North America. They range from as far south as the St. Johns River, Florida (possibly extirpated from this system) to as far north as the Saint John River in New Brunswick, Canada. The species is anadromous in the southern portion of its range (*i.e.*, south of Chesapeake Bay), while some northern populations are amphidromous (NMFS 1998a). In Chesapeake Bay, shortnose sturgeon are most often found in Maryland waters of the mainstem bay and tidal tributaries such as the Susquehanna, Potomac, and Rappahannock Rivers (Spells 1998; Litwiler 2001; Kynard et al. 2007, 2009; SSSRT 2010). Shortnose sturgeon have been captured in pound nets in Maryland waters, but we have no data suggesting that captures occur in the Virginia portion of Chesapeake Bay or in nearshore and coastal waters off Virginia. Information on the use of Virginia waters of the Chesapeake Bay by shortnose sturgeon is very limited with only two documented captures since at least the 1970s; both captures were in the James River (Balazik 2017). Given the range of the species (remaining mostly in river systems, with some coastal migrations between Northeast U.S. rivers), its limited presence outside of the upper part of Chesapeake Bay (Maryland portion), and the proposed action occurring in the southern portion of the bay and nearshore coastal waters off Virginia, shortnose sturgeon are expected to be extremely rare in areas where the pound net fishery operates. No interactions with shortnose sturgeon have been reported in Virginia fisheries, including the pound net fishery. As there are no proposed changes to the operation or distribution of the Virginia pound net fishery that would increase the likelihood of interactions between shortnose sturgeon and this gear, we do not anticipate any future interactions. As shortnose sturgeon are extremely unlikely to be present in the action area, effects of the action are also extremely unlikely and effects are discountable.

On August 17, 2017, NMFS issued a final rule designating critical habitat for the five listed DPSs of Atlantic sturgeon found in U.S. waters (82 FR 39160). The action area for this consultation overlaps slightly with the river mouths of the Rappahannock, York, and James rivers; a portion of each of these rivers is designated as critical habitat for the Chesapeake Bay DPS of Atlantic sturgeon. We have analyzed the potential impacts of the Virginia pound net fishery on this designated critical habitat, inclusive of the four physical and biological features (PBFs) described in the final rule. We have determined that the effects to these PBFs from the pound net fishery consistent with the NMFS gear regulations will be insignificant or discountable as described below.

The Virginia pound net fishery does not overlap with, and thus will not affect, hard bottom substrate (e.g., rock, cobble, gravel, limestone, boulder, etc.) in low salinity waters (*i.e.*, 0.0-0.5 ppt range) that is used for settlement of fertilized eggs, refuge, growth, and development of early life stages (PBF 1). These features occur far upstream of the areas where pound net gear is typically placed in Virginia waters of Chesapeake Bay. As there is no overlap between PBF 1 in any of the critical habitat units and the action area, there will be no effects to PBF 1.

It is extremely unlikely that the pound net fishery will affect the aquatic habitats between the river mouth and spawning sites that are used for juvenile foraging and physiological development (PBF 2). These waters are characterized by a gradual downstream salinity gradient of 0.5 up to as high as 30 ppt and soft substrate (e.g., sand, mud). As the pound net fishery only involves the deployment and hauling of net gear and occasional vessel transits to fish the gear, it is extremely unlikely to affect the salinity gradient or the natural structure of the soft bottom habitat at these river mouth locations. As such, any reduction in the capacity of the soft bottom substrate, food resources, and natural cover to meet the conservation needs of juvenile Atlantic sturgeon is extremely unlikely. In addition, the fishery is extremely unlikely to affect the forage base of juveniles, as their prey are not the target of the fishery and all netting will be hung above the benthos of the estuary where preferred prey of juvenile sturgeon subsides. Therefore, effects to PBF 2 are discountable.

The pound net fishery is extremely unlikely to result in a physical barrier to Atlantic sturgeon passage, as the gear placement will only affect small portions of the shore near specific river mouths at any given time. In addition, the action will not affect the depth or flow of water. As such, effects to PBF 3 are extremely unlikely and discountable.

Finally, as the fishery only involves the deployment and hauling of net gear and occasional vessel transits to fish the gear, it is extremely unlikely to affect water quality parameters (temperature, salinity, and dissolved oxygen) that support spawning, survival, growth, development, and recruitment (PBF 4). Therefore, effects to PBF 4 are discountable. Based upon this analysis, as all effects to designated critical habitat in the action area will be insignificant or discountable, the action is not likely to adversely affect critical habitat designated for the Chesapeake Bay DPS of Atlantic sturgeon.

4.2 Species Likely to be Adversely Affected by the Proposed Action

We have determined that the proposed action considered in this Opinion may affect the following listed species in the action area in a manner that will likely result in adverse effects:

Common name	Scientific name	ESA Status
Loggerhead sea turtle - NWA DPS ¹	<i>Caretta caretta</i>	Threatened
Kemp's ridley sea turtle	<i>Lepidochelys kempii</i>	Endangered
Green sea turtle - North Atlantic DPS ²	<i>Chelonia mydas</i>	Threatened
Leatherback sea turtle	<i>Dermochelys coriacea</i>	Endangered
Atlantic sturgeon	<i>Acipenser oxyrinchus oxyrinchus</i>	
Gulf of Maine (GOM) DPS		Threatened
New York Bight (NYB) DPS		Endangered
Chesapeake Bay (CB) DPS		Endangered
Carolina DPS		Endangered
South Atlantic (SA) DPS		Endangered

¹ NWA DPS = Northwest Atlantic DPS, the only loggerhead sea turtle DPS expected to occur in the action area.

² The North Atlantic DPS is the only green sea turtle DPS expected to occur in the action area.

This section will focus on the status of the various ESA-listed species likely to be adversely affected within the action area, summarizing information necessary to establish the environmental baseline and to assess the effects of the proposed action.

4.2.1 Status of Sea Turtles

With the exception of loggerheads and greens, sea turtles are listed under the ESA at the species level rather than as subspecies or DPSs. Therefore, information on the range-wide status of Kemp's ridley and leatherback sea turtles is included to provide the status of each species overall. Information on the status of loggerhead and green sea turtles will only be presented for the DPS affected by this action. Additional background information on the range-wide status of these species can be found in a number of published documents, including sea turtle status reviews and biological reports (NMFS and U.S. FWS 1995, 2007a, 2007b, 2013; 2015; Hirth 1997; Marine Turtle Expert Working Group [TEWG] 1998, 2000, 2007, 2009; Conant *et al.* 2009; Seminoff *et al.* 2015), and recovery plans for the loggerhead sea turtle (NMFS and U.S. FWS 2008), Kemp's ridley sea turtle (NMFS *et al.* 2011), green sea turtle (NMFS and U.S. FWS 1991), and leatherback sea turtle (NMFS and U.S. FWS 1992, 1998b).

2010 BP Deepwater Horizon Oil Spill

The April 20, 2010, explosion of the Deepwater Horizon oil rig affected sea turtles in the Gulf of Mexico. This extensive oiling event contaminated important sea turtle foraging, migratory, and breeding habitats at the surface, in the water column, on the ocean bottom, and on beaches throughout the northern Gulf of Mexico in areas used by different life stages. Sea turtles were exposed to oil when in contaminated water or habitats; breathing oil droplets, oil vapors, and smoke; ingesting oil-contaminated water and prey; and potentially by maternal transfer of oil compounds to embryos (DWH NRDA Trustees 2016). Response activities and shoreline oiling also directly injured sea turtles and disrupted or deterred sea turtle nesting in the Gulf.

During direct at-sea capture events, more than 900 turtles were sighted, 574 of which were captured and examined for oiling (Stacy 2012). Of the turtles captured during these operations, greater than 80% were visibly oiled (DWH NRDA Trustees 2016). Most of the rescued turtles were taken to rehabilitation facilities; more than 90% of the turtles admitted to rehabilitation centers eventually recovered and were released (Stacy 2012; Stacy and Innis 2012). Recovery efforts also included relocating nearly 300 sea turtle nests from the northern Gulf to the east coast of Florida in 2010, with the goal of preventing hatchlings from entering the oiled waters of the northern Gulf. Approximately 14,000 hatchlings were released off the Atlantic coast of Florida, 95% of which were loggerheads (<http://www.nmfs.noaa.gov/pr/health/oilspill/gulf2010.htm>).

Direct observations of the effects of oil on turtles obtained by at-sea captures, sightings, and strandings only represent a fraction of the scope of the injury. As such, the DWH NRDA Trustees used expert opinion, surface oiling maps, and statistical approaches to apply the directly observed adverse effects of oil exposure to turtles in areas and at times that could not be surveyed. The Trustees estimated that between 4,900 and up to 7,600 large juvenile and adult sea turtles (Kemp's ridleys, loggerheads, and hard-shelled sea turtles not identified to species), and between 55,000 and 160,000 small juvenile sea turtles (Kemp's ridleys, green turtles,

loggerheads, hawksbills, and hard-shelled sea turtles not identified to species) were killed by the DWH oil spill (DWH NRDA Trustees 2016). Nearly 35,000 hatchling sea turtles (loggerheads, Kemp's ridleys, and green turtles) were also injured by response activities. Despite uncertainties and some unquantified injuries to sea turtles (e.g., injury to leatherbacks, unrealized reproduction), the Trustees conclude that this assessment adequately quantifies the nature and magnitude of injuries to sea turtles caused by the DWH oil spill and related activities.

Based on this quantification of sea turtle injuries caused by the DWH oil spill, sea turtles from all life stages and all geographic areas were lost from the northern Gulf of Mexico ecosystem. The DWH NRDA Trustees (2016) conclude that the recovery of sea turtles in the northern Gulf of Mexico from injuries caused by the DWH oil spill will require decades of sustained efforts to reduce the most critical threats and enhance survival of turtles at multiple life stages. The ultimate population level effects of the spill and impacts of the associated response activities are likely to remain unknown for some period into the future.

4.2.1.1 Status of Loggerhead Sea Turtles – Northwest Atlantic DPS

The loggerhead is the most abundant species of sea turtle in U.S. waters. Loggerhead sea turtles are found in temperate and subtropical waters and occupy a range of habitats including offshore waters, continental shelves, bays, estuaries, and lagoons. They are also exposed to a variety of natural and anthropogenic threats in the terrestrial and marine environment.

Listing History

Loggerhead sea turtles were listed as threatened throughout their global range on July 28, 1978. Since that time, several status reviews have been conducted to review the status of the species and make recommendations regarding its ESA listing status. Based on a 2007 five-year status review of the species, which discussed a variety of threats to loggerheads including climate change, NMFS and U.S. FWS (2007a) determined that loggerhead sea turtles should not be delisted or reclassified as endangered. However, it was also determined that an analysis and review of the species should be conducted in the future to determine whether DPSs should be identified for the loggerhead (NMFS and U.S. FWS 2007a). Genetic differences exist between loggerhead sea turtles that nest and forage in the different ocean basins (Bowen 2003; Bowen and Karl 2007). Differences in the maternally inherited mitochondrial DNA also exist between loggerhead nesting groups that occur within the same ocean basin (TEWG 2000; Pearce 2001; Bowen 2003; Bowen *et al.* 2005; Shamblin 2007; TEWG 2009; NMFS and U.S. FWS 2008). Site fidelity of females to one or more nesting beaches in an area is believed to account for these genetic differences (TEWG 2000; Bowen 2003).

In part to evaluate those genetic differences, in 2008, NMFS and U.S. FWS established a Loggerhead Biological Review Team (BRT) to assess the global loggerhead population structure to determine whether DPSs exist and, if so, the status of each DPS. The BRT evaluated genetic data, tagging and telemetry data, demographic information, oceanographic features, and geographic barriers to determine whether population segments exist. The BRT report was completed in August 2009 (Conant *et al.* 2009). In this report, the BRT identified the following nine DPSs as being discrete from other conspecific population segments and significant to the species: (1) North Pacific Ocean, (2) South Pacific Ocean, (3) North Indian Ocean, (4) Southeast

Indo-Pacific Ocean, (5) Southwest Indian Ocean, (6) Northwest Atlantic Ocean, (7) Northeast Atlantic Ocean, (8) Mediterranean Sea, and (9) South Atlantic Ocean.

The BRT concluded that although some DPSs are indicating increasing trends at nesting beaches (Southwest Indian Ocean and South Atlantic Ocean), available information about anthropogenic threats to juveniles and adults in neritic and oceanic environments indicate possible unsustainable additional mortalities. According to an analysis using expert opinion in a matrix model framework, the BRT report stated that all loggerhead DPSs have the potential to decline in the foreseeable future. Based on the threat matrix analysis, the potential for future decline was reported as greatest for the North Indian Ocean, Northwest Atlantic Ocean, Northeast Atlantic Ocean, Mediterranean Sea, and South Atlantic Ocean DPSs (Conant *et al.* 2009). The BRT concluded that the North Pacific Ocean, South Pacific Ocean, North Indian Ocean, Southeast Indo-Pacific Ocean, Northwest Atlantic Ocean, Northeast Atlantic Ocean, and Mediterranean Sea DPSs were at risk of extinction. The BRT concluded that although the Southwest Indian Ocean and South Atlantic Ocean DPSs were likely not currently at immediate risk of extinction, the extinction risk was likely to increase in the foreseeable future.

On March 16, 2010, NMFS and U.S. FWS published a proposed rule (75 FR 12598) to divide the worldwide population of loggerhead sea turtles into nine DPSs, as described in the 2009 Status Review. Two of the DPSs were proposed to be listed as threatened and seven of the DPSs, including the Northwest Atlantic Ocean DPS, were proposed to be listed as endangered. NMFS and U.S. FWS accepted comments on the proposed rule through September 13, 2010 (75 FR 30769, June 2, 2010). On March 22, 2011 (76 FR 15932), NMFS and U.S. FWS extended the date by which a final determination on the listing action would be made to no later than September 16, 2011. This action was taken to address the interpretation of the existing data on status and trends and its relevance to the assessment of risk of extinction for the Northwest Atlantic Ocean DPS, as well as the magnitude and immediacy of the fisheries bycatch threat and measures to reduce this threat. New information or analyses to help clarify these issues were requested by April 11, 2011.

On September 22, 2011, NMFS and U.S. FWS issued a final rule (76 FR 58868), determining that the loggerhead sea turtle is composed of nine DPSs (as defined in Conant *et al.* 2009) that constitute species that may be listed as threatened or endangered under the ESA. Five DPSs were listed as endangered (North Pacific Ocean, South Pacific Ocean, North Indian Ocean, Northeast Atlantic Ocean, and Mediterranean Sea), and four DPSs were listed as threatened (Northwest Atlantic Ocean, South Atlantic Ocean, Southeast Indo-Pacific Ocean, and Southwest Indian Ocean). Note that the Northwest Atlantic Ocean (NWA) DPS and the Southeast Indo-Pacific Ocean DPS were originally proposed as endangered. The NWA DPS was determined to be threatened based on review of nesting data available after the proposed rule was published, information provided in public comments on the proposed rule, and further discussions within the agencies. The two primary factors considered were population abundance and population trend. NMFS and U.S. FWS found that an endangered status for the NWA DPS was not warranted given the large size of the nesting population, the overall nesting population remains widespread, the trend for the nesting population appears to be stabilizing, and substantial conservation efforts are underway to address threats. This final listing rule became effective on October 24, 2011.

The September 2011 final rule also noted that critical habitat for the two DPSs occurring within the U.S. (NWA DPS and North Pacific DPS) would be designated in a future rulemaking. Information from the public related to the identification of critical habitat, essential physical or biological features for this species, and other relevant impacts of a critical habitat designation was solicited. On July 10, 2014, U.S. FWS and NMFS published two separate final rules in the Federal Register designating critical habitat for the NWA DPS of loggerhead sea turtles under the ESA (79 FR 39755 for nesting beaches under U.S. FWS jurisdiction; 79 FR 39856 for marine areas under NMFS jurisdiction). Effective August 11, 2014, NMFS's final rule for marine areas designated 38 occupied areas within the at-sea range of the DPS. These recently designated marine areas of critical habitat contain one or a combination of: nearshore reproductive habitat, overwintering habitat, breeding habitat, migratory habitat, and *Sargassum* habitat.

Presence of Loggerhead Sea Turtles in the Action Area

The effects of the proposed action are only experienced within Virginia's nearshore and coastal waters and its portion of Chesapeake Bay and associated river mouths. We have considered the available information on the distribution of the nine DPSs to determine the origin of any loggerhead sea turtles that may occur in the action area. As noted in Conant *et al.* (2009), the range of the four DPSs occurring in the Atlantic Ocean are as follows: NWA DPS – north of the equator, south of 60° N latitude, and west of 40° W longitude; Northeast Atlantic Ocean (NEA) DPS – north of the equator, south of 60° N latitude, east of 40° W longitude, and west of 5° 36' W longitude; South Atlantic DPS – south of the equator, north of 60° S latitude, west of 20° E longitude, and east of 60° W longitude; Mediterranean DPS – the Mediterranean Sea east of 5° 36' W longitude. These boundaries were determined based on oceanographic features, loggerhead sightings, thermal tolerance, fishery bycatch data, and information on loggerhead distribution from satellite telemetry and flipper tagging studies. While adults are highly structured with no overlap, there may be some degree of overlap by juveniles of the NWA, NEA, and Mediterranean DPSs on oceanic foraging grounds (Laurent *et al.* 1993, 1998; Bolten *et al.* 1998; LaCasella *et al.* 2005; Carreras *et al.* 2006; Monzón-Argüello *et al.* 2006; Revelles *et al.* 2007). Previous literature (Bowen *et al.* 2004) has suggested that there is the potential, albeit small, for some juveniles from the Mediterranean DPS to be present in U.S. Atlantic coastal foraging grounds. These conclusions must be interpreted with caution however, as they may be representing a shared common haplotype and lack of representative sampling at Eastern Atlantic rookeries rather than an actual presence of Mediterranean DPS turtles in U.S. Atlantic coastal waters. A re-analysis of the data by the Atlantic Loggerhead Turtle Expert Working Group has found that that it is unlikely that U.S. fishing fleets are interacting with either the NEA or Mediterranean DPS (Peter Dutton, NMFS, Marine Turtle Genetics Program, Program Leader, personal communication, September 10, 2011). Given that the action area is a very small subset of the area fished by U.S. fleets, it is reasonable to assume that based on this analysis, no individuals from the NEA or Mediterranean DPS would be present in the action area. Sea turtles of the South Atlantic DPS do not inhabit the action area of this consultation (Conant *et al.* 2009). As such, the remainder of this consultation will focus on the NWA DPS, listed as threatened.

Distribution and Life History

Ehrhart *et al.* (2003) provided a summary of the literature identifying known nesting habitats and foraging areas for loggerheads within the Atlantic Ocean. Detailed information is also provided

in the five-year status review for loggerheads (NMFS and U.S. FWS 2007a), the TEWG (2009) report, and the final revised recovery plan for loggerheads in the Northwest Atlantic Ocean (NMFS and U.S. FWS 2008), which is a second revision to the original recovery plan that was approved in 1984 and subsequently revised in 1991.

In the western Atlantic, waters as far north as the Gulf of Maine and the Canadian Maritimes are used for foraging by juveniles as well as adults (Shoop 1987; Shoop and Kenney 1992; Ehrhart *et al.* 2003; Mitchell *et al.* 2003; NEFSC 2011a). In U.S. Atlantic waters, loggerheads commonly occur throughout the inner continental shelf from Florida to Cape Cod, Massachusetts and in the Gulf of Mexico from Florida to Texas, although their presence varies with the seasons due to changes in water temperature (Shoop and Kenney 1992; Epperly *et al.* 1995a, 1995b; Braun and Epperly 1996; Mitchell *et al.* 2003; Braun-McNeill *et al.* 2008). Loggerheads have been observed in waters with surface temperatures of 7°C to 30°C, but water temperatures $\geq 11^\circ\text{C}$ are most favorable (Shoop and Kenney 1992; Epperly *et al.* 1995b). The presence of loggerhead sea turtles in U.S. Atlantic waters is also influenced by water depth. Aerial surveys of continental shelf waters north of Cape Hatteras, North Carolina indicated that loggerhead sea turtles were most commonly sighted in waters with bottom depths ranging from 22 to 49 meters deep (Shoop and Kenney 1992). However, more recent survey and satellite tracking data support that they occur in waters from the beach to beyond the continental shelf (Mitchell *et al.* 2003; Braun-McNeill and Epperly 2004; Mansfield 2006; Blumenthal *et al.* 2006; Hawkes *et al.* 2006; McClellan and Read 2007; Mansfield *et al.* 2009).

Loggerhead sea turtles occur year round in ocean waters off North Carolina, South Carolina, Georgia, and Florida. In these areas of the South Atlantic Bight, water temperature is influenced by the proximity of the Gulf Stream. As coastal water temperatures warm in the spring, loggerheads begin to migrate to inshore waters of the Southeast U.S. (e.g., Pamlico and Core Sounds) and also move up the U.S. Atlantic coast (Epperly *et al.* 1995a, 1995b, 1995c; Braun-McNeill and Epperly 2004), occurring in Virginia foraging areas as early as April/May and on the most northern foraging grounds in the Gulf of Maine in June (Shoop and Kenney 1992). The trend is reversed in the fall as water temperatures cool. The large majority leave the Gulf of Maine by mid-September but some turtles may remain in Mid-Atlantic and Northeast areas until late fall. By December, loggerheads have migrated from inshore and more northern coastal waters to waters offshore of North Carolina, particularly off of Cape Hatteras, and waters further south where the influence of the Gulf Stream provides temperatures favorable to sea turtles (Shoop and Kenney 1992; Epperly *et al.* 1995b).

Recent studies have established that the loggerhead's life history is more complex than previously believed. Rather than making discrete developmental shifts from oceanic to neritic environments, research is showing that both adults and (presumed) neritic stage juveniles continue to use the oceanic environment and will move back and forth between the two habitats (Witzell 2002; Blumenthal *et al.* 2006; Hawkes *et al.* 2006; McClellan and Read 2007; Mansfield *et al.* 2009). One of the studies tracked the movements of adult post-nesting females and found that differences in habitat use were related to body size with larger adults staying in coastal waters and smaller adults traveling to oceanic waters (Hawkes *et al.* 2006). A tracking study of large juveniles found that the habitat preferences of this life stage were also diverse with some remaining in neritic waters and others moving off into oceanic waters (McClellan and Read

2007). However, unlike the Hawkes *et al.* (2006) study, there was no significant difference in the body size of turtles that remained in neritic waters versus oceanic waters (McClellan and Read 2007).

Pelagic and benthic juveniles are omnivorous and forage on crabs, mollusks, jellyfish, and vegetation at or near the surface (Dodd 1988; NMFS and U.S. FWS 2008). Sub-adult and adult loggerheads are primarily coastal dwelling and typically prey on benthic invertebrates such as mollusks and decapod crustaceans in hard bottom habitats (NMFS and U.S. FWS 2008). As presented below, Table 3 from the 2008 loggerhead recovery plan (Table 1 in this Opinion) highlights the key life history parameters for loggerheads nesting in the U.S.

Population Dynamics and Status

By far, the majority of Atlantic nesting occurs on beaches of the southeastern U.S. (NMFS and U.S. FWS 2007a). For the past decade or so, the scientific literature has recognized five distinct nesting groups, or subpopulations, of loggerhead sea turtles in the Northwest Atlantic, divided geographically as follows: (1) a northern group of nesting females that nest from North Carolina to northeast Florida at about 29° N latitude; (2) a south Florida group of nesting females that nest from 29° N latitude on the east coast to Sarasota on the west coast; (3) a Florida Panhandle group of nesting females that nest around Eglin Air Force Base and the beaches near Panama City, Florida; (4) a Yucatán group of nesting females that nest on beaches of the eastern Yucatán Peninsula, Mexico; and (5) a Dry Tortugas group that nests on beaches of the islands of the Dry Tortugas, near Key West, Florida and on Cal Sal Bank (TEWG 2009). Genetic analyses of mitochondrial DNA, which a sea turtle inherits from its mother, indicate that there are genetic differences between loggerheads that nest at and originate from the beaches used by each of the five identified nesting groups of females (TEWG 2009). However, analyses of microsatellite loci from nuclear DNA, which represents the genetic contribution from both parents, indicates little to no genetic differences between loggerheads originating from nesting beaches of the five Northwest Atlantic nesting groups (Pearce and Bowen 2001; Bowen 2003; Bowen *et al.* 2005; Shamblin 2007). These results suggest that female loggerheads have site fidelity to nesting beaches within a particular area, while males provide an avenue of gene flow between nesting groups by mating with females that originate from different nesting groups (Bowen 2003; Bowen *et al.* 2005). The extent of such gene flow, however, is unclear (Shamblin 2007).

The lack of genetic structure makes it difficult to designate specific boundaries for the nesting subpopulations based on genetic differences alone. Therefore, the Loggerhead Recovery Team recently used a combination of geographic distribution of nesting densities, geographic separation, and geopolitical boundaries, in addition to genetic differences, to reassess the designation of these subpopulations to identify recovery units in the 2008 recovery plan.

Table 1: Typical values of life history parameters for loggerheads nesting in the U.S.

Life History Parameter	Data
Clutch size	100-126 eggs ¹
Egg incubation duration (varies depending on time of year and latitude)	42-75 days ^{2,3}
Pivotal temperature (incubation temperature that produces an equal number of males and females)	29.0°C ⁵
Nest productivity (emerged hatchlings/total eggs) x 100 (varies depending on site specific factors)	45-70% ^{2,6}
Clutch frequency (number of nests/female/season)	3-5.5 nests ⁷
Internesting interval (number of days between successive nests within a season)	12-15 days ⁸
Juvenile (<87 cm CCL) sex ratio	65-70% female ⁴
Remigration interval (number of years between successive nesting migrations)	2.5-3.7 years ⁹
Nesting season	late April-early September
Hatching season	late June-early November
Age at sexual maturity	32-35 years ¹⁰
Life span	>57 years ¹¹

¹ Dodd 1988.

² Dodd and Mackinnon (1999, 2000, 2001, 2002, 2003, 2004).

³ Blair Witherington, FFWCC, personal communication, 2006 (information based on nests monitored throughout Florida beaches in 2005, n=865).

⁴ National Marine Fisheries Service (2001); Allen Foley, FFWCC, personal communication, 2005.

⁵ Mrosovsky (1988).

⁶ Blair Witherington, FFWCC, personal communication, 2006 (information based on nests monitored throughout Florida beaches in 2005, n=1,680).

⁷ Murphy and Hopkins (1984); Frazer and Richardson (1985); Ehrhart, unpublished data; Hawkes *et al.* 2005; Scott 2006; Tony Tucker, Mote Marine Laboratory, personal communication, 2008.

⁸ Caldwell (1962), Dodd (1988).

⁹ Richardson *et al.* (1978); Bjørndal *et al.* (1983); Ehrhart, unpublished data.

¹⁰ Melissa Snover, NMFS, personal communication, 2005; see Table A1-6.

¹¹ Dahlen *et al.* (2000).

In the 2008 recovery plan, the Loggerhead Recovery Team designated five recovery units for the Northwest Atlantic population of loggerhead sea turtles based on the aforementioned nesting groups and inclusive of a few other nesting areas not mentioned above. The first four of these recovery units represent nesting assemblages located in the Southeast U.S. The fifth recovery unit is composed of all other nesting assemblages of loggerheads within the Greater Caribbean, outside the U.S., but which occur within U.S. waters during some portion of their lives. The five recovery units representing nesting assemblages are: (1) the Northern Recovery Unit (NRU: Florida/Georgia border through southern Virginia), (2) the Peninsular Florida Recovery Unit (PFRU: Florida/Georgia border through Pinellas County, Florida), (3) the Dry Tortugas Recovery Unit (DTRU: islands located west of Key West, Florida), (4) the Northern Gulf of Mexico Recovery Unit (NGMRU: Franklin County, Florida through Texas), and (5) the Greater Caribbean Recovery Unit (GCRU: Mexico through French Guiana, Bahamas, Lesser Antilles, and Greater Antilles).

The Loggerhead Recovery Team evaluated the status and trends of the Northwest Atlantic loggerhead population for each of the five recovery units, using nesting data available as of October 2008 (NMFS and U.S. FWS 2008). The level and consistency of nesting coverage varies among recovery units, with coverage in Florida generally being the most consistent and thorough over time. Since 1989, nest count surveys in Florida have occurred in the form of statewide surveys (a near complete census of entire Florida nesting) and index beach surveys (Witherington *et al.* 2009). Index beaches were established to standardize data collection methods and maintain a constant level of effort on key nesting beaches over time.

NMFS and U.S. FWS (2008), Witherington *et al.* (2009), and TEWG (2009) analyzed the status of the nesting assemblages within the NWA DPS using standardized data collected over periods ranging from 10-23 years. These analyses used different analytical approaches, but found the same finding that there had been a significant, overall nesting decline within the NWA DPS. However, with the addition of nesting data from 2008 to 2017, the trend line changes, showing a strong positive trend since 2007 (<http://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/>). The nesting data presented in the Recovery Plan (through 2008) is described below, with updated trend information through 2010 for two recovery units.

From the beginning of standardized index surveys in 1989 until 1998, the PFRU, the largest nesting assemblage in the Northwest Atlantic by an order of magnitude, had a significant increase in the number of nests. However, from 1998 through 2008, there was a 41% decrease in annual nest counts from index beaches, which represent an average of 70% of the statewide nesting activity (NMFS and U.S. FWS 2008). From 1989-2008, the PFRU had an overall declining nesting trend of 26% (95% CI: -42% to -5%; NMFS and U.S. FWS 2008). With the addition of nesting data through 2010, the nesting trend for the PFRU does not show a nesting decline statistically different from zero (76 FR 58868, September 22, 2011). The NRU, the second largest nesting assemblage of loggerheads in the U.S., has been declining at a rate of 1.3% annually since 1983 (NMFS and U.S. FWS 2008). The NRU dataset included 11 beaches with an uninterrupted time series of coverage of at least 20 years; these beaches represent approximately 27% of NRU nesting (in 2008). Through 2008, there was strong statistical data to suggest the NRU has experienced a long-term decline, but with the inclusion of nesting data through 2010, nesting for the NRU is showing possible signs of stabilizing (76 FR 58868, September 22, 2011). Evaluation of long-term nesting trends for the NGMRU is difficult because of changed and expanded beach coverage. However, the NGMRU has shown a significant declining trend of 4.7% annually since index nesting beach surveys were initiated in 1997 (NMFS and U.S. FWS 2008). No statistical trends in nesting abundance can be determined for the DTRU because of the lack of long-term data. Similarly, statistically valid analyses of long-term nesting trends for the entire GCRU are not available because there are few long-term standardized nesting surveys representative of the region. Additionally, changing survey effort at monitored beaches and scattered and low-level nesting by loggerheads at many locations currently precludes comprehensive analyses (NMFS and U.S. FWS 2008).

Sea turtle census nesting surveys are important in that they provide information on the relative abundance of nesting each year, and the contribution of each nesting group to total nesting of the species. Nest counts can also be used to estimate the number of reproductively mature females nesting annually. The 2008 recovery plan compiled information on mean number of loggerhead

nests and the approximated counts of nesting females per year for four of the five identified recovery units (i.e., nesting groups). They are: (1) for the NRU, a mean of 5,215 loggerhead nests per year (from 1989-2008) with approximately 1,272 females nesting per year; (2) for the PFRU, a mean of 64,513 nests per year (from 1989-2007) with approximately 15,735 females nesting per year; (3) for the DTRU, a mean of 246 nests per year (from 1995-2004, excluding 2002) with approximately 60 females nesting per year; and (4) for the NGMRU, a mean of 906 nests per year (from 1995-2007) with approximately 221 females nesting per year. For the GCRU, the only estimate available for the number of loggerhead nests per year is from Quintana Roo, Yucatán, Mexico, where a range of 903-2,331 nests per year was estimated from 1987-2001 (NMFS and U.S. FWS 2007a). There are no annual nest estimates available for the Yucatán since 2001 or for any other regions in the GCRU, nor are there any estimates of the number of nesting females per year for any nesting assemblage in this recovery unit. Note that the above values for average nesting females per year were based upon 4.1 nests per female per Murphy and Hopkins (1984).

Genetic studies of juvenile and a few adult loggerhead sea turtles collected from Northwest Atlantic foraging areas (beach strandings, a power plant in Florida, and North Carolina fisheries) show that the loggerheads that occupy U.S. East Coast waters originate from these Northwest Atlantic nesting groups; primarily from the nearby nesting beaches of southern Florida, as well as the northern Florida to North Carolina beaches, and finally from the beaches of the Yucatán Peninsula, Mexico (Rankin-Baransky *et al.* 2001; Witzell *et al.* 2002; Bass *et al.* 2004; Bowen *et al.* 2004). The contribution of these three nesting assemblages varies somewhat among the foraging habitats and age classes surveyed along the east coast. The distribution is not random and bears a significant relationship to the proximity and size of adjacent nesting colonies (Bowen *et al.* 2004). Bass *et al.* (2004) attribute the variety in the proportions of sea turtles from loggerhead nesting assemblages documented in different east coast foraging habitats to a complex interplay of currents and the relative size and proximity of nesting beaches.

Unlike nesting surveys, in-water studies of sea turtles typically sample both sexes and multiple age classes. In-water studies have been conducted in some areas of the Northwest Atlantic and provide data by which to assess the relative abundance of loggerhead sea turtles and changes in abundance over time (Maier *et al.* 2004; Morreale *et al.* 2005; Mansfield 2006; Ehrhart *et al.* 2007; Epperly *et al.* 2007). The TEWG (2009) used raw data from six in-water study sites to conduct trend analyses. They identified an increasing trend in the abundance of loggerheads from three of the four sites located in the Southeast U.S., one site showed no discernible trend, and the two sites located in the northeast U.S. showed a decreasing trend in abundance of loggerheads. The 2008 loggerhead recovery plan also includes a full discussion of in-water population studies for which trend data have been reported, and a brief summary will be provided here.

Maier *et al.* (2004) used fishery-independent trawl data to establish a regional index of loggerhead abundance for the southeast coast of the U.S. (Winyah Bay, South Carolina to St. Augustine, Florida) during the period 2000-2003. A comparison of loggerhead catch data from this study with historical values suggested that in-water populations of loggerhead sea turtles along the southeast U.S. coast appear to be larger, possibly an order of magnitude higher than they were 25 years ago, but the authors caution a direct comparison between the two studies given differences in sampling methodology (Maier *et al.* 2004). A comparison of catch rates for

sea turtles in pound net gear fished in the Pamlico-Albemarle Estuarine Complex of North Carolina between the years 1995-1997 and 2001-2003 found a significant increase in catch rates for loggerhead sea turtles for the latter period (Epperly *et al.* 2007). A long-term, on-going study of loggerhead abundance in the Indian River Lagoon System of Florida found a significant increase in the relative abundance of loggerheads over the last four years of the study (Ehrhart *et al.* 2007). However, there was no discernible trend in loggerhead abundance during the 24-year time period of the study (1982-2006) (Ehrhart *et al.* 2007). At St. Lucie Power Plant, data collected from 1977-2004 show an increasing trend of loggerheads at the power plant intake structures (FPL and Quantum Resources 2005).

In contrast to these studies, Morreale *et al.* (2005) observed a decline in the percentage and relative numbers of loggerhead sea turtles incidentally captured in pound net gear fished around Long Island, New York during the period 2002-2004 in comparison to the period 1987-1992, with only two loggerheads (of a total 54 turtles) observed captured in pound net gear during the period 2002-2004. This is in contrast to the previous decade's study where numbers of individual loggerheads ranged from 11 to 28 per year (Morreale *et al.* 2005). No additional loggerheads were reported captured in pound net gear in New York through 2007, although two were found cold-stunned on Long Island bay beaches in the fall of 2007 (Memo to the File, L. Lankshear, December 2007). Potential explanations for this decline include major shifts in loggerhead foraging areas and/or increased mortality in pelagic or early benthic stage/age classes (Morreale *et al.* 2005). Using aerial surveys, Mansfield (2006) also found a decline in the densities of loggerhead sea turtles in Chesapeake Bay over the period 2001-2004 compared to aerial survey data collected in the 1980s. Significantly fewer loggerheads ($p < 0.05$) were observed in both the spring (May-June) and the summer (July-August) of 2001-2004 compared to those observed during aerial surveys in the 1980s (Mansfield 2006). A comparison of median densities from the 1980s to the 2000s suggested that there had been a 63.2% reduction in densities during the spring residency period and a 74.9% reduction in densities during the summer residency period (Mansfield 2006). The decline in observed loggerhead populations in Chesapeake Bay may be related to a significant decline in prey, namely horseshoe crabs and blue crabs, with loggerheads redistributing outside of Bay waters (NMFS and U.S. FWS 2008).

As with other turtle species, population estimates for loggerhead sea turtles are difficult to determine, largely given their life history characteristics. However, a recent loggerhead assessment using a demographic matrix model estimated that the loggerhead adult female population in the western North Atlantic ranges from 16,847 to 89,649, with a median size of 30,050 (SEFSC 2009). The model results for population trajectory suggest that the population is most likely declining, but this result was very sensitive to the choice of the position of the parameters within their range and hypothesized distributions. The pelagic stage survival parameter had the largest effect on the model results. As a result of the large uncertainty in our knowledge of loggerhead life history, at this point predicting the future populations or population trajectories of loggerhead sea turtles with precision is very uncertain. It should also be noted that additional analyses are underway which will incorporate any newly available information.

As part of the Atlantic Marine Assessment Program for Protected Species (AMAPPS), line transect aerial abundance surveys and turtle telemetry studies were conducted along the U.S. Atlantic coast in the summer of 2010. AMAPPS is a multi-agency initiative to assess marine

mammal, sea turtle, and seabird abundance and distribution in the Atlantic. Aerial surveys were conducted from Cape Canaveral, Florida to the Gulf of St. Lawrence, Canada. Satellite tags on juvenile loggerheads were deployed in two locations – off the coasts of northern Florida to South Carolina (n=30) and off the New Jersey and Delaware coasts (n=14). As presented in NEFSC (2011a), the 2010 survey found a preliminary total surface abundance estimate within the entire study area of about 60,000 loggerheads (CV=0.13) or 85,000 if a portion of unidentified hard-shelled sea turtles were included (CV=0.10). Surfacing times were generated from the satellite tag data collected during the aerial survey period, resulting in a 7% (5%-11% inter-quartile range) median surface time in the South Atlantic area and a 67% (57%-77% inter-quartile range) median surface time to the north. The calculated preliminary regional abundance estimate is about 588,000 loggerheads along the U.S. Atlantic coast, with an inter-quartile range of 382,000-817,000 (NEFSC 2011a). The estimate increases to approximately 801,000 (inter-quartile range of 521,000-1,111,000) when based on known loggerheads and a portion of unidentified turtle sightings. The density of loggerheads was generally lower in the north than the south; based on number of turtle groups detected, 64% were seen south of Cape Hatteras, North Carolina, 30% in the southern Mid-Atlantic Bight, and 6% in the northern Mid-Atlantic Bight. Although they have been seen farther north in previous studies (e.g., Shoop and Kenney 1992), no loggerheads were observed during the aerial surveys conducted in the summer of 2010 in the more northern zone encompassing Georges Bank, Cape Cod Bay, and the Gulf of Maine. These estimates of loggerhead abundance over the U.S. Atlantic continental shelf are considered very preliminary. A more thorough analysis will be completed pending the results of further studies related to improving estimates of regional and seasonal variation in loggerhead surface time (by increasing the sample size and geographical area of tagging) and other information needed to improve the biases inherent in aerial surveys of sea turtles (e.g., research on depth of detection and species misidentification rate). This survey effort represents the most comprehensive assessment of sea turtle abundance and distribution in many years. Additional aerial and vessel surveys as well as tagging research to improve abundance estimates of loggerheads have continued through 2017.

Threats

The diversity of a loggerhead sea turtle's life history leaves them susceptible to many natural and human impacts, including impacts while they are on land, in the neritic environment, and in the oceanic environment. The five-year status review and 2008 recovery plan provide a summary of natural as well as anthropogenic threats to loggerhead sea turtles (NMFS and U.S. FWS 2007a, 2008). Amongst those of natural origin, hurricanes are known to be destructive to sea turtle nests. Sand accretion, rainfall, and wave action that result from these storms can appreciably reduce hatchling success. Other sources of natural mortality include cold-stunning, biotoxin exposure, and native species predation.

Anthropogenic factors that impact hatchlings and adult females on land, or the success of nesting and hatching include: beach erosion, beach armoring, and nourishment; artificial lighting; beach cleaning; beach pollution; increased human presence; recreational beach equipment; vehicular and pedestrian traffic; coastal development/construction; exotic dune and beach vegetation; removal of native vegetation; and poaching. An increased human presence at some nesting beaches or close to nesting beaches has led to secondary threats such as the introduction of exotic fire ants, feral hogs, dogs, and an increased presence of native species (e.g., raccoons, armadillos, and opossums), which raid nests and feed on turtle eggs (NMFS and U.S. FWS 2007a, 2008).

Although sea turtle nesting beaches are protected along large expanses of the Northwest Atlantic coast (in areas like Merritt Island, Archie Carr, and Hobe Sound National Wildlife Refuges), other areas along these coasts have limited or no protection. Sea turtle nesting and hatching success on unprotected high density East Florida nesting beaches from Indian River to Broward County are affected by all of the above threats.

Loggerheads are affected by a completely different set of anthropogenic threats in the marine environment. These include oil and gas exploration, coastal development, and transportation; marine pollution; pile driving and underwater explosions; hopper dredging; offshore artificial lighting; power plant entrainment and/or impingement; entanglement in and ingestion of marine debris; marina and dock construction and operation; boat collisions; poaching; and fishery interactions (including both commercial and recreational fisheries).

A 1990 National Research Council (NRC) report concluded that for juveniles, subadults, and breeding adults in coastal waters, the most important source of human caused mortality in U.S. Atlantic waters was fishery interactions. The sizes and reproductive values of sea turtles taken by fisheries vary significantly, depending on the location and season of the fishery, and size-selectivity resulting from gear characteristics. Therefore, it is possible for fisheries that interact with fewer, more reproductively valuable turtles to have a greater detrimental effect on the population than one that takes greater numbers of less reproductively valuable turtles (Wallace *et al.* 2008). The Loggerhead Biological Review Team determined that the greatest threats to the NWA DPS of loggerheads result from cumulative fishery bycatch in neritic and oceanic habitats (Conant *et al.* 2009). Attaining a more thorough understanding of the characteristics, as well as the quantity of sea turtle bycatch across all fisheries is of great importance.

Finkbeiner *et al.* (2011) compiled cumulative sea turtle bycatch information in U.S. fisheries from 1990 through 2007, before and after implementation of bycatch mitigation measures. Information was obtained from peer reviewed publications and NMFS documents (e.g., Opinions and bycatch reports). In the Atlantic, a mean estimate of 137,700 bycatch interactions, of which 4,500 were mortalities, occurred annually (since implementation of bycatch mitigation measures). Kemp's ridleys interacted with fisheries most frequently, with the highest level of mean annual mortality (2,700), followed by loggerheads (1,400), greens (300), and leatherbacks (40). The Southeast/Gulf of Mexico shrimp trawl fishery was responsible for the vast majority of U.S. interactions (up to 98%) and mortalities (more than 80%). While this provides an initial cumulative bycatch assessment, there are a number of caveats that should be considered when interpreting this information, such as sampling inconsistencies and limitations.

Of the many fisheries known to adversely affect loggerheads, the U.S. South Atlantic and Gulf of Mexico shrimp fisheries were considered to pose the greatest threat of mortality to neritic juvenile and adult age classes of loggerheads (NRC 1990, Finkbeiner *et al.* 2011). Significant changes to the U.S. South Atlantic and Gulf of Mexico shrimp fisheries have occurred since 1990, and the effects of these shrimp fisheries on ESA-listed species, including loggerhead sea turtles, have been assessed several times through section 7 consultation. There is also a lengthy regulatory history with regard to the use of Turtle Excluder Devices (TEDs) in the U.S. South Atlantic and Gulf of Mexico shrimp fisheries (Epperly and Teas 2002; NMFS 2002; Lewison *et al.* 2003). A section 7 consultation on the U.S. South Atlantic and Gulf of Mexico shrimp

fisheries completed in 2002 estimated the total annual level of loggerhead interactions to be 163,160 (the total number of turtles that enter a shrimp trawl, which may then escape through the TED or fail to escape and be captured) with 3,948 of those being lethal (NMFS 2002).

In addition to improvements in TED designs and TED enforcement, interactions between loggerheads and the shrimp fishery have also been declining because of reductions in fishing effort unrelated to fisheries management actions. The 2002 Opinion take estimates were based in part on fishery effort levels. In recent years, low shrimp prices, rising fuel costs, competition with imported products, and the impacts of recent hurricanes in the Gulf of Mexico have all impacted the shrimp fleets; in some cases reducing fishing effort by as much as 50% for offshore waters of the Gulf of Mexico (GMFMC 2007). As a result, loggerhead interactions and mortalities in the Gulf of Mexico have been substantially less than were projected in the 2002 Opinion. In 2008, the NMFS Southeast Fisheries Science Center (SEFSC) estimated annual number of interactions between loggerheads and shrimp trawls in the Gulf of Mexico shrimp fishery to be 23,336, with 647 (2.8%) of those interactions resulting in mortality (Memo from Dr. B. Ponwith, Southeast Fisheries Science Center to Dr. R. Crabtree, Southeast Region, PRD, December 2008). However, the most recent section 7 consultation on the shrimp fishery, completed in April 2014, was unable to estimate the total annual level of loggerhead interactions at present. Instead, it qualitatively estimated that the shrimp fishery, as currently operating, would result in at least thousands and possibly tens of thousands of interactions annually, of which at least hundreds and possibly thousands are expected to be lethal (NMFS 2014).

Loggerhead sea turtles are also known to interact with non-shrimp trawl, gillnet, longline, dredge, pound net, pot/trap, and hook and line fisheries. The NRC (1990) report stated that other U.S. Atlantic fisheries collectively accounted for 500 to 5,000 loggerhead deaths each year, but recognized that there was considerable uncertainty in the estimate. The reduction of sea turtle captures in fishing operations is identified in recovery plans and five-year status reviews as a priority for the recovery of all sea turtle species. In the threats analysis of the loggerhead recovery plan, trawl bycatch is identified as the greatest source of mortality. Loggerhead bycatch in U.S. Mid-Atlantic bottom otter trawl gear has been previously estimated for the periods of 1996-2004 (Murray 2008) and 2005-2008 (Warden 2011a, 2011b), with the most recent bycatch analysis estimating the number of loggerhead sea turtle interactions with U.S. Mid-Atlantic bottom trawl gear from 2009-2013 (Murray 2015a). From 2009-2013, a total of 1,156 loggerheads (95% CI: 908-1,488) were estimated to have interacted with bottom trawl gear in the U.S. Mid-Atlantic, of which 479 resulted in mortality. That equates to an annual average of 231 loggerhead interactions (95% CI: 182-298) for the period of 2009-2013. The total number of estimated interactions from 2009-2013 was equivalent to 166 adults, of which 68 resulted in mortality (Murray 2015a). Compared to other gear types worldwide, trawls have higher adult equivalent interactions, and therefore a greater impact on loggerhead populations, due to the co-occurrence of trawling effort with larger, more mature turtles (Wallace *et al.* 2008). The trawl fishery targeting Atlantic croaker in the southern Mid-Atlantic had the highest turtle interactions among fisheries investigated, which may be due to larger mesh sizes in the mouth of the trawl and high headline height of the gear. Murray (2015a) found that retained catch, depth, latitude, and sea surface temperature (SST) were associated with the interaction rate, with the rates being highest south of 37°N latitude in warm, shallow (<50 meters deep) waters. This estimate is a decrease from the average annual loggerhead bycatch in U.S. Mid-Atlantic bottom otter trawls

during the 1996-2004 and 2005-2008 time periods, which were estimated to be 616 (95% CI: 367-890) and 352 turtles (95% CI: 276-439), respectively (Murray 2008; Warden 2011a, 2011b; Murray 2015a).

There have been several published estimates of the number of loggerheads interacting annually with the dredge fishery for Atlantic sea scallops, ranging from a low of zero in 2005 (Murray 2007) to a high of 749 in 2003 (Murray 2004). Murray (2011) re-evaluated loggerhead sea turtle interactions in scallop dredge gear from 2001-2008. In that paper, the average number of annual observable interactions of hard-shelled sea turtles in the Mid-Atlantic scallop dredge fishery prior to the implementation of chain mats (January 1, 2001 through September 25, 2006) was estimated to be 288 turtles (95% CI: 209-363) [equivalent to 49 adults], 218 of which were loggerheads [equivalent to 37 adults]. After the implementation of chain mats, the average annual number of observable interactions was estimated to be 20 hard-shelled sea turtles (95% CI: 3-42), 19 of which were loggerheads. If the rate of observable interactions from dredges without chain mats had been applied to trips with chain mats, the estimated number of observable and inferred interactions of hard-shelled sea turtles after chain mats were implemented would have been 125 turtles per year (95% CI: 88-163) [equivalent to 22 adults], 95 of which were loggerheads [equivalent to 16 adults]. Interaction rates of hard-shelled turtles were correlated with SST, depth, and use of a chain mat. Results from that analysis suggested that chain mats and fishing effort reductions contributed to the decline in estimated loggerhead sea turtle interactions with scallop dredge gear after 2006 (Murray 2011). A more recent analysis has indicated that the average annual observable sea turtle interactions in the Mid-Atlantic scallop dredge fishery plus unobserved, quantifiable interactions was 22 loggerheads per year (95% CI: 4-67), 9-19 of which were lethal (Murray 2015b). The 22 interactions equate to two adult equivalents per year and 1-2 adult equivalent mortalities. Thus, estimated interactions in the scallop dredge fishery have decreased relative to 2001-2008, although the utility of observers as a monitoring tool for turtle interactions in the fishery seems to be decreasing (Murray 2015b). This is due to the lack of observed turtle interactions in dredges equipped with bycatch reduction devices chain mats and turtle deflectors. Still, observers continue to monitor the scallop dredge fishery for sea turtle interactions, documenting the use of chain mats and turtle deflectors, and recording sea turtle interactions outside of the gear-regulated time and areas (Murray 2015b).

An estimate of the number of loggerheads interacting annually with U.S. Mid-Atlantic gillnet fisheries has also recently been published (Murray 2013). From 2007-2011, an annual average of 95 hard-shelled sea turtles (95% CI: 60-138) and 89 loggerheads (equivalent to nine adults) were estimated to have interacted with U.S. Mid-Atlantic gillnet gear. An estimated 52 annual loggerhead interactions (equivalent to five adults) were considered to result in mortality. Gillnet trips landing monkfish had the highest estimated number of loggerhead and hard-shelled sea turtle interactions during 2007-2011. Estimated rates and interactions have decreased relative to those from 1996-2006. Bycatch rates were correlated with latitude, SST, and mesh size. High interaction rates are estimated in the southern Mid-Atlantic, in warm surface temperature water, and in large-mesh gillnets; findings which are consistent with prior loggerhead bycatch analyses (Murray 2013).

The U.S. tuna and swordfish longline fisheries that are managed under the Highly Migratory Species (HMS) Fishery Management Plan (FMP) are estimated to capture 1,905 loggerheads (no

more than 339 mortalities) for each three-year period starting in 2007 (NMFS 2004b). NMFS has mandated gear changes for the HMS fishery to reduce sea turtle bycatch and the likelihood of death from those incidental takes that would still occur (Garrison and Stokes 2017). In 2015, there were 30 observed interactions between loggerhead sea turtles and longline gear used in the HMS fishery (Garrison and Stokes 2017). All of the loggerheads were released alive, with 14 out of 30 (47%) released with all gear removed. A total of 242.6 (95% CI: 161.9-363.6) loggerhead sea turtles were estimated to have interacted with the longline fisheries managed under the HMS FMP in 2015 based on the observed bycatch events (Garrison and Stokes 2017).

Including the 2015 estimate, loggerhead interactions since 2000 have been below the historical highs that occurred in the mid-1990s (Garrison and Stokes 2017). Following the implementation of regulations, the bycatch dropped in 2005, but rebounded to be similar to the pre-regulation period. There appears to be a cyclical pattern in loggerhead bycatch rate occurring at four-year intervals since 1996 with a generally increasing trend over a four-year period, followed by a sharp decline. This cycle continued during the 2010-2015 period. The 2014 and 2015 estimates remain relatively low and seem to be consistent with an overall downward trend since the late 1990s. Notably, the estimate for 2015 was consistent with that from 2014 despite a sharp decline in fishing effort (Garrison and Stokes 2017). This fishery represents just one of several longline fisheries operating in the Atlantic Ocean. Lewison *et al.* (2004) estimated that 150,000-200,000 loggerheads were taken in all Atlantic longline fisheries in 2000 (including the U.S. Atlantic tuna and swordfish longline fisheries as well as others).

Documented interactions also occur in other fishery gear types and by non-fishery mortality sources (e.g., hopper dredges, power plants, vessel collisions), although quantitative/qualitative estimates are only available for activities on which NMFS has consulted.

The most recent Recovery Plan for loggerhead sea turtles as well as the 2009 Status Review Report identifies global climate change as a threat to loggerhead sea turtles. However, trying to assess the likely effects of climate change on loggerhead sea turtles is extremely difficult given the uncertainty in all climate change models and the difficulty in determining the likely rate of temperature increases and the scope and scale of any accompanying habitat effects. Additionally, no significant climate change-related impacts to loggerhead sea turtle populations have been observed to date. Over the long-term, climate change related impacts are expected to influence biological trajectories on a century scale (Parmesan and Yohe 2003). As noted in the 2009 Status Review (Conant *et al.* 2009), impacts from global climate change induced by human activities are likely to become more apparent in future years (IPCC 2007). Climate change related increasing temperatures, sea level rise, changes in ocean productivity, and increased frequency of storm events may affect loggerhead sea turtles.

Increasing temperatures are expected to result in rising sea levels (Titus and Narayanan 1995 in Conant *et al.* 2009), which could result in increased erosion rates along nesting beaches. Sea level rise could result in the inundation of nesting sites and decrease available nesting habitat (Daniels *et al.* 1993; Fish *et al.* 2005; Baker *et al.* 2006). The BRT noted that the loss of habitat as a result of climate change could be accelerated due to a combination of other environmental and oceanographic changes such as an increase in the frequency of storms and/or changes in prevailing currents, both of which could lead to increased beach loss via erosion (Antonelis *et al.*

2006; Baker *et al.* 2006; both in Conant *et al.* 2009). Along developed coastlines, and especially in areas where erosion control structures have been constructed to limit shoreline movement, rising sea levels may cause severe effects on nesting females and their eggs as nesting females may deposit eggs seaward of the erosion control structures potentially subjecting them to repeated tidal inundation. However, if global temperatures increase and there is a range shift northwards, beaches not currently used for nesting may become available for loggerhead sea turtles, which may offset some loss of accessibility to beaches in southern portions of the range.

Climate change also has the potential to result in changes at nesting beaches that may affect loggerhead sex ratios. Loggerhead sea turtles exhibit temperature-dependent sex determination. Rapidly increasing global temperatures may result in warmer incubation temperatures and highly female-biased sex ratios (e.g., Glen and Mrosovsky 2004; Hawkes *et al.* 2009); however, to the extent that nesting can occur at beaches further north where sand temperatures are not as warm, these effects may be partially offset. The BRT specifically identified climate change as a threat to loggerhead sea turtles in the neritic/oceanic zone where climate change may result in future trophic changes, thus impacting loggerhead prey abundance and/or distribution. In the threats matrix analysis, climate change was considered for oceanic juveniles and adults as well as for eggs/hatchlings. The report states that for oceanic juveniles and adults, “although the effect of trophic level change from...climate change...is unknown it is believed to be very low.” For eggs/hatchlings, the report states that total mortality from anthropogenic causes, including sea level rise resulting from climate change, is believed to be low relative to the entire life stage. However, only limited data are available on past trends related to climate effects on loggerhead sea turtles; current scientific methods are not able to reliably predict the future magnitude of climate change, associated impacts, whether and to what extent some impacts will offset others, or the adaptive capacity of this species.

While there is a reasonable degree of certainty that certain climate change related effects will be experienced globally (e.g., rising temperatures and changes in precipitation patterns), due to a lack of scientific data, the specific effects to sea turtles resulting from climate change, and the severity of and rate at which these impacts will occur, are not predictable or quantifiable at this time (Hawkes *et al.* 2009). Nonetheless, it is likely that once climate change impacts get to a certain level, there will be feedback loops that may cause indications of climate change (e.g., increases in greenhouse gas concentrations, rising global temperatures, and sea level rise) to get much worse much more quickly (Torn and Harte 2006).

In terms of “climate forcing” (which is different from what we are defining as “climate change,” in that it also factors in the effects of cyclical climate patterns such as the North Atlantic and Pacific Decadal Oscillations in addition to ongoing effects from anthropogenically-induced changes in climate under Intergovernmental Panel on Climate Change [IPCC] projections), Van Houtan and Halley (2011) recently developed climate-based models to investigate loggerhead nesting in the Northwest Atlantic and North Pacific. These models, which considered juvenile recruitment and breeding remigration, found that climate conditions/oceanographic influences explain loggerhead nesting variability, with climate models alone explaining an average of 60% (range 18%-88%) of the observed nesting changes over the past several decades. Hindcasts indicate that climatic conditions may have been a factor in past nesting declines in both the Atlantic and Pacific. However, in terms of future nesting projections, modeled climate data show

a future positive trend for Atlantic nesting in Florida, with substantial increases through 2040 as a result of the Atlantic Multidecadal Oscillation signal (Van Houton and Halley 2011). Thus, independent of any dramatic losses of sea turtle nesting habitat in the Northwest Atlantic due to climate change, NWA DPS loggerheads are expected to increase their nesting output over the next few decades. Van Houton and Halley (2011) did not project nesting trends in the Northwest Atlantic beyond 2040 as forecasting beyond that point was not deemed possible given their methods. Much like our analyses of climate change, climate forcing analyses can only predict so far into the future.

Summary of Status for the Northwest Atlantic DPS of Loggerhead Sea Turtles

Loggerheads continue to be affected by many factors occurring on nesting beaches and in the water. These include poaching, habitat loss, and nesting predation that affects eggs, hatchlings, and nesting females on land, as well as fishery interactions, vessel interactions, marine pollution, and non-fishery (e.g., dredging) operations affecting all sexes and age classes in the water (NRC 1990; NMFS and U.S. FWS 2007a, 2008). As a result, loggerheads still face many of the original threats that were the cause of their listing under the ESA.

As mentioned previously, a final revised recovery plan for loggerhead sea turtles in the Northwest Atlantic was published by NMFS and U.S. FWS in December 2008. The revised recovery plan is significant in that it identifies five unique recovery units, which comprise the population of loggerheads in the Northwest Atlantic, and describes specific recovery criteria for each recovery unit. The recovery plan noted a decline in annual nest counts for three of the five recovery units for loggerheads in the Northwest Atlantic, including the PFRU, which is the largest (in terms of number of nests laid) in the Atlantic Ocean. The nesting trends for the other two recovery units could not be determined due to an absence of long term data.

NMFS convened a new Loggerhead Turtle Expert Working Group (TEWG) to review all available information on Atlantic loggerheads in order to evaluate the status of this species in the Atlantic. A final report from the Loggerhead TEWG was published in July 2009. In this report, the TEWG indicated that it could not determine whether the decreasing annual numbers of nests among the Northwest Atlantic loggerhead subpopulations were due to stochastic processes resulting in fewer nests, a decreasing average reproductive output of adult females, decreasing numbers of adult females, or a combination of these factors. Many factors are responsible for past or present loggerhead mortality that could impact current nest numbers; however, no single mortality factor stands out as a likely primary factor. It is likely that several factors compound to create the current decline, including incidental capture (in fisheries, power plant intakes, and dredging operations), lower adult female survival rates, increases in the proportion of first-time nesters, continued directed harvest, and increases in mortality due to disease. Regardless, the TEWG stated that “it is clear that the current levels of hatchling output will result in depressed recruitment to subsequent life stages over the coming decades” (TEWG 2009). However, the report does not provide information on the rate or amount of expected decrease in recruitment but goes on to state that the ability to assess the current status of loggerhead stocks is limited due to a lack of fundamental life history information and specific census and mortality data.

While several documents reported the decline in nesting numbers in the NWA DPS (NMFS and U.S. FWS 2008, TEWG 2009), when nest counts through 2010 are analyzed, the nesting trends

from 1989-2010 are not significantly different than zero for all recovery units within the NWA DPS for which there are enough data to analyze (76 FR 58868, September 22, 2011). The SEFSC (2009) estimated the number of adult females in the NWA DPS at 30,000, and if a 1:1 adult sex ratio is assumed, the result is 60,000 adults in this DPS. Based on the reviews of nesting data, as well as information on population abundance and trends, NMFS and U.S. FWS determined in the September 2011 listing rule that the NWA DPS should be listed as threatened. They found that an endangered status for the NWA DPS was not warranted given the large size of the nesting population, the overall nesting population remains widespread, the trend for the nesting population appears to be stabilizing, and substantial conservation efforts are underway to address threats.

4.2.1.2 Status of Kemp's Ridley Sea Turtles

Distribution and Life History

The Kemp's ridley is one of the least abundant of the world's sea turtle species. In contrast to loggerhead, green, and leatherback sea turtles, which are found in multiple oceans of the world, Kemp's ridleys typically occur only in the Gulf of Mexico and the northwestern Atlantic Ocean (NMFS *et al.* 2011).

Kemp's ridleys likely mature at 10-18 years of age (Caillouet *et al.* 1995; Schmid and Witzell 1997; Shaver and Wibbels 2007; Snover *et al.* 2007; NMFS and U.S. FWS 2015). Nesting occurs from April through July each year with hatchlings emerging after 45-58 days (NMFS *et al.* 2011). Females lay an average of 2.5 clutches within a season (TEWG 1998, 2000) and the mean remigration interval for adult females is two years (Márquez *et al.* 1982; TEWG 1998, 2000). Once they leave the nesting beach, hatchlings presumably enter the Gulf of Mexico where they feed on available *Sargassum* and associated infauna or other epipelagic species (NMFS *et al.* 2011). The presence of juvenile turtles along both the U.S. Atlantic and Gulf of Mexico coasts, where they are recruited to the coastal benthic environment, indicates that post-hatchlings are distributed in both the Gulf of Mexico and Atlantic Ocean (TEWG 2000).

The location and size classes of dead turtles recovered by the Sea Turtle Stranding and Salvage Network (STSSN) suggests that benthic immature developmental areas occur along the U.S. coast and that these areas may change given resource quality and quantity (TEWG 2000). Developmental habitats are defined by several characteristics, including coastal areas sheltered from high winds and waves such as embayments and estuaries, and nearshore temperate waters shallower than 50 meters (NMFS and U.S. FWS 2015). The suitability of these habitats depends on resource availability, with optimal environments providing rich sources of crabs and other invertebrates. Kemp's ridleys consume a variety of crab species, including *Callinectes*, *Ovalipes*, *Libinia*, and *Cancer* species. Mollusks, shrimp, and fish are consumed less frequently (Bjorndal 1997). A wide variety of substrates have been documented to provide good foraging habitat, including seagrass beds, oyster reefs, sandy and mud bottoms, and rock outcroppings (NMFS and U.S. FWS 2015).

Foraging areas documented along the U.S. Atlantic coast include Charleston Harbor, Pamlico Sound (Epperly *et al.* 1995c), Chesapeake Bay (Musick and Limpus 1997), Delaware Bay (Stetzar 2002), and Long Island Sound (Morreale and Standora 1993; Morreale *et al.* 2005). For

instance, in the Chesapeake Bay, Kemp's ridleys frequently forage in submerged aquatic grass beds for crabs (Musick and Limpus 1997). Upon leaving Chesapeake Bay in the fall, juvenile Kemp's ridleys migrate down the coast, passing Cape Hatteras in December and January (Musick and Limpus 1997). These larger juveniles are joined by juveniles of the same size from North Carolina and smaller juveniles from New York and New England to form one of the densest concentrations of Kemp's ridleys outside of the Gulf of Mexico (Epperly *et al.* 1995a, 1995b; Musick and Limpus 1997).

Adult Kemp's ridleys are found in the coastal regions of the Gulf of Mexico and southeastern U.S., but are typically rare in the northeastern U.S. waters of the Atlantic (TEWG 2000). Adults are primarily found in nearshore waters of 68 meters or less (mean 33.2 ± 25.3 kilometers from shore) that are rich in crabs and have a sandy or muddy bottom (NMFS and U.S. FWS 2015).

Population Dynamics and Status

The majority of Kemp's ridleys nest along a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Carr 1963; NMFS *et al.* 2011; NMFS and U.S. FWS 2015). There is a limited amount of scattered nesting to the north and south of the primary nesting beach (NMFS and U.S. FWS 2015). Nesting often occurs in synchronized emergences termed *arribadas*. The number of recorded nests reached an estimated low of 702 nests in 1985, estimated to be fewer than 250 adult females nesting in that season (TEWG 2000; NMFS *et al.* 2011; NMFS and U.S. FWS 2015). Conservation efforts by Mexican and U.S. agencies have aided this species by eliminating egg harvest, protecting eggs and hatchlings, and reducing at-sea mortality through fishing regulations (TEWG 2000). From the mid-1980s to the early 2000s, the number of nests observed at Rancho Nuevo and nearby beaches increased 14-16% per year (Heppell *et al.* 2005), allowing cautious optimism that the population was on its way to recovery. The total number of nests for all of Mexico was 22,458 in 2012 (the highest nesting total recorded since 1947), but fell back to 16,944 in 2013 and 12,060 in 2014. Based on an average of 2.5 nests per female per nesting season (NMFS *et al.* 2011), the total number of nests on Mexico beaches represented about 8,984 nesting females in 2012, 6,778 in 2013, and 4,824 in 2014 (NMFS and U.S. FWS 2015). The most recent five-year review (NMFS and U.S. FWS 2015) suggested that the population growth rate (measured by numbers of nests) stopped abruptly after 2009, possibly due to the Deepwater Horizon oil spill and other anthropogenic factors such as fisheries bycatch and climate change. Given the lower nesting numbers from 2009-2014, the population was not projected to grow at former rates in 2015. Recent data, however, indicates an increase in nesting. In 2015 there were 14,006 recorded nests in Mexico, and in 2016 overall numbers increased to 18,354 recorded nests (Gladys Porter Zoo 2016). Preliminary information indicates a record high nesting season in 2017, with 24,570 nests recorded on Mexican beaches (J. Pena, pers. comm., 2017). At this time, it is unclear if future Kemp's ridley nesting will steadily and continuously increase, similar to what occurred from 1990-2009, or if nesting will continue to exhibit sporadic declines and increases as recorded in the past eight years.

A small nesting population is also emerging in the U.S., primarily at Padre Island National Seashore in Texas, rising from six nests in 1996, to 42 in 2004, to a record high of 353 nests in 2017 (<https://www.nps.gov/pais/learn/nature/2017-nesting-season.htm>). It is worth noting that nesting in Texas has paralleled the trends observed in Mexico, with an overall increase in nests

from 2000-2009, a significant decline in 2010, an all-time high in 2012, followed by a second decline in 2013-2014, and a rebound from 2015-2017 (NMFS and U.S. FWS 2015).

Threats

Kemp's ridley sea turtles face many of the same natural threats as loggerheads, including destruction of nesting habitat from storm events, predators, and oceanographic-related events such as cold-stunning. Although cold-stunning can occur throughout the range of the species, it may be a greater risk for Kemp's ridleys that use the more northern habitats of Cape Cod Bay and Long Island Sound. From 2009-2013, the number of cold-stunned Kemp's ridleys on Massachusetts beaches averaged 185 turtles (NMFS unpublished data). The numbers ranged from a low of 132 in 2011 to a high of 235 in 2012. However, in 2014, the number of cold-stunned Kemp's ridleys documented in Massachusetts skyrocketed to 1,179, of which 466 died (NMFS unpublished data). In 2015, the total number of Kemp's ridley cold stunning events in Massachusetts dropped to 464 (NMFS unpublished data), which is still a good deal above the annual average of cold-stunned Kemp's ridleys observed from 2009-2013. As evidenced by these recent increases, annual cold stun events can vary greatly in magnitude. The extent of episodic major cold stun events may be associated with numbers of sea turtles utilizing Northeast U.S. waters in a given year, oceanographic conditions, and/or the occurrence of storm events in the late fall. Although many cold-stunned turtles can survive if they are found early enough, these events represent a significant source of natural mortality for Kemp's ridley sea turtles.

Like other sea turtle species, the severe decline in the Kemp's ridley population appears to have been heavily influenced by a combination of exploitation of eggs and impacts from fishery interactions. From the 1940s through the early 1960s, nests from Ranch Nuevo were heavily exploited, but beach protection in 1967 helped to curtail this activity (NMFS *et al.* 2011). Following World War II, there was a substantial increase in the number of trawl vessels, particularly shrimp trawlers, in the Gulf of Mexico where adult Kemp's ridley sea turtles occur. Information from fisheries observers helped to demonstrate the high number of turtles captured in these shrimp trawls (U.S. FWS and NMFS 1992). Subsequently, NMFS has worked with the industry to reduce sea turtle captures in shrimp trawls and other trawl fisheries, including the development and use of TEDs. As described above, there is lengthy regulatory history on the use of TEDs in the U.S. South Atlantic and Gulf of Mexico shrimp fisheries (NMFS 2002; Epperly 2003; Lewison *et al.* 2003). The 2002 Opinion on shrimp trawling in the southeastern U.S. concluded that 155,503 Kemp's ridley sea turtles would be captured annually in the fishery with 4,208 of the captures resulting in mortality (NMFS 2002).

Although modifications to shrimp trawls have helped to reduce mortality of Kemp's ridleys, a recent assessment found that the Southeast/Gulf of Mexico shrimp trawl fishery remained responsible for the vast majority of U.S. fishery interactions (up to 98%) and mortalities (more than 80%). Finkbeiner *et al.* (2011) compiled cumulative sea turtle bycatch information in U.S. fisheries from 1990 through 2007, before and after implementation of bycatch mitigation measures. Information was obtained from peer reviewed publications and NMFS documents (e.g., Opinions and bycatch reports). In the Atlantic, a mean estimate of 137,700 bycatch interactions, of which 4,500 were mortalities, occurred annually (since implementation of bycatch mitigation measures). Kemp's ridleys interacted with fisheries most frequently, with the highest level of mean annual mortality (2,700), followed by loggerheads (1,400), greens (300),

and leatherbacks (40). While this provides an initial cumulative bycatch assessment, there are a number of caveats that should be considered when interpreting this information, such as sampling inconsistencies and limitations. The most recent section 7 consultation on the shrimp fishery, completed in April 2014, was unable to estimate the total annual level of Kemp's ridley interactions occurring in the fishery. Instead, it qualitatively estimated that the shrimp fishery, as currently operating, would result in at least tens of thousands and possibly hundreds of thousands of interactions annually, of which at least thousands and possibly tens of thousands are expected to be lethal (NMFS 2014).

This species is also affected by other sources of anthropogenic impact (fishery and non-fishery related), similar to those discussed above. One Kemp's ridley capture in Mid-Atlantic trawl fisheries was documented by NMFS observers between 2009 and 2013 (Murray 2015b), and five Kemp's ridleys were documented by NMFS observers in Mid-Atlantic sink gillnet fisheries between 2007 and 2011 (Murray 2013). Additionally, in the spring of 2000, five Kemp's ridley carcasses were recovered from the same North Carolina beaches where 275 loggerhead carcasses were found. The cause of death for most of the turtles recovered was unknown, but the mass mortality event was suspected by NMFS to have been from a large-mesh gillnet fishery for monkfish and dogfish operating offshore in the preceding weeks (67 FR 71895, December 3, 2002). The five Kemp's ridley carcasses that were found are likely to have been only a minimum count of the number of Kemp's ridleys that were killed or seriously injured as a result of the fishery interaction, since it is unlikely that all of the carcasses washed ashore. The NEFSC also documented 14 Kemp's ridleys entangled in or impinged on Virginia pound net leaders from 2002-2005. Note that bycatch estimates for Kemp's ridleys in various fishing gear types (e.g., trawl, gillnet, dredge) are not available at this time, largely due to the low number of observed interactions precluding a robust estimate. Kemp's ridley interactions in non-fisheries have also been observed; for example, the Oyster Creek Nuclear Generating Station in Barnegat Bay, New Jersey, recorded a total of 56 Kemp's ridleys (36 of which were found alive) impinged or captured on their intake screens from 1992-2011 (NMFS 2011).

The recovery plan for Kemp's ridley sea turtles (NMFS *et al.* 2011) identifies climate change as a threat; however, as with the other species discussed above, no significant climate change-related impacts to Kemp's ridley sea turtles have been observed to date. Atmospheric warming could cause habitat alteration which may change food resources such as crabs and other invertebrates. It may increase hurricane activity, leading to an increase in debris in nearshore and offshore waters, which may result in an increase in entanglement, ingestion, or drowning. In addition, increased hurricane activity may cause damage to nesting beaches or inundate nests with sea water. Atmospheric warming may change convergence zones, currents, and other oceanographic features that are relevant to Kemp's ridleys, as well as change rain regimes and levels of nearshore runoff.

Considering that the Kemp's ridley has temperature-dependent sex determination (Wibbels 2003) and the vast majority of the nesting range is restricted to the State of Tamaulipas, Mexico, global warming could potentially shift population sex ratios towards females and thus change the reproductive ecology of this species. A female bias is presumed to increase egg production (assuming that the availability of males does not become a limiting factor) (Coyne and Landry 2007) and increase the rate of recovery; however, it is unknown at what point the percentage of

males may become insufficient to facilitate maximum fertilization rates in a population. If males become a limiting factor in the reproductive ecology of the Kemp's ridley, then reproductive output in the population could decrease (Coyne 2000). Low numbers of males could also result in the loss of genetic diversity within a population; however, there is currently no evidence that this is a problem in the Kemp's ridley population (NMFS *et al.* 2011). Models (Davenport 1997, Hulin and Guillon 2007, Hawkes *et al.* 2007, all referenced in NMFS *et al.* 2011) predict very long-term reductions in fertility in sea turtles due to climate change, but due to the relatively long life cycle of sea turtles, reductions may not be seen until 30 to 50 years in the future.

Another potential impact from global climate change is sea level rise, which may result in increased beach erosion at nesting sites. Beach erosion may be accelerated due to a combination of other environmental and oceanographic changes such as an increase in the frequency of storms and/or changes in prevailing currents. In the case of the Kemp's ridley where most of the critical nesting beaches are undeveloped, beaches may shift landward and still be available for nesting. The Padre Island National Seashore shoreline is accreting, unlike much of the Texas coast, and with nesting increasing and sand temperatures slightly cooler than at Rancho Nuevo, Padre Island could become an increasingly important source of males for the population.

As with the other sea turtle species discussed in this section, while there is a reasonable degree of certainty that certain climate change related effects will be experienced globally (e.g., rising temperatures and changes in precipitation patterns), due to a lack of scientific data, the specific effects of climate change on this species are not predictable or quantifiable at this time (Hawkes *et al.* 2009). Based on the most recent five-year status review (NMFS and U.S. FWS 2015), and following from the climate change discussion on loggerheads, significant impacts from climate change in the future are to be expected, but the severity of and rate at which these impacts will occur is currently unknown.

Summary of Status for Kemp's Ridley Sea Turtles

The majority of Kemp's ridleys nest along a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Carr 1963; NMFS *et al.* 2011; NMFS and U.S. FWS 2015). The number of nesting females in the Kemp's ridley population declined dramatically from the late 1940s through the mid-1980s, with an estimated 40,000 nesting females in a single *arribada* in 1947 and fewer than 300 nesting females in the entire 1985 nesting season (TEWG 2000; NMFS *et al.* 2011). However, the total annual number of nests at Rancho Nuevo gradually began to increase in the 1990s and 2000s (NMFS and U.S. FWS 2015). Based on an average of 2.5 nests per female per nesting season (NMFS *et al.* 2011), the total number of nests on Mexico beaches represented about 4,824 nesting females in 2014 (NMFS and U.S. FWS 2015). The number of adult males in the population is unknown, but sex ratios of hatchlings and immature Kemp's ridleys suggest that the population is female-biased, suggesting that the number of adult males is less than the number of adult females (NMFS and U.S. FWS 2015). While there is still potential for recovery, factors such as the Deepwater Horizon oil spill, an overall decrease in the number of nests since 2009, climate change, and stranding events associated increased skimmer trawl use and poor TED compliance in the northern Gulf of Mexico may have dampened recent population growth.

As with the other sea turtle species, fishery mortality accounts for a large proportion of annual human-caused mortality outside the nesting beaches, while other activities like dredging, pollution, and habitat destruction also contribute to annual human caused mortality, but the levels are unknown. A revised bi-national recovery plan was published in September 2011 by the NMFS, U.S. FWS, and the Secretary of Environment and Natural Resources, Mexico (SEMARNAT) to address these ongoing threats. Based on their recent five-year status review of the species, NMFS and U.S. FWS (2015) determined that Kemp's ridley sea turtles should remain classified as endangered under the ESA and that the Recovery Priority Number for the species be changed from a '5' to a '1.' A recovery priority 1 is defined as a species whose extinction is almost certain in the immediate future because of a rapid population decline or habitat destruction, whose limiting factors and threats are well understood and the needed management actions are known and have a high probability of success, and is a species that is in conflict with construction or other developmental projects or other forms of economic activity.

4.2.1.3 Status of Green Sea Turtles – North Atlantic DPS

Green sea turtles are distributed circumglobally, occurring throughout tropical, subtropical waters, and, to a lesser extent, temperate waters. They can be found in the Pacific, Indian, and Atlantic Oceans as well as the Mediterranean Sea (NMFS and U.S. FWS 1991, 2007b; Seminoff 2004; Seminoff *et al.* 2015). Their movements within the marine environment are not fully understood, but it is believed that green sea turtles inhabit coastal waters of over 140 countries (Groombridge and Luxmoore 1989).

Listing History

The green sea turtle was originally listed under the ESA on July 28, 1978 (43 FR 32800). Breeding populations of the green sea turtle in Florida and along the Pacific coast of Mexico were listed as endangered; while all other populations were listed as threatened. The major factors contributing to its status at the time included human encroachment and associated activities on nesting beaches; commercial harvest of eggs, subadults, and adults; predation; lack of comprehensive and consistent protective regulations; and incidental take in fisheries. Marine critical habitat for the green sea turtle was designated on September 2, 1998, for the waters surrounding Culebra Island, Puerto Rico, and its outlying keys (63 FR 46693).

On April 6, 2016, NMFS and U.S. FWS issued a final determination that the green sea turtle is comprised of eleven DPSs, constituting the "species," to be listed as threatened or endangered under the ESA (81 FR 20058). Effective May 6, 2016, three DPSs were listed as endangered, eight as threatened. The April 2016 final rule replaced the 1978 global listing of green sea turtles.

In the final ESA listing decision, NMFS and U.S. FWS listed eleven green sea turtle DPSs distributed globally: (1) North Atlantic (threatened), (2) Mediterranean (endangered), (3) South Atlantic (threatened), (4) Southwest Indian (threatened), (5) North Indian (threatened), (6) East Indian-West Pacific (threatened), (7) Central West Pacific (endangered), (8) Southwest Pacific (threatened), (9) Central South Pacific (endangered), (10) Central North Pacific (threatened), and (11) East Pacific (threatened) (81 FR 20058; April 6, 2016). Based on the best available scientific and commercial data, only one listed DPS is likely to occur in the action area, the threatened North Atlantic DPS. The range of the North Atlantic DPS extends from the boundary

of South and Central America, north along the coast to include Panama, Costa Rica, Nicaragua, Honduras, Belize, Mexico, and the U.S. It extends due east across the Atlantic Ocean at 48°N and follows the coast south to include the northern portion of the Islamic Republic of Mauritania (Mauritania) on the African continent to 19°N. It extends west at 19°N to the Caribbean basin to 65.1°W, then due south to 14°N, 65.1°W, then due west to 14°N, 77°W, and due south to 7.5°N, 77°W, the boundary of South and Central America. It includes Puerto Rico, the Bahamas, Cuba, Turks and Caicos Islands, Republic of Haiti, Dominican Republic, Cayman Islands, and Jamaica. The North Atlantic DPS includes the Florida breeding population, which was originally listed as endangered under the ESA (43 FR 32800; July 28, 1978).

In regards to discreteness, North Atlantic DPS populations of green sea turtles exhibit minimal mixing with the adjacent South Atlantic DPS and no mixing with the adjacent Mediterranean DPS. Occasionally, juvenile turtles from the North Atlantic may settle into foraging grounds in the South Atlantic or Mediterranean, while adult turtles nesting at sites in the equatorial region of the North Atlantic may travel to, and reside at, foraging grounds in the South Atlantic (Troëng *et al.* 2005). However, the reverse (i.e., turtles from the South Atlantic or Mediterranean DPS settling in North Atlantic waters) has yet to be documented. Furthermore, green sea turtles from the Mediterranean DPS appear to be spatially separated from populations in the Atlantic Ocean (Seminoff *et al.* 2015).

Distribution and Life History

Green sea turtles were once the target of directed fisheries in the U.S. and throughout the Caribbean. In 1890, over one million pounds of green sea turtles were captured in a directed fishery in the Gulf of Mexico (Doughty 1984). However, declines in the turtle fishery throughout the Gulf of Mexico were evident by 1902 (Doughty 1984).

In the North Atlantic, large juvenile and adult green sea turtles are largely herbivorous, occurring in habitats containing benthic algae and seagrasses from Massachusetts to Central America, including the Gulf of Mexico and Caribbean (Wynne and Schwartz 1999). Green sea turtles occur seasonally in U.S. Mid-Atlantic and Northeast waters such as Chesapeake Bay and Long Island Sound (Musick and Limpus 1997; Morreale and Standora 1998; Morreale *et al.* 2005), which serve as foraging and developmental habitats.

Some of the principal feeding areas in the North Atlantic Ocean include the upper west coast of Florida, the Florida Keys, and the northwestern coast of the Yucatán Peninsula. Additional important foraging areas in the western Atlantic include the Mosquito and Indian River Lagoon systems and nearshore wormrock reefs between Sebastian and Fort Pierce Inlets in Florida, Florida Bay, the Culebra archipelago and other Puerto Rico coastal waters, the south coast of Cuba, the Mosquito Coast of Nicaragua, and the Caribbean coast of Panama (Hirth 1971).

Age at maturity for green sea turtles is estimated to be 20-50 years (Balazs 1982; Frazer and Ehrhart 1985; Seminoff 2004). Adult females may nest multiple times in a season (average three nests/season with approximately 100 eggs/nest) and typically do not nest in successive years (NMFS and U.S. FWS 1991; Hirth 1997).

Population Dynamics and Status

Nest count information for green sea turtles provides information on the relative abundance of nesting, and the contribution of each nesting group to total nesting of the species. Nest counts can also be used to estimate the number of reproductively mature females nesting annually. The North Atlantic DPS contains an estimated 167,424 females nesting at 73 sites (81 FR 20058).

In 2015, the Green Turtle Status Review Team (SRT) identified those 73 nesting sites within the North Atlantic DPS, although some represent numerous individual beaches. There are four regions that support high density nesting concentrations for which data were available: Costa Rica (Tortuguero), Mexico (Campeche, Yucatan, and Quintana Roo), U.S. (Florida), and Cuba. Nester abundance was assessed by the SRT for 48 nesting sites within the North Atlantic DPS. Abundance was estimated using the best scientific information available. Remigration intervals and clutch frequencies were used to estimate total nester abundance when counts of nesters were not available. In terms of nester distribution, the largest nesting site (Tortuguero, Costa Rica) hosts 79% of total nester abundance (167,528 nesters). There were also 26 nesting sites for which there were qualitative reports of nesting activity but no nesting data: three in the Bahamas, three in Belize, one in Costa Rica, four in Cuba, one in the Dominican Republic, one in Haiti, six in Honduras, two in Jamaica, one in Mauritania, one in Panama, and three in the Turks and Caicos Islands (Seminoff *et al.* 2015). Green turtle nesting populations in the North Atlantic are some of the most studied in the world, with time series exceeding 40 years in Costa Rica and 35 years in Florida. There are seven sites for which ten years or more of recent data are available for annual nester abundance.

By far, the most important nesting concentration for green sea turtles in the North Atlantic DPS is in Tortuguero, Costa Rica (Seminoff *et al.* 2015). This population has been studied since the 1950s and nesting has increased markedly since the early 1970s. From 1971 to 1975, there were approximately 41,250 nesting emergences per year and from 1992 to 1996 there were approximately 72,200 nesting emergences per year (Bjorndal *et al.* 1999). From 1999 to 2003, about 104,411 nests/year were deposited, which corresponds to approximately 17,402–37,290 nesting females each year (Troëng and Rankin 2005). An estimated 180,310 nests were laid during 2010, the highest level of green sea turtle nesting estimated since the start of nesting track surveys in 1971. This equates to 30,052–64,396 nesters in 2010. This increase has occurred despite substantial human impacts to the population at the nesting beach and at foraging areas (Troëng 1998; Campbell and Lagueux 2005; Troëng and Rankin 2005). The number of females nesting per year on beaches in Mexico, Florida, and Cuba number in the hundreds to low thousands, depending on the site (Seminoff *et al.* 2015).

The status of the Florida breeding population was also evaluated in the 2015 status review (Seminoff *et al.* 2015). In Florida, nesting occurs in coastal areas of all regions except the Big Bend area of west central Florida. The bulk of nesting occurs along the Atlantic coast of eastern central Florida, where a mean of 5,055 nests were deposited each year from 2001 to 2005 (Meylan *et al.* 2006) and 10,377 each year from 2008 to 2012 (B. Witherington, Florida Fish and Wildlife Conservation Commission, pers. comm., 2013). Nesting has increased substantially over the last 20 years and peaked in 2011 with 15,352 nests statewide (Chaloupka *et al.* 2008; B. Witherington, Florida Fish and Wildlife Conservation Commission, pers. comm., 2013). The estimated total nester abundance for Florida is 8,426 turtles.

The pattern of green sea turtle nesting shows biennial peaks in abundance, with a generally positive trend since establishment of the Florida index beach surveys in 1989. This trend is perhaps due to increased protective legislation throughout the Caribbean (Meylan *et al.* 1995), as well as protections in Florida and throughout the U.S. (Seminoff *et al.* 2015). The statewide Florida index beach surveys (1989-2017) have shown that green sea turtle nest counts have increased over one hundredfold since 1989, from a low of 267 to a high of almost 39,000 in 2017 (<http://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/>). The last four odd-numbered years (2011, 2013, 2015, and 2017) have all broken previous records for the highest numbers of green sea turtle nests on Florida's index beaches.

Most nesting occurs along the east coast of Florida, but occasional nesting has been documented along the Gulf coast of Florida, at Southwest Florida beaches, as well as the beaches in the Florida Panhandle (Meylan *et al.* 1995). More recently, green sea turtle nesting occurred on Bald Head Island, North Carolina (just east of the mouth of the Cape Fear River), Onslow Island, and Cape Hatteras National Seashore. One green sea turtle nested on a beach in Delaware in 2011, although its occurrence was considered very rare.

Similar to the nesting trend found in Florida, in-water studies in Florida have also recorded increases in green sea turtle captures at the Indian River Lagoon site, with a 661% increase over 24 years (Ehrhart *et al.* 2007), and the St Lucie Power Plant site, with a significant increase in the annual rate of capture of immature green sea turtles (SCL<90 centimeters) from 1977 to 2002 or 26 years (3,557 green sea turtles total; Witherington *et al.* 2006).

Threats

Green sea turtles face many of the same natural threats as loggerhead and Kemp's ridley sea turtles. In addition, green sea turtles appear to be particularly susceptible to fibropapillomatosis, an epizootic disease producing lobe-shaped tumors on the soft portion of a turtle's body. Juveniles appear to have the highest incidence of disease and the most extensive lesions, whereas lesions in nesting adults are rare. Also, green sea turtles frequenting nearshore waters, areas adjacent to large human populations, and areas with low water turnover, such as lagoons, have a higher incidence of the disease than individuals in deeper, more remote waters. The occurrence of fibropapilloma tumors may result in impaired foraging, breathing, or swimming ability, leading potentially to death (George 1997).

Incidental fishery mortality accounts for a large proportion of annual human-caused mortality outside the nesting beaches. Witherington *et al.* (2009) observed that because green sea turtles spend a shorter time in oceanic waters, and as older juveniles occur on shallow seagrass pastures (where benthic trawling is unlikely), they avoid high mortalities in pelagic longline and benthic trawl fisheries. Although the relatively low number of observed green sea turtle captures makes it difficult to estimate bycatch rates and annual levels of interactions, green sea turtles have been observed captured in the pelagic driftnet, pelagic longline, southeast shrimp trawl, and Mid-Atlantic trawl and gillnet fisheries. Two green sea turtle captures in Mid-Atlantic trawl fisheries was documented by NMFS observers between 2009 and 2013 (Murray 2015b), while Murray (2009a) indicated that there were 12 observed captures of green sea turtles in Mid-Atlantic sink gillnet gear between 2007 and 2011.

Finkbeiner *et al.* (2011) compiled cumulative sea turtle bycatch information in U.S. fisheries from 1990 through 2007, before and after implementation of bycatch mitigation measures. Information was obtained from peer reviewed publications and NMFS documents (e.g., Opinions and bycatch reports). In the Atlantic, a mean estimate of 137,700 bycatch interactions, of which 4,500 were mortalities, occurred annually (since implementation of bycatch mitigation measures). Kemp's ridleys interacted with fisheries most frequently, with the highest level of mean annual mortality (2,700), followed by loggerheads (1,400), greens (300), and leatherbacks (40). The Southeast/Gulf of Mexico shrimp trawl fishery was responsible for the vast majority of U.S. interactions (up to 98%) and mortalities (more than 80%). While this provides an initial cumulative bycatch assessment, there are a number of caveats that should be considered when interpreting this information, such as sampling inconsistencies and limitations. The most recent section 7 consultation on the shrimp fishery, completed in April 2014, was unable to estimate the total annual level of green sea turtle interactions occurring in the fishery. Instead, it qualitatively estimated that the shrimp fishery, as currently operating, would result in at least hundreds and possibly low thousands of interactions annually, of which hundreds are expected to be lethal (NMFS 2014).

Other activities like channel dredging, marine debris, pollution, vessel strikes, power plant impingement, and habitat destruction account for an unquantifiable level of other mortality. Stranding reports indicate that between 200-400 green sea turtles strand annually along the eastern U.S. coast from a variety of causes most of which are unknown (STSSN database).

The most recent five-year status review for green sea turtles (Seminoff *et al.* 2015) notes that global climate change is affecting the species and will likely continue to be a threat. There is an increasing female bias in the sex ratio of green sea turtle hatchlings. While this is partly attributable to imperfect egg hatchery practices, global climate change is also implicated as a likely cause, as warmer sand temperatures at nesting beaches are likely to result in the production of more female embryos. Climate change may also impact nesting beaches through sea level rise which may reduce the availability of nesting habitat and increase the risk of nest inundation. Loss of appropriate nesting habitat may also be accelerated by a combination of other environmental and oceanographic changes, such as an increase in the frequency of storms and/or changes in prevailing currents, both of which could lead to increased beach loss via erosion. Oceanic changes related to rising water temperatures could result in changes in the abundance and distribution of the primary food sources of green sea turtles, which in turn could result in changes in behavior and distribution of this species. Seagrass habitats may suffer from decreased productivity and/or increased stress due to sea level rise, as well as salinity and temperature changes (Short and Neckles 1999; Duarte 2002).

As noted above, the increasing female bias in green sea turtle hatchlings is thought to be at least partially linked to increases in temperatures at nesting beaches. However, due to a lack of scientific data, the specific future effects of climate change on green sea turtles species are not predictable or quantifiable to any degree at this time (Hawkes *et al.* 2009). For example, information is not available to predict the extent and rate to which sand temperatures at the nesting beaches used by green sea turtles may increase in the short-term future and the extent to which green sea turtles may be able to cope with this change by selecting cooler areas of the

beach or shifting their nesting distribution to other beaches at which increases in sand temperature may not be experienced. Based on the most recent five-year status review (Seminoff *et al.* 2015), and following from the climate change discussions on the other hard-shelled sea turtle species, significant impacts from climate change in the future are to be expected, but the severity of and rate at which these impacts will occur is currently unknown.

Summary of Status for the North Atlantic DPS of Green Sea Turtles

In the North Atlantic, nesting groups are considered to be doing relatively well (i.e., the number of sites with increasing nesting are greater than the number of sites with decreasing nesting) (Seminoff *et al.* 2015). However, given the late age to maturity for green sea turtles, caution is urged regarding the status of nesting groups in the North Atlantic DPS since no area has a dataset spanning a full green sea turtle generation (Seminoff *et al.* 2015).

Seminoff *et al.* (2015) concluded that green sea turtle abundance is increasing for four nesting sites in the North Atlantic. They also concluded that nesting at Tortuguero, Costa Rica represents the most important nesting area for green sea turtles in the North Atlantic and that nesting at Tortuguero has increased markedly since the 1970s (Seminoff *et al.* 2015). However, the five-year status review also noted that the Tortuguero nesting stock continues to be affected by ongoing directed captures at their primary foraging area in Nicaragua. The breeding population in Florida appears to be increasing rapidly in recent years based upon index nesting data from 1989-2015.

As with the other sea turtle species, fishery mortality accounts for a large proportion of annual human-caused mortality outside the nesting beaches, while other activities like hopper dredging, pollution, and habitat destruction also contribute to human caused mortality, though the level is unknown.

4.2.1.4 Status of Leatherback Sea Turtles

Leatherback sea turtles are widely distributed throughout the oceans of the world, including the Atlantic, Pacific, and Indian Oceans, and the Mediterranean Sea (Ernst and Barbour 1972). Leatherbacks are the largest living turtles and range farther than any other sea turtle species. Their large size and tolerance of relatively low water temperatures allows them to occur in boreal waters such as those off Labrador and in the Barents Sea (NMFS and U.S. FWS 1995).

In 1980, the leatherback population was estimated at approximately 115,000 adult females globally (Pritchard 1982). By 1995, this global population of adult females was estimated to have declined to 34,500 (Spotila *et al.* 1996). The most recent population size estimate for the North Atlantic alone is a range of 34,000-94,000 adult leatherbacks (TEWG 2007). Thus, there is substantial uncertainty with respect to global population estimates of leatherback sea turtles.

Pacific Ocean

Leatherback nesting has been declining at all major Pacific basin nesting beaches for the last two decades (Spotila *et al.* 1996, 2000; NMFS and U.S. FWS 1998, 2013; Sarti *et al.* 2000). The western Pacific major nesting beaches are in Papua New Guinea, Indonesia, Solomon Islands, and Vanuatu, with an approximate 2,700-4,500 total breeding females, estimated from nest

counts (Dutton *et al.* 2007). While there appears to be overall long term population decline, the Indonesian nesting aggregation at Jamursba-Medi is currently stable (since 1999), although there is evidence to suggest a significant and continued decline in leatherback nesting in Papua New Guinea and Solomon Islands over the past 30 years (NMFS 2011). Leatherback sea turtles disappeared from India before 1930, have been virtually extinct in Sri Lanka since 1994, and appear to be approaching extinction in Malaysia (Spotila *et al.* 2000). In Fiji, Thailand, and Australia, leatherbacks have only been known to nest in low densities and scattered sites.

The largest, extant leatherback nesting group in the Indo-Pacific lies on the North Vogelkop coast of West Papua, Indonesia, with 3,000-5,000 nests reported annually in the 1990s (Suárez *et al.* 2000). However, in 1999, local villagers started reporting dramatic declines in sea turtles near their villages (Suárez 1999). Declines in nesting groups have been reported throughout the western Pacific region where observers report that nesting groups are well below abundance levels that were observed several decades ago (e.g., Suárez 1999).

Leatherback sea turtles in the western Pacific are threatened by poaching of eggs, killing of nesting females, human encroachment on nesting beaches, incidental capture in fishing gear, beach erosion, and egg predation by animals.

In the eastern Pacific Ocean, major leatherback nesting beaches are located in Mexico and Costa Rica, where nest numbers have been declining. According to reports from the late 1970s and early 1980s, beaches located on the Mexican Pacific coasts of Michoacán, Guerrero, and Oaxaca sustained a large portion, perhaps 50%, of all global nesting by leatherbacks (Sarti *et al.* 1996). A dramatic decline has been seen on nesting beaches in Pacific Mexico, where aerial survey data was used to estimate that tens of thousands of leatherback nests were laid on the beaches in the 1980s (Pritchard 1982), but a total of only 120 nests on the four primary index beaches (combined) were counted in the 2003-2004 season (Sarti Martinez *et al.* 2007). Since the early 1980s, the Mexican Pacific population of adult female leatherback turtles has declined to slightly more than 200 during 1998-1999 and 1999-2000 (Sarti *et al.* 2000). Spotila *et al.* (2000) reported the decline of the leatherback nesting at Playa Grande, Costa Rica, which had been the fourth largest nesting group in the world and the most important nesting beach in the Pacific. Between 1988 and 1999, the nesting group declined from 1,367 to 117 female leatherback sea turtles. An analysis of the Costa Rican nesting beaches indicates a decline in nesting during 15 years of monitoring (1989-2004) with approximately 1,504 females nesting in 1988-1989 to an average of 188 females nesting in 2000-2001 and 2003-2004 (NMFS and U.S. FWS 2013), indicating that the reductions in nesting females were not as extreme as the reductions predicted by Spotila *et al.* (2000).

On September 26, 2007, NMFS received a petition to revise the critical habitat designation for leatherback sea turtles to include waters along the U.S. West Coast. On December 28, 2007, NMFS published a positive 90-day finding on the petition and convened a critical habitat review team. On January 26, 2012, NMFS published a final rule to revise the critical habitat designation to include three particular areas of marine habitat. The designation includes approximately 16,910 square miles along the California coast from Point Arena to Point Arguello east of the 3,000 meter depth contour, and 25,004 square miles from Cape Flattery, Washington to Cape Blanco, Oregon east of the 2,000 meter depth contour. The areas comprise approximately 41,914

square miles of marine habitat and include waters from the ocean surface down to a maximum depth of 262 feet. The designated critical habitat areas contain the physical or biological feature essential to the conservation of the species that may require special management conservation or protection. In particular, the team identified one Primary Constituent Element: the occurrence of prey species, primarily scyphomedusae of the order Semaestomeae, of sufficient condition, distribution, diversity, abundance and density necessary to support individual as well as population growth, reproduction, and development of leatherbacks.

Leatherbacks in the eastern Pacific face a number of threats to their survival. For example, commercial and artisanal swordfish fisheries off Chile, Columbia, Ecuador, and Peru; purse seine fisheries for tuna in the eastern tropical Pacific Ocean; and California/Oregon drift gillnet fisheries are known to capture, injure, or kill leatherbacks in the eastern Pacific. Given the declines in leatherback nesting in the Pacific, some researchers have concluded that the leatherback is on the verge of extinction in the Pacific Ocean (e.g., Spotila *et al.* 1996, 2000).

Indian Ocean

Leatherbacks nest in several areas around the Indian Ocean. These sites include Tongaland, South Africa (Pritchard 2002) and the Andaman and Nicobar Islands (Andrews *et al.* 2002). Intensive survey and tagging work in 2001 provided new information on the level of nesting in the Andaman and Nicobar Islands (Andrews *et al.* 2002). Based on the survey and tagging work, it was estimated that 400-500 female leatherbacks nest annually on Great Nicobar Island (Andrews *et al.* 2002). The number of nesting females using the Andaman and Nicobar Islands combined was estimated to be around 1,000 (Andrews and Shanker 2002). Some nesting also occurs along the coast of Sri Lanka, although in much smaller numbers than in the past (Pritchard 2002).

Mediterranean Sea

Casale *et al.* (2003) reviewed the distribution of leatherback sea turtles in the Mediterranean. Among the 411 individual records of leatherback sightings in the Mediterranean, there were no nesting records. Nesting in the Mediterranean is believed to be extremely rare if it occurs at all. Leatherbacks found in Mediterranean waters originate from the Atlantic Ocean (P. Dutton, NMFS, unpublished data).

Atlantic Ocean

Distribution and Life History

Evidence from tag returns and strandings in the western Atlantic suggests that adult leatherback sea turtles engage in routine migrations between northern temperate and tropical waters (NMFS and U.S. FWS 1992). Leatherbacks are frequently thought of as a pelagic species that feed on jellyfish (e.g., *Stomolophus*, *Chrysaora*, and *Aurelia* species) and tunicates (e.g., salps, pyrosomas) (Rebel 1974; Davenport and Balazs 1991). However, leatherbacks are also known to use coastal waters of the U.S. continental shelf (James *et al.* 2005a; Eckert *et al.* 2006; Murphy *et al.* 2006), as well as the European continental shelf on a seasonal basis (Witt *et al.* 2007).

Tagging and satellite telemetry data indicate that leatherbacks from the western North Atlantic nesting beaches use the entire North Atlantic Ocean (TEWG 2007). For example, leatherbacks tagged at nesting beaches in Costa Rica have been found in Texas, Florida, South Carolina,

Delaware, and New York (STSSN database). Leatherback sea turtles tagged in Puerto Rico, Trinidad, and the Virgin Islands have also been subsequently found on U.S. beaches of southern, Mid-Atlantic, and northern states (STSSN database). Leatherbacks from the South Atlantic nesting assemblages (West Africa, South Africa, and Brazil) have not been re-sighted in the western North Atlantic (TEWG 2007).

The CeTAP aerial survey of the outer continental shelf from Cape Hatteras, North Carolina to Cape Sable, Nova Scotia conducted between 1978 and 1982 showed leatherbacks to be present throughout the area with the most numerous sightings made from the Gulf of Maine south to Long Island. Leatherbacks were sighted in water depths ranging from one to 4,151 meters, but 84.4% of sightings were in waters less than 180 meters (Shoop and Kenney 1992). Leatherbacks were sighted in waters within a SST range similar to that observed for loggerheads; from 7° to 27.2°C (Shoop and Kenney 1992). However, leatherbacks appear to have a greater tolerance for colder waters in comparison to loggerhead sea turtles since more leatherbacks were found at the lower temperatures (Shoop and Kenney 1992). Studies of satellite tagged leatherbacks suggest that they spend 10-41% of their time at the surface, depending on the phase of their migratory cycle (James *et al.* 2005b). The greatest amount of surface time (up to 41%) was recorded when leatherbacks occurred in continental shelf and slope waters north of 38°N (James *et al.* 2005b).

In 1979, the waters adjacent to Sandy Point, St. Croix, U.S. Virgin Islands were designated as critical habitat for the leatherback sea turtle. On February 2, 2010, NMFS received a petition from the Sierra Club to revise the critical habitat designation for leatherback sea turtles to include waters adjacent to a major nesting beach in Puerto Rico. NMFS published a 90-day finding on the petition on July 16, 2010, which found that the petition did not present substantial scientific information indicating that the petitioned revision was warranted. The original petitioners submitted a second petition on November 2, 2010, to revise the critical habitat designation to again include waters adjacent to a major nesting beach in Puerto Rico, including additional information on the usage of the waters. NMFS again denied the petitioned revision in a 12-month finding on June 4, 2012 (77 FR 32909).

Leatherbacks are a long lived species (>30 years). They were originally believed to mature at a younger age than loggerhead sea turtles, with a previous estimated age at sexual maturity of about 13-14 years for females with nine years reported as a likely minimum (Zug and Parham 1996) and 19 years as a likely maximum (SEFSC 2001). However, new sophisticated analyses suggest that leatherbacks in the Northwest Atlantic may reach maturity at 24.5-29 years of age (Avens *et al.* 2009). In the U.S. and Caribbean, female leatherbacks nest from March through July. In the Atlantic, most nesting females average between 150-160 centimeters curved carapace length (CCL), although smaller (<145 centimeters CCL) and larger nesters are observed (Stewart *et al.* 2007; TEWG 2007). They nest frequently (up to seven nests per year) during a nesting season and nest about every two to three years. They produce 100 eggs or more in each clutch and can produce 700 eggs or more per nesting season (Schultz 1975). However, a significant portion (up to approximately 30%) of the eggs can be infertile. As is the case with other sea turtle species, leatherback hatchlings enter the water soon after hatching. Based on a review of all sightings of leatherback sea turtles of <145 centimeters CCL, Eckert (1999) found that leatherback juveniles remain in waters warmer than 26°C until they exceed 100 centimeters CCL.

Population Dynamics and Status

As described earlier, sea turtle nesting survey data is important because it provides information on the relative abundance of nesting, and the contribution of each population/subpopulation to total nesting of the species. Nest counts can also be used to estimate the number of reproductively mature females nesting annually, and as an indicator of the trend in the number of nesting females in the nesting group. The most recent five-year review for leatherback sea turtles (NMFS and U.S. FWS 2013) compiled the most recent information on mean number of leatherback nests per year for each of the seven leatherback populations or groups of populations that were identified by the Leatherback TEWG as occurring within the Atlantic. These are: Florida, North Caribbean, Western Caribbean, Southern Caribbean, West Africa, South Africa, and Brazil (TEWG 2007).

In the U.S., the Florida Statewide Nesting Beach Survey program has documented an increase in leatherback nesting numbers from 98 nests in 1988 to between 800 and 900 nests in the early 2000s (NMFS and U.S. FWS 2013). Stewart *et al.* (2011) evaluated nest counts from 68 Florida beaches over 30 years (1979-2008) and found that nesting increased at all beaches with trends ranging from 3.1%-16.3% per year, with an overall increase of 10.2% per year. An analysis of Florida's index nesting beach sites from 1989-2006 shows a substantial increase in leatherback nesting in Florida during this time, with an annual growth rate of approximately 1.17 (TEWG 2007). However, leatherback nest numbers on index beaches in Florida have recently been in decline, from 657 in 2014 to 205 in 2017 (<http://myfwc.com/research/wildlife/sea-turtles/nesting/beach-survey-totals/>). The TEWG reports an increasing or stable nesting trend for all of the seven populations or groups of populations, with the exceptions of the Western Caribbean and West Africa groups. The leatherback rookery along the northern coast of South America in French Guiana and Suriname supports the majority of leatherback nesting in the western Atlantic (TEWG 2007), and represents more than half of total nesting by leatherback sea turtles worldwide (Hilterman and Goverse 2004). Nest numbers in Suriname have shown an increase and the long-term trend for the Suriname and French Guiana nesting group seems to show an increase (Hilterman and Goverse 2004). In 2001, the number of nests for Suriname and French Guiana combined was 60,000, one of the highest numbers observed for this region in 35 years (Hilterman and Goverse 2004). The TEWG (2007) report indicates that a positive population growth rate was found for French Guinea and Suriname using nest numbers from 1967-2005, a 39-year period, and that there was a 95% probability that the population was growing. Given the magnitude of leatherback nesting in this area compared to other nest sites, negative impacts in leatherback sea turtles in this area could have profound impacts on the entire species.

The CeTAP aerial survey conducted from 1978-1982 estimated the summer leatherback population for the northeastern U.S. at approximately 300-600 animals (from near Nova Scotia, Canada to Cape Hatteras, North Carolina) (Shoop and Kenney 1992). However, the estimate was based on turtles visible at the surface and does not include those that were below the surface out of view. Therefore, it likely underestimated the leatherback population for the northeastern U.S. at the time of the survey. Estimates of leatherback abundance of 1,052 turtles and 1,174 turtles were obtained from surveys conducted from Virginia to the Gulf of St. Lawrence in 1995 and 1998, respectively (Palka 2000). However, since these estimates were also based on sightings at

the surface, the author considered the estimates to be negatively biased and the true abundance of leatherbacks may be 4.27 times higher (Palka 2000).

Threats

The five-year status review (NMFS and U.S. FWS 2013) and TEWG (2007) report provide summaries of natural as well as anthropogenic threats to leatherback sea turtles. Of the Atlantic sea turtle species, leatherbacks seem to be the most vulnerable to entanglement in fishing gear, trap/pot gear in particular. This susceptibility may be the result of their body type (large size, long pectoral flippers, and lack of a hard shell), their diving and foraging behavior, their distributional overlap with the gear, their possible attraction to gelatinous organisms and algae that collect on buoys and buoy lines at or near the surface, and perhaps to the lightsticks used to attract target species in longline fisheries. Leatherbacks entangled in fishing gear generally have a reduced ability to feed, dive, surface to breathe, or perform any other behavior essential to survival (Balazs 1985). In addition to drowning from forced submergence, they may be more susceptible to boat strikes if forced to remain at the surface, and entangling lines can constrict blood flow resulting in tissue necrosis. The long-term impacts of entanglement on leatherback health remain unclear. Innis *et al.* (2010) conducted a health evaluation of leatherback sea turtles during direct capture (n=12) and disentangling (n=7). They found no significant difference in many of the measured health parameters between entangled and directly captured turtles. However, blood parameters, including but not limited to sodium, chloride, and blood urea nitrogen, for entangled turtles showed several key differences that were most likely due to reduced foraging and associated seawater ingestion, as well as a general stress response.

Finkbeiner *et al.* (2011) compiled cumulative sea turtle bycatch information in U.S. fisheries from 1990 through 2007, before and after implementation of bycatch mitigation measures. Information was obtained from peer reviewed publications and NMFS documents (e.g., Opinions and bycatch reports). In the Atlantic, a mean estimate of 137,700 bycatch interactions, of which 4,500 were mortalities, occurred annually (since implementation of bycatch mitigation measures). Kemp's ridleys interacted with fisheries most frequently, with the highest level of mean annual mortality (2,700), followed by loggerheads (1,400), greens (300), and leatherbacks (40). The Southeast/Gulf of Mexico shrimp trawl fishery was responsible for the vast majority of U.S. interactions (up to 98%) and mortalities (more than 80%). While this provides an initial cumulative bycatch assessment, there are a number of caveats that should be considered when interpreting this information, such as sampling inconsistencies and limitations. The most recent section 7 consultation on the shrimp fishery, completed in April 2014, was unable to estimate the total annual level of leatherback interactions occurring in the fishery at present. Instead, it qualitatively estimated that the shrimp fishery, as currently operating, would result in a few hundred interactions annually, of which a subset are expected to be lethal (NMFS 2014).

Leatherbacks have been documented interacting with longline, trap/pot, trawl, and gillnet fishing gear. For instance, an estimated 6,363 leatherback sea turtles were caught by the U.S. Atlantic tuna and swordfish longline fisheries between 1992 and 1999 (SEFSC 2001). Currently, the U.S. tuna and swordfish longline fisheries managed under the HMS FMP are estimated to capture 1,764 leatherbacks (no more than 252 mortalities) for each three-year period starting in 2007 (NMFS 2004b). In 2015, there were 43 observed interactions between leatherback sea turtles and longline gear used in the HMS fishery (Garrison and Stokes 2017). All but one of the

leatherbacks were released alive, with all gear removed in 10 (23%) of the 43 captures. A total of 300.0 (95% CI: 199.7-450.5) leatherback sea turtles are estimated to have interacted with the longline fisheries managed under the HMS FMP in 2015 based on the observed bycatch events (Garrison and Stokes 2017). Compared to historical highs in 2004, the estimated take of leatherbacks in the U.S. Atlantic pelagic longline fishery remained low and generally trended downward from 2007-2011, but then sharply increased in 2012 associated with an increase in reported fishing effort. The estimates have returned to a downward trend in recent years. The estimate for 2015 is consistent with that for 2014, despite a sharp decrease in reported fishing effort, and is consistent with estimates during the period from 2004-2011 (Garrison and Stokes 2017). Since the U.S. fleet accounts for only 5-8% of the longline hooks fished in the Atlantic Ocean, adding up the under-represented observed takes of the other 23 countries actively fishing in the area would likely result in annual take estimates of thousands of leatherbacks (SEFSC 2001). Lewison *et al.* (2004) estimated that 30,000-60,000 leatherbacks were taken in all Atlantic longline fisheries in 2000 (including the U.S. Atlantic tuna and swordfish longline fisheries).

Leatherbacks are susceptible to entanglement in the lines associated with trap/pot gear used in several fisheries. From 1990-2000, 92 entangled leatherbacks were reported from New York through Maine (Dwyer *et al.* 2002). Additional leatherbacks stranded wrapped in line of unknown origin or with evidence of a past entanglement (Dwyer *et al.* 2002). More recently, from 2002 to 2010, NMFS received 137 reports of sea turtles entangled in vertical lines from Maine to Virginia, with 128 events confirmed (verified by photo documentation or response by a trained responder; NMFS 2008a). Of the 128 confirmed events during this period, 117 events involved leatherbacks. NMFS identified the gear type and fishery for 72 of the 117 confirmed events, which included lobster (42³), whelk/conch (15), black sea bass (10), crab (2), and research pot gear (1). A review of leatherback mortality documented by the STSSN in Massachusetts suggests that vessel strikes and entanglement in fixed gear (primarily lobster pots and whelk pots) are the principal sources of this mortality (Dwyer *et al.* 2002).

Leatherback interactions with the U.S. South Atlantic and Gulf of Mexico shrimp fisheries are also known to occur (NMFS 2002). Leatherbacks are likely to encounter shrimp trawls working in the coastal waters off the U.S. Atlantic coast (from Cape Canaveral, Florida through North Carolina) as they make their annual spring migration north. For many years, TEDs that were required for use in the U.S. South Atlantic and Gulf of Mexico shrimp fisheries were less effective for leatherbacks as compared to the smaller, hard-shelled turtle species, because the TED openings were too small to allow leatherbacks to escape. To address this problem, NMFS issued a final rule on February 21, 2003, to amend the TED regulations (68 FR 8456, February 21, 2003). Modifications to the design of TEDs are now required in order to exclude leatherbacks as well as large benthic immature and sexually mature loggerhead and green sea turtles. Given those modifications, Epperly *et al.* (2002) anticipated an average of 80 leatherback mortalities a year in shrimp gear interactions, dropping to an estimate of 26 leatherback mortalities in 2009 due to effort reduction in the Southeast shrimp fishery (Memo from Dr. B. Ponwith, SEFSC, to Dr. R. Crabtree, SERO, January 5, 2011).

Other trawl fisheries are also known to interact with leatherback sea turtles on a much smaller scale. In October 2001, for example, a NMFS fisheries observer documented the capture of a

³ One case involved both lobster and whelk/conch gear.

leatherback in a bottom otter trawl fishing for *Loligo* squid off Delaware. TEDs are not currently required in this fishery. In November 2007, fisheries observers reported the capture of a leatherback sea turtle in bottom otter trawl gear fishing for summer flounder. Four leatherback sea turtle captures in Mid-Atlantic trawl fisheries were documented by NMFS observers between 2009 and 2013 (Murray 2015b).

Gillnet fisheries operating in the waters of the Mid-Atlantic states are also known to capture, injure, and/or kill leatherbacks when these fisheries and leatherbacks co-occur. Data collected by the Northeast Fisheries Observer Program (NEFOP) from 1994-1998 (excluding 1997) indicate that a total of 37 leatherbacks were incidentally captured (16 lethally) in drift gillnets set in offshore waters from Maine to Florida during this period. Observer coverage for this period ranged from 54-92%. In North Carolina, six additional leatherbacks were reported captured in gillnet sets in the spring (SEFSC 2001). In addition to these, in September 1995, two dead leatherbacks were removed from an 11-inch (28.2-centimeter) monofilament shark gillnet set in the nearshore waters off of Cape Hatteras (STSSN unpublished data reported in SEFSC 2001). Lastly, Murray (2013) reported one observed leatherback capture in Mid-Atlantic sink gillnet fisheries between 2007 and 2011.

Fishing gear interactions can occur throughout the range of leatherbacks, including in Canadian waters. Goff and Lien (1988) reported that 14 of 20 leatherbacks encountered off the coast of Newfoundland/Labrador were entangled in salmon nets, herring nets, gillnets, trawl lines, and crab pot lines. Leatherbacks are known to drown in fish nets set in coastal waters of Sao Tome, West Africa (Castroviejo *et al.* 1994; Graff 1995). Gillnets are one of the suspected causes for the decline in the leatherback population in French Guiana (Chevalier *et al.* 1999), and gillnets targeting green and hawksbill sea turtles in the waters of coastal Nicaragua also incidentally catch leatherback sea turtles (Lagueux 1998). Observers on shrimp trawlers operating in the northeastern region of Venezuela documented the capture of six leatherbacks from 13,600 trawls (Marcano and Alio-M. 2000). An estimated 1,000 mature female leatherback sea turtles are caught annually in fishing nets off Trinidad and Tobago with mortality estimated to be between 50% and 95% (Eckert and Lien 1999). Many of the sea turtles do not die as a result of drowning, but rather because the fishermen butcher them to get them out of their nets (SEFSC 2001).

Leatherbacks may be more susceptible to marine debris ingestion than other sea turtle species due to the tendency of floating debris to concentrate in convergence zones that juveniles and adults use for feeding (Shoop and Kenney 1992; Lutcavage *et al.* 1997). Investigations of the necropsy results of leatherback sea turtles revealed that a substantial percentage (34% of the 408 leatherback necropsies' recorded between 1885 and 2007) reported plastic within the turtle's stomach contents, and in some cases (8.7% of those cases in which plastic was reported), blockage of the gut was found in a manner that may have caused the mortality (Mrosovsky *et al.* 2009). An increase in reports of plastic ingestion was evident in leatherback necropsies conducted after the late 1960s (Mrosovsky *et al.* 2009). Along the coast of Peru, intestinal contents of 19 of 140 (13%) leatherback carcasses were found to contain plastic bags and film (Fritts 1982). The presence of plastic debris in the digestive tract suggests that leatherbacks might not be able to distinguish between prey items (e.g., jellyfish) and plastic debris (Mrosovsky 1981). Balazs (1985) speculated that plastic objects may resemble food items by

their shape, color, size, or even movements as they drift about, and induce a feeding response in leatherbacks.

Global climate change has been identified as a factor that may affect leatherback habitat and biology (NMFS and U.S. FWS 2013); however, no significant climate change related impacts to leatherback sea turtle populations have been observed to date. Over the long term, climate change related impacts will likely influence biological trajectories in the future on a century scale (Parmesan and Yohe 2003). Changes in marine systems associated with rising water temperatures, changes in ice cover, salinity, oxygen levels and circulation including shifts in ranges and changes in algal, plankton, and fish abundance could affect leatherback prey distribution and abundance. Climate change is expected to expand foraging habitats into higher latitude waters and some concern has been noted that increasing temperatures may increase the female:male sex ratio of hatchlings on some beaches (Mrosovsky *et al.* 1984 and Hawkes *et al.* 2007 in NMFS and U.S. FWS 2013). However, due to the tendency of leatherbacks to have individual nest placement preferences and deposit some clutches in the cooler tide zone of beaches, the effects of long-term climate on sex ratios may be mitigated (Kamel and Mrosovsky 2004 in NMFS and U.S. FWS 2013). Additional potential effects of climate change on leatherbacks include range expansion and changes in migration routes as increasing ocean temperatures shift range-limiting isotherms north (Robinson *et al.* 2008). Leatherbacks have expanded their range in the Atlantic north by 330 kilometers in the last few decades as warming has caused the northerly migration of the 15°C SST isotherm, the lower limit of thermal tolerance for leatherbacks (McMahon and Hays 2006). Leatherbacks are speculated to be the best able to cope with climate change of all the sea turtle species due to their wide geographic distribution and relatively weak beach fidelity. Leatherback sea turtles may be most affected by any changes in the distribution of their primary jellyfish prey, which may affect leatherback distribution and foraging behavior (NMFS and U.S. FWS 2013). Jellyfish populations may increase due to ocean warming and other factors (Brodeur *et al.* 1999; Attrill *et al.* 2007; Richardson *et al.* 2009). However, any increase in jellyfish populations may or may not impact leatherbacks as there is no evidence that any leatherback populations are currently food-limited.

As discussed for the other three sea turtle species, increasing temperatures are expected to result in rising sea levels (Titus and Narayanan 1995 in Conant *et al.* 2009), which could result in increased erosion rates along nesting beaches. Sea level rise could result in the inundation of nesting sites and decrease available nesting habitat (Fish *et al.* 2005). This effect would potentially be accelerated due to a combination of other environmental and oceanographic changes such as an increase in the frequency of storms and/or changes in prevailing currents. While there is a reasonable degree of certainty that climate change related effects will be experienced globally (e.g., rising temperatures and changes in precipitation patterns), due to a lack of scientific data, the specific effects of climate change on this species are not predictable or quantifiable at this time (Hawkes *et al.* 2009). Based on the most recent five-year status review (NMFS and U.S. FWS 2013), and following from the climate change discussion in the previous sections on sea turtles, significant impacts from climate change in the future are to be expected, but the severity of and rate at which these impacts will occur is currently unknown.

Summary of Status for Leatherback Sea Turtles

In the Pacific Ocean, the abundance of leatherback sea turtles on nesting beaches has declined dramatically during the past 10 to 20 years. Nesting groups throughout the eastern and western Pacific Ocean have been reduced to a fraction of their former abundance due to human activities that have reduced the number of nesting females and reduced the reproductive success of females (for example, by egg poaching) (NMFS and U.S. FWS 2013). No reliable long term trend data for the Indian Ocean populations are currently available. While leatherbacks are known to occur in the Mediterranean Sea, nesting in this region is not known to occur (NMFS and U.S. FWS 2013).

Nest counts in many areas of the Atlantic Ocean show increasing trends, including for beaches in Suriname and French Guiana, which support the majority of leatherback nesting in this region (NMFS and U.S. FWS 2013). The species as a whole continues to face numerous threats in nesting and marine habitats. As with the other sea turtle species, mortality due to fisheries interactions accounts for a large proportion of annual human-caused mortality outside the nesting beaches, while other activities like pollution and habitat destruction account for an unknown level of other anthropogenic mortality. The long term recovery potential of this species may be further threatened by observed low genetic diversity, even in the largest nesting groups (NMFS and U.S. FWS 2013).

Based on its five-year status review of the species, NMFS and U.S. FWS (2013) determined that endangered leatherback sea turtles should not be delisted or reclassified. However, it also was determined that an analysis and review of the species should be conducted in the future to determine whether DPSs should be identified (NMFS and U.S. FWS 2013).

4.2.2 Status of Atlantic Sturgeon

The section below describes the Atlantic sturgeon listing, provides life history information that is relevant to all DPSs of Atlantic sturgeon, and then provides information specific to the status of each DPS of Atlantic sturgeon. Below, we also provide a description of the Atlantic sturgeon DPSs likely to occur in the action area and their use of the action area.

The Atlantic sturgeon is a subspecies of sturgeon distributed along the east coast of North America from Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida (Scott and Scott 1988; ASSRT 2007). We have delineated U.S. populations of Atlantic sturgeon into five DPSs: Gulf of Maine (GOM), New York Bight (NYB), Chesapeake Bay (CB), Carolina, and South Atlantic (SA) (77 FR 5880 and 77 FR 5914; Figure 4)⁴. The results of genetic studies suggest that natal origin influences the distribution of Atlantic sturgeon in the marine environment (Wirgin and King 2011). However, satellite tracking and tagging data along with other genetic data demonstrate that Atlantic sturgeon from all five DPSs and Canada occur throughout the full range of the subspecies. Therefore, Atlantic sturgeon originating from any of the five DPSs can be affected by threats in the marine, estuarine, and riverine environment that occur far from natal spawning rivers.

At present, the NYB, CB, Carolina, and SA DPSs are listed as endangered, while the GOM DPS is listed as threatened (77 FR 5880 and 77 FR 5914; February 6, 2012). The effective date of the listings was April 6, 2012. The DPSs do not include Atlantic sturgeon that are spawned in Canadian rivers. Therefore, Canadian spawned fish are not included in the listings. As described below, individuals originating from all five listed DPSs are likely to occur in the action area. Information general to all Atlantic sturgeon as well as information specific to each DPS is provided below.

Life history

Atlantic sturgeon are long lived (approximately 60 years), late maturing, estuarine dependent, anadromous⁵ fish (Bigelow and Schroeder 1953; Vladykov and Greeley 1963; Mangin 1964; Pikitch *et al.* 2005; Dadswell 2006; ASSRT 2007). They are relatively large fish, even amongst sturgeon species (Pikitch *et al.* 2005) and can grow to over 14 feet and weigh up to 800 pounds. Atlantic sturgeon are bottom feeders that suck food into a ventral protruding mouth (Bigelow and Schroeder 1953). Four barbels in front of the mouth assist the sturgeon in locating prey (Bigelow and Schroeder 1953). Diets of adult and migrant subadult Atlantic sturgeon include mollusks, gastropods, amphipods, annelids, decapods, isopods, and fish such as sand lance (Bigelow and Schroeder 1953; ASSRT 2007; Guilbard *et al.* 2007; Savoy 2007). Juvenile Atlantic sturgeon feed on aquatic insects, larvae, and other invertebrates (Bigelow and Schroeder 1953; ASSRT 2007; Guilbard *et al.* 2007). The life history of Atlantic sturgeon can be divided into five general categories as described in Table 2 below (adapted from ASSRT 2007).

⁴ To be considered for listing under the ESA, a group of organisms must constitute a “species.” A “species” is defined in section 3 of the ESA to include “any subspecies of fish or wildlife or plants, and any distinct population segment of any species of vertebrate fish or wildlife which interbreeds when mature.”

⁵ Anadromous refers to a fish that is born in freshwater, spends most of its life in the sea, and returns to freshwater to spawn (NEFSC FAQ’s, available at <http://www.nefsc.noaa.gov/faq/fishfaq1a.html>, modified June 16, 2011)

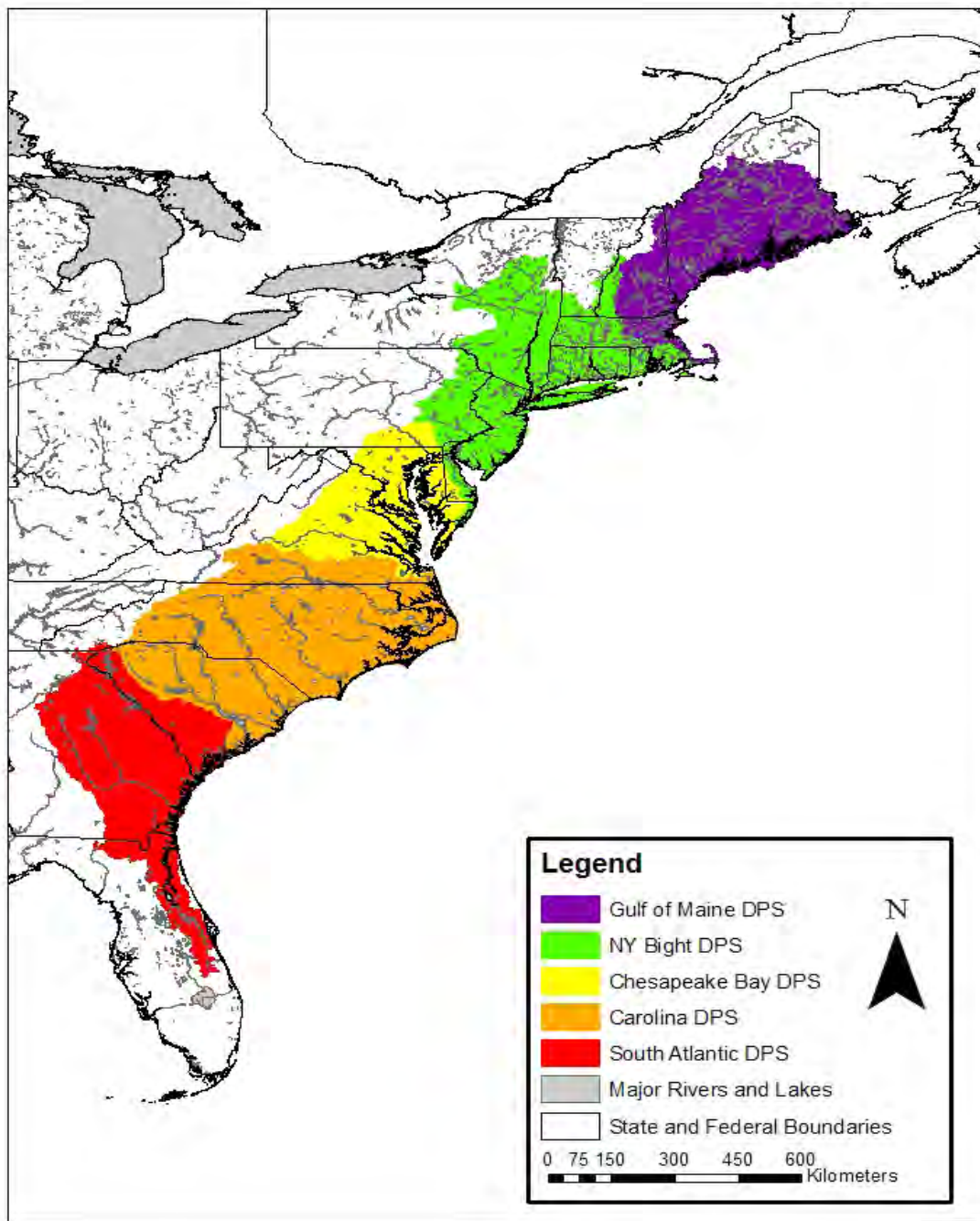


Figure 4. Map depicting the five Atlantic sturgeon DPSs.

Table 2. Descriptions of Atlantic sturgeon life history stages.

Age Class	Size	Description
Egg		Fertilized or unfertilized
Larvae		Negative photo-taxis, nourished by yolk sac
Young-of-the-Year (YOY)	0.3 grams; <41 cm TL	Fish that are > 3 months and < one year; capable of capturing and consuming live food
Sub-adults	>41 cm and <150 cm TL	Fish that are at least age 1 and are not sexually mature
Adults	>150 cm TL	Sexually mature fish

Rate of maturation is affected by water temperature and gender. In general: (1) Atlantic sturgeon that originate from southern systems grow faster and mature sooner than Atlantic sturgeon that originate from more northern systems; (2) males grow faster than females; (3) fully mature females attain a larger size (i.e., length) than fully mature males. The largest recorded Atlantic sturgeon was a female captured in 1924 that measured approximately 4.26 meters (Vladykov and Greeley 1963). Dadswell (2006) reported seeing seven fish of comparable size in the St. John River estuary from 1973 to 1995. Observations of large-sized sturgeon are particularly important given that egg production is correlated with age and body size (Smith *et al.* 1982; Van Eenennaam *et al.* 1996; Van Eenennaam and Doroshov 1998; Dadswell 2006). The lengths of Atlantic sturgeon caught since the mid-late 20th century have typically been less than three meters (Smith *et al.* 1982, Smith and Dingley 1984; Smith 1985; Scott and Scott 1988; Young *et al.* 1998; Collins *et al.* 2000; Caron *et al.* 2002; Dadswell 2006; ASSRT 2007; Kahnle *et al.* 2007; DFO 2011). While females are prolific, with egg production ranging from 400,000 to four million eggs per spawning year, females spawn at intervals of two to five years (Vladykov and Greeley 1963; Smith *et al.* 1982; Van Eenennaam *et al.* 1996; Van Eenennaam and Doroshov 1998; Stevenson and Secor 1999; Dadswell 2006). Given spawning periodicity and a female's relatively late age to maturity, the age at which 50% of the maximum lifetime egg production is achieved is estimated to be 29 years (Boreman 1997). Males exhibit spawning periodicity of one to five years (Smith 1985; Collins *et al.* 2000; Caron *et al.* 2002). While long-lived, Atlantic sturgeon are exposed to a multitude of threats prior to achieving maturation and have a limited number of spawning opportunities once mature.

Water temperature plays a primary role in triggering the timing of spawning migrations (Greene *et al.* 2009). Spawning migrations generally occur during February-March in southern systems, April-May in Mid-Atlantic systems, and May-July in Canadian systems (Murawski and Pacheco 1977; Smith 1985; Bain 1997; Smith and Clugston 1997; Caron *et al.* 2002). Male sturgeon begin upstream spawning migrations when waters reach approximately 6°C (43°F) (Smith *et al.* 1982; Dovel and Berggren 1983; Smith 1985; Greene *et al.* 2009), and remain on the spawning grounds throughout the spawning season (Bain 1997). Females begin spawning migrations when temperatures are closer to 12° to 13°C (54° to 55°F) (Dovel and Berggren 1983; Smith 1985; Collins *et al.* 2000), make rapid spawning migrations upstream, and quickly depart following spawning (Bain 1997).

The spawning areas in most U.S. rivers have not been well defined. However, the habitat characteristics of spawning areas have been identified based on historical accounts of where fisheries occurred, tracking and tagging studies of spawning sturgeon, and physiological needs of early life stages. Spawning is believed to occur in flowing water between the salt front of estuaries and the fall line of large rivers, when and where optimal flows are 46-76 centimeters/second and depths are 3-27 meters (Borodin 1925; Dees 1961; Leland 1968; Scott and Crossman 1973; Crance 1987; Shirey *et al.* 1999; Bain *et al.* 2000; Collins *et al.* 2000; Caron *et al.* 2002; Hatin *et al.* 2002; Greene *et al.* 2009). Sturgeon eggs are deposited on hard bottom substrate such as cobble, coarse sand, and bedrock (Dees 1961; Scott and Crossman 1973; Gilbert 1989; Smith and Clugston 1997; Bain *et al.* 2000; Collins *et al.* 2000; Caron *et al.* 2002; Hatin *et al.* 2002; Mohler 2003; Greene *et al.* 2009), and become adhesive shortly after fertilization (Murawski and Pacheco 1977; Van den Avyle 1984; Mohler 2003). Incubation time for the eggs increases as water temperature decreases (Mohler 2003). At temperatures of 20° and 18°C, hatching occurs approximately 94 and 140 hours, respectively, after deposition (ASSRT 2007).

Larval Atlantic sturgeon (i.e., less than four weeks old, with TL less than 30 millimeters; Van Eenennaam *et al.* 1996) are assumed to mostly live on or near the bottom and inhabit the same riverine or estuarine areas where they were spawned (Smith *et al.* 1980; Bain *et al.* 2000; Kynard and Horgan 2002; Greene *et al.* 2009). Studies suggest that age-0 (i.e., YOY), age-1, and age-2 juvenile Atlantic sturgeon occur in low salinity waters of the natal estuary (Haley 1999; Hatin *et al.* 2007; McCord *et al.* 2007; Munro *et al.* 2007) while older fish are more salt tolerant and occur in higher salinity waters as well as low salinity waters (Collins *et al.* 2000). Atlantic sturgeon remain in the natal estuary for months to years before emigrating to open ocean as subadults (Holland and Yelverton 1973; Dovel and Berggen 1983; Waldman *et al.* 1996; Dadswell 2006; ASSRT 2007).

After emigration from the natal estuary, subadults and adults travel within the marine environment, typically in waters less than 50 meters in depth, using coastal bays, sounds, and ocean waters (Vladykov and Greeley 1963; Murawski and Pacheco 1977; Dovel and Berggren 1983; Smith 1985; Collins and Smith 1997; Welsh *et al.* 2002b; Savoy and Pacileo 2003; Stein *et al.* 2004a; Laney *et al.* 2007; Dunton *et al.* 2010; Erickson *et al.* 2011; Wirgin and King 2011). Tracking and tagging studies reveal seasonal movements of Atlantic sturgeon along the coast. Satellite-tagged adult sturgeon from the Hudson River concentrated in the southern part of the Mid-Atlantic Bight at depths greater than 20 meters during winter and spring, and in the northern portion of the Mid-Atlantic Bight at depths less than 20 meters in summer and fall (Erickson *et al.* 2011). A similar movement pattern for juvenile Atlantic sturgeon has been found based on recaptures of fish originally tagged in the Delaware River (C. Shirey, Delaware Department of Fish and Wildlife, unpublished data reviewed in Greene *et al.* 2009). After leaving the Delaware River estuary during the fall, juvenile Atlantic sturgeon were recaptured by commercial fishermen in nearshore waters along the Atlantic coast as far south as Cape Hatteras from November through early March. In the spring, a portion of the tagged fish re-entered the Delaware River estuary. However, many fish continued a northerly coastal migration through the Mid-Atlantic as well as into southern New England waters where they were recovered throughout the summer months. Movements as far north as Maine were documented. A southerly coastal migration was apparent from tag returns reported in the fall. The majority of these tag returns were reported from relatively shallow nearshore fisheries with few fish reported

from waters in excess of 25 meters (C. Shirey, Delaware Department of Fish and Wildlife, unpublished data reviewed in Greene *et al.* 2009). Areas where migratory Atlantic sturgeon commonly aggregate include the Bay of Fundy (e.g., Minas and Cumberland Basins), Massachusetts Bay, Connecticut River estuary, Long Island Sound, New York Bight, Delaware Bay, Chesapeake Bay, and waters off of North Carolina from the Virginia/North Carolina border to Cape Hatteras at depths up to 24 meters (Dovel and Berggren 1983; Dadswell *et al.* 1984; Johnson *et al.* 1997; Rochard *et al.* 1997; Kynard *et al.* 2000; Stein *et al.* 2004a; Wehrell 2005; Dadswell 2006; ASSRT 2007; Laney *et al.* 2007; Eyler *et al.* 2009). These sites may be used as foraging sites and/or thermal refugia.

Determination of DPS Composition in the Action Area

As explained above, the range of all five DPSs overlaps and extends from Canada through Cape Canaveral, Florida. The Chesapeake Bay is known to be used by Atlantic sturgeon originating from all five DPSs. We have considered the best available information from a recent mixed stock analysis to determine from which DPSs individuals in the action area are likely to have originated. We have determined that Atlantic sturgeon in the action area likely originate from the five DPSs at the following frequencies: NYB 51.7%; SA 21.9%; CB 11.8%; GOM 10.1%; and Carolina 2.4%. Approximately 2.2% of the Atlantic sturgeon in the action area originate from Canadian rivers or management units. These percentages are based on genetic sampling of all individuals (n=173) captured during observed fishing trips along the Atlantic coast from Maine through North Carolina, and the results of the genetic analyses for these 173 fish were compared against a reference population of 411 fish and results for an additional 790 fish from other sampling efforts. Therefore, they represent the best available information on the likely genetic makeup of individuals occurring in the action area. The genetic assignments have corresponding 95% confidence intervals. However, for purposes of section 7 consultation, we have selected the reported values without their associated confidence intervals. The reported values, which approximate the mid-point of the range, are a reasonable indication of the likely genetic makeup of Atlantic sturgeon in the action area. These assignments and the data from which they are derived are described in detail in Wirgin *et al.* (2015).

Distribution and Abundance

Atlantic sturgeon underwent significant range-wide declines from historical abundance levels due to overfishing in the mid to late 19th century when a caviar market was established (Scott and Crossman 1973; Taub 1990; MNRPD 1993; Smith and Clugston 1997; Dadswell 2006; ASSRT 2007). Abundance of spawning-aged females prior to this period of exploitation was predicted to be greater than 100,000 for the Delaware River, and at least 10,000 females for other spawning stocks (Secor and Waldman 1999; Secor 2002). Historical records suggest that Atlantic sturgeon spawned in at least 35 rivers prior to this period. Currently, only 17 U.S. rivers are known to support spawning (i.e., presence of YOY or gravid Atlantic sturgeon documented within the past 15 years) (ASSRT 2007). While there may be other rivers supporting spawning for which definitive evidence has not been obtained (e.g., in the Penobscot and York Rivers), the number of rivers supporting spawning of Atlantic sturgeon are approximately half of what they were historically. In addition, only five rivers (Kennebec, Androscoggin, Hudson, Delaware, and James) are known to currently support spawning from Maine through Virginia, where historical records show that there used to be 15 spawning rivers (ASSRT 2007). Thus, there are substantial

gaps between Atlantic sturgeon spawning rivers amongst northern and Mid-Atlantic states which could make recolonization of extirpated populations more difficult.

There are no current, published population abundance estimates for any of the currently known spawning stocks or for any of the five DPSs of Atlantic sturgeon. An estimate of 863 mature adults per year (596 males and 267 females) was calculated for the Hudson River based on fishery-dependent data collected from 1985-1995 (Kahnle *et al.* 2007). An estimate of 343 spawning adults per year is available for the Altamaha River, Georgia, based on fishery-independent data collected in 2004 and 2005 (Schueller and Peterson 2006). Using the data collected from the Hudson and Altamaha Rivers to estimate the total number of Atlantic sturgeon in either subpopulation is not possible, since mature Atlantic sturgeon may not spawn every year (Vladykov and Greeley 1963; Smith 1985; Van Eenennaam *et al.* 1996; Stevenson and Secor 1999; Collins *et al.* 2000; Caron *et al.* 2002), the age structure of these populations is not well understood, and stage to stage survival is unknown. In other words, the information that would allow us to take an estimate of annual spawning adults and expand that estimate to an estimate of the total number of individuals (e.g., yearlings, subadults, and adults) in a population is lacking. The ASSRT presumed that the Hudson and Altamaha Rivers had the most robust of the remaining U.S. Atlantic sturgeon spawning populations and concluded that the other U.S. spawning populations were likely less than 300 spawning adults per year (ASSRT 2007).

Lacking complete estimates of population abundance across the distribution of Atlantic sturgeon, the NEFSC developed a virtual population analysis model with the goal of estimating bounds of Atlantic sturgeon ocean abundance. The NEFSC suggested that cumulative annual estimates of surviving fishery discards could provide a minimum estimate of abundance. The objectives of producing the Atlantic Sturgeon Production Index (ASPI) were to characterize uncertainty in abundance estimates arising from multiple sources of observation and process error and to complement future efforts to conduct a more comprehensive stock assessment (Table 3). The ASPI provides a general abundance metric to assess risk for actions that may affect Atlantic sturgeon in the ocean; however, it is not a comprehensive stock assessment. In general, the model uses empirical estimates of post-capture survivors and natural survival, as well as probability estimates of recapture using tagging data from the U.S. FWS sturgeon tagging database, and federal fishery discard estimates from 2006 to 2010 to produce a virtual population. The U.S. FWS sturgeon tagging database is a repository for sturgeon tagging information on the Atlantic coast. The database contains tag release and recapture information from state and federal researchers. The database records recaptures by the fishing fleet, researchers, and researchers on fishery vessels.

In addition to the ASPI, a population estimate was derived from the NEAMAP trawl surveys (Table 3). The NEAMAP trawl surveys are conducted from Cape Cod, Massachusetts to Cape Hatteras, North Carolina in nearshore waters at depths up to 18.3 meters (60 feet) during the fall since 2007 and spring since 2008. Each survey employs a spatially stratified random design with a total of 35 strata and 150 stations. The Atlantic States Marine Fisheries Commission (ASMFC) has initiated a new stock assessment with the goal of completing it in the near future. NMFS will be partnering with them to conduct the stock assessment, and the ocean population abundance estimates produced by the NEFSC will be shared with the stock assessment committee for consideration in the stock assessment.

Table 3. Description of the ASPI model and NEAMAP survey based area estimate method.

Model Name	Model Description
A. ASPI	Uses tag-based estimates of recapture probabilities from 1999 to 2009. Natural mortality based on Kahnle <i>et al.</i> (2007) rather than estimates derived from tagging model. Tag recaptures from commercial fisheries are adjusted for non-reporting based on recaptures from observers and researchers. Tag loss assumed to be zero.
B. NEAMAP Swept Area	Uses NEAMAP survey-based swept area estimates of abundance and assumed estimates of gear efficiency. Estimates based on average of ten surveys from fall 2007 to spring 2012.

Atlantic sturgeon are frequently encountered during the NEAMAP surveys. The information from these surveys can be used to calculate minimum swept area population estimates within the strata swept by the surveys. The estimate from fall surveys ranges from 6,980 to 42,160 with coefficients of variation between 0.02 and 0.57, and the estimates from spring surveys ranges from 25,540 to 52,990 with coefficients of variation between 0.27 and 0.65 (Table 4). These are considered minimum estimates because the calculation makes the assumption that the gear will capture (i.e., net efficiency) 100% of the sturgeon in the water column along the tow path and that all sturgeon are within the sampling domain of the survey. We define catchability as: 1) the product of the probability of capture given encounter (i.e., net efficiency), and 2) the fraction of the population within the sampling domain. Catchabilities less than 100% will result in estimates greater than the minimum. The true catchability depends on many factors including the availability of the species to the survey and the behavior of the species with respect to the gear. True catchabilities much less than 100% are common for most species. The average ASPI estimate of 417,934 fish implies a catchability of between 6% and 13% for the spring NEAMAP surveys, and a catchability of between 2% and 10% for the fall NEAMAP surveys. If the availability of Atlantic sturgeon in the areas sampled by the spring NEAMAP surveys were say 50%, then the implied range of net efficiencies for this survey would double to 12% and 26%. The ratio of total sturgeon habitat to area sampled by the NEAMAP surveys is unknown, but is certainly greater than one.

The NEAMAP-based estimates do not include YOY fish and juveniles in the rivers; however, those segments of the Atlantic sturgeon populations are at minimal risk from the proposed action since they are rare to absent within the action area. The NEAMAP surveys are conducted in waters that include the preferred depth ranges of subadult and adult Atlantic sturgeon and take place during seasons that coincide with known Atlantic sturgeon coastal migration patterns in the ocean. Therefore, the NEAMAP estimates are minimum estimates of the ocean population of Atlantic sturgeon but are based on sampling throughout the action area, in known sturgeon coastal migration areas during times that sturgeon are expected to be migrating north and south.

Table 4. Annual minimum swept area estimates for Atlantic sturgeon during the spring and fall NEAMAP surveys. Estimates provided by Dr. Chris Bonzek (VIMS) and assume 100% net efficiencies.

Year	Fall Number	CV	Spring Number	CV
2007	6,981	0.015		
2008	33,949	0.322	25,541	0.391
2009	32,227	0.316	41,196	0.353
2010	42,164	0.566	52,992	0.265
2011	22,932	0.399	52,840	0.480
2012			28,060	0.652

Available data do not support estimation of true catchability (i.e., net efficiency x availability) of the NEAMAP trawl survey for Atlantic sturgeon. Thus, the NEAMAP swept area biomass estimates were produced and presented for catchabilities from 5% to 100%. Assuming the NEAMAP surveys have been 100% efficient would require the unlikely assumption that the survey gear captures all Atlantic sturgeon within the path of the trawl and all sturgeon are within the sampling area of the NEAMAP survey. The 50% efficiency assumption seems to reasonably account for the robust, yet not complete sampling of the Atlantic sturgeon oceanic temporal and spatial ranges and the documented high rates of encounter with NEAMAP survey gear and Atlantic sturgeon. For this Opinion, we have determined that the best available data at this time are the population estimates derived from NEAMAP swept area biomass resulting from the 50% catchability rate (Table 5). The estimates are derived directly from empirical data with fewer assumptions than have been required to model Atlantic sturgeon populations to date.

Table 5. Modeled results from the ASPI and NEAMAP Atlantic sturgeon estimation methods.

<u>Model Run</u>	<u>Model Years</u>	<u>95% low</u>	<u>Mean</u>	<u>95% high</u>
A. ASPI	1999-2009	165,381	417,934	744,597
B.1 NEAMAP Survey, swept area assuming 100% efficiency	2007-2012	8,921	33,888	58,856
B.2 NEAMAP Survey, swept area assuming 50% efficiency	2007-2012	13,962	67,776	105,984
B.3 NEAMAP Survey, swept area assuming 10% efficiency	2007-2012	89,206	338,882	588,558

The ocean population abundance of 67,776 fish estimated from the NEAMAP surveys assuming 50% efficiency (based on net efficiency and the fraction of the total population exposed to the survey) was subsequently partitioned by DPS based on genetic frequencies of occurrence in the sampled area (Table 6). Given the proportion of adults to subadults in the observer database (approximate ratio of 1:3), we have also estimated a number of subadults originating from each DPS. However, this cannot be considered an estimate of the total number of subadults because it only considers those subadults that are of a size vulnerable to capture in commercial sink gillnet

and otter trawl gear in the marine environment and are present in the marine environment, which is only a fraction of the total number of subadults.

Table 6. Summary of calculated population estimates based upon the NEAMAP survey swept area model assuming 50% efficiency.

DPS	Estimated Ocean Population Abundance	Estimated Ocean Population of Adults	Estimated Ocean Population of Subadults (of size vulnerable to capture in fisheries)
GOM	7,455	1,864	5,591
NYB	34,566	8,642	25,925
CB	8,811	2,203	6,608
Carolina	1,356	339	1,017
SA	14,911	3,728	11,183
Canada	678	170	509

The ASMFC released a new benchmark stock assessment for Atlantic sturgeon in October 2017 (ASMFC 2017a). The assessment used both fishery-dependent and fishery-independent data, as well as biological and life history information. Fishery-dependent data came from commercial fisheries that formerly targeted Atlantic sturgeon (before the moratorium), as well as fisheries that catch sturgeon incidentally. Fishery-independent data were collected from scientific research and survey programs.

Table 1: Stock status determination for the coastwide stock and DPSs (from the ASMFC's Atlantic Sturgeon Stock Assessment Overview, October 2017)

Population	Mortality Status	Biomass/Abundance Status	
	Probability that $Z > Z_{50\%EPR}$ 80%	Relative to Historical Levels	Average probability of terminal year of indices > 1998* value
Coastwide	7%	Depleted	95%
Gulf of Maine	74%	Depleted	51%
New York Bight	31%	Depleted	75%
Chesapeake Bay	30%	Depleted	36%
Carolina	75%	Depleted	67%
South Atlantic	40%	Depleted	Unknown (no suitable indices)

* For indices that started after 1998, the first year of the index was used as the reference value.

At the coastwide and DPS levels, the stock assessment concluded that Atlantic sturgeon are depleted relative to historical levels. The low abundance of Atlantic sturgeon is not due solely to effects of historic commercial fishing, so the ‘depleted’ status was used instead of ‘overfished.’ This status reflects the array of variables preventing Atlantic sturgeon recovery (e.g., bycatch, habitat loss, and ship strikes).

As described in the Assessment Overview, Table 7 shows “the stock status determination for the coastwide stock and DPSs based on mortality estimates and biomass/abundance status relative to historic levels, and the terminal year (i.e., the last year of available data) of indices relative to the start of the moratorium as determined by the ARIMA⁶ analysis.”

Despite the depleted status, the assessment did include signs that the coastwide index is above the 1998 value (95% chance). The GOM, NYB, and Carolina DPS indices also all had a greater than 50% chance of being above their 1998 value; however, the index from the CB DPS (highlighted red) only had a 36% chance of being above the 1998 value. There were no representative indices for the SA DPS. Total mortality from the tagging model was very low at the coastwide level. Small sample sizes made mortality estimates at the DPS level more difficult. The NYB, CB, and SA DPSs all had a less than 50% chance of having a mortality rate higher than the threshold. The GOM and Carolina DPSs (highlighted red) had 74%-75% probability of being above the mortality threshold (ASMFC 2017a).

Threats

Atlantic sturgeon are susceptible to over exploitation given their life history characteristics (e.g., late maturity, dependence on a wide-variety of habitats). Similar to other sturgeon species (Vladykov and Greeley 1963; Pikitch *et al.* 2005), Atlantic sturgeon experienced range-wide declines from historical abundance levels due to overfishing (for caviar and meat) and impacts to habitat in the 19th and 20th centuries (Taub 1990; Smith and Clugston 1997; Secor and Waldman 1999).

Because a DPS is a group of populations, the stability, viability, and persistence of individual populations affects the persistence and viability of the larger DPS. The loss of any population within a DPS could result in: (1) a long-term gap in the range of the DPS that is unlikely to be recolonized; (2) loss of reproducing individuals; (3) loss of genetic biodiversity; (4) loss of unique haplotypes; (5) loss of adaptive traits; and (6) reduction in total number. The loss of a population will negatively impact the persistence and viability of the DPS as a whole, as fewer than two individuals per generation spawn outside their natal rivers (Secor and Waldman 1999). The persistence of individual populations, and in turn the DPS, depends on successful spawning and rearing within the freshwater habitat, emigration to marine habitats to grow, and return of adults to natal rivers to spawn.

Based on the best available information, we have concluded that unintended catch in fisheries, vessel strikes, poor water quality, freshwater availability, dams, lack of regulatory mechanisms for protecting the fish, and dredging are the most significant threats to Atlantic sturgeon (77 FR 5880 and 77 FR 5914; February 6, 2012). While all the threats are not necessarily present in the

⁶ “The ARIMA (Auto-Regressive Integrated Moving Average) model uses fishery-independent indices of abundance to estimate how likely an index value is above or below a reference value” (ASMFC 2017a).

same area at the same time, given that Atlantic sturgeon subadults and adults use ocean waters from Labrador, Canada to Cape Canaveral, Florida, as well as estuaries of large rivers along the U.S. East Coast, activities affecting these water bodies are likely to impact more than one Atlantic sturgeon DPS. In addition, because Atlantic sturgeon depend on a variety of habitats, every life stage is likely affected by one or more of the identified threats.

Atlantic sturgeon are particularly sensitive to bycatch mortality because they are a long-lived species, have an older age at maturity, have lower maximum fecundity values, and a large percentage of egg production occurs later in life. Based on these life history traits, Boreman (1997) calculated that Atlantic sturgeon can only withstand the annual loss of up to 5% of their population to bycatch mortality without suffering population declines. Mortality rates of Atlantic sturgeon taken as bycatch in various types of fishing gear range between 0% and 51%, with the greatest mortality occurring in sturgeon caught by sink gillnets. Atlantic sturgeon are particularly vulnerable to being caught in sink gillnets; therefore, fisheries using this type of gear account for a high percentage of Atlantic sturgeon bycatch. Fisheries known to incidentally catch Atlantic sturgeon occur throughout the marine range of the species and in some riverine waters as well. Because Atlantic sturgeon mix extensively in marine waters and may access multiple river systems, they are subject to being caught in multiple fisheries throughout their range. In addition, stress or injury to Atlantic sturgeon taken as bycatch but released alive may result in increased susceptibility to other threats, such as poor water quality (e.g., exposure to toxins and low dissolved oxygen). This may result in reduced ability to perform major life functions, such as foraging and spawning, or even post-capture mortality.

As a wide-ranging, anadromous species, Atlantic sturgeon are subject to numerous Federal (U.S. and Canadian), state and provincial, and inter-jurisdictional laws, regulations, and agency activities. While these mechanisms, including the prohibition on possession, have addressed impacts to Atlantic sturgeon through directed fisheries, there are currently insufficient mechanisms in place to address the significant risk posed to Atlantic sturgeon from commercial bycatch.

An ASMFC interstate fishery management plan for sturgeon (Sturgeon FMP) was developed and implemented in 1990 (Taub 1990). In 1998, the remaining Atlantic sturgeon fisheries in U.S. state waters were closed per Amendment 1 to the FMP. NMFS implemented complementary regulations in 1999 that prohibited fishing for, harvesting, possessing, or retaining Atlantic sturgeon or their parts in or from the U.S. Exclusive Economic Zone (EEZ) in the course of a commercial fishing activity.

Commercial fisheries for Atlantic sturgeon still exist in Canadian waters (DFO 2011). Sturgeon belonging to one or more of the DPSs may be harvested in the Canadian fisheries. In particular, the Bay of Fundy fishery in the Saint John estuary may capture sturgeon of U.S. origin given that sturgeon from the GOM and the NYB DPSs have been incidentally captured in other Bay of Fundy fisheries (DFO 2011; Wirgin and King 2011). Because Atlantic sturgeon are listed under Appendix II of the Convention on International Trade in Endangered Species (CITES), the U.S. and Canada are currently working on a conservation strategy to address the potential for captures of U.S. fish in Canadian directed Atlantic sturgeon fisheries and of Canadian fish incidentally captured in U.S. commercial fisheries. At this time, there are no estimates of the number of

individuals from any of the DPSs that are captured or killed in Canadian fisheries each year. Based on geographic distribution, most U.S. Atlantic sturgeon that are intercepted in Canadian fisheries are likely to originate from the GOM DPS, with a smaller percentage from the NYB DPS.

Fisheries bycatch in U.S. waters is the primary threat faced by all five DPSs. At this time, we have an estimate of the number of Atlantic sturgeon captured and killed in sink gillnet and otter trawl fisheries authorized by Federal FMPs (NEFSC 2011b) in the Greater Atlantic Region but do not have a similar estimate for Southeast fisheries. We also do not have an estimate of the number of Atlantic sturgeon captured or killed in state fisheries. At this time, we are not able to quantify the effects of other significant threats (e.g., vessel strikes, poor water quality, water availability, dams, and dredging) in terms of habitat impacts or loss of individuals. While we have some information on the number of mortalities that have occurred in the past in association with certain activities (e.g., mortalities in the Delaware and James Rivers that are thought to be due to vessel strikes), we are not able to use those numbers to extrapolate effects throughout one or more DPS. This is because of (1) the small number of data points and, (2) lack of information on the percent of incidences that the observed mortalities represent.

As noted above, the NEFSC prepared an estimate of the number of encounters of Atlantic sturgeon in fisheries authorized by Northeast FMPs (NEFSC 2011b). The analysis estimates that from 2006-2010 there were averages of 1,548 and 1,569 encounters per year in observed gillnet and trawl fisheries, respectively, with an average of 3,118 encounters combined annually. Mortality rates in gillnet gear were approximately 20%. Mortality rates in otter trawl gear were generally lower at approximately 5%.

Based on the results of a NEFSC climate vulnerability analysis, diadromous fish are amongst the functional groups with the highest overall climate vulnerability (data quality is moderate; Hare et al. 2016). Specifically, the overall vulnerability of Atlantic sturgeon to climate change is very high (Hare et al. 2016). The contributing factors to climate exposure included ocean surface temperature, air temperature and ocean acidification, and contributing biological sensitivity attributes included stock status, population growth rate, habitat specialization, and dispersal and early life history (Hare et al. 2016). Hare et al. (2016) noted some of the following studies related to climate change effects on abundance and distribution: 1) juvenile metabolism and survival were impacted by increasing hypoxia in combination with increasing temperature (Secor and Gunderson; 1998); and 2) a 1°C temperature increase reduced productivity by 65% when a multivariable bioenergetics and survival model was used to generate spatially explicit maps of potential production in the Chesapeake Bay (Niklitschek and Secor, 2005).

4.2.2.1 Gulf of Maine DPS of Atlantic sturgeon

The GOM DPS includes the following: all anadromous Atlantic sturgeon that spawn or are spawned in the watersheds from the Maine/Canadian border and, extending southward, all watersheds draining into the Gulf of Maine as far south as Chatham, Massachusetts. The marine range of Atlantic sturgeon from the GOM DPS extends from Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida. The riverine range of the GOM DPS and the adjacent portion of the marine range are shown in Figure 4. Within this range, Atlantic sturgeon historically spawned in

the Androscoggin, Kennebec, Merrimack, Penobscot, and Sheepscot Rivers (ASSRT 2007). Spawning still occurs in the Kennebec and Androscoggin Rivers, and it is possible that it still occurs in the Penobscot River as well. Spawning in the Androscoggin River was just recently confirmed by the Maine Department of Marine Resources when they captured a larval Atlantic sturgeon during the 2011 spawning season below the Brunswick Dam. There is no evidence of recent spawning in the remaining rivers. In the 1800s, construction of the Essex Dam on the Merrimack River at river kilometer (rkm) 49 blocked access to 58% of Atlantic sturgeon habitat in the river (Oakley 2003; ASSRT 2007). However, the accessible portions of the Merrimack seem to be suitable habitat for Atlantic sturgeon spawning and rearing (i.e., nursery habitat) (Kieffer and Kynard 1993). Therefore, the availability of spawning habitat does not appear to be the reason for the lack of observed spawning in the Merrimack River. Studies are on-going to determine whether Atlantic sturgeon are spawning in the Penobscot and Saco Rivers. Atlantic sturgeon that are spawned elsewhere continue to use habitats within all of these rivers as part of their overall marine range (ASSRT 2007).

At its mouth, the Kennebec River drains an area of 24,667 square kilometers, and is part of a large estuarine system that includes the Androscoggin and Sheepscot Rivers (ASMFC 1998a; ASSRT 1998; Squiers 1998). The Kennebec and Androscoggin Rivers flow into Merrymeeting Bay, a tidal freshwater bay, and exit as a combined river system through a narrow channel, flowing approximately 32 kilometers (20 miles) to the Atlantic Ocean as the tidal segment of the Kennebec River (Squiers 1998). This lower tidal segment of the Kennebec River forms a complex with the Sheepscot River estuary (ASMFC 1998a; Squiers 1998).

Substrate type in the Kennebec estuary is largely sand and bedrock (Fenster and FitzGerald 1996; Moore and Reblin 2010). Main channel depths at low tide typically range from 17 meters (58 feet) near the mouth to less than 10 meters (33 feet) in the Kennebec River above Merrymeeting Bay (Moore and Reblin 2010). Salinities range from 31 parts per thousand at Parker Head (five kilometers from the mouth) to 18 parts per thousand at Doubling Point during summer low flows (ASMFC 1998a). The 14-kilometer river segment above Doubling Point to Chops Point (the outlet of Merrymeeting Bay) is an area of transition (mid estuary) (ASMFC 1998a). The salinities in this section vary both seasonally and over a tidal cycle. During spring freshets this section is entirely fresh water but during summer low flows, salinities can range from two to three parts per thousand at Chops Point to 18 ppt at Doubling Point (ASMFC 1998a). The river is essentially tidal freshwater from the outlet of Merrymeeting Bay upriver to the site of the former Edwards Dam (ASMFC 1998a). Mean tidal amplitude ranges from 2.56 meters at the mouth of the Kennebec River estuary to 1.25 meters in Augusta near the head of tide on the Kennebec River (in the vicinity of the former Edwards Dam) and 1.16 meters at Brunswick on the Androscoggin River (ASMFC 1998a).

Bigelow and Schroeder (1953) surmised that Atlantic sturgeon likely spawned in Gulf of Maine Rivers in May-July. More recent captures of Atlantic sturgeon in spawning condition within the Kennebec River suggest that spawning more likely occurs in June-July (Squiers *et al.* 1981; ASMFC 1998a; ASSRT 1998). Evidence for the timing and location of Atlantic sturgeon spawning in the Kennebec River includes: (1) the capture of five adult male Atlantic sturgeon in spawning condition (i.e., expressing milt) in July 1994 below the (former) Edwards Dam; (2) the capture of 31 adult Atlantic sturgeon from June 15 through July 26, 1980, in a small commercial

fishery directed at Atlantic sturgeon from the South Gardiner area (above Merrymeeting Bay) that included at least four ripe males and one ripe female captured on July 26, 1980; and, (3) the capture of nine adults during a gillnet survey conducted from 1977-1981, the majority of which were captured in July in the area from Merrymeeting Bay and upriver as far as Gardiner, Maine (ASSRT 1998; ASMFC TC 2007). The low salinity values for waters above Merrymeeting Bay are consistent with values found in other rivers where successful Atlantic sturgeon spawning is known to occur.

Age to maturity for GOM DPS Atlantic sturgeon is unknown. However, Atlantic sturgeon riverine populations exhibit clinal variation with faster growth and earlier age to maturity for those that originate from southern waters, and slower growth and later age to maturity for those that originate from northern waters (75 FR 61872; October 6, 2010). Age at maturity is 11 to 21 years for Atlantic sturgeon originating from the Hudson River (Young *et al.* 1998), and 22 to 34 years for Atlantic sturgeon that originate from the Saint Lawrence River (Scott and Crossman 1973). Therefore, age at maturity for Atlantic sturgeon of the GOM DPS likely falls within these values. Of the 18 sturgeon examined from the commercial fishery that occurred in the Kennebec River in 1980, all of which were considered mature, age estimates for the 15 males ranged from 17-40 years, and from 25-40 years old for the three females (Squiers *et al.* 1981).

Several threats play a role in shaping the current status of GOM DPS Atlantic sturgeon. Historical records provide evidence of commercial fisheries for Atlantic sturgeon in the Kennebec and Androscoggin Rivers dating back to the 17th century (Squiers *et al.* 1979). In 1849, 160 tons of sturgeon was caught in the Kennebec River by local fishermen (Squiers *et al.* 1979). After the collapse of sturgeon stock in the 1880s, the sturgeon fishery was almost non-existent. All directed Atlantic sturgeon fishing as well as retention of Atlantic sturgeon bycatch has been prohibited since 1998. Nevertheless, mortalities associated with bycatch in fisheries in state and Federal waters still occurs. In the marine range, GOM DPS Atlantic sturgeon are incidentally captured in Federal and state-managed fisheries, reducing survivorship of subadult and adult Atlantic sturgeon (Stein *et al.* 2004b; ASMFC TC 2007). As explained above, we have estimates of the number of subadults and adults that are killed as a result of bycatch in fisheries authorized under Northeast FMPs. At this time, we are not able to quantify the impacts from other threats or estimate the number of individuals killed as a result of other anthropogenic threats. Habitat disturbance and direct mortality from anthropogenic sources are the primary concerns.

Riverine habitat may be impacted by dredging and other in-water activities, disturbing spawning habitat and also altering the benthic forage base. Many rivers in the GOM DPS have navigation channels that are maintained by dredging. Dredging outside of Federal channels and in-water construction occurs throughout the GOM DPS. While some dredging projects operate with observers present to document fish mortalities, many do not. To date we have not received any reports of Atlantic sturgeon killed during dredging projects in the Gulf of Maine region. At this time, we do not have any information to quantify the number of Atlantic sturgeon killed or disturbed during dredging or in-water construction projects are also not able to quantify any effects to habitat.

Connectivity is disrupted by the presence of dams on several rivers in the Gulf of Maine region, including the Penobscot and Merrimack Rivers. While there are also dams on the Kennebec, Androscoggin, and Saco Rivers, these dams are near the site of historical natural falls and likely represent the maximum upstream extent of sturgeon occurrence even if the dams were not present. Because no Atlantic sturgeon occur upstream of any hydroelectric projects in the Gulf of Maine region, passage over hydroelectric dams or through hydroelectric turbines is not a source of injury or mortality in this area. The extent that Atlantic sturgeon are affected by operations of dams in the Gulf of Maine region is currently unknown; however, the documentation of an Atlantic sturgeon larvae downstream of the Brunswick Dam in the Androscoggin River suggests that Atlantic sturgeon spawning may be occurring in the vicinity of at least that project and therefore, may be affected by project operations. The range of Atlantic sturgeon in the Penobscot River is limited by the presence of the Milford Dam, at the base of which is the presumed historical spawning habitat. Atlantic sturgeon are known to occur in the Penobscot River, but it is unknown if spawning is currently occurring in this river. The Essex Dam on the Merrimack River blocks access to approximately 58% of historically accessible habitat in this river. Atlantic sturgeon occur in the Merrimack River but spawning has not been documented. As with the Penobscot, it is unknown how the Essex Dam affects the likelihood of spawning in this river.

GOM DPS Atlantic sturgeon may also be affected by degraded water quality. In general, water quality has improved in the Gulf of Maine over the past decades (Lichter *et al.* 2006; EPA 2008). Many rivers in Maine, including the Androscoggin River, were heavily polluted in the past from pulp and paper mill industrial discharges. While water quality has improved and most discharges are limited through regulations, many pollutants persist in the benthic environment. This can be particularly problematic if pollutants are present on spawning and nursery grounds, as developing eggs and larvae are particularly susceptible to exposure to contaminants.

There are no direct in-river abundance estimates for the GOM DPS. The Atlantic Sturgeon Status Review Team (ASSRT 2007) presumed that the GOM DPS was comprised of less than 300 spawning adults per year, based on extrapolated abundance estimates from the Hudson and Altamaha riverine populations of Atlantic sturgeon. Surveys of the Kennebec River over two time periods, 1977-1981 and 1998-2000, resulted in the capture of nine adult Atlantic sturgeon (Squiers 2004). However, since the surveys were primarily directed at capture of shortnose sturgeon, the capture gear used may not have been selective for the larger-sized, adult Atlantic sturgeon; several hundred subadult Atlantic sturgeon were caught in the Kennebec River during these studies. As described earlier in Section 4.2.2, we have estimated that there are a minimum of 7,455 GOM DPS adult and subadult Atlantic sturgeon of size vulnerable to capture in U.S. Atlantic waters. We note further that this estimate is predicated on the assumption that fish in the GOM DPS would be available for capture in the NEAMAP surveys which extend from Block Island Sound, Rhode Island southward. Recoveries of tagged sturgeon do not support this migration pattern.

Summary of the Gulf of Maine DPS

Spawning for the GOM DPS is known to occur in two rivers (Kennebec and Androscoggin). Spawning may be occurring in other rivers, such as the Sheepscot, Merrimack, and Penobscot, but has not been confirmed. There are indications of potential increasing abundance of Atlantic sturgeon belonging to the GOM DPS. Atlantic sturgeon continue to be present in the Kennebec

River; in addition, they are captured in directed research projects in the Penobscot River, and are observed in rivers where they were unknown to occur or had not been observed to occur for many years (e.g., Saco, Presumpscot, and Charles Rivers). These observations suggest that abundance of the GOM DPS of Atlantic sturgeon is sufficient such that recolonization to rivers historically suitable for spawning may be occurring. However, despite some positive signs, there is not enough information to establish a trend for this DPS.

Some of the impacts from the threats that contributed to the decline of the GOM DPS have been removed (e.g., directed fishing), or reduced as a result of improvements in water quality and removal of dams (e.g., the Edwards Dam on the Kennebec River in 1999 and the Veazie Dam on the Penobscot River in 2013). In Maine state waters, there are strict regulations on the use of fishing gear that incidentally catches sturgeon. In addition, in the last several years there have been reductions in fishing effort in state and Federal waters, which most likely would result in a reduction in bycatch mortality of Atlantic sturgeon. A significant amount of fishing in the Gulf of Maine is conducted using trawl gear, which is known to have a much lower mortality rate for Atlantic sturgeon caught in the gear compared to sink gillnet gear (ASMFC TC 2007). Atlantic sturgeon from the GOM DPS are not commonly taken as bycatch in areas south of Chatham, Massachusetts, with only 8% (e.g., 7 of 84 fish) of interactions observed south of Chatham being assigned to the GOM DPS (Wirgin and King 2011). Tagging results also indicate that GOM DPS fish tend to remain within the waters of the Gulf of Maine and only occasionally venture to points south.

Data on Atlantic sturgeon incidentally caught in trawls and intertidal fish weirs fished in the Minas Basin area of the Bay of Fundy (Canada) indicate that approximately 35% originated from the GOM DPS (Wirgin *et al.* 2012). Thus, a significant number of the GOM DPS fish appear to migrate north into Canadian waters where they may be subjected to a variety of threats including bycatch.

As noted previously, studies have shown that in order to rebuild, Atlantic sturgeon can only sustain low levels of bycatch and other anthropogenic mortality (Boreman 1997; ASMFC TC 2007; Kahnle *et al.* 2007; Brown and Murphy 2010). We have determined that the GOM DPS is at risk of becoming endangered in the foreseeable future throughout all of its range (i.e., is a threatened species) based on the following: (1) significant declines in population sizes and the protracted period during which sturgeon populations have been depressed; (2) the limited amount of current spawning; and, (3) the impacts and threats that have and will continue to affect recovery.

4.2.2.2 New York Bight DPS of Atlantic sturgeon

The NYB DPS includes the following: all anadromous Atlantic sturgeon that spawn or are spawned in the watersheds that drain into coastal waters from Chatham, Massachusetts to the Delaware-Maryland border on Fenwick Island. The marine range of Atlantic sturgeon from the NYB DPS extends from Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida. The riverine range of the NYB DPS and the adjacent portion of the marine range are shown in Figure 4. Within this range, Atlantic sturgeon historically spawned in the Connecticut, Delaware, Hudson, and Taunton Rivers (Murawski and Pacheco 1977; Secor 2002; ASSRT 2007).

Spawning still occurs in the Delaware and Hudson Rivers, but there is no recent evidence (within the last 15 years) of spawning in the Connecticut and Taunton Rivers (ASSRT 2007). Atlantic sturgeon that are spawned elsewhere continue to use habitats within the Connecticut and Taunton Rivers as part of their overall marine range (ASSRT 2007; Savoy 2007; Wirgin and King 2011).

The abundance of the Hudson River Atlantic sturgeon riverine population before the over-exploitation of the 1800s is unknown, but has been conservatively estimated at 6,000 adult females (Secor 2002). Current abundance is likely at least one order of magnitude smaller than historical levels (Secor 2002; ASSRT 2007; Kahnle *et al.* 2007). As described above, an estimate of the mean annual number of mature adults (863 total; 596 males and 267 females) was calculated for the Hudson riverine population based on fishery-dependent data collected from 1985-1995 (Kahnle *et al.* 2007). Kahnle *et al.* (1998, 2007) also showed that the level of fishing mortality from the Hudson River Atlantic sturgeon fishery during the period of 1985-1995 exceeded the estimated sustainable level of fishing mortality for the riverine population and may have led to reduced recruitment. All available data on abundance of juvenile Atlantic sturgeon in the Hudson River Estuary indicate a substantial drop in production of young since the mid-1970s (Kahnle *et al.* 1998). A decline appeared to occur in the mid to late 1970s followed by a secondary drop in the late 1980s (Kahnle *et al.* 1998; Sweka *et al.* 2007; ASMFC 2010). Catch-per-unit-effort (CPUE) data suggests that recruitment has remained depressed relative to catches of juvenile Atlantic sturgeon in the estuary during the mid-late 1980s (Sweka *et al.* 2007; ASMFC 2010). The CPUE data from 1985-2011 show significant fluctuations. There appears to be a decline in the number of juveniles between the late 1980s and early 1990s and then a slight increase in the 2000s, but, given the significant annual fluctuation, it is difficult to discern any trend. Despite the CPUEs from 2000-2011 being slightly higher than those from 1990-1999, they are low compared to the late 1980s (Figure 5). There is currently not enough information regarding any life stage to establish a trend for the Hudson River population.

There is no overall, empirical abundance estimate for the Delaware River population of Atlantic sturgeon. Harvest records from the 1800s indicate that this was historically a large population with an estimated 180,000 adult females prior to 1890 (Secor and Waldman 1999; Secor 2002). Sampling in 2009 to target YOY Atlantic sturgeon in the Delaware River (i.e., natal sturgeon) resulted in the capture of 34 YOY, ranging in size from 178 to 349 millimeters TL (Fisher 2009), and the collection of 32 YOY Atlantic sturgeon in a separate study (Brundage and O'Herron 2009 in Calvo *et al.* 2010). Genetics information collected from 33 of these YOY indicates that at least three females successfully contributed to the 2009 year class (Fisher 2011). Therefore, while the capture of YOY in 2009 provides evidence that successful spawning still occurs in the Delaware River, the relatively low numbers suggest the existing riverine population is small.

Several threats play a role in shaping the current status and trends observed in the Delaware River and Estuary. In-river threats include habitat disturbance from dredging, and impacts from historical pollution and impaired water quality. A dredged navigation channel extends from Trenton seaward through the tidal river (Brundage and O'Herron 2009), and the river receives significant shipping traffic. Vessel strikes have been identified as a threat in the Delaware River and may be detrimental to the long-term viability of the NYB DPS, as well as other DPSs (Brown and Murphy 2010).

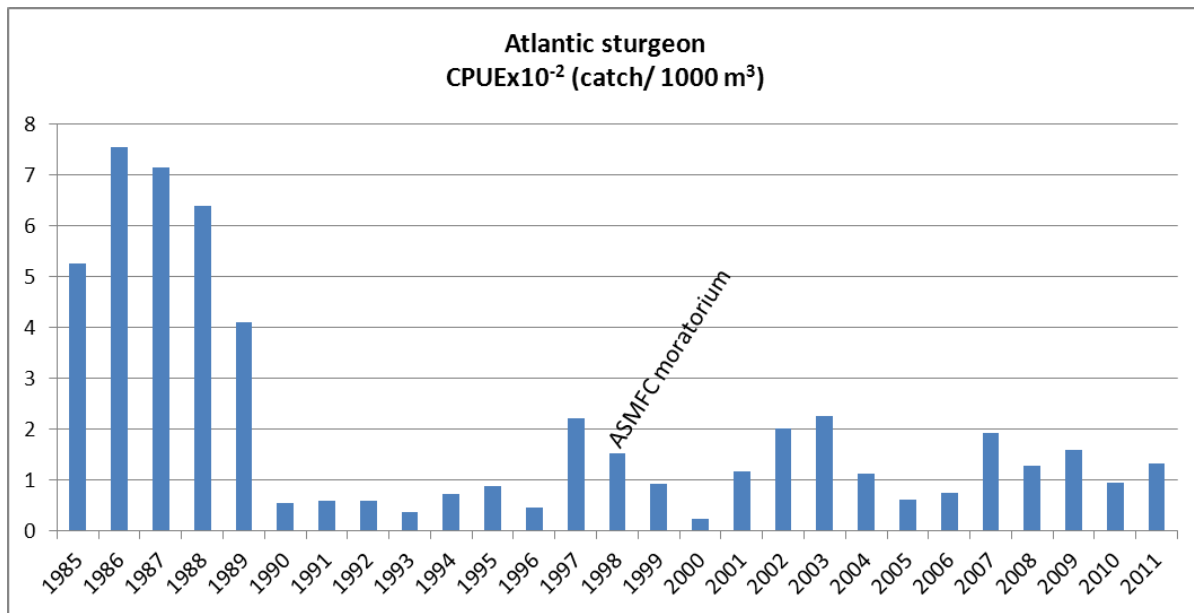


Figure 5. Hudson River Atlantic sturgeon CPUE juvenile index (1985-2011).

Summary of the New York Bight DPS

Atlantic sturgeon originating from the NYB DPS have been documented to spawn in the Hudson and Delaware Rivers and may spawn in the Connecticut and Housatonic Rivers, although that has not been confirmed. While genetic testing can differentiate between individuals originating from the Hudson or Delaware River, the available information suggests that the straying rate is relatively high between these rivers. Some of the impact from the threats that contributed to the decline of the NYB DPS have been removed (e.g., directed fishing) or reduced as a result of improvements in water quality since passage of the Clean Water Act (CWA). In addition, there have been reductions in fishing effort in state and Federal waters, which may result in a reduction in bycatch mortality of Atlantic sturgeon. Nevertheless, areas with persistent, degraded water quality, habitat impacts from dredging, continued bycatch in state and federally-managed fisheries, and vessel strikes remain significant threats to the NYB DPS.

In its marine range, NYB DPS Atlantic sturgeon are incidentally captured in Federal and state-managed fisheries, reducing survivorship of subadult and adult Atlantic sturgeon (Stein *et al.* 2004a; ASMFC TC 2007). Based on mixed stock analysis results presented by Wirgin and King (2011), more than 40% of the Atlantic sturgeon bycatch interactions in the Mid-Atlantic Bight region were sturgeon from the NYB DPS. Individual-based assignment and mixed stock analysis of samples collected from sturgeon captured in Canadian fisheries in the Bay of Fundy indicated that approximately 1%-2% were from the NYB DPS (Wirgin *et al.* 2012). At this time, we are not able to quantify the impacts from threats other than fisheries or estimate the number of individuals killed as a result of other anthropogenic threats.

Riverine habitat may be impacted by dredging and other in-water activities, disturbing spawning habitat and also altering the benthic forage base. Both the Hudson and Delaware Rivers have navigation channels that are maintained by dredging. Dredging is also used to maintain channels

in the nearshore marine environment. Dredging outside of Federal channels and in-water construction occurs throughout the New York Bight region. While some dredging projects operate with observers present to document fish mortalities, many do not. We have reports of one Atlantic sturgeon entrained during hopper dredging operations in Ambrose Channel, New Jersey, and four entrained during hopper dredging operations aboard the McFarland in the Delaware River. We have recently consulted on two Army Corps of Engineers (ACOE) dredging projects: (1) the Deepening and Maintenance of the Delaware River Federal Navigation Channel and (2) the New York and New Jersey Harbor Deepening Project. In both cases, we determined that while the proposed actions may adversely affect Atlantic sturgeon, they were not likely to jeopardize the continued existence of any DPS of Atlantic sturgeon.

In the Hudson and Delaware Rivers, dams do not block access to historical habitat. The Holyoke Dam on the Connecticut River blocks passage past the dam at Holyoke; however, the extent that Atlantic sturgeon would historically have used habitat upstream of Holyoke is unknown. The first dam on the Taunton River may block access to historical spawning habitat. Connectivity also may be disrupted by the presence of dams on several smaller rivers in the New York Bight region. Because no Atlantic sturgeon occur upstream of any hydroelectric projects in the New York Bight region, passage over hydroelectric dams or through hydroelectric turbines is not a source of injury or mortality in this area. The extent to which Atlantic sturgeon are affected by operations of dams in the New York Bight region is currently unknown. Atlantic sturgeon may also be impinged or entrained at power plants in the Hudson and Delaware Rivers, and may be adversely affected by the operation of the power plants, but the power plants have not been found to jeopardize their continued existence.

NYB DPS Atlantic sturgeon may also be affected by degraded water quality. Rivers in the New York Bight region, including the Hudson and Delaware, have been heavily polluted by industrial and sewer discharges. In general, water quality has improved in the Hudson and Delaware over the past several decades (Lichter *et al.* 2006; EPA 2008). While water quality has improved and most discharges are limited through regulations, it is likely that pollutants persist in the benthic environment. This can be particularly problematic if pollutants are present on spawning and nursery grounds, where developing eggs and larvae are particularly susceptible to exposure to contaminants.

Vessel strikes are known to occur in the Delaware River and may also be occurring in the Hudson and other New York Bight rivers. Twenty-nine mortalities believed to be the result of vessel strikes were documented in the Delaware River from 2004-2008, and at least 13 of these fish were large adults. Given the time of year in which the fish were observed (predominantly May through July, with two in August), it is likely that many of the adults were migrating through the river to the spawning grounds. Because we do not know the percent of total vessel strikes that the observed mortalities represent, we are not able to quantify the number of individuals likely killed as a result of vessel strikes in the NYB DPS.

Studies have shown that to rebuild, Atlantic sturgeon can only sustain low levels of anthropogenic mortality (Boreman 1997; ASMFC TC 2007; Kahnle *et al.* 2007; Brown and Murphy 2010). There are no empirical abundance estimates of the number of Atlantic sturgeon in the NYB DPS. As described in Section 4.2.2, we have estimated that there are a minimum of

34,566 NYB DPS adult and subadult Atlantic sturgeon of size vulnerable to capture in U.S. Atlantic waters. We have determined that the NYB DPS is currently at risk of extinction due to: (1) precipitous declines in population sizes and the protracted period in which sturgeon populations have been depressed; (2) the limited amount of current spawning; and (3) the impacts and threats that have and will continue to affect population recovery.

4.2.2.3 Chesapeake Bay DPS of Atlantic sturgeon

The CB DPS includes the following: all anadromous Atlantic sturgeon that spawn or are spawned in the watersheds that drain into the Chesapeake Bay and into coastal waters from the Delaware-Maryland border on Fenwick Island to Cape Henry, Virginia. The marine range of Atlantic sturgeon from the CB DPS extends from Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida. The riverine range of the CB DPS and the adjacent portion of the marine range are shown in Figure 4. Within this range, Atlantic sturgeon historically spawned in the Susquehanna, Potomac, James, York, Rappahannock, and Nottoway Rivers (ASSRT 2007). Based on the review by Oakley (2003), 100% of Atlantic sturgeon habitat is currently accessible in these rivers since most of the barriers to passage (i.e., dams) are located upriver of where spawning is expected to have historically occurred (ASSRT 2007). Spawning still occurs in the James River, and the presence of juvenile and adult sturgeon in the York River suggests that spawning may occur there as well (Musick *et al.* 1994; ASSRT 2007; Greene *et al.* 2009). However, conclusive evidence of current spawning is only available for the James River, where a recent study found evidence of Atlantic sturgeon spawning in the fall (Balazik *et al.* 2012a). Atlantic sturgeon that are spawned elsewhere are known to use the Chesapeake Bay for other life functions, such as foraging and as juvenile nursery habitat (Vladykov and Greeley 1963; Wirgin *et al.* 2000; ASSRT 2007; Grunwald *et al.* 2008).

Age to maturity for CB DPS Atlantic sturgeon is unknown. However, Atlantic sturgeon riverine populations exhibit clinal variation with faster growth and earlier age to maturity for those that originate from southern waters, and slower growth and later age to maturity for those that originate from northern waters (75 FR 61872; October 6, 2010). Age at maturity is five to 19 years for Atlantic sturgeon originating from South Carolina rivers (Smith *et al.* 1982) and 11 to 21 years for Atlantic sturgeon originating from the Hudson River (Young *et al.* 1998). Therefore, age at maturity for Atlantic sturgeon of the CB DPS likely falls within these values.

Several threats play a role in shaping the current status of CB DPS Atlantic sturgeon. Historical records provide evidence of the large-scale commercial exploitation of Atlantic sturgeon from the James River and Chesapeake Bay in the 19th century (Hildebrand and Schroeder 1928; Vladykov and Greeley 1963; ASMFC 1998b; Secor 2002; Bushnoe *et al.* 2005; ASSRT 2007) as well as subsistence fishing and attempts at commercial fisheries as early as the 17th century (Secor 2002; Bushnoe *et al.* 2005; ASSRT 2007; Balazik *et al.* 2010). Habitat disturbance caused by in-river work, such as dredging for navigational purposes, is thought to have reduced available spawning habitat in the James River (Holton and Walsh 1995; Bushnoe *et al.* 2005; ASSRT 2007). At this time, we do not have information to quantify this loss of spawning habitat.

Decreased water quality also threatens Atlantic sturgeon of the CB DPS, especially since the Chesapeake Bay system is vulnerable to the effects of nutrient enrichment due to a relatively low

tidal exchange and flushing rate, large surface-to-volume ratio, and strong stratification during the spring and summer months (Pyzik *et al.* 2004; ASMFC 1998a; ASSRT 2007; EPA 2008). These conditions contribute to reductions in dissolved oxygen levels throughout the Bay. The availability of nursery habitat, in particular, may be limited given the recurrent hypoxia (low dissolved oxygen) conditions within the Bay (Niklitschek and Secor 2005, 2010). Heavy industrial development during the 20th century in rivers inhabited by sturgeon impaired water quality and impeded these species' recovery.

Although there have been improvements in the some areas of the Bay's health, the ecosystem remains in poor condition. The EPA gave the overall health of the Bay a grade of 45% based on goals for water quality, habitats, lower food web productivity, and fish and shellfish abundance (EPA CBP 2010). This was a 6% increase from 2008. According to the EPA, the modest gain in the health score was due to a large increase in the adult blue crab population, expansion of underwater grass beds growing in the Bay's shallows, and improvements in water clarity and bottom habitat health as highlighted below:

- 12% of the Bay and its tidal tributaries met CWA standards for dissolved oxygen between 2007 and 2009, a decrease of 5% from 2006 to 2008,
- 26% of the tidal waters met or exceeded guidelines for water clarity, a 12% increase from 2008,
- Underwater bay grasses covered 9,039 more acres of the Bay's shallow waters for a total of 85,899 acres, 46% of the Bay-wide goal,
- The health of the Bay's bottom dwelling species reached a record high of 56% of the goal, improving by approximately 15% Bay-wide, and
- The adult blue crab population increased to 223 million, its highest level since 1993.

At this time we do not have sufficient information to quantify the extent that degraded water quality effects habitat or individuals in the James River or throughout the Chesapeake Bay.

Vessel strikes have been observed in the James River (ASSRT 2007). Eleven Atlantic sturgeon were reported to have been struck by vessels from 2005-2007. Several of these were mature individuals. Because we do not know the percent of total vessel strikes that the observed mortalities represent, we are not able to quantify the number of individuals likely killed as a result of vessel strikes in the CB DPS.

In the marine and coastal range of the CB DPS from Canada to Florida, fisheries bycatch in federally and state-managed fisheries poses a threat to the DPS, reducing survivorship of subadults and adults and potentially causing an overall reduction in the spawning population (Stein *et al.* 2004b; ASMFC TC 2007; ASSRT 2007).

Summary of the Chesapeake Bay DPS

Spawning for the CB DPS is known to occur in only the James and Pamunkey Rivers. Spawning may be occurring in other rivers, such as the York, Rappahannock, Potomac, Nanticoke, and Susquehanna, but has not been confirmed for any of those. There are anecdotal reports of increased sightings and captures of Atlantic sturgeon in the James River. However, this information has not been comprehensive enough to develop a population estimate for the James

River or to provide sufficient evidence to confirm increased abundance. Some of the impact from the threats that facilitated the decline of the CB DPS have been removed (e.g., directed fishing) or reduced as a result of improvements in water quality since passage of the CWA. As described in Section 4.2.2, we have estimated that there are a minimum of 8,811 CB DPS adult and subadult Atlantic sturgeon of size vulnerable to capture in U.S. Atlantic waters.

Areas with persistent, degraded water quality, habitat impacts from dredging, continued bycatch in U.S. state and federally-managed fisheries, Canadian fisheries, and vessel strikes remain significant threats to the CB DPS of Atlantic sturgeon. Of the 35% of Atlantic sturgeon incidentally caught in the Bay of Fundy, about 1% were CB DPS fish (Wirgin *et al.* 2012). Studies have shown that Atlantic sturgeon can only sustain low levels of bycatch mortality (Boreman 1997; ASMFC TC 2007; Kahnle *et al.* 2007). The CB DPS is currently at risk of extinction given (1) precipitous declines in population sizes and the protracted period in which sturgeon populations have been depressed; (2) the limited amount of current spawning; and, (3) the impacts and threats that have and will continue to affect the potential for population recovery.

4.2.2.4 Carolina DPS of Atlantic sturgeon

The Carolina DPS includes all Atlantic sturgeon that spawn or are spawned in the watersheds (including all rivers and tributaries) from Albemarle Sound southward along the southern Virginia, North Carolina, and South Carolina coastal areas to Charleston Harbor. The marine range of Atlantic sturgeon from the Carolina DPS extends from the Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida. The riverine range of the Carolina DPS and the adjacent portion of the marine range are shown in Figure 4. Sturgeon are commonly captured 40 miles offshore (D. Fox, Delaware State University, pers. comm.). Records providing fishery bycatch data by depth show the vast majority of Atlantic sturgeon bycatch via gillnets is observed in waters less than 50 meters deep (Stein *et al.* 2004b, ASMFC TC 2007), but Atlantic sturgeon are recorded as bycatch out to 500 fathoms.

Rivers known to have current spawning populations within the range of the Carolina DPS include the Roanoke, Tar-Pamlico, Cape Fear, Waccamaw, and Pee Dee Rivers. We determined spawning was occurring if YOY were observed or mature adults were present in freshwater portions of a system (Table 8). However, in some rivers, spawning by Atlantic sturgeon may not be contributing to population growth because of lack of suitable habitat and the presence of other stressors on juvenile survival and development. There may also be spawning populations in the Neuse, Santee, and Cooper Rivers, though it is uncertain. Historically, both the Sampit and Ashley Rivers were documented to have spawning populations at one time. However, the spawning population in the Sampit River is believed to be extirpated, and the current status of the spawning population in the Ashley River is unknown. Both rivers may be used as nursery habitat by young Atlantic sturgeon originating from other spawning populations. Fish from the Carolina DPS likely use other river systems than those listed here for their specific life functions.

Historical landings data indicate that between 7,000 and 10,500 adult female Atlantic sturgeon were present in North Carolina prior to 1890 (Armstrong and Hightower 2002; Secor 2002). Secor (2002) estimates that 8,000 adult females were present in South Carolina during that same time frame. Prior reductions from the commercial fishery and ongoing threats have drastically

reduced the numbers of Atlantic sturgeon within the Carolina DPS. Currently, the Atlantic sturgeon spawning population in at least one river system within the Carolina DPS has been extirpated, with potential extirpation in an additional system. The abundances of the remaining river populations within the DPS, each estimated to have fewer than 300 spawning adults, are estimated to be less than 3% of what they were historically (ASSRT 2007). As described in Section 4.2.2, we have estimated that there are a minimum of 1,356 Carolina DPS adult and subadult Atlantic sturgeon of size vulnerable to capture in U.S. Atlantic waters.

Table 8. Major rivers, tributaries, and sounds within the range of the Carolina DPS and currently available data on the presence of an Atlantic sturgeon spawning population in each system.

River/Estuary	Spawning Population	Data
Roanoke River, VA/NC; Albemarle Sound, NC	Yes	collection of 15 YOY (1997-1998); single YOY (2005)
Tar-Pamlico River, NC; Pamlico Sound	Yes	one YOY (2005)
Neuse River, NC; Pamlico Sound	Unknown	
Cape Fear River, NC	Yes	upstream migration of adults in the fall, carcass of a ripe female upstream in mid-September (2006)
Waccamaw River, SC; Winyah Bay	Yes	age-1, potentially YOY (1980s)
Pee Dee River, SC; Winyah Bay	Yes	running ripe male in Great Pee Dee River (2003)
Sampit, SC; Winyah Bay	Extirpated	
Santee River, SC	Unknown	
Cooper River, SC	Unknown	
Ashley River, SC	Unknown	

Threats

The Carolina DPS was listed as endangered under the ESA as a result of a combination of habitat curtailment and modification, overutilization (i.e., being taken as bycatch) in commercial fisheries, and the inadequacy of regulatory mechanisms in ameliorating these impacts and threats.

The modification and curtailment of Atlantic sturgeon habitat resulting from dams, dredging, and degraded water quality is contributing to the status of the Carolina DPS. Dams have curtailed Atlantic sturgeon spawning and juvenile developmental habitat by blocking more than 60% of the historical sturgeon habitat upstream of the dams in the Cape Fear and Santee-Cooper River systems. Water quality (velocity, temperature, and dissolved oxygen) downstream of these dams, as well as on the Roanoke River, has been reduced, which modifies and curtails the extent of spawning and nursery habitat for the Carolina DPS. Dredging in spawning and nursery grounds

modifies the quality of the habitat and is further curtailing the extent of available habitat in the Cape Fear and Cooper Rivers, where Atlantic sturgeon habitat has already been modified and curtailed by the presence of dams. Reductions in water quality from terrestrial activities have modified habitat used by the Carolina DPS. In the Pamlico and Neuse systems, nutrient-loading and seasonal anoxia are occurring, associated in part with concentrated animal feeding operations (CAFOs). Heavy industrial development and CAFOs have also degraded water quality in the Cape Fear River. Water quality in the Waccamaw and Pee Dee Rivers has been affected by industrialization and riverine sediment samples contain high levels of various toxins, including dioxins. Additional stressors arising from water allocation and climate change threaten to exacerbate water quality problems that are already present throughout the range of the Carolina DPS. Twenty interbasin water transfers in existence prior to 1993, averaging 66.5 million gallons per day (mgd), were authorized at their maximum levels without being subjected to an evaluation for certification by the North Carolina Department of Environmental and Natural Resources and other resource agencies. Since the 1993 legislation requiring certificates for transfers took effect, almost 170 mgd of interbasin water withdrawals have been authorized, with an additional 60 mgd pending certification. The removal of large amounts of water from the system will alter flows, temperature, and dissolved oxygen. Existing water allocation issues will likely be compounded by population growth and potentially climate change. Climate change is also predicted to elevate water temperatures and exacerbate nutrient-loading, pollution inputs, and lower dissolved oxygen, all of which are current stressors to the Carolina DPS.

Overutilization of Atlantic sturgeon from directed fishing caused initial severe declines in Atlantic sturgeon populations in the Southeast in the mid- to late 19th century, from which they have never rebounded. Continued bycatch of Atlantic sturgeon in commercial fisheries is an ongoing impact to the Carolina DPS. More robust fishery independent data on bycatch are available for the Northeast and Mid-Atlantic than in the Southeast where high levels of bycatch underreporting are suspected.

Though there are statutory and regulatory regulations that authorize reducing the impact of dams on riverine and anadromous species, these mechanisms have proven inadequate for preventing dams from blocking access to habitat upstream and degrading habitat downstream. Water quality continues to be a problem in the Carolina DPS, even with existing controls on some pollution sources. Current regulatory regimes are not effective in controlling water allocation issues (e.g., no restrictions on interbasin water transfers in South Carolina, the lack of ability to regulate non-point source pollution, etc.).

The recovery of Atlantic sturgeon along the Atlantic Coast, especially in areas where habitat is limited and water quality is severely degraded, will require improvements in the following areas: (1) elimination of barriers to spawning habitat either through dam removal, breaching, or installation of successful fish passage facilities; (2) operation of water control structures to provide appropriate flows, especially during spawning season; (3) imposition of dredging restrictions including seasonal moratoriums and avoidance of spawning/nursery habitat; and (4) mitigation of water quality parameters that are restricting sturgeon use of a river (i.e., dissolved oxygen). Additional data regarding sturgeon use of riverine and estuarine environments are needed.

The concept of a viable population able to adapt to changing environmental conditions is critical to Atlantic sturgeon, and the low population numbers of every river population in the Carolina DPS put them in danger of extinction throughout their range; none of the populations are large or stable enough to provide with any level of certainty for the continued existence of Atlantic sturgeon in this part of its range. Although the largest impact that caused the precipitous decline of the species has been curtailed (directed fishing), the population sizes within the Carolina DPS have remained relatively constant at greatly reduced levels (approximately 3% of historical population sizes) for 100 years. Small numbers of individuals resulting from drastic reductions in populations, such as that which occurred due to the commercial fishery, can remove the buffer against natural demographic and environmental variability provided by large populations (Berry 1971; Soulé 1980; Shaffer 1981). Recovery of depleted populations is an inherently slow process for late-maturing species such as Atlantic sturgeon, and they continue to face a variety of other threats that contribute to their risk of extinction. Their late age at maturity provides more opportunities for individual Atlantic sturgeon to be removed from the population before reproducing. While a long life-span also allows multiple opportunities to contribute to future generations, it also increases the timeframe over which exposure to the multitude of threats facing the Carolina DPS can occur. The viability of the Carolina DPS depends on having multiple self-sustaining riverine spawning populations and maintaining suitable habitat to support the various life functions (spawning, feeding, growth) of Atlantic sturgeon populations.

Summary of the Status of the Carolina DPS of Atlantic Sturgeon

Recovery of depleted populations is an inherently slow process for a late-maturing species such as Atlantic sturgeon. Their late age at maturity provides more opportunities for individuals to be removed from the population before reproducing. While a long life-span also allows multiple opportunities to contribute to future generations, this is hampered within the Carolina DPS by habitat alteration and bycatch. This DPS was severely depleted by past directed commercial fishing, and faces ongoing impacts and threats from habitat alteration or inaccessibility, bycatch, and the inadequacy of existing regulatory mechanisms to address and reduce habitat alterations and bycatch that have prevented river populations from rebounding and will prevent their recovery.

The presence of dams has resulted in the loss of more than 60% of the historical sturgeon habitat on the Cape Fear River and in the Santee-Cooper system. Dams are contributing to the status of the Carolina DPS by curtailing the extent of available spawning habitat and further modifying the remaining habitat downstream by affecting water quality parameters (such as depth, temperature, velocity, and dissolved oxygen) that are important to sturgeon. Dredging is also contributing to the status of the Carolina DPS by modifying Atlantic sturgeon spawning and nursery habitat. Habitat modifications through reductions in water quality are contributing to the status of the Carolina DPS due to nutrient-loading, seasonal anoxia, and contaminated sediments. Interbasin water transfers and climate change threaten to exacerbate existing water quality issues. Bycatch is also a current threat to the Carolina DPS that is contributing to its status. Fisheries known to incidentally catch Atlantic sturgeon occur throughout the marine range of the species and in some riverine waters as well. Because Atlantic sturgeon mix extensively in marine waters and may use multiple river systems for nursery and foraging habitat in addition to their natal spawning river, they are subject to being caught in multiple fisheries throughout their range. In addition to direct mortality, stress or injury to Atlantic sturgeon taken as bycatch but released

alive may result in increased susceptibility to other threats, such as poor water quality (e.g., exposure to toxins). This may result in either reduced ability to perform major life functions, such as foraging and spawning, or even post-capture mortality. While many of the threats to the Carolina DPS have been ameliorated or reduced due to existing regulatory mechanisms, such as the moratorium on directed fisheries for Atlantic sturgeon, bycatch and habitat alterations are currently not being addressed through existing mechanisms. Further, despite NMFS's authority under the Federal Power Act to prescribe fish passage and existing controls on some pollution sources, access to habitat and improved water quality continues to be a problem. The inadequacy of regulatory mechanisms to control bycatch and habitat alterations is contributing to the status of the Carolina DPS.

4.2.2.5 South Atlantic DPS of Atlantic sturgeon

The SA DPS includes all Atlantic sturgeon that spawn or are spawned in the watersheds (including all rivers and tributaries) of the Ashepoo, Combahee, and Edisto Rivers (ACE) Basin southward along the South Carolina, Georgia, and Florida coastal areas to the St. Johns River, Florida. The marine range of Atlantic sturgeon from the SA DPS extends from the Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida. The riverine range of the SA DPS and the adjacent portion of the marine range are shown in Figure 4. Sturgeon are commonly captured 40 miles offshore (D. Fox, Delaware State University, pers. comm.). Records providing fishery bycatch data by depth show the vast majority of Atlantic sturgeon bycatch via gillnets is observed in waters less than 50 meters deep (Stein *et al.* 2004b, ASMFC TC 2007), but Atlantic sturgeon are recorded as bycatch out to 500 fathoms (900 meters).

Rivers known to have current spawning populations within the range of the South Atlantic DPS include the Combahee, Edisto, Savannah, Ogeechee, Altamaha, and Satilla Rivers. We determined spawning was occurring if YOY were observed, or mature adults were present, in freshwater portions of a system (Table 9). However, in some rivers, spawning by Atlantic sturgeon may not be contributing to population growth because of lack of suitable habitat and the presence of other stressors on juvenile survival and development. Historically, both the Broad-Coosawatchie and St. Marys Rivers were documented to have spawning populations at one time; there is also evidence that spawning may have occurred in the St. Johns River or one of its tributaries. However, the spawning population in the St. Marys River, as well as any historical spawning population present in the St. Johns, is believed to be extirpated, and the status of the spawning population in the Broad-Coosawatchie is unknown. Both the St. Marys and St. Johns Rivers are used as nursery habitat by young Atlantic sturgeon originating from other spawning populations. The use of the Broad-Coosawatchie by sturgeon from other spawning populations is unknown at this time. The presence of historical and current spawning populations in the Ashepoo River has not been documented; however, this river may currently be used for nursery habitat by young Atlantic sturgeon originating from other spawning populations. Fish from the SA DPS likely use other river systems than those listed here for their specific life functions.

Secor (2002) estimates that 8,000 adult females were present in South Carolina before the collapse of the fishery in 1890. However, because fish from South Carolina are included in both the Carolina and SA DPSs, it is likely that some of the historical 8,000 fish would be attributed to both the Carolina DPS and SA DPS. The sturgeon fishery had been the third largest fishery in

Georgia. Reductions from the commercial fishery and ongoing threats have drastically reduced the numbers of Atlantic sturgeon within the South Atlantic DPS. Currently, the Atlantic sturgeon population in at least two river systems within the SA DPS has been extirpated. As described in Section 4.2.2, we have estimated that there are a minimum of 14,911 SA DPS adult and subadult Atlantic sturgeon of size vulnerable to capture in U.S. Atlantic waters.

Table 9. Major rivers, tributaries, and sounds within the range of the SA DPS and currently available data on the presence of an Atlantic sturgeon spawning population in each system.

River/Estuary	Spawning Population	Data
ACE (Ashepoo, Combahee, and Edisto Rivers) Basin, SC; St. Helena Sound	Yes	1,331 YOY (1994-2001); gravid female and running ripe male in the Edisto (1997); 39 spawning adults (1998)
Broad-Coosawhatchie Rivers, SC; Port Royal Sound	Unknown	
Savannah River, SC/GA	Yes	22 YOY (1999-2006); running ripe male (1997)
Ogeechee River, GA	Yes	age-1 captures, but high inter-annual variability (1991-1998); 17 YOY (2003); 9 YOY (2004)
Altamaha River, GA	Yes	74 captured/308 estimated spawning adults (2004); 139 captured/378 estimated spawning adults (2005)
Satilla River, GA	Yes	4 YOY and spawning adults (1995-1996)
St. Marys River, GA/FL	Extirpated	
St. Johns River, FL	Extirpated	

Threats

The SA DPS was listed as endangered under the ESA as a result of a combination of habitat curtailment and modification, overuse (i.e., being taken as bycatch) in commercial fisheries, and the inadequacy of regulatory mechanisms in ameliorating these impacts and threats.

The modification and curtailment of Atlantic sturgeon habitat resulting from dredging and degraded water quality is contributing to the status of the SA DPS. Dredging is a present threat to the SA DPS and is contributing to its status by modifying the quality and availability of Atlantic sturgeon habitat. Maintenance dredging is currently modifying Atlantic sturgeon nursery habitat in the Savannah River and modeling indicates that the proposed deepening of the navigation channel will result in reduced dissolved oxygen and upriver movement of the salt wedge, curtailing spawning habitat. Dredging is also modifying nursery and foraging habitat in the St. Johns Rivers. Reductions in water quality from terrestrial activities have modified habitat used by the SA DPS. Low dissolved oxygen is modifying sturgeon habitat in the Savannah due to

dredging, and non-point source inputs are causing low dissolved oxygen in the Ogeechee River and in the St. Marys River, which completely eliminates juvenile nursery habitat in summer. Low dissolved oxygen has also been observed in the St. Johns River in the summer. Sturgeon are more sensitive to low dissolved oxygen and the negative (metabolic, growth, and feeding) effects caused by it increase when water temperatures are concurrently high, as they are within the range of the SA DPS. Additional stressors arising from water allocation and climate change threaten to exacerbate water quality problems that are already present throughout the range of the SA DPS. Large withdrawals of over 240 million gallons per day mgd of water occur in the Savannah River for power generation and municipal uses. However, permits for users withdrawing less than 100,000 gallons per day (gpd) are not required to get permits, so actual water withdrawals from the Savannah and other rivers within the range of the SA DPS are unknown, but likely much higher. The removal of large amounts of water from the system will alter flows, temperature, and dissolved oxygen. Water shortages and “water wars” are already occurring in the rivers occupied by the SA DPS and will likely be compounded in the future by population growth and, potentially, by climate change. Climate change is also predicted to elevate water temperatures and exacerbate nutrient-loading, pollution inputs, and lower dissolved oxygen, all of which are current stressors to the SA DPS.

The directed Atlantic sturgeon fishery caused initial severe declines in southeast Atlantic sturgeon populations. Although the directed fishery is closed, bycatch in other commercial fisheries continues to impact the SA DPS. Statutory and regulatory mechanisms exist that authorize reducing the impact of dams on riverine and anadromous species such as Atlantic sturgeon, but these mechanisms have proven inadequate for preventing dams from blocking access to habitat upstream and degrading habitat downstream. Further, water quality continues to be a problem in the SA DPS, even with existing controls on some pollution sources. Current regulatory regimes are not effective in controlling water allocation issues (e.g., no permit requirements for water withdrawals under 100,000 gpd in Georgia, no restrictions on interbasin water transfers in South Carolina, the lack of ability to regulate non-point source pollution.)

The recovery of Atlantic sturgeon along the Atlantic coast, especially in areas where habitat is limited and water quality is severely degraded, will require improvements in the following areas: (1) elimination of barriers to spawning habitat either through dam removal, breaching, or installation of successful fish passage facilities; (2) operation of water control structures to provide appropriate flows, especially during spawning season; (3) imposition of dredging restrictions including seasonal moratoriums and avoidance of spawning/nursery habitat; and (4) mitigation of water quality parameters that are restricting sturgeon use of a river (i.e., dissolved oxygen). Additional data regarding sturgeon use of riverine and estuarine environments is needed.

Summary of the Status of the South Atlantic DPS of Atlantic Sturgeon

As described in Section 4.2.2, we have estimated that there are a minimum of 14,911 SA DPS adult and subadult Atlantic sturgeon of size vulnerable to capture in U.S. Atlantic waters. The DPS's freshwater range occurs in the watersheds (including all rivers and tributaries) of the ACE Basin southward along the South Carolina, Georgia, and Florida coastal areas to the St. Johns River, Florida. Recovery of depleted populations is an inherently slow process for a late-maturing species such as Atlantic sturgeon. Their late age at maturity provides more

opportunities for individuals to be removed from the population before reproducing. While a long life-span also allows multiple opportunities to contribute to future generations, this is hampered within the SA DPS by habitat alteration, bycatch, and from the inadequacy of existing regulatory mechanisms to address and reduce habitat alterations and bycatch.

Dredging is contributing to the status of the SA DPS by modifying spawning, nursery, and foraging habitat. Habitat modifications through reductions in water quality and dissolved oxygen are also contributing to the status of the SA DPS, particularly during times of high water temperatures, which increase the detrimental effects on Atlantic sturgeon habitat. Interbasin water transfers and climate change threaten to exacerbate existing water quality issues. Bycatch also contributes to the SA DPS's status. Fisheries known to incidentally catch Atlantic sturgeon occur throughout the marine range of the species and in some riverine waters as well. Because Atlantic sturgeon mix extensively in marine waters and may use multiple river systems for nursery and foraging habitat in addition to their natal spawning river, they are subject to being caught in multiple fisheries throughout their range. In addition to direct mortality, stress or injury to Atlantic sturgeon taken as bycatch but released alive may result in increased susceptibility to other threats, such as poor water quality (e.g., exposure to toxins). This may result in reduced ability to perform major life functions, such as foraging and spawning, or even post-capture mortality. While many of the threats to the SA DPS have been ameliorated or reduced due to the existing regulatory mechanisms, such as the moratorium on directed fisheries for Atlantic sturgeon, bycatch and habitat alteration are currently not being addressed through existing mechanisms. Further, access to habitat and good water quality continues to be a problem even with NMFS's authority under the Federal Power Act to prescribe fish passage and existing controls on some pollution sources. There is a lack of regulation for some large water withdrawals, which threatens sturgeon habitat. Current regulatory regimes do not require a permit for water withdrawals under 100,000 gpd in Georgia and there are no restrictions on interbasin water transfers in South Carolina. Data required to evaluate water allocation issues are either very weak, in terms of determining the precise amounts of water currently being used, or non-existent, in terms of our knowledge of water supplies available for use under historical hydrologic conditions in the region. Existing water allocation issues will likely be compounded by population growth, drought, and, potentially, climate change. The inadequacy of regulatory mechanisms to control bycatch and habitat alterations is contributing to the status of the SA DPS.

5.0 ENVIRONMENTAL BASELINE

Environmental baselines for biological opinions include the past and present impacts of all state, federal, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions that are contemporaneous with the consultation in process (50 CFR 402.02). The environmental baseline for this Opinion includes the effects of several activities that may affect the survival and recovery of ESA-listed species in the action area. The activities that shape the environmental baseline in the action area of this consultation generally include: commercial and recreational fisheries, hopper dredging operations, sand mining and beach nourishment activities, commercial shipping and other vessel activities, military operations, scientific research, projects affecting water quality and pollution, global climate change, and recovery activities associated with reducing impacts to listed species.

5.1 Federal Actions that have Undergone Section 7 Consultation

We have undertaken a number of section 7 consultations to address the effects of Federal actions on threatened and endangered species in the action area. Each of those consultations sought to develop ways to reduce the probability of adverse impacts of the action on listed species.

5.1.1 Authorization of Fisheries through Fishery Management Plans

NMFS authorizes the operation of several nearshore fisheries in the action area under the authority of the Magnuson-Stevens Fishery Conservation Act and through FMPs and their implementing regulations. Commercial and recreational fisheries in the action area employ gear that is known to harass, injure, and/or kill sea turtles and Atlantic sturgeon.

In the Greater Atlantic Region (Maine through Virginia), a formal ESA section 7 consultation has been conducted on the Northeast multispecies, monkfish, spiny dogfish, Northeast skate complex, Atlantic bluefish, Atlantic mackerel/squid/butterfish, and summer flounder/scup/black sea bass fisheries, the last three of which may overlap in part with the action area for the Virginia pound net fishery. This consultation (the “batched fisheries Opinion”) considered adverse effects to loggerhead, green, Kemp’s ridley, and leatherback sea turtles. In the batched fisheries Opinion, we concluded that the seven fisheries were likely to adversely affect but were not likely to jeopardize the continued existence of any sea turtle species. The Opinion included an ITS exempting a certain amount of lethal or non-lethal take resulting from interactions with the fisheries. The ITS is summarized in the table below (Table 10).

Table 10. Sea turtle incidental take information from the most recent NMFS GARFO Opinion for seven federally managed fisheries, three of which (in bold) overlap with the action area.

Opinion	Date	Loggerhead	Kemp’s ridley	Green	Leatherback
Northeast Multispecies, Monkfish, Spiny Dogfish, Atlantic Bluefish , Northeast Skate Complex, Atlantic Mackerel/Squid/Butterfish , and Summer Flounder/Scup/Black Sea Bass (Batched Fisheries)	December 16, 2013 (ITS amended March 10, 2016)	1,345 (835 lethal) every 5 years in gillnets; 1,020 (335 lethal) every 5 years in bottom trawls; 1 (lethal or non-lethal) annually in pot/trap gear	4 (3 lethal) annually in gillnets; 3 (2 lethal) annually in bottom trawls	4 (3 lethal) annually in gillnets; 3 (2 lethal) annually in bottom trawls	4 (3 lethal) annually in gillnets; 4 (2 lethal) annually in bottom trawls; 4 (lethal or non-lethal) annually in pot/trap gear

Although there are documented incidental takes of sea turtles in these fisheries, the action area for them includes the entire EEZ along the U.S. Atlantic coast from Maine through Florida. The nearshore and coastal waters of Virginia and those inside Chesapeake Bay represent a small fraction of the action area assessed and for which interactions of sea turtles are anticipated in the batched fisheries Opinion. Thus, the amount of incidental take of sea turtles that occurs in

Virginia state waters as a result of Federal fisheries is also a small fraction of the amount exempted in that Opinion. Furthermore, very little commercial and recreational fishing effort for those species occurs in Virginia state waters, and even less occurs within Chesapeake Bay. Scup and summer flounder have a larger state waters recreational component, but that effort is often exerted offshore and outside of the bay, where very few Virginia pound nets are expected to be set and fished. In the batched fisheries Opinion, we also concluded that the potential for interactions (i.e., vessel strikes) between sea turtles and fishing vessels was extremely low and similarly that any effects to their prey and/or habitat would be insignificant and discountable.

Atlantic sturgeon originating from each the five listed DPSs are captured and killed in otter trawl, sink gillnet, and hook and line fisheries operating in the action area. At the time of this writing, the batched fisheries Opinion covers Atlantic sturgeon interactions in most commercial trawl and gillnet gear in the Greater Atlantic Region. As noted in the *Status of the Species* section above, the NEFSC prepared a bycatch estimate for Atlantic sturgeon captured in sink gillnet and otter trawl fisheries operated from Maine through Virginia. This estimate indicated that from 2006-2010, an annual average of 3,118 Atlantic sturgeon were captured in these fisheries with 1,569 in sink gillnet and 1,548 in otter trawls. The mortality rate in sink gillnets was estimated at approximately 20% and the mortality rate in otter trawls was estimated at 5%. Based on this estimate, a total of 391 Atlantic sturgeon were estimated to be killed annually in these fisheries that are prosecuted in the Greater Atlantic Region. Again, nearshore and coastal waters of Virginia and those inside Chesapeake Bay represent a small fraction of the action area assessed and for which interactions of Atlantic sturgeon are anticipated in the batched fisheries Opinion. Nonetheless, any Federal fisheries that use sink gillnets, otter trawls, or hook and line gear are likely to interact with Atlantic sturgeon and be an additional, albeit minor, source of incidental take and mortality in the action area. An updated Atlantic sturgeon bycatch estimate in Northeast sink gillnet and otter trawl fisheries for 2011-2015 was prepared by the NEFSC in 2016. Using this information, the authors of the recent ASMFC (2017) Atlantic Sturgeon Benchmark Stock Assessment estimated that 1,139 fish (295 lethal; 25%) were caught in gillnet fisheries and 1,062 fish (41 lethal; 4%) were caught in otter trawl fisheries per year from 2000-2015. Atlantic sturgeon bycatch estimates for Northeast gillnet and trawl gear from 2011-2015 (approximately 761 fish per year for gillnets, 777 for trawls) are substantially lower than those from 2006-2010 (approximately 1,074 fish per year for gillnets, 1,016 for trawls) (ASMFC 2017).

5.1.2 Hopper Dredging, Sand Mining, and Beach Nourishment

The construction and maintenance of Federal navigation channels, sand mining (“borrow”) activities, beach nourishment, and shoreline restoration/stabilization projects are sources of sea turtle and Atlantic sturgeon incidental take and mortality in the action area. The majority of these projects in the action area are authorized and carried out by the U.S. Army Corps of Engineers (ACOE), with a few facility-specific projects overseen by the National Aeronautics and Space Administration (NASA) and U.S. Navy. In the action area, ACOE projects are under the jurisdiction of the Baltimore and Norfolk District of the North Atlantic Division. From 1993-2017, hopper dredging projects in the Chesapeake Bay area have resulted in the recorded incidental take of 66 loggerheads, 6 Kemp’s ridleys, 1 green, and 4 unidentified hard shell turtles. Nearly all of these interactions have occurred in nearshore coastal waters with very few interactions in the open ocean. Few interactions between hopper dredges and Atlantic sturgeon

have been reported, with just two records documenting interactions between hopper dredges and Atlantic sturgeon in the action area (in Virginia near the Chesapeake Bay entrance).

We have completed several ESA section 7 consultations with the ACOE to consider effects of these dredging, sand mining, and nourishment projects on listed sea turtles and Atlantic sturgeon. In an Opinion issued to the ACOE in 2012, we estimated that over a 50-year period of the ACOE's maintenance dredging of the Chesapeake Bay entrance channels and use of sand borrow areas for beach nourishment (from 2012-2062), up to 937 loggerhead (452 lethal), 275 Kemp's ridley (48 lethal), and 38 green (11 lethal) sea turtles will be incidentally taken. We also anticipated that up to 750 Atlantic sturgeon (124 lethal) will be incidentally taken during the same action over the same period. Non-lethal takes of Atlantic sturgeon were anticipated as a result of relocation trawling that is sometimes required in association with channel dredging. Up to 50 lethal sea turtle takes (37 loggerheads, 11 Kemp's ridleys, and 2 greens) were anticipated during the same relocation trawling activities over the 50-year maintenance dredging period.

In two other 2012 Opinions, we determined that the U.S. Navy's Dam Annex Shoreline Protection System Repairs project and Joint Expeditionary Base (JEB) Little Creek/Fort Story Shoreline Restoration and Protection project would both result in the lethal entrainment of up to one loggerhead or Kemp's ridley sea turtle and up to one Atlantic sturgeon from any of the five DPSs during hopper dredging operations at the Sandbridge Shoal borrow area, located a short distance offshore of the installations. Both projects were also anticipated to result in the lethal entrainment of up to one Atlantic sturgeon from any of the five DPSs during mechanical dredging operations at the installations themselves. Table 11 below provides information on Opinions covering dredging, beach nourishment, and shoreline restoration/stabilization projects in the action area and the associated ITS for sea turtles (unless otherwise noted, take estimates are per dredge cycle). Takes of sea turtles and Atlantic sturgeon during relocation trawling activities are also included in the ACOE consultation. Relocation trawling has been successful at temporarily displacing loggerhead, Kemp's ridley, leatherback, and green sea turtles, and more recently Atlantic sturgeon, from navigation channels and nearshore mining/borrow areas in both the Atlantic and Gulf of Mexico during periods when hopper dredging was imminent or ongoing.

Table 11. Information on NMFS GARFO consultations for dredging, nourishment, and shoreline restoration/stabilization projects that occur in the action area, and their ITSs for sea turtles.

Project	Date of Opinion	Loggerhead	Kemp's ridley	Green	Leatherback	Notes
U.S. Navy Shoreline Restoration and Protection Project, JEB Little Creek/Fort Story, VA Beach	7/13/2012	1 loggerhead or Kemp's ridley		0	0	

U.S. Navy Shoreline Protection Sys Repairs, Naval Air Station Oceana, Dam Neck Annex, VA Beach	7/20/2012	1 loggerhead or Kemp's ridley		0	0	
ACOE Dredging of Chesapeake Bay Entrance Channels and Beach Nourishment	10/16/2012	937 non-lethal captures, 452 mortalities	275 non-lethal captures, 48 mortalities	38 non-lethal captures, 11 mortalities	0	total takes over 50-year project life
		Relocation Trawling: up to 938 captures (37 mortalities) of loggerheads, 275 captures (11 mortalities) of Kemp's ridleys, and 37 captures (2 mortalities) of green sea turtles				

5.1.3 Vessel Activity and Military Operations

Potential sources of adverse effects to sea turtles and Atlantic sturgeon from Federal vessel operations in the action area include operations of the U.S. Navy (USN) and the U.S. Coast Guard (USCG), which maintain the largest Federal fleets, as well as the Bureau of Ocean Energy Management (BOEM), Maritime Administration (MARAD), Environmental Protection Agency (EPA), NOAA, and ACOE. We have conducted formal consultations with the USN, USCG, EPA, and NOAA on their vessel-based operations. We have also conducted section 7 consultations with BOEM and MARAD on vessel traffic related to energy projects in the Greater Atlantic Region and implemented conservation measures. Through the section 7 process, where applicable, NMFS has and will continue to establish conservation measures for all these agency vessel operations to avoid or minimize adverse effects to listed species. To date, ocean-going vessels and military activities have not been identified as significant threats to Atlantic sturgeon. However, the possibility exists for interactions between vessels and these species in marine, estuarine, and riverine environments. However, because of a lack of information on the effects of these activities on sturgeon, the discussion below focuses on sea turtles.

Although consultations on individual Navy and USCG activities have been completed, only a few formal consultations on overall military activities along the U.S. Atlantic coast have been completed at this time. In June 2009, NMFS prepared an Opinion on Navy activities in each of their four training range complexes along the U.S. Atlantic coast—Northeast, Virginia Capes, Cherry Point, and Jacksonville (NMFS 2009). The Virginia Capes Operating Area overlaps with the action area for this consultation. In August 2017, NMFS prepared an Opinion on the operation of the Surveillance Towed Array Sensor System (SURTASS) Low Frequency Active (LFA) sonar onboard four Navy vessels (NMFS 2017). In addition, the following Opinions for the Navy (NMFS 1996, 1997, 2008b) and USCG (NMFS 1995, 1998b) contain details on the scope of vessel operations for these agencies and the conservation measures that are being implemented as standard operating procedures. In the U.S. Atlantic, the operation of USCG boats and cutters is estimated to take no more than one individual sea turtle, of any species, per year (NMFS 1995).

Military activities such as ordnance detonation also affect listed species of sea turtles. A section 7 consultation was conducted in 1997 for Navy aerial bombing training in the ocean off the southeast U.S. coast, involving drops of live ordnance (500 and 1,000-lb bombs). The resulting Opinion for this consultation determined that the activity was likely to adversely affect sea turtles but would not jeopardize their continued existence. In the ITS included within the Opinion, these training activities were estimated to have the potential to injure or kill, annually, 84 loggerheads, 12 leatherbacks, and 12 greens or Kemp's ridleys, in combination (NMFS 1997a).

NMFS has also conducted section 7 consultations on Navy explosive ordnance disposal, mine warfare, sonar testing (e.g., AFAST, SURTASS LFA), and other major training exercises (e.g., bombing, Naval gunfire, combat search and rescue, anti-submarine warfare, and torpedo and missile exercises) in the Atlantic Ocean. These consultations have determined that the proposed Navy activities may adversely affect but would not jeopardize the continued existence of ESA-listed sea turtles (NMFS 2008b, 2009, 2017). NMFS estimated that five loggerhead and six Kemp's ridley sea turtles were likely to be harmed as a result of training activities in the Virginia Capes Range Complex from June 2009 to June 2010, and that nearly 1,500 sea turtles, including ten leatherbacks, were likely to experience harassment (NMFS 2009). For SURTASS LFA sonar testing, NMFS was unable to estimate the number of sea turtles of each species occurring in USN mission areas that could be incidentally taken, although all takes were expected to result in behavioral harassment rather than post-interaction mortality (NMFS 2017).

Similarly, operations of vessels by other Federal agencies within the action area (BOEM, MARAD, EPA, and ACOE) may adversely affect sea turtles and Atlantic sturgeon. However, vessel activities of those agencies are often limited in scope, as they operate a limited number of vessels or are engaged in research/operational activities that are unlikely to contribute a large amount of risk.

5.1.4 Research and Other Permitted Activities

Research activities either conducted or funded by Federal agencies within the action area may adversely affect ESA-listed sea turtles and fish, and may require a section 7 consultation. Several section 7 consultations on research activities have recently been completed, as described below.

Fish Surveys funded by the U.S. FWS

U.S. FWS Region 5 provides funds to 13 states and the District of Columbia under the Dingell-Johnson Sport Fish Restoration Grant program and the State Wildlife Grant Program, including Virginia. We completed a Biological Opinion in 2013 which bundled the eleven independent actions carried out by U.S. FWS (i.e., awarding of each grant fund to each state is an independent action). The Opinion provides an ITS by activity and provided a summary by state. Studies occurring in Virginia state waters including juvenile fish trawl surveys, juvenile striped bass beach seine surveys, and the Chesapeake Bay Multispecies Monitoring and Assessment Program (ChesMMAP) surveys. These surveys have resulted in the non-lethal capture of both sea turtles (eight loggerheads and one Kemp's ridley) and Atlantic sturgeon (seven total) since 2013. The only mortalities that we anticipate for the surveys that take place in Virginia state waters are

three Atlantic sturgeon (originating from any of the five DPSs) during striped bass and shad gillnet surveys in the action area.

Section 10(a)(1)(A) Permits

NMFS has issued additional research permits under section 10(a)(1)(A) of the ESA, which authorizes activities for scientific purposes or to enhance the propagation or survival of the affected species. The permitted activities aim to benefit the investigated species in the long-term and are consistent with the purposes of the ESA, as outlined in section 2 of the Act. A total of 13 section 10(a)(1)(A) permits are currently in effect for sea turtles and Atlantic sturgeon within the action area for this consultation. Four of the permitted projects in the action area are allowed a small number of ‘unintentional’ mortalities of sea turtles or Atlantic sturgeon caught in fishing gear during sampling activities or gear modification studies. Two of the projects are permitted a small number of ‘intentional’ mortalities via egg mat sampling of early life stages (eggs, larvae).

5.2 Non-Federally Regulated Fisheries

Sea turtles and Atlantic sturgeon may be vulnerable to capture, injury, and mortality in fisheries occurring in Virginia state waters. Information on the number of sea turtles and Atlantic sturgeon captured or killed in Virginia state fisheries is extremely limited and as such, efforts are currently underway to obtain more information on the numbers of these species captured and killed in state water fisheries. We are currently working with the Northeast Fisheries Observer Program (NEFOP), Atlantic States Marine Fisheries Commission (ASMFC), the Virginia Marine Resources Commission (VMRC), and the Virginia Aquarium and Marine Science Center to assess the impacts of state authorized fisheries on sea turtles and Atlantic sturgeon. We are also currently working with Virginia on applications for ESA section 10(a)(1)(B) Incidental Take Permits to cover their fisheries. Below, we discuss the different fisheries authorized by the state of Virginia and any available information on interactions between these fisheries and sea turtles/Atlantic sturgeon.

American eel fishery

American eel is exploited in fresh, brackish, and coastal waters from the southern tip of Greenland to northeastern South America. Eel fisheries are conducted primarily in tidal and inland waters. Eels are typically caught with hook and line or with eel traps and may also be caught with fyke nets. Sturgeon and sea turtles are not known to interact with the eel fishery.

Atlantic croaker fishery

An Atlantic croaker fishery using trawl and gillnet gear also occurs within the action area and sea turtle interactions have been observed in the fishery. The average annual bycatch of loggerhead sea turtles in bottom otter trawl gear used in the Atlantic croaker fishery was estimated to be 92 loggerhead sea turtles (with a 95% CI of 63-121) from 2009-2013 (Murray 2015a). Additional information on sea turtle interactions with gillnet gear used in the Atlantic croaker fishery has also been recently published by Murray (2013). The average annual bycatch of loggerhead sea turtles in gillnet gear used in the Atlantic croaker fishery, based on VTR data from 2007-2011, was estimated to be 6 per year with a 95% CI of 2-10 (Murray 2013). These estimates encompass the bycatch of loggerheads in the Atlantic croaker fishery in both state and Federal waters. Bycatch of the other three sea turtle species likely occurs in the Atlantic croaker fishery as well,

and is occasionally documented by the NEFOP, but at much lower frequencies such that calculating an annual bycatch estimate is difficult due to the small sample size of events.

Atlantic sturgeon interactions have also been observed in the Atlantic croaker fishery, but a quantitative assessment of the number of Atlantic sturgeon captured in the croaker fishery is not available. A mortality rate of Atlantic sturgeon in commercial trawls has been estimated at 5%. A review of the NEFOP database indicates that from 2006-2010, 60 Atlantic sturgeon (out of a total of 726 observed interactions) were captured during observed trips where the trip target was identified as croaker. This represents a minimum number of Atlantic sturgeon captured in the croaker fishery during this time period as it only considers trips that included a NEFOP observer onboard.

Weakfish fishery

The weakfish fishery occurs in both state and Federal waters, but the majority of commercially and recreationally caught weakfish are caught in state waters (ASMFC 2002). The dominant commercial gears include gillnets, pound nets, haul seines, flynets, and trawls, with the majority of landings occurring in the fall and winter months (ASMFC 2002). Weakfish landings were dominated by the trawl fishery through the mid-1980s, after which gillnet landings began to account for most weakfish landed (ASMFC 2002). Virginia has ranked second among U.S. Atlantic states in annual landings since 1972 (ASMFC 2002). Sea turtle bycatch in the weakfish fishery has occurred (Murray 2013, 2015a) and NMFS originally assessed the impacts of the fishery on sea turtles in an Opinion back in 1997 (NMFS 1997b). Currently, the average annual bycatch of loggerhead sea turtles in bottom otter trawl gear used in the weakfish fishery is estimated to be 0 loggerheads (with a 95% CI of 0-1) from 2009-2013 (Murray 2015a). Additional information on loggerhead sea turtle interactions with gillnet gear has also been recently published by Murray (2009a, 2009b). The average annual bycatch of loggerhead sea turtles in gillnet gear used in the weakfish fishery, based on VTR data from 2002-2006, was estimated to be one per year with a 95% CI of 0-1 (Murray 2009b), although the more recent Murray (2013) gillnet bycatch estimate for 2007-2011 does not include a loggerhead bycatch estimate for the weakfish gillnet fishery. These estimates encompass the bycatch of loggerheads in the weakfish fishery in both state and Federal waters. Bycatch of the other three sea turtle species likely occurs in the weakfish fishery as well, and is occasionally documented by the NEFOP, but at even lower frequencies such that calculating an annual bycatch estimate is difficult due to the small sample size of events.

A quantitative assessment of the number of Atlantic sturgeon captured in the weakfish fishery is not available. A mortality rate of Atlantic sturgeon in commercial trawls has been estimated at 5%. A review of the NEFOP observer database indicates that from 2006-2010, 36 Atlantic sturgeon (out of a total of 726 observed interactions) were captured during observed trips where the trip target was identified as weakfish. This represents a minimum number of Atlantic sturgeon captured in the weakfish fishery during this time period as it only considers observed trips, and most inshore fisheries are not observed. An earlier review of bycatch rates and landings for the weakfish fishery reported that the weakfish-stripped bass fishery had an Atlantic sturgeon bycatch rate of 16% from 1989-2000; the weakfish-Atlantic croaker fishery had an Atlantic sturgeon bycatch rate of 0.02%, and the weakfish fishery had an Atlantic sturgeon bycatch rate of 1.0% (ASSRT 2007).

Whelk fishery

A whelk fishery using pot/trap gear is known to occur in Virginia waters of Chesapeake Bay. Whelk pots, which unlike lobster traps are not fully enclosed, have been suggested as a potential source of entrapment for loggerhead sea turtles that may be enticed to enter the trap to get the bait or whelks caught in the trap (Mansfield *et al.* 2001). Loggerhead, leatherback, and green sea turtles are known to become entangled in lines associated with pot/trap gear used in several fisheries including lobster, whelk, and crab species (SEFSC 2001; Dwyer *et al.* 2002; NMFS 2007). Whelk fisheries in Virginia have been verified as the fisheries involved in a handful of loggerhead, leatherback, and green sea turtle entanglements since 2001, averaging around one per year (Northeast Region Sea Turtle Disentanglement Network [STDN] database). Whelk pots are not known to interact with Atlantic sturgeon.

Crab fisheries

Various crab fisheries, such as horseshoe crab and blue crab, also occur in Virginia state waters. Loggerhead, leatherback, and green sea turtles are known to become entangled in lines associated with pot/trap gear used in several fisheries including lobster, whelk, and crab species (SEFSC 2001; Dwyer *et al.* 2002; NMFS 2007). The Virginia blue crab fishery has been verified as the fishery involved in a handful of loggerhead and leatherback sea turtle entanglements since 2001 (Northeast Region STDN database). In 2017, crab fisheries in Virginia accounted for two live and possibly one dead leatherbacks entangled in vertical lines of the gear.

The crab fisheries may have detrimental impacts on sea turtles beyond entanglement in the fishing gear itself. Loggerheads are known to prey on crab species, including horseshoe and blue crabs. In a study of the diet of loggerhead sea turtles in Virginia waters from 1983 to 2002, Seney and Musick (2007) found a shift in the diet of loggerheads in the area from horseshoe and blue crabs to fish, particularly menhaden and Atlantic croaker. The authors suggested that a decline in the crab species have resulted in the shift and loggerheads are likely foraging on fish captured in fishing nets or on discarded fishery bycatch (Seney and Musick 2007). The physiological impacts of this shift are uncertain although it was suggested as a possible explanation for the declines in loggerhead abundance noted by Mansfield (2006). Other studies have detected seasonal declines in loggerhead abundance coincident with seasonal declines of horseshoe and blue crabs in the same area (Maier *et al.* 2005). While there is no evidence of a decline in horseshoe crab abundance in the Southeast during the period 1995-2003, declines were evident in some parts of the Mid-Atlantic (ASMFC 2004; Eyler *et al.* 2007). Given the variety of loggerheads prey items (Dodd 1988; Burke *et al.* 1993; Bjørndal 1997; Morreale and Standora 1998) and the differences in regional abundance of horseshoe crabs and other prey items (ASMFC 2004; Eyler *et al.* 2007), a direct correlation between loggerhead sea turtle abundance and horseshoe crab and blue crab availability cannot be made at this time. Nevertheless, the decline in loggerhead abundance in Virginia waters (Mansfield 2006), coincident with noted declines in the abundance of horseshoe crab and other crab species, raises concerns that crab fisheries may be impacting the forage base for loggerheads in some areas of their range.

Atlantic sturgeon are known to be caught in state water horseshoe crab fisheries, which currently operate in all Northeast U.S. states except New Jersey. Along the U.S. East Coast, hand, trawl, and dredge fisheries account for more than 85% of the commercial horseshoe crab landings in

the bait fishery. Other methods used are gillnets, pound nets, and traps (ASMFC 2016). State waters from Delaware to Virginia are closed to horseshoe crab harvest and landing from January 1 to June 7 (ASMFC 2016). The majority of horseshoe crab landings in 2010 came from Massachusetts, Virginia, and Delaware. Stein *et al.* (2004b) examined bycatch of Atlantic sturgeon using the NMFS sea-sampling/observer database (1989-2000) and found that the bycatch rate for horseshoe crabs was low, at 0.05%. An Atlantic sturgeon “reward program,” where commercial fishermen were provided monetary rewards for reporting captures of Atlantic sturgeon in the Maryland waters of Chesapeake Bay, operated from 1996 to 2012 (Mangold *et al.* 2007).⁷ The data from this program during the 11-year period of 1996-2006 show that one of 1,395 wild Atlantic sturgeon was found caught in a crab pot (Mangold *et al.* 2007).

Fish trap, seine, and channel net fisheries

Incidental captures of loggerheads in fish traps have been reported from several states along the U.S. Atlantic coast (Shoop and Ruckdeschel 1989; W. Teas, NMFS, pers. comm.), while leatherbacks have been documented as entangled in the buoy line systems of conch and sea bass traps off Massachusetts (Northeast Region STDN database). Long haul seines, purse seines, and channel nets are also known to incidentally capture sea turtles in sounds and other inshore waters along the U.S. Atlantic coast, although no lethal interactions have been reported (SEFSC 2001). No information on interactions between Atlantic sturgeon and fish traps, long haul seines, purse seines, or channel nets is currently available; however, depending on where this gear is set and the mesh size, the potential exists for Atlantic sturgeon to be entangled or captured in this gear.

Striped bass fishery

The striped bass fishery occurs only in state waters, as Federal waters have been closed to the harvest and possession of striped bass since 1990, except that possession is allowed in a defined area around Block Island, Rhode Island (ASMFC 2017b). The ASMFC has managed striped bass since 1981, and provides guidance to states from Maine to North Carolina through an ISFMP. All states are required to have recreational and commercial size limits, recreational creel limits, and commercial quotas. The commercial striped bass fishery is closed in Maine, New Hampshire, and Connecticut, but open in Massachusetts (hook and line only), Rhode Island, New Jersey (hook and line only), Delaware, Maryland, Virginia, and North Carolina. Recreational striped bass fishing occurs all along the U.S. East Coast.

Since 1989, only two sea turtle bycatch events (one loggerhead, one Kemp’s ridley) have been documented on NEFOP observed trips where the primary species landed was striped bass. Thus, this fishery likely results in a very low level of sea turtle bycatch (NMFS and ASMFC 2013).

Several states have reported incidental catch of Atlantic sturgeon (NMFS Sturgeon Workshop 2011). Data from the Atlantic Coast Sturgeon Tagging Database (2000-2004) shows that the striped bass fishery accounted for 43% of Atlantic sturgeon recaptures (ASSRT 2007). The striped bass-weakfish fishery also had one of the highest bycatch rates of 30 directed fisheries according to NMFS Observer Program data from 1989-2000 (ASSRT 2007). However, greater rates of bycatch do not necessarily translate into high mortality rates. Other factors, such as gear, season, and soak times, may be important variables in understanding Atlantic sturgeon mortality.

⁷ The program was terminated in February 2012, with the listing of Atlantic sturgeon under the ESA.

State gillnet fisheries

Two 10- to 14-inch (25.6- to 35.9-centimeter) mesh gillnet fisheries, the black drum and sandbar shark gillnet fisheries, occur in Virginia state waters along the tip of the eastern shore. Given the gear type, these fisheries may capture or entangle sea turtles. Entanglements of sea turtles in gillnet sets targeting and/or landing both species have been recorded in the NEFOP database. Similarly, sea turtles are thought to be vulnerable to capture in small mesh gillnet fisheries occurring in Virginia state waters. During May-June 2001, NMFS observed 2% of the Atlantic croaker fishery and 12% of the dogfish fishery (which represent approximately 82% of Virginia's total small mesh gillnet landings from offshore and inshore waters during this time), yet no sea turtle captures were observed (NMFS 2004c). Based on gear type (i.e., gillnets), it is likely that Atlantic sturgeon would be vulnerable to capture in these fisheries. An Atlantic sturgeon "reward program" where fishermen were provided monetary rewards for reporting captures of Atlantic sturgeon, operated in the late 1990s in Virginia. The majority of reports of Atlantic sturgeon captures were in drift gillnets and pound nets. No quantitative information on the number of Atlantic sturgeon captured or killed in Virginia fisheries is currently available.

State recreational fisheries

Observations of state recreational fisheries in Virginia have shown that loggerhead, leatherback, Kemp's ridley, and green sea turtles are known to bite baited hooks, and loggerheads frequently ingest the hooks. Hooked sea turtles have been reported by the public fishing from boats, piers, beaches, banks, and jetties, and from commercial fishermen fishing with both single rigs and bottom longlines (SEFSC 2001). A summary of known impacts of hook-and-line captures on loggerhead sea turtles can be found in the TEWG (1998, 2000, 2009) reports. Stranding data also provide some evidence of interactions between recreational hook-and-line gear and sea turtles, but assigning the gear to a specific fishery is rarely, if ever, possible. In 2017, the Northeast STDN documented one dead Kemp's ridley sea turtle in Virginia waters with a circle hook in its mouth and wrapped around the neck in monofilament line, strong indications that a recreational fisherman may have been the cause.

Atlantic sturgeon have also been observed captured in hook-and-line gear, yet the number of interactions that occur annually is unknown. While most Atlantic sturgeon are likely to be released alive, we currently have no information on post-release survival. NMFS is currently working on a project to assess the extent of sea turtle interactions that occur in recreational fisheries of the Southeast (North Carolina to Florida) and believes that the survey platform and questionnaire may also be applicable for determining the amount of Atlantic sturgeon interactions as well.

5.3 Other Activities

5.3.1 Maritime Industry

Private and commercial vessels, including fishing vessels, operating in the action area of this consultation also have the potential to interact with sea turtles and Atlantic sturgeon. The effects of fishing vessels, recreational vessels, or other types of commercial vessels on ESA-listed species may involve disturbance or injury/mortality due to collisions or entanglement in anchor lines. During 2007-2010, researchers documented 31 carcasses of adult Atlantic sturgeon in the

tidal freshwater portion of the James River, Virginia. Twenty-six of the carcasses had gashes from vessel propellers, and the remaining five carcasses were too decomposed to allow determination of the cause of death. The types of vessels responsible for these mortalities were not explicitly demonstrated. Most (84%) of the carcasses were found in a relatively narrow reach that was modified to increase shipping efficiency (Balazik *et al.* 2012b). Listed species may also be affected by fuel oil spills resulting from vessel accidents. Fuel oil spills could affect animals through the food chain. However, these spills typically involve small amounts of material that are unlikely to adversely affect listed species. Larger oil spills may result from severe accidents, although these events would be rare and involve small areas. No direct adverse effects on listed sea turtles and Atlantic sturgeon resulting from fishing vessel fuel spills have been documented.

5.3.2 Pollution

Anthropogenic sources of marine pollution, while difficult to attribute to a specific Federal, state, local, or private action, may affect sea turtles and Atlantic sturgeon in the action area. Sources of pollutants in the action area include atmospheric loading of pollutants such as PCBs; storm water runoff from coastal towns, cities, and villages; runoff into rivers emptying into bays; groundwater discharges; sewage treatment plant effluents; and oil spills. The pathological effects of oil spills on sea turtles have been documented in several laboratory studies (Vargo *et al.* 1986). Nutrient loading from land-based sources, such as coastal communities and agricultural operations, is known to stimulate plankton blooms in closed or semi-closed estuarine systems. The effect to larger embayments is unknown. Contaminants could degrade habitat if pollution and other factors reduce the food available to sea turtles and Atlantic sturgeon.

5.3.3 Coastal Development

Beachfront development, lighting, and beach erosion control all are ongoing activities along the Mid- and South Atlantic coastlines of the U.S. These activities potentially reduce or degrade sea turtle nesting habitats or interfere with hatchling movement to sea. Nocturnal human activities along nesting beaches may also discourage sea turtles from nesting sites. The extent to which these activities reduce sea turtle nesting and hatchling production is unknown. However, more and more coastal counties are adopting stringent protective measures to protect hatchling sea turtles from the disorienting effects of beach lighting. Coastal development may also impact sea turtles and Atlantic sturgeon if it disturbs or degrades foraging habitats or otherwise affects the ability of these species to use coastal habitats. At present, only limited nesting of sea turtles occurs on Virginia beaches, primarily in the southernmost part of the state. Virginia represents the northernmost extreme of loggerhead sea turtle nesting along the U.S. Atlantic coast. From 1970-2015, 166 loggerhead nests have been documented on Virginia's ocean-facing beaches. The state's first and only green sea turtle nest was reported in 2005 and its first and second Kemp's ridley nests were documented in 2012 and 2014, respectively (Virginia DGIF 2016).

5.3.4 Global Climate Change and Ocean Acidification

In addition to the information on climate change presented in the *Status of the Species* section for sea turtles and Atlantic sturgeon, the discussion below presents further background information on global climate change as well as past and projected effects of global climate change

throughout the range of the ESA-listed species considered in this Opinion. Below is the available information on projected effects of climate change in the action area and how listed sea turtles and Atlantic sturgeon may be affected by those projected environmental changes. Since the proposed action is assumed to go on in perpetuity, at least until a reinitiation trigger is met or the regulations are eliminated, the effects are summarized over a time span for which we can realistically analyze impacts, yet are discussed and considered for longer time periods when feasible.

In its Fifth Assessment Report (AR5) from 2014, the Intergovernmental Panel on Climate Change (IPCC) stated that the globally averaged combined land and ocean surface temperature data has shown a warming of 0.85°C (likely range: 0.65° to 1.06°C) over the period of 1880-2012. Similarly, the total increase between the average of the 1850-1900 period and the 2003-2012 period is 0.78°C (likely range: 0.72° to 0.85°C). On a global scale, ocean warming has been largest near the surface, with the upper 75 meters of the world's oceans having warmed by 0.11°C (likely range: 0.09° to 0.13°C) per decade over the period of 1971-2010 (IPCC 2014). In regards to resultant sea level rise, it is very likely that the mean rate of global averaged sea level rise was 1.7 millimeters/year (likely range: 1.5 to 1.9 millimeters/year) between 1901 and 2010, 2.0 millimeters/year (likely range: 1.7 to 2.3 millimeters/year) between 1971 and 2010, and 3.2 millimeters/year (likely range: 2.8 to 3.6 millimeters/year) between 1993 and 2010.

Climate model projections exhibit a wide range of plausible scenarios for both temperature and precipitation over the next several decades. The global mean surface temperature change for the period 2016-2035 relative to 1986-2005 will likely be in the range of 0.3° to 0.7°C (medium confidence). This assessment is based on multiple lines of evidence and assumes there will be no major volcanic eruptions or secular changes in total solar irradiance. Relative to natural internal variability, near-term increases in seasonal mean and annual mean temperatures are expected to be larger in the tropics and subtropics than in mid- and high latitudes (high confidence). This temperature increase will very likely be associated with more extreme precipitation and faster evaporation of water, leading to greater frequency of both very wet and very dry conditions. Climate warming has also resulted in increased river discharge and glacial and sea-ice melting (Greene *et al.* 2008). The strongest ocean warming is projected for the surface in tropical and Northern Hemisphere subtropical regions. At greater depths, the warming will be most pronounced in the Southern Ocean (high confidence). Best estimates of ocean warming in the top 100 meters are about 0.6° to 2.0°C, and about 0.3° to 0.6°C at a depth of about 1,000 meters by the end of the 21st century (IPCC 2014).

Under Representative Concentration Pathway (RCP) 8.5, the projected change in global mean surface air temperature and global mean sea level rise for the mid- and late 21st century relative to the reference period of 1986-2005 is as follows. Global average surface temperatures are likely to be 2.0°C higher (likely range: 1.4° to 2.6°C) from 2046-2065 and 3.7°C higher (likely range: 2.6° to 4.8°C) from 2081-2100. Global mean sea levels are likely to be 0.30 meters higher (likely range: 0.22 to 0.38 meters) from 2046-2065 and 0.63 meters higher (likely range: 0.45 to 0.82 meters) from 2081-2100, with a rate of sea level rise during 2081-2100 of 8 to 16 millimeters/year (medium confidence).

The past three decades have witnessed major changes in ocean circulation patterns in the Arctic, and these were accompanied by climate associated changes as well (Greene *et al.* 2008). Shifts in atmospheric conditions have altered Arctic Ocean circulation patterns and the export of freshwater to the North Atlantic (IPCC 2007; Greene *et al.* 2008). With respect specifically to the North Atlantic Oscillation (NAO), changes in salinity and temperature are thought to be the result of changes in the Earth's atmosphere caused by anthropogenic forces (IPCC 2007). The NAO impacts climate variability throughout the Northern Hemisphere (IPCC 2007). Data from the 1960s through the 2000s showed that the NAO index increased from minimum values in the 1960s to strongly positive index values in the 1990s and somewhat declined since (IPCC 2007). This warming extends over 1,000 meters deep and is deeper than anywhere in the world's oceans and is particularly evident under the Gulf Stream/North Atlantic Current system (IPCC 2007). On a global scale, large discharges of freshwater into the North Atlantic subarctic seas can lead to intense stratification of the upper water column and a disruption of North Atlantic Deepwater (NADW) formation (IPCC 2007; Greene *et al.* 2008). There is evidence that the NADW has already freshened significantly (IPCC 2007). This in turn can lead to a slowing down of the global ocean thermohaline (large-scale circulation in the ocean that transforms low-density upper ocean waters to higher density intermediate and deep waters and returns those waters back to the upper ocean), which can have climatic ramifications for the entire world (Greene *et al.* 2008).

There is a high confidence, based on substantial new evidence, that observed changes in marine systems are associated with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels, and circulation. Ocean acidification resulting from massive amounts of carbon dioxide and pollutants released into the air can have major adverse impacts on the calcium balance in the oceans. Changes to the marine ecosystem due to climate change include shifts in ranges and changes in algal, plankton, and fish abundance (IPCC 2007). These trends have been most apparent over the past few decades, although this may also be due to increased research. Information on future impacts of climate change in the action area is discussed below.

While predictions are available regarding potential effects of climate change globally, it is more difficult to assess the potential effects of climate change over the next few decades on coastal and marine resources on smaller geographic scales, such as the action area, especially as climate variability is a dominant factor in shaping coastal and marine systems. The effects of future change will vary greatly in diverse coastal regions for the U.S. Additional information on potential effects of climate change specific to the action area is discussed below. Warming is very likely to continue in the U.S. over the next 50 years regardless of reduction in greenhouse gases, due to emissions that have already occurred (NAST 2000). It is very likely that the magnitude and frequency of ecosystem changes will continue to increase in the next 50 years, and it is possible that they will accelerate. Climate change can cause or exacerbate direct stress on ecosystems through high temperatures, a reduction in water availability, and altered frequency of extreme events and severe storms. Water temperatures in streams and rivers are likely to increase as the climate warms and are very likely to have both direct and indirect effects on aquatic ecosystems. Changes in temperature will be most evident during low flow periods when they are of greatest concern (NAST 2000). In some marine and freshwater systems, shifts in geographic ranges and changes in algal, plankton, and fish abundance are associated with high confidence with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels and circulation (IPCC 2007).

Expected consequences of climate change for river systems could be a decrease in the amount of dissolved oxygen in surface waters and an increase in the concentration of nutrients and toxic chemicals due to reduced flushing rate (Murdoch *et al.* 2000). Because many rivers are already under a great deal of stress due to excessive water withdrawal or land development, and this stress may be exacerbated by changes in climate, anticipating and planning adaptive strategies may be critical (Hulme 2005). A warmer-wetter climate could ameliorate poor water quality conditions in places where human-caused concentrations of nutrients and pollutants currently degrade water quality (Murdoch *et al.* 2000). Increases in water temperature and changes in seasonal patterns of runoff will very likely disturb fish habitat and affect recreational uses of lakes, streams, and wetlands. Surface water resources along the U.S. Atlantic coast are intensively managed with dams and channels and almost all are affected by human activities; in some systems water quality is either below recommended levels or nearly so. A global analysis of the potential effects of climate change on river basins indicates that due to changes in discharge and water stress, the area of large river basins in need of reactive or proactive management interventions in response to climate change will be much higher for basins impacted by dams than for basins with free-flowing rivers (Palmer *et al.* 2008). Human-induced disturbances also influence coastal and marine systems, often reducing the ability of the systems to adapt so that systems that might ordinarily be capable of responding to variability and change are less able to do so. Because stresses on water quality are associated with many activities, the impacts of the existing stresses are likely to be exacerbated by climate change. Within 50 years, river basins that are impacted by dams or by extensive development will experience greater changes in discharge and water stress than unimpacted, free-flowing rivers (Palmer *et al.* 2008).

While debated, researchers anticipate: 1) the frequency and intensity of droughts and floods will change across the nation; 2) a warming of about 0.2°C per decade; and 3) a rise in sea level (NAO 2000). Sea level is expected to continue rising; during the 20th century global sea level has increased 15 to 20 centimeters. It is also important to note that ocean temperature in the U.S. Northeast Shelf and surrounding Northwest Atlantic waters have warmed faster than the global average over the last decade (Pershing *et al.* 2015). New projections for the U.S. Northeast Shelf and Northwest Atlantic Ocean suggest that this region will warm two to three times faster than the global average and thus existing projections from the IPCC may be too conservative (Saba *et al.* 2015).

Effects on sea turtles and Atlantic sturgeon globally

Sea turtles

Sea turtle species have persisted for millions of years and throughout this time have experienced wide variations in global climate conditions and have successfully adapted to these changes. As such, climate change at normal rates (thousands of years) is not thought to have historically been a problem for sea turtle species. As explained in the *Status of the Species* sections above, sea turtles are most likely to be affected by climate change due to (1) changing air temperature and rainfall at nesting beaches, which in turn could impact nest success (hatching success and hatchling emergence rate) and sex ratios among hatchlings; (2) sea level rise, which could result in a reduction or shift in available nesting beach habitat and increased risk of nest inundation; (3) changes in the abundance and distribution of forage species, which could result in changes in the

foraging behavior and distribution of sea turtle species; and (4) changes in water temperature, which could possibly lead to a northward shift in their range and changes in phenology (timing of nesting seasons, timing of migrations). Over the time period of this action considered in this Opinion, sea surface temperatures are expected to rise less than 1°C. It is unknown if that is enough of a change to contribute to shifts in the range, distribution, and recruitment of sea turtles. Theoretically, we expect that as waters in the action area warm, more sea turtles could be present or sea turtles could be present for longer periods of time.

It has been speculated that the nesting range of some sea turtle species may shift northward. Nesting in the Mid-Atlantic generally is extremely rare and no nesting has been documented at any beach in the Northeast. In 2010, one green sea turtle came up on the beach in Sea Isle City, New Jersey; however, it did not lay any eggs. In August 2011, a loggerhead came up on the beach in Stone Harbor, New Jersey, but did not lay any eggs. On August 18, 2011, a green sea turtle laid one nest at Cape Henlopen Beach in Lewes, Delaware, near the entrance to Delaware Bay. The nest contained 190 eggs and was transported indoors to an incubation facility on October 7. A total of 12 eggs hatched, with eight hatchlings surviving. In December, seven of the hatchlings were released in Cape Hatteras, North Carolina. It is important to consider that in order for nesting to be successful in the Mid-Atlantic, fall and winter temperatures need to be warm enough to support the successful rearing of eggs and sea temperatures must be warm enough for hatchlings not to die when they enter the water. The projected increase in ocean temperature over the next five years is not great enough to allow successful rearing of sea turtle eggs in the any new parts of the action area. Therefore, it is unlikely that over the time period considered here, that there would be an increase in nesting activity in the action area.

As noted above, sea level rise has the potential to remove possible beach nesting habitat. A recent study by the U.S. Geological Survey found that sea levels in a 620-mile “hot spot” along the East Coast are rising three to four times faster than the global average (Sallenger *et al.* 2012). The disproportionate sea level rise is due to the slowing of Atlantic currents caused by fresh water from the melting of the Greenland Ice Sheet. Sharp rises in sea levels from North Carolina to Massachusetts could threaten wetland and beach habitats, and negatively affect sea turtle nesting along the North Carolina coast. If warming temperatures moved favorable nesting sites northward, it is possible that rises in sea level could constrain the availability of nesting sites on existing beaches. In the next 100 years, the study predicted that sea levels will rise an additional 20-27 centimeters along the Atlantic coast “hot spot” (Sallenger *et al.* 2012).

Warming sea temperatures are likely to result in a shift in the seasonal distribution of sea turtles in the action area, such that sea turtles may begin northward migrations from their southern overwintering grounds earlier in the spring and thus would be present in the action area earlier in the year. Likewise, if water temperatures were warmer in the fall, sea turtles could remain in the action area later in the year. In the next ten years, the expected small increase in temperature is unlikely to cause a significant effect to sea turtles or a significant modification to the number of sea turtles likely to be present in the action area.

Changes in water temperature may also alter the forage base and thus, foraging behavior of sea turtles. Changes in the foraging behavior of sea turtles in the action area could lead to either an increase or decrease in the number of sea turtles in the action area, depending on whether there

was an increase or decrease in the forage base and/or a seasonal shift in water temperature. For example, if there was a decrease in sea grasses in the action area resulting from increased water temperatures or other climate-change related factors, it is reasonable to expect that there may be a decrease in the number of foraging green sea turtles in the action area. Likewise, if the prey base for loggerhead, Kemp's ridley, or leatherback sea turtles was affected, there may be changes in the abundance and distribution of these species in the action area. However, as noted above, because we do not know the adaptive capacity of these individuals or how much of a change in temperature would be necessary to cause a shift in distribution, it is not possible to predict changes to the foraging behavior of sea turtles over the next ten years. If sea turtle distribution shifted along with prey distribution, it is likely that there would be minimal, if any, impact on the availability of food. Similarly, if sea turtles shifted to areas where different forage was available and sea turtles were able to obtain sufficient nutrition from that new source of forage, any effect would be minimal. The greatest potential for effect to forage resources would be if sea turtles shifted to an area or time where insufficient forage was available; however, the likelihood of this happening seems low because sea turtles feed on a wide variety of species and in a wide variety of habitats. Finally, it is important to note that ocean temperature in the U.S. Northeast continental shelf and surrounding Northwest Atlantic waters have warmed faster than the global average over the last decade (Pershing *et al.* 2015). New projections for the U.S. Northeast shelf and Northwest Atlantic Ocean suggest that this region will warm two to three times faster than the global average and thus existing projections from the IPCC may be too conservative (Saba *et al.* 2015).

Atlantic sturgeon

Atlantic sturgeon have persisted for millions of years and have experienced wide variations in global climate conditions, to which they have successfully adapted. Climate change at historical rates (thousands of years) is not thought to have been a problem for sturgeon species. However, at the current rate of global climate change, future effects to sturgeon are possible. Rising sea level may result in the salt wedge moving upstream in affected rivers. Atlantic sturgeon spawning occurs in fresh water reaches of rivers because early life stages have little to no tolerance for salinity. Similarly, juvenile sturgeon have limited tolerance to salinity and remain in waters with little to no salinity. If the salt wedge moves further upstream, sturgeon spawning and rearing habitat could be restricted. In river systems with dams or natural falls that are impassable by sturgeon, the extent that spawning or rearing may be shifted upstream to compensate for the shift in the movement of the salt wedge would be limited. While there is an indication that an increase in sea level rise would result in a shift in the location of the salt wedge, at this time there are no predictions on the timing or extent of any shifts that may occur; thus, it is not possible to predict any future loss in spawning or rearing habitat. However, in all river systems, spawning occurs miles upstream of the salt wedge. It is unlikely that shifts in the location of the salt wedge would eliminate freshwater spawning or rearing habitat. If habitat was severely restricted, productivity or survivability may decrease.

The increased rainfall predicted by some models in some areas may increase runoff and scour spawning areas and flooding events could cause temporary water quality issues. Rising temperatures predicted for all of the U.S. could exacerbate existing water quality problems with dissolved oxygen (DO) and temperature. While this occurs primarily in rivers in the southeast U.S. and the Chesapeake Bay, it may start to occur more commonly in the northern rivers.

Atlantic sturgeon are tolerant to water temperatures up to approximately 28°C (82.4°F); these temperatures are experienced naturally in some areas of rivers during the summer months. If river temperatures rise and temperatures above 28°C are experienced in larger areas, sturgeon may be excluded from some habitats.

Increased droughts (and water withdrawal for human use) predicted by some models in some areas may cause loss of habitat including loss of access to spawning habitat. Drought conditions in the spring may also expose eggs and larvae in rearing habitats. If a river becomes too shallow or flows become intermittent, all sturgeon life stages, including adults, may become susceptible to strandings or habitat restriction. Low flow and drought conditions are also expected to cause additional water quality issues. Any of the conditions associated with climate change are likely to disrupt river ecology causing shifts in community structure and the type and abundance of prey. Additionally, cues for spawning migration and spawning could occur earlier in the season causing a mismatch in prey that are currently available to developing sturgeon in rearing habitat.

Atlantic sturgeon in the action area are most likely to experience the effects of global climate change in warming water temperatures, which could change their range and migratory patterns. Warming temperatures predicted to occur over the next 100 years would likely result in a northward shift/extension of their range (i.e., into the St. Lawrence River, Canada) while truncating the southern distribution, thus affecting the recruitment and distribution of sturgeon rangewide. In the next five years, this increase in sea surface temperature is expected to be minimal, and thus, it is unlikely that this expanded range will be observed in the near future. If any shift does occur, it is likely to be minimal and thus, it seems unlikely that this small increase in temperature will cause a significant effect to shortnose and Atlantic sturgeon or a significant modification to the number of sturgeon likely to be present in the action area over the life of the proposed action. However, even a small increase in temperature can affect DO concentrations. A one degree change in temperature in Chesapeake Bay could make parts of Chesapeake Bay inaccessible to sturgeon due to decreased levels of DO (Batiuk *et al.* 2009).

Although the action area does not include spawning grounds for Atlantic sturgeon, sturgeon are migrating through the action area to reach their natal rivers to spawn. Elevated temperatures could modify cues for spawning migration, resulting in an earlier spawning season, and thus, altering the time of year sturgeon may or may not be present within the action area. This may cause an increase or decrease in the number of sturgeon present in the action area. However, because spawning is not triggered solely by water temperature, but also by day length (which would not be affected by climate change) and river flow (which could be affected by climate change), it is not possible to predict how any change in water temperature alone will affect the seasonal movements of sturgeon through the action area.

In addition, changes in water temperature may also alter the forage base and thus, foraging behavior of sturgeon. Any forage species that are temperature-dependent may also shift in distribution as water temperatures warm and cause a shift in the distribution of sturgeon. However, because we do not know the adaptive capacity of these species or how much of a change in temperature would be necessary to cause a shift in distribution, it is not possible to predict how these changes may affect foraging sturgeon. If sturgeon distribution shifted along with prey distribution, it is likely that there would be minimal, if any, impact on the availability

of food. Similarly, if sturgeon shifted to areas where different forage was available and sturgeon were able to obtain sufficient nutrition from that new source of forage, any effect would be minimal. The greatest potential for effect to forage resources would be if sturgeon shifted to an area or time where insufficient forage was available; however, the likelihood of this happening seems low because sturgeon feed on a wide variety of species and in a wide variety of habitats.

5.4 Reducing Threats to ESA-listed Species

5.4.1 Education and Outreach Activities

Education and outreach activities are considered some of the primary tools that will effectively reduce the threats to all protected species. For example, NMFS has been active in public outreach to educate fishermen about handling and resuscitation techniques for sea turtles and sturgeon, and educates recreational fishermen and boaters on how to avoid interactions with these species. NMFS also has a program called “SCUTES” (Student Collaborating to Undertake Tracking Efforts for Sturgeon), which offers educational programs and activities about the movements, behaviors, and threats to sturgeon. NMFS intends to continue these outreach efforts in the action area in an attempt to reduce interactions with protected species, and to reduce the likelihood of injury to protected species when interactions do occur.

5.4.2 Stranding and Salvage Programs

The NMFS-managed Sea Turtle Stranding and Salvage Network (STSSN) does not directly reduce the threats to sea turtles. However, the extensive network of STSSN participants along the Atlantic and Gulf of Mexico coasts not only collects data on dead sea turtles, but also rescues and rehabilitates live stranded turtles, reducing mortality of injured or sick animals. Data collected by the STSSN are used to monitor stranding levels, to identify areas where unusual or elevated mortality is occurring, and to identify sources of mortality. These data are also used to monitor incidence of disease, study toxicology and contaminants, and conduct genetic studies to determine population structure. All of the states that participate in the STSSN tag live turtles when encountered (either via the stranding network through incidental takes or in-water studies). Tagging studies help improve our understanding of sea turtle movements, longevity, and reproductive patterns, all of which contribute to our ability to reach recovery goals for the species.

A salvage program is also in place for sturgeon. Sturgeon carcasses can provide pertinent life history data and information on new or evolving threats. Their use in scientific research studies can reduce the need to collect live sturgeon. The NMFS Sturgeon Salvage Program is a network of individuals qualified to retrieve and/or use sturgeon carcasses and parts for scientific research and education. All carcasses and parts are retrieved opportunistically and participation in the network is voluntary.

5.4.3 Sea Turtle Disentanglement Network

The NMFS Greater Atlantic Region established the Northeast Sea Turtle Disentanglement Network (STDN) in 2002 in response to the high number of leatherback sea turtles found

entangled in pot gear along the U.S. Northeast Atlantic coast. The STDN is considered a component of the larger STSSN program, and it operates in all states in the region. The STDN responds to entangled sea turtles and disentangles and releases live animals, thereby reducing post-interaction mortality. In addition, the STDN collects data on live and dead sea turtle entanglement events, providing valuable information for management purposes. The NMFS Greater Atlantic Regional Office oversees the STDN program and manages the STDN database. As knowledge of the network and number of participants involved in the network has increased, so have reports of sea turtle entanglements in Virginia waters increased over the past several years. In 2017, the STDN documented eleven sea turtle entanglements in the state of Virginia in gears such as pound nets, the vertical lines of crab traps, and monofilament or unknown line.

5.4.4 Regulatory Measures for Sea Turtles

Numerous efforts are ongoing to reduce threats to listed sea turtles. Below, we detail efforts that are ongoing within the action area. The majority of these activities are related to regulations that have been implemented to reduce the potential for incidental mortality of sea turtles from commercial fisheries. These include sea turtle release gear requirements for TEDs in the southern part of the summer flounder trawl fishery and mesh size restrictions in Virginia's gillnet fisheries. The summaries below discuss all of these measures in more detail.

Large Mesh Gillnet Requirements in the Mid-Atlantic

In March 2002, NMFS published new restrictions for the use of gillnets with larger than 8-inch (20.3 cm) stretched mesh, in Federal waters (3-200 nautical miles) off of North Carolina and Virginia. These restrictions were published in an interim final rule under the authority of the ESA (67 FR 13098) and were implemented to reduce the impact of the monkfish and other large-mesh gillnet fisheries on ESA-listed sea turtles in areas where sea turtles are known to concentrate. Following review of public comments submitted on the interim final rule, NMFS published a final rule on December 3, 2002, that established the restrictions on an annual basis. As a result, gillnets with larger than 8-inch (20.3 cm) stretched mesh are not allowed in Federal waters (3-200 nautical miles) in the areas described as follows: (1) North of the North Carolina/South Carolina border at the coast to Oregon Inlet at all times; (2) north of Oregon Inlet to Currituck Beach Light, NC from March 16 through January 14; (3) north of Currituck Beach Light, NC, to Wachapreague Inlet, VA, from April 1 through January 14; and (4) north of Wachapreague Inlet, VA, to Chincoteague, VA, from April 16 through January 14. On April 26, 2006, NMFS published a final rule (71 FR 24776) that included modifications to the large-mesh gillnet restrictions. The new final rule revised the gillnet restrictions to apply to stretched mesh that is ≥ 7 inches (17.9 cm). Federal waters north of Chincoteague, VA, remain unaffected by the large-mesh gillnet restrictions. These measures are in addition to the HPTRP measures that prohibit the use of large-mesh gillnets in southern Mid-Atlantic waters (territorial and Federal waters from Delaware through North Carolina out to 72°30'W longitude) from February 15 through March 15, annually. The measures are also in addition to comparable North Carolina and Virginia regulations for large-mesh gillnet fisheries in their respective state waters that were enacted in 2005.

Modified Scallop Dredge Gear in the Mid-Atlantic Sea Scallop Fishery

To reduce post-interaction mortality to sea turtles resulting from capture in the sea scallop dredge bag, NMFS has required the use of a chain-mat modified dredge in the Atlantic sea scallop fishery since 2006 (71 FR 50361, August 25, 2006; 71 FR 66466, November 15, 2006; 73 FR 18984, April 8, 2008; 74 FR 20667, May 5, 2009). Federally permitted scallop vessels south of 41°09'N from the shoreline to the outer boundary of the EEZ are required to modify their dredge gear by adding an arrangement of horizontal and vertical chains (a “chain mat”) over the opening of the dredge bag from May 1 through November 30 each year. This modification is not expected to reduce the overall number of sea turtle interactions with gear. However, it is expected to reduce the severity of the interactions.

Since May 1, 2013, all limited access scallop vessels, as well as Limited Access General Category vessels with a dredge width of 10.5 feet or greater, have been required to use a Turtle Deflector Dredge (TDD) in the Mid-Atlantic (west of 71°W) from May 1 through October 31 each year (77 FR 20728, April 6, 2012). The purpose of the TDD requirement is to deflect sea turtles over the dredge frame and bag rather than under the cutting bar, so as to reduce sea turtle injuries due to contact with the dredge frame on the ocean bottom (including being crushed under the dredge frame). The TDD has specific components that are defined in the regulations. When combined with the effects of chain mats, which decrease captures in the dredge bag, the TDD should provide greater sea turtle benefits by reducing post-interaction mortality due to interactions with the dredge frame, compared to a standard New Bedford dredge.

To eliminate confusion, the seasons and areas for these two gear measures designed to protect sea turtles were later aligned through the final rule for Framework 26 to the Atlantic Sea Scallop FMP (80 FR 22119; April 21, 2015). Following the enactment of the final rule, sea turtle chain mats and TDDs are now required west of 71°W longitude from May through November.

TED Requirements for the Summer Flounder Fishery

As mentioned above, significant measures have been developed to reduce the incidental take of sea turtles in summer flounder trawls and trawls that meet the definition of a summer flounder trawl (which would include fisheries for other species like scup and black sea bass) by requiring TEDs in trawl nets fished in trawls used in the area of greatest turtle bycatch off the North Carolina and part of the Virginia coast from North Carolina/South Carolina border to Cape Charles, Virginia. The TED requirements for the summer flounder trawl fishery do not, however, require the use of larger TEDs that are required in the U.S. Southeast shrimp trawl fisheries.

Sea Turtle Entanglements and Rehabilitation

A final rule (70 FR 42508) published on July 25, 2005, allows any agent or employee of NMFS, U.S. FWS, USCG, or any other Federal land or water management agency, or any agent or employee of a state agency responsible for fish and wildlife, when acting in the course of his or her official duties, to take endangered sea turtles encountered in the marine environment if such taking is necessary to aid a sick, injured, or entangled endangered sea turtle, or dispose of a dead endangered sea turtle, or salvage a dead endangered sea turtle that may be useful for scientific or educational purposes. NMFS already affords the same protection to sea turtles listed as threatened under the ESA (50 CFR 223.206(b)).

5.4.5 Regulatory Measures for Atlantic Sturgeon

Sturgeon Recovery Planning

Several conservation actions aimed at reducing threats to Atlantic sturgeon are currently ongoing. In the near future, NMFS will be convening a recovery team and drafting a recovery plan which will outline recovery goals and criteria and steps necessary to recover all Atlantic sturgeon DPSs. Numerous research activities are underway for sturgeon, involving NMFS and other Federal, state, and academic partners, to obtain more information on the distribution and abundance of sturgeon throughout their range, including in the action area. Efforts are also underway to better understand threats faced by sturgeon and ways to minimize these threats, including bycatch and water quality. Fishing gear research is underway to design fishing gear that minimizes interactions with Atlantic sturgeon while maximizing retention of targeted fish species. Several states are in the process of preparing ESA section 10 Habitat Conservation Plans aimed at minimizing the effects of state fisheries on Atlantic sturgeon.

Research Activity Guidelines

Research activities aid in the conservation of listed species by furthering our understanding of the species' life history and biological requirements. We recognize, however, that many scientific research activities involve capture and may pose some level of risk to individuals or to the species. Therefore, it is necessary for research activities to be carried out in a manner that minimizes the adverse impacts of the activities on individuals and the species while obtaining crucial information that will benefit the species. Guidelines developed by sturgeon researchers in cooperation with NMFS staff (Moser *et al.* 2000; Damon-Randall *et al.* 2010; Kahn and Mohead 2010) provide standardized research protocols that minimize the risk to sturgeon from capture, handling, and sampling. These guidelines must be followed by any entity receiving a federal permit to do research on Atlantic sturgeon.

Protections for the GOM DPS of Atlantic Sturgeon

The prohibitions listed under section 9(a)(1) of the ESA automatically apply when a species is listed as endangered but not when listed as threatened. When a species is listed as threatened, section 4(d) of the ESA requires the Secretary of Commerce (Secretary) to issue regulations, as deemed necessary and advisable, to provide for the conservation of the species. The Secretary may, with respect to any threatened species, issue regulations that prohibit any act covered under section 9(a)(1). Whether section 9(a)(1) prohibitions are necessary and advisable for a threatened species is largely dependent on the biological status of the species and the potential impacts of various activities on the species. On June 10, 2011, we proposed protective measures for the GOM DPS of Atlantic sturgeon (76 FR 34023). On November 19, 2013 we published a preliminary final rule that applied all prohibitions of section 9(a)(1) to the GOM DPS beginning on December 19, 2013 (78 FR 69310).

5.5 Summary of Available Information on Listed Species Likely to be Adversely Affected by the Proposed Action in the Action Area

5.5.1 Sea Turtles

As described in sections 4.2.1.1 - 4.2.1.4, the occurrence of loggerhead, Kemp's ridley, green, and leatherback sea turtles along the U.S. Atlantic coast is primarily temperature dependent (Thompson 1984; Keinath *et al.* 1987; Shoop and Kenney 1992; Musick and Limpus 1997; Morreale and Standora 1998, 2005; Mitchell *et al.* 2003; Braun-McNeill and Epperly 2004; James *et al.* 2005a). In general, sea turtles move up the U.S. Atlantic coast from southern wintering areas as water temperatures warm in the spring (Keinath *et al.* 1987; Shoop and Kenney 1992; Musick and Limpus 1997; Morreale and Standora 1998, 2005; Mitchell *et al.* 2003; Braun-McNeill and Epperly 2004; James *et al.* 2005a). The trend is reversed in the fall as water temperatures cool. By December, sea turtles have passed Cape Hatteras, returning to more southern waters for the winter (Keinath *et al.* 1987; Shoop and Kenney 1992; Musick and Limpus 1997; Morreale and Standora 1998, 2005; Mitchell *et al.* 2003; Braun-McNeill and Epperly 2004; James *et al.* 2005a). Recreational anglers have reported sightings of sea turtles in waters defined as inshore waters (bays, inlets, rivers, or sounds; Braun-McNeill and Epperly 2004) as far north as New York as early as March-April, but in relatively low numbers (Braun-McNeill and Epperly 2004). Greater numbers of loggerheads, Kemp's ridleys, and greens are found in inshore, nearshore, and offshore waters of North Carolina (north of Cape Hatteras) and Virginia from May through November and in inshore, nearshore, and offshore waters of New York from June through October (Keinath *et al.* 1987; Morreale and Standora 1993; Braun-McNeill and Epperly 2004). Leatherback sea turtles have a similar seasonal distribution but have a more extensive range in the Gulf of Maine and further north into Canadian waters compared to the hard-shelled species (Shoop and Kenney 1992; Mitchell *et al.* 2003; STSSN database).

Extensive survey effort of the continental shelf from Cape Hatteras to Nova Scotia, Canada in the 1980s (CeTAP 1982) revealed that loggerheads were observed at the surface in waters from the beach to waters with bottom depths of up to 4,481 meters. However, they were generally found in waters where bottom depths ranged from 22-49 meters deep (the median value was 36.6 meters; Shoop and Kenney 1992). Leatherbacks were sighted at the surface in waters with bottom depths ranging from 1-4,151 meters deep (Shoop and Kenney 1992). However, 84.4% of leatherback sightings occurred in waters where the bottom depth was less than 180 meters (Shoop and Kenney 1992), whereas 84.5% of loggerhead sightings occurred in waters where the bottom depth was less than 80 meters (Shoop and Kenney 1992). The CeTAP study did not include Kemp's ridley and green sea turtle sightings, given the difficulty of sighting these smaller sea turtle species (CeTAP 1982).

Sea turtles are generally present in Virginia waters from May to November each year, with the highest number of individuals present from June to October. Sea turtles occur throughout the Virginia portion of Chesapeake Bay, from shallow waters along the shoreline and near river mouths to deeper waters in the bay's interior and near its confluence with the Atlantic Ocean. One of the main factors influencing sea turtle presence in Mid-Atlantic waters is seasonal temperature patterns (Ruben and Morreale 1999). Temperature is correlated with the time of year, with warmer waters in the late spring, summer, and early fall being the most suitable for

cold-blooded sea turtles. Sea turtles are most likely to occur in the action area when water temperatures are above 11°C, although depending on seasonal weather patterns and prey availability, they could be also present in months when water temperatures are cooler (as evidenced by fall and winter cold stunning records as well as year round stranding records). Sea turtles have also been documented in the action area through aerial and vessel surveys, satellite tracking programs, and by fisheries observers. The majority of sea turtle observations in the Chesapeake Bay and vicinity are of loggerhead sea turtles, yet all four species of sea turtles have been recorded in the action area.

To some extent, water depth also dictates the number of sea turtles occurring in a particular area. Satellite tracking studies of sea turtles in the Northeast U.S. found that foraging turtles mainly occurred in areas where the water depth was between approximately 16 and 49 feet (Ruben and Morreale 1999). This depth was interpreted not to be as much an upper physiological depth limit for turtles, as a natural limiting depth where light and food are most suitable for foraging turtles (Morreale and Standora 1990). The areas to be fished by pound net gear and the depths preferred by sea turtles do overlap, suggesting that if suitable forage is present, adult and juvenile loggerhead, leatherback, and green sea turtles as well as juvenile Kemp's ridley sea turtles may be foraging in the areas where Virginia pound net fishing will occur.

5.5.2 Atlantic Sturgeon

The marine and estuarine range of all five Atlantic sturgeon DPSs overlaps and extends from Canada through Cape Canaveral, Florida. Based on the best available information, Atlantic sturgeon originating from any of five DPSs could occur in the Virginia portion of Chesapeake Bay and nearshore waters off the state (Damon-Randall et al. 2013; Wirgin *et al.* 2015). The Virginia pound net fishery does not overlap with freshwater; therefore, eggs and early life stages will not be present in the action area. Juvenile, subadult, and adult Atlantic sturgeon are likely to occur in the Virginia portion of Chesapeake Bay and nearshore waters off the state as they have been documented throughout the bay in spring, summer, and fall and in coastal ocean waters of the Mid-Atlantic year round. Atlantic sturgeon are known to use the action area for spawning migrations, foraging, and as juvenile development habitat prior to entering marine waters as subadults and adults.

Atlantic sturgeon from all five DPSs can be found in Virginia nearshore and coastal waters and within Chesapeake Bay, typically from spring through fall. Migratory behaviors occur from April to November for adults and subadults and year round for juveniles (Dovel and Berggren 1983; Secor *et al.* 2000; Welsh *et al.* 2002b; Horne and Stence 2016). Each of these life stages are expected to wander among coastal and estuarine habitats of the bay. Foraging behaviors typically occur in areas where suitable forage and appropriate habitat conditions are present. These areas include tidally influenced flats and mud, sand, and mixed cobble substrates (Stein *et al.* 2004a). The areas to be fished by pound net gear and the depths preferred by Atlantic sturgeon do overlap, suggesting that if suitable forage and/or habitat features are present, adult and subadults from any of the five listed DPSs may be foraging or undertaking migrations in the areas where Virginia pound net fishing will occur.

6.0 EFFECTS OF THE ACTION

As discussed earlier in section 3, the proposed action is NMFS's implementation of gear regulations for the Virginia pound net fishery, in the form of protected species conservation measures pursuant to the ESA and MMPA. This consultation considers the continued operation of the Virginia pound net fishery as a whole into the foreseeable future or until such time that one of the four triggers for reinitiation of section 7 consultation is met. Sea turtles and Atlantic sturgeon may be adversely affected by the proposed action in a number of ways. These include: (1) direct entrapment or entanglement in pound net fishing gear, (2) behavioral modification due to the placement or operation of pound net fishing gear, (3) interactions with or disturbance from fishing vessels, and (4) effects to prey and/or habitat due to the placement or hauling of pound net fishing gear. The following effects analysis will be organized along these four topics, with the majority of the analysis focusing on entrapment/entanglement in the gear as it is the adverse effect from the fishery and its regulations that is most easily documented and monitored. For both sea turtles and Atlantic sturgeon, we have estimated future incidental takes in the Virginia pound net fishery based on past interactions in pound net fishing gear as well as other types of gears used in parts of the action area where future pound net fishing activities are anticipated.

6.1 Effects to Sea Turtles from Entrapment/Entanglement

Given the seasonal occurrence patterns and depth preferences of sea turtles off the U.S. Atlantic coast, we expect the distribution of all four species will overlap with the Virginia pound net fishery primarily from May through November, although interactions could occur year round as sea turtle strandings in Virginia waters have been documented in all four seasons (Barco and Swingle 2014). The year round presence of sea turtles in the action area, with a peak from May through November, is also confirmed by past captures of sea turtles in Virginia pound net gear as well as other commercial and recreational fishing gear in the action area (e.g., trawls, gillnets, dredges, hook and line), as documented through NEFOP and state specific incidental take data.

Direct and indirect effects of the Virginia pound net fishery and its regulations on sea turtles may include: (1) stress, injury, or mortality due to entrapment/entanglement in specific components of the gear (leaders, hearts, or pounds), (2) stress, injury, or mortality due to fishing vessel activities (e.g., acoustic disturbance or vessel strikes), (3) disturbance or changes in sea turtle behavior due to placement of the gear itself, and (4) removal of sea turtle prey and/or habitat due to setting or hauling of the gear. In regards to these potential effects, effects from entanglement, entrapment, and impingement in pound net gear are the most easily measurable and quantifiable. Loggerhead, Kemp's ridley, green, and leatherback sea turtles are at most risk in areas of Chesapeake Bay where pound net fishing is abundant and where the zone of passage is relatively small. Sea turtles may become entangled in any portion of the pound net, most commonly around their head and front flippers; this is anticipated to happen almost exclusively in the leaders versus other parts of the gear. Entanglements can result in bodily injury or drowning. Entrapment occurs when a sea turtle finds its way into a pound net but cannot get out. Sea turtles may also become pinned against the netting (called an impingement) in a fast moving current and drown if they cannot free themselves.

Captures in Pound Net Gear – Pounds and Hearts

Sea turtles are occasionally found swimming in the pound portion of pound net gear, and one loggerhead sea turtle was documented in the heart portion of the gear (on August 20, 2013). Sea turtles documented in pounds and hearts are almost always alive, as the mesh used for these gear components is small (i.e., 2-4 inches stretched mesh), precluding most sea turtle entanglements, and the top of the pounds and hearts are open, allowing turtles to surface for air. Therefore, although the continued operation of the pound net fishery may result in the capture of sea turtles in the pounds and hearts, the likelihood that these turtles will be injured or killed is very low. The duration of time of in which Virginia pound net gear is left sitting prior to monitoring and hauling fish is a short duration (a few days at a time), which greatly reduces the risk of lethal or injurious effects to sea turtles from restricted movements or potential drowning.

Researchers have documented the repeated capture of previously tagged sea turtles in pounds, occasionally documenting the same turtle in the same pound in the same season. This suggests that these sea turtles may be returning to the pounds to forage. If sea turtles are entering the pounds on their own volition and continue to reoccupy pounds despite their repeated release, this is still considered a take under the ESA definition (e.g., capture). However, we are not aware of any instances in which these captures resulted in the serious injury or mortality of the sea turtle. Nonetheless, post-interaction mortality of sea turtles due to forced submergence resulting from entanglement or impingement in pounds and hearts cannot be ruled out since unfavorable environmental conditions (e.g., strong currents or tidal cycles, sudden drops in water temperature below a sea turtle's thermal tolerance), the physical condition of an animal (e.g., small size, poor health, prior entanglement in other gear or lines), and infrequent monitoring/hauling of gear by fishermen can all make a sea turtle more susceptible to a lethal entanglement or impingement.

From 1980 to 1999, the annual average number of sea turtles captured in pound nets set near the mouth of the Potomac River was approximately five loggerheads and one Kemp's ridley per net (NMFS 2004a). Based on these previously recorded captures in Chesapeake Bay, which still represent the best available information on pound net and heart captures at this time, we anticipate that up to five loggerhead and one Kemp's ridley sea turtles per licensed net will be captured annually in the pound or heart portion of Virginia pound net gear. There are 161 total licenses issued in Virginia, where one license is assigned to each pound net. As this consultation considers the effects of the proposed action year round, there is the potential that all 161 nets could be fished throughout the year. This likely overestimates the number of active pound nets in Virginia waters, but it is difficult to know exactly how many nets will be fished throughout the year based upon the available data. As described above, 158 of the 161 licenses for pound nets were active in 2017. Given the best available data on the number of pound nets set throughout the action area (n=161) and the expected interaction rate for loggerheads and Kemp's ridleys mentioned above, we expect the capture of up to 805 loggerhead and 161 Kemp's ridley sea turtles per year. Nearly all of these captures are anticipated to be of live animals. As the likelihood of a lethal capture is low, yet still reasonably certain to occur for the reasons mentioned in the prior paragraph above, we anticipate that up to one sea turtle of each species per year could be killed as a result of entanglement or impingement in a pound or heart.

Green sea turtles are less likely to occur in the action area than loggerheads or Kemp's ridleys, but are nonetheless susceptible to capture in pounds and hearts throughout the year for the same

reasons as their hard-shelled cousins. Green sea turtles have been captured in pounds in the Potomac River, albeit at a much lower rate than loggerheads and Kemp's ridleys (only two were documented over the course of twenty years from 1980 to 1999; NMFS 2004a). They have also been captured during hopper dredging operations at the mouth of the Chesapeake Bay and have occasionally stranded on Virginia beaches (NMFS 2004a). An annual estimate from the historic Potomac River pound net data equates to 0.1 turtles per year. By multiplying that estimate with the maximum number of pound nets set throughout the action area (n=161), we anticipate that up to 16 green sea turtles could be captured in the pounds or hearts of pound net gear annually. Like loggerheads and Kemp's ridleys, nearly all of these captures are anticipated to be of live animals. As the likelihood of a lethal capture is low, yet still reasonably certain to occur for the reasons mentioned in the paragraphs above, we anticipate that up to one green sea turtle per year could be killed as a result of entanglement or impingement in a pound or heart.

Leatherback sea turtles have been documented in Virginia waters and have stranded on Virginia beaches during the spring, summer, and fall. However, it is highly unlikely that leatherbacks will be found in the pound or heart of a pound net, as the individuals anticipated to be found in Virginia waters would likely be too large to enter these components. Further, leatherbacks forage on different species than loggerhead, Kemp's ridley, and green sea turtles and are likely not attracted to the fish and invertebrate species that are either caught or wander in the pounds or hearts. As such, captures of leatherbacks in pounds/hearts of pound net gear are not anticipated.

Summarized below are the number of estimated captures and post-interaction mortalities of sea turtles in the semi-enclosed pound and heart portions of Virginia pound net gear. Most of the estimated captures are of loggerhead sea turtles, as they are the most common sea turtle present in Chesapeake Bay. For captures in pounds and hearts, we expect:

- Up to 805 loggerhead sea turtles may be captured per year and up to one of those loggerheads may die due to forced submergence;
- Up to 161 Kemp's ridley sea turtles may be captured per year and up to one of those Kemp's ridleys may die due to forced submergence; and
- Up to 16 green sea turtles may be captured per year and up to one of those turtles may die due to forced submergence.

Entanglements in Pound Net Gear – Leaders

As described previously, sea turtles have been documented entangled in and impinged on leaders with greater than or equal to 12 inches stretched mesh and leaders with stringers in the Virginia Chesapeake Bay. The modified pound net leader regulations that were issued by NMFS in the early 2000s reduced the number of interactions compared to the time period before the regulations were in place. Recently however, there have been leatherback sea turtle entanglements in the hard lay vertical line component of modified leaders with mesh less than 12 inches. The VMRC also disentangled an unidentified sea turtle in an inshore leader in September 2017. While interactions with pound net leaders and sea turtles are highest in the spring, which is the season with the most historical pound net monitoring and highest rates of sea turtle strandings in Virginia waters, entanglements and impingements may theoretically occur whenever sea turtle distribution and the use of these leaders overlap. Note that the typical sea turtle residency period in Virginia waters occurs from approximately May to November. Pound

nets are set in Virginia's coastal waters and in Chesapeake Bay during the period of May through November, which coincides with the time when the majority of sea turtles are found in this area.

Sea turtles entangled in pound net leaders likely remain entangled until the tissue anchoring it has deteriorated (Bellmund *et al.* 1987) or until a fisherman or responder can free them from the mesh or lines. Due to the increased education of fishermen regarding sea turtle entanglements as well as increased reporting of sea turtle entanglements in Virginia pound leaders over the past 15 years, we have determined that the majority of sea turtle entanglements in leaders will be observed and reported to us. We anticipate that only an extremely small number of sea turtles would either free themselves from a leader prior to being observed or would not be reported to us in the event a fisherman did not inspect their leaders while setting or hauling their pounds.

To this point, only leatherback sea turtles have been documented as entangled in modified pound net leaders in Virginia waters, and all of them but one have occurred in the Cape Henry area of Chesapeake Bay (Figure 6). Table 12 provides a summary of all leatherback sea turtle interactions in modified Virginia pound net leaders since 2013. Sixteen leader entanglements have been documented from 2013-2017, with two of those being lethal. The previous 2004 Opinion anticipated up to two leatherback sea turtle entanglements in pound net leaders per year.

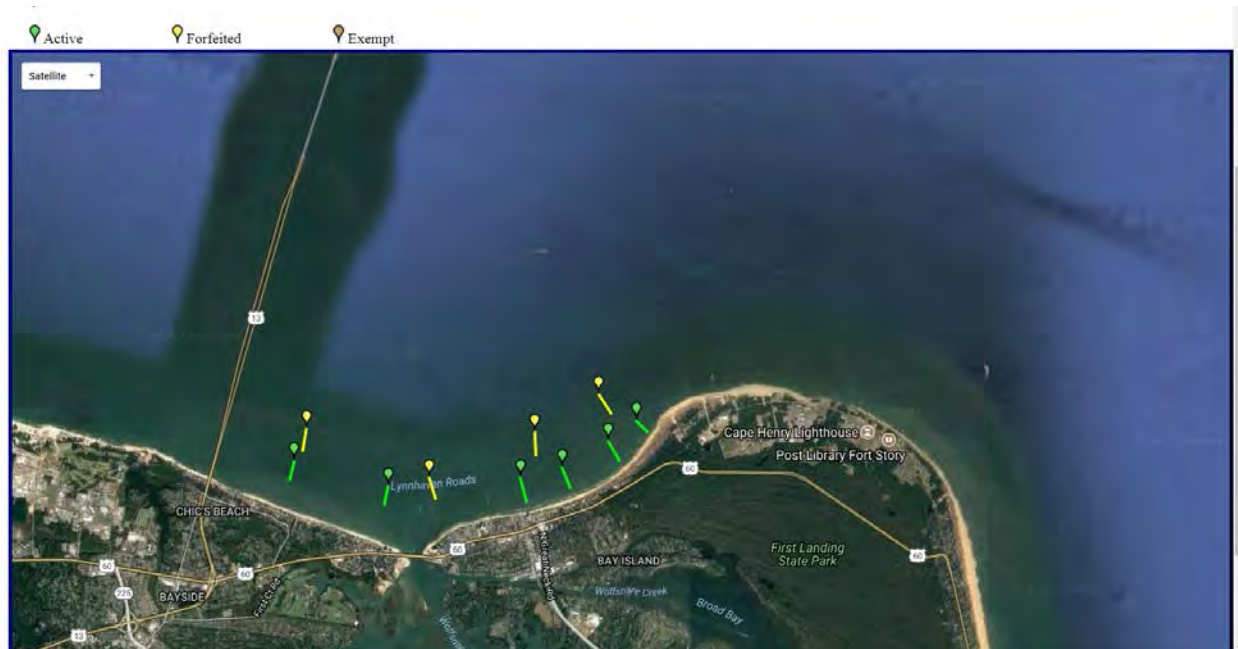


Figure 6. Virginia pound nets in the Cape Henry area where most leatherback entanglements in modified leaders have occurred. Source:

https://webapps.mrc.virginia.gov/public/maps/virginia_poundnets.php.

Table 12. Leatherback Interactions in Virginia Modified Pound Net Leaders – Through 2017
(Source: NMFS Northeast Sea Turtle Disentanglement Network, unpublished data).

DATE	STATUS	TOTAL
2013		2
	17-May	alive
	16-Jun	alive
2014		1
	12-Jun	dead
2015		2
	19-May	alive
	2-Jun	alive
2016		6
	27-May	alive
	29-May	alive
	4-Jun	alive
	4-Jun	alive
	9-Jun	alive
	10-Jun	alive
2017		5
	2-Jun	alive
	9-Jun	alive
	11-Jun	dead
	14-Jun	alive
	28-Jun	alive
		16

Information available since that time, including the entanglements recorded since 2013, indicate that the current and future annual entanglement rate is likely to be higher. Taking into account the previous maximum number of leatherback entanglements in leaders per year (six) and our assumption that leatherback interactions are likely to increase due to expected increases in the presence of both leatherbacks and their preferred jellyfish prey in the action area (<https://www.delmarvanow.com/story/news/local/2017/08/11/jellyfish-season-begins-early-climate-change/519681001/>), we expect up to eight leatherback sea turtles may be entangled in Virginia pound net leaders per year and that up to half of those may result in mortality.

A pound net characterization study by VIMS documented the entanglement of one dead juvenile loggerhead sea turtle in a pound net leader (approximately 11 inches) in October of 2000 (Mansfield *et al.* 2001), while another dead loggerhead was found entangled in a pound net leader in August 2001 (Mansfield *et al.* 2002a). It was not known if those animals were dead prior to entanglement or if the interaction with the pound net leader resulted in their death. Nonetheless, these two past incidents indicate that pound net leader entanglements of hard-shelled sea turtles are possible. Given the presence of three hard-shelled sea turtle species in the action area, we expect that any of these species could be entangled. Based on this information, we anticipate the entanglement of one green, loggerhead, and Kemp's ridley sea turtle in pound net leaders each year.

Summarized below are the number of estimated entanglements and post-interaction mortalities of sea turtles in the leader portions of Virginia pound net gear (modified or otherwise). Most of the estimated entanglements are of leatherback sea turtles, as they are the species most commonly entangled in pound net leaders in Chesapeake Bay. For entanglements in leaders, we expect:

- Up to eight leatherback sea turtles may be entangled per year and four of those takes may be lethal; and
- Up to one each of loggerhead, Kemp's ridley, and green sea turtles may be entangled per year and up to one each of those takes may be lethal.

Conclusion

Table 13 provides a summary of the estimated future takes of sea turtles per year in all portions of Virginia pound net gear. Results from Barco *et al.* (2016) suggest that the majority of fishery interaction mortalities of sea turtles are of normal, healthy turtles in the population versus those that may be compromised. Thus, although possible, it is extremely unlikely that a dead sea turtle entrapped or entangled in pound net gear would be one that died previously from other causes.

Table 13. Estimated Future Interactions with Sea Turtles in Virginia Pound Net Fishing Gear

Gear component	Pounds and Hearts		Leaders		Totals	
Species	Captures per year	Mortalities per year	Captures per year	Mortalities per year	Captures per year	Mortalities per year
Loggerhead	805	1	1	1	806	2
Kemp's ridley	161	1	1	1	162	2
Green	16	1	1	1	17	2
Leatherback	0	0	8	4	8	4

6.2 Effects to Atlantic Sturgeon from Entrapment/Entanglement

The Virginia pound net fishery is not typically prosecuted upstream of the mouths of major Chesapeake Bay rivers, so eggs and early life stages of Atlantic sturgeon will not be present in the action area and thus will not be affected by the proposed action. Juvenile, subadult, and adult Atlantic sturgeon occur in Chesapeake Bay and Virginia coastal waters throughout the year, with adults and subadults most prevalent from April to November (Dovel and Berggren 1983; Secor *et al.* 2000; Welsh *et al.* 2002b; Horne and Stence 2016). Each of these life stages is known to be present in many coastal and estuarine areas throughout Virginia. Diets of adult and subadult Atlantic sturgeon include mollusks, gastropods, amphipods, annelids, decapods, isopods, and fish such as sand lance (Bigelow and Schroeder 1953; ASSRT 2007; Guilbard *et al.* 2007; Savoy 2007). Juvenile Atlantic sturgeon feed on aquatic insects, insect larvae, and other invertebrates (Bigelow and Schroeder 1953; ASSRT 2007; Guilbard *et al.* 2007). Because of the benthic nature of their prey, it is likely that foraging Atlantic sturgeon could swim into and ultimately be entrapped or entangled in pound net gear operating in the action area. Because pound nets and leaders are not baited, Atlantic sturgeon are unlikely to be attracted to pound nets or leaders, which reduces the likelihood of entrapment/entanglement.

Atlantic sturgeon are known to become entrapped in pound nets and were routinely observed in Maryland waters, primarily through the U.S. FWS reward program (U.S. FWS 2007). We have only anecdotal reports of Atlantic sturgeon entrapped in pound nets in Virginia. Before 1996, very little information was known about the abundance or occurrence of Atlantic sturgeon in the Chesapeake Bay. In 1996, commercial fishermen in Maryland were offered a monetary award for live sturgeon that would be turned over to U.S. FWS biologists for tagging. Atlantic sturgeon captures were reported throughout the Maryland portion of the Chesapeake Bay from the Maryland/Virginia line north to the Susquehanna Flats, including bay tributaries. The majority of captures occurred during the spring months of April, May, and June. This time period corresponds to the peak of commercial pound net activity in the Chesapeake Bay. From 1996-2006, 260 different fishermen participated in the reward program. Commercial pound nets accounted for the majority of wild Atlantic sturgeon captures (58.9%, n=822) followed by gill nets (40.7%, n=568), with very few fish captured in fyke nets, trawls, and crab pots. The Atlantic sturgeon captures in the reward program were dominated by juveniles, with over 75% measuring less than 850 millimeters (U.S. FWS 2007).

Given that Atlantic sturgeon are present in the Virginia portion of Chesapeake Bay, interactions with pound nets, although not historically documented, are reasonably certain to occur in Virginia waters of the bay as well. Due to the available quantitative data on sturgeon interactions with pound nets in Maryland waters and assuming that the risk of entrapment in a pound net is the same for an Atlantic sturgeon in Maryland waters of the Chesapeake Bay compared to Virginia waters, we have determined that the Maryland data represents the best available information to determine the effects of the Virginia pound net fishery on Atlantic sturgeon.

Anticipated Interactions of Atlantic Sturgeon in Pound Net Gear

Data pertaining to the Virginia pound net fishery, relative to interactions with Atlantic sturgeon are limited, so we must make assumptions to overcome the limits in the available information. Much of the information used to estimate interaction levels for this fishery was generated from

past available data. The analysis of potential future incidental captures uses capture rates from the aforementioned reward program and the estimated number of annual pound nets in the two states to estimate future captures.

The following paragraphs describe the data used, the processes, and the results of our analyses for estimating the number or amount of Atlantic sturgeon interactions in the Virginia pound net fishery. When calculating the Atlantic sturgeon interaction rate, we used U.S. FWS reward program data documented during 1996-2006 in Maryland waters. We believe this approach is reasonable for a number of reasons. First, Atlantic sturgeon that occur in the action area are all highly migratory and found in both Maryland and Virginia waters (Horne and Stence 2016). Second, pound net construction and fishing methods are very similar in the both states, and effort throughout the seasons is similar (U.S. FWS 2007; Eyler *et al.* 2009; Piavis *et al.* 2012). Although Virginia has specific federal regulations in place related to its pound net leaders, those are solely based on sea turtle interactions at this time, since Atlantic sturgeon interactions in leaders have only recently documented in the last year. In addition, the vast majority of pound net fishing effort in both states occurs in nearshore waters where Atlantic sturgeon are known to occur frequently. Thus, neither fishery is expected to have a disproportionate rate of Atlantic sturgeon interactions based on the distributions of Atlantic sturgeon and pound net fishery effort. This estimate of interactions provides a quantitative association between the sturgeon encounters and gear types and represents the most accurate predictor of annual Atlantic sturgeon interactions in the Virginia pound net fishery that can be generated based on the best available information.

The formation of the sturgeon reward program in 1996 has increased the detail and accuracy of data on sturgeon interactions with pound nets. For the purposes of this Opinion, the estimate of Atlantic sturgeon interactions by the Virginia pound net fishery is calculated using sturgeon reported captured in a pound net in Maryland waters to the U.S. FWS between the years 1996 and 2006. Any of the estimates that produced fractional numbers were rounded up to whole numbers to complete the final estimates.

From 1996-2006, 822 Atlantic sturgeon were captured in Maryland pound nets (U.S. FWS 2007). The annual captures ranged from 3 (2000) to 225 (1998). This results in an average annual bycatch estimate of 74.72 Atlantic sturgeon captured in Maryland pound nets per year. For the purposes of this Opinion, we are rounding the annual average of 74.72 to 75 since a partial sturgeon take is not possible.

In 2017, 1,096 pound net sites were registered in Maryland (<http://dnr.maryland.gov/fisheries/Pages/poundnets/index.aspx>). Assuming the number of active pound net sites in Maryland has not increased since 1996, the current number of pound net sites in Maryland represents a conservative estimate for estimating the average number of sturgeon captured per pound net registered. Given that an average of 75 sturgeon were captured annually, one pound net is expected to capture 0.068 sturgeon per year.

The number of pound net licenses issued in Virginia has remained the same since 1994, due to a limited entry program, and one license is assigned to each pound net. So while the number of pound nets has apparently decreased since the 1980s, the number of licenses issued (n=161) has

been approximately the same since 1994. This suggests that the number of pound nets in the Virginia portion of Chesapeake Bay has been approximately the same since 1994.

The Virginia pound net fishery has a limit of 161 licenses that can be sold and fished per year. This represents the maximum amount of fishing effort in the Virginia pound net fishery. We recognize that in both states the number of active nets may vary among years. However, for the purpose of this Opinion, we assume that all 161 licenses in Virginia and 1,096 registered sites in Maryland are fished each year. Given the similarities of the Virginia pound net fishery to Maryland pound net fishery, we expect 0.068 Atlantic sturgeon to be captured per net in the Virginia pound net fishery. Therefore, 161 pound nets are expected to capture 10.948 Atlantic sturgeon per year. Since a partial sturgeon take is not possible, this number is rounded up to 11.

This estimate of 11 Atlantic sturgeon interactions per year with Virginia pounds and hearts provides the best available information for determining the anticipated bycatch of Atlantic sturgeon in that gear component in the action area. This represents the total number of interactions we are expecting annually in the Virginia pound net fishery and not just the number observed.

In regards to Virginia pound net leaders, two Atlantic sturgeon were documented as being entangled in a pound net leader at Cape Henry on June 10, 2017. One was determined to be deceased, while the other was released alive (2017 JEA Pound Net Inspections; VMRC 2017c). No genetic information is available for these fish, so we assume that they could be from any of the five listed DPSs. This represents the best available information on Atlantic sturgeon entanglements in Virginia pound net leaders. As nearly all sea turtle-pound net leader entanglements are ultimately observed, unless the animal can somehow free itself on its own (which we believe to be rare and have not documented in recent times), we assume the same will hold true for Atlantic sturgeon. As a result, we anticipate up to two Atlantic sturgeon entanglements in leaders annually, with one of those likely to result in mortality. The two entanglements and one mortality could be from any of the five listed DPSs of Atlantic sturgeon, although based on a mixed stock analysis described below, they are likely to be from some DPSs more than others.

Shortly after the ESA listing of Atlantic sturgeon by DPS, Damon-Randall *et al.* (2013) used information on Atlantic sturgeon interactions in conjunction with genetic testing results from Atlantic sturgeon sampled through the NEFOP to calculate the percentages of each DPS that end up as bycatch in fisheries in the Northeast region. The percentages for Marine Mixing Zone 2, which represented the U.S. Mid-Atlantic from roughly Cape Cod, Massachusetts, to Cape Hatteras, North Carolina, were as follows: GOM DPS - 11%; NYB DPS - 51%; CB DPS - 13%; Carolina DPS - 2%; SA DPS - 22%; and Canada - 1% (from the St. Lawrence and St. John rivers). More recently, Wirgin *et al.* (2015) updated these percent DPS breakdowns for Atlantic sturgeon bycatch along the Northeast U.S. coast as follows (rounded to the nearest whole number): GOM - 10%, NYB - 52%, CB - 12%, Carolina - 2%, SA - 22%, and non-listed Canada management units - 2%. We believe the Wirgin *et al.* (2015) analysis is the best available information on the DPS breakdown of Atlantic sturgeon taken as bycatch in U.S. Atlantic coast fisheries, including the Virginia pound net fishery.

Based on the mixed-stock analysis, we expect that of the 13 Atlantic sturgeon that could be captured annually in Virginia pound net gear, 10% (1.30 individuals) would be from the GOM DPS, 52% (6.76 individuals) from the NYB DPS, 12% (1.56 individuals) from the CB DPS, 2% (0.26 individuals) from the Carolina DPS, 22% (2.86 individuals) from the SA DPS, and 2% from Canadian management units (0.26 individuals). As these numbers represent fractions of fish, we are choosing to round some values up and others down based up the relative proximity of the action area to the spawning rivers of the DPSs in question. Overall, we anticipate that of the 13 captures per year, seven would be from the NYB DPS, three would be from the SA DPS, two would be from the CB DPS, and one would be from either the GOM or Carolina DPS.

Estimated Mortalities and Age Classes of Atlantic Sturgeon that Interact with Pound Nets
Captures in the pound/heart configuration likely occur with survival estimated to be 100% (Kahnle *et al.* 1998). The short duration of the net haul and handling/release of any Atlantic sturgeon once encountered in the pounds or hearts is likely to result in a low potential for mortality. Based on this information, we expect that all Atlantic sturgeon entrapped in Virginia pounds and hearts will be released alive. Additionally, there has never been a documented entanglement of an Atlantic sturgeon in the mesh or netting of a Virginia pound net (Mark Swingle, Virginia Aquarium Stranding Database, pers. comm., 2013). Therefore, the continued operation of the pound net fishery may result in the capture of Atlantic sturgeon in the pounds or hearts, but it is unlikely that these sturgeon will be killed. However, we anticipate that half of all Atlantic sturgeon entangled in Virginia pound net leaders will die. The one Atlantic sturgeon mortality expected annually in pound net leaders is most likely to be a NYB DPS fish. Based on the mixed stock analysis, for every ten pound net leader mortalities (i.e., over a ten-year period), we expect five to be from the NYB DPS, two from the SA DPS, and one apiece from the GOM, CB, and Carolina DPS.

Atlantic sturgeon entrapped in Virginia pound nets are expected to be subadults or adults, although juveniles could be captured on rare occasions. Data from the U.S. FWS indicates that of the Atlantic sturgeon interactions that have been observed in Chesapeake Bay, approximately 75% were subadults and 25% were adults based on length (n=726; subadults less than 150 centimeters, adults 150 centimeters or longer). More specifically, the encountered ratios for gillnet gear were approximately 72% subadults to 28% adults and the ratios for trawl gear were 79% subadults to 21% adults.

6.3 Effects due to Interactions with Pound Net Fishing Vessels

Vessel strikes are a threat to a number of marine species worldwide including sea turtles and Atlantic sturgeon (Hazel *et al.* 2007; Brown and Murphy 2010; Work *et al.* 2010; Balazik *et al.* 2012b; Barco *et al.* 2016). Sea turtles are known to be injured or killed as a result of being struck by commercial and recreational vessels on the water. Interactions between vessels and sea turtles occur and can take many forms, from the most severe (death or bisection of an animal or penetration to the viscera), to severed limbs or cracks to the carapace which can also lead to mortality directly or indirectly. Sea turtle stranding data for the U.S. Gulf of Mexico and Atlantic coasts, Puerto Rico, and the U.S. Virgin Islands show that between 1986 and 1993, about 9% of living and dead stranded sea turtles had propeller or other boat strike injuries (Lutcavage *et al.* 1997). According to 2001 STSSN stranding data, at least 33 sea turtles (including loggerhead,

green, Kemp's ridley and leatherbacks) that stranded on beaches within the Northeast (Maine through North Carolina) were struck by a boat. However, these numbers underestimate the actual number of boat strikes that occurred since not every boat-struck turtle will strand, every stranded turtle will not be found, and many stranded turtles are too decomposed to determine whether the turtle was struck by a boat. It should be noted, however, that it is not known whether all boat strikes were the cause of death or whether they occurred post-mortem (NMFS SEFSC 2001). More recently, boat strike wounds were confirmed to be ante-mortem in over 75% of sea turtles that were found dead or stranded along the U.S. Atlantic coast (B. Stacy, NMFS, pers. comm., 2017) and a majority of sea turtles struck in Virginia waters were healthy prior to those collisions (Barco *et al.* 2016).

Information is lacking on the type or speed of vessels involved in turtle vessel strikes. However, there does appear to be a correlation between the number of vessel struck turtles and the level of recreational boat traffic (NRC 1990). Although little is known about a sea turtle's reaction to vessel traffic, it is generally assumed that sea turtles are more likely to avoid collisions with slower moving vessels since the turtle has more time to maneuver and avoid the vessel. In addition, the risk of ship strike will be influenced by the amount of time the animal remains near the surface of the water. With respect to the proposed action, the effects to sea turtles as a result of vessel activities are discountable. The small number of vessels that will operate on the water as a result of the proposed action are extremely unlikely to strike sea turtles in the action area given that: (a) the vessels will operate/travel at a slow speed such that sea turtles would have the speed and maneuverability to avoid contact with the vessel and (b) sea turtles spend part of their time at depths out of range of a vessel collision.

As noted in the status review and listing rules for the species (ASSRT 2007; 77 FR 5880 and 77 FR 5914; February 6, 2012), vessel strikes have been identified as a threat to Atlantic sturgeon in certain regions. While the exact number of sturgeon killed as a result of being struck by boat hulls or propellers is unknown, it is an area of concern in many areas including the Delaware and James Rivers. Brown and Murphy (2010) examined 28 dead Atlantic sturgeon observed in the Delaware River from 2005-2008. Fifty-percent of the mortalities resulted from apparent vessel strikes and 71% of these (ten of 14) had injuries consistent with being struck by a large vessel (Brown and Murphy 2010). Eight of the 14 vessel struck sturgeon were adult-sized fish (Brown and Murphy 2010). Given the time of year in which the fish were observed (predominantly May through July; Brown and Murphy 2010), it is likely that many of the adults were migrating through the river to the spawning grounds.

The factors relevant to determining the risk to Atlantic sturgeon from vessel strikes are currently unknown, but they may be related to size and speed of the vessels, navigational clearance (i.e., depth of water and draft of the vessel) in the area where the vessel is operating, and the behavior of sturgeon in the area (e.g., foraging, migrating, etc.). The risk of vessel strikes between sturgeon and fishing vessels operating in the open ocean or large estuaries is likely to be low given that the vessels are likely to be operating at slow speeds and there are no restrictions forcing Atlantic sturgeon into close proximity with the vessel as may be present in some rivers.

Adding small fishing vessels to the existing baseline will not increase the risk that any vessel in the area will strike an Atlantic sturgeon, or will increase it to such a small extent that the effect of

the action (i.e., any increase in risk of a strike caused by the action) cannot be meaningfully measured or detected. The baseline risk of a vessel strike within Virginia waters is unknown. The increase in traffic associated with the proposed action is extremely small, as all the fishermen affected by NMFS regulations have been and would be fishing their gear anyway. During the proposed action, a minimal number of vessels could be added to the baseline if the number of Virginia pound net permits is increased in future years. However, most pound net fishermen hold multiple permits at a time and would use the same vessel to tend multiple gear sites in close proximity. The addition of any vessels will also be intermittent, temporary, and restricted to a small portion of the overall action area on any given day. As such, any increased risk of a vessel strike caused by the proposed action will be too small to be meaningfully measured or detected. As a result, the effect of the action on the risk of a vessel strike in the action area is insignificant.

6.4 Effects to Prey

Sea turtles could be negatively affected by the loss of prey as a result of pound net fishing that removes or incidentally kills such prey. However, the amount of potential sea turtle prey that will be disturbed or removed is minimal. The species targeted by pound net fishermen in Virginia waters are typically weakfish, spot, and Atlantic croaker, which are not preferred prey items for sea turtles. Thus, the proposed action considered here is expected to have an insignificant effect on the availability of prey for sea turtles, which most often include other organisms such as crabs (loggerheads and Kemp's ridleys), jellyfish (leatherbacks), and algae/seagrass (greens).

Atlantic sturgeon use the action area as a migratory route and for overwintering and foraging. Any effects on habitat due to pound net fishing gear are most likely to be on sturgeon prey items, as discussed below. Atlantic sturgeon are known to aggregate in certain areas and at certain times of the year, and some of these areas experience high fishing effort. Despite the overlap in aggregations with some areas of high fishing effort, we have no information that indicates negative effects on sturgeon prey items.

Atlantic sturgeon feed primarily on benthic invertebrates and occasionally on small fish. Because of the small size or benthic nature of these prey species, it is unlikely that the proposed action will result in the capture of any sturgeon prey items. Thus, the proposed action will not affect the availability of prey for sturgeon. Again, any effects to prey will be limited to minor disturbances to the river/estuary/ocean bottom from the pound net gear. Because of this, we have determined that any effects to sturgeon prey or foraging sturgeon will be insignificant.

6.5 Effects to Habitat

As pound nets are a form of fixed gear (i.e., stationary, not moving) in which contact with the seafloor is limited to a small area, limited effects to bottom habitat are possible as a result of utilizing these forms of fish harvest gear. The gear is anchored to the bottom by poles and is capable of getting pushed by slow moving currents, or, when the gear is in process of being retrieved. Yet since pound net gear hauls are rarely conducted during adverse weather conditions (i.e., when winds and currents may be stronger) and the gear is frequently checked while in the water, adverse effects on habitat are not expected. As stated above, the effects on sea turtle and Atlantic sturgeon benthic prey items from these fixed gears are expected to be insignificant.

In regards to effects on the pelagic habitat of some sea turtles (e.g., leatherbacks) and Atlantic sturgeon, we do not anticipate any adverse effects from pound net gear on those areas since the gears and vessels to be used are not expected to affect the prevailing currents, water quality, or other environmental conditions of those habitats.

7.0 CUMULATIVE EFFECTS

Cumulative effects as defined in 50 CFR 402.02 include the effects of future State, tribal, local, or private actions that are reasonably certain to occur within the action area considered in this Opinion. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA. For that reason, future effects of other Federal fisheries are not considered in this section of the document; all Federal fisheries that may affect listed species are the subject of formal section 7 consultations. Effects of ongoing Federal activities, including other fisheries, are considered in the *Environmental Baseline* and *Status of the Species* sections above and are also factored into the *Integration and Synthesis of Effects* section below.

Sources of human-induced mortality, injury, and/or harassment of sea turtles and Atlantic sturgeon in the action area that are reasonably certain to occur in the future include interactions in state-regulated and recreational fishing activities, vessel collisions, ingestion of plastic debris, pollution, underwater noise, and global climate change. While the combination of these activities may affect sea turtles and Atlantic sturgeon, preventing or slowing a species' recovery, the magnitude of these effects is currently unknown.

State Water Fisheries - Future recreational and commercial fishing activities in state waters may capture, injure, or kill sea turtles and sturgeon. However, it is not clear to what extent these future activities would affect listed species differently than the current state fishery activities described in the *Environmental Baseline* section. Atlantic sturgeon are captured and killed in fishing gear operating in the action area; however, at this time we are not able to quantify the number of interactions that occur. However, this Opinion assumes effects in the future would be similar to those in the past and are, therefore, reflected in the anticipated trends described in the *Status of the Species* and *Environmental Baseline* sections.

Fishing activities are considered one of the most significant causes of death and serious injury for sea turtles. Finkbeiner *et al.* (2011) compiled cumulative sea turtle bycatch information in U.S. fisheries from 1990 through 2007, before and after implementation of bycatch mitigation measures. In the Atlantic, a mean estimate of 137,700 bycatch interactions, of which 4,500 were mortalities, occurred annually (since implementation of bycatch mitigation measures). Kemp's ridleys interacted with fisheries most frequently, with the highest level of mean annual mortality (2,700), followed by loggerheads (1,400), greens (300), and leatherbacks (40). The Southeast/Gulf of Mexico shrimp trawl fishery was responsible for the vast majority of U.S. interactions (up to 98%) and mortalities (more than 80%). Fishing gear in state waters, including bottom trawls, gillnets, trap/pot gear, and pound nets, interacts with sea turtles each year. NMFS is working with state agencies to address the bycatch of sea turtles in state water fisheries within the action area of this consultation where information exists to show that these fisheries capture

sea turtles. Action has been taken by some states to reduce or remove the likelihood of sea turtle bycatch and/or the likelihood of serious injury or mortality in one or more gear types. However, given that state managed commercial and recreational fisheries along the U.S. Atlantic coast are reasonably certain to occur within the action area in the foreseeable future, additional interactions of sea turtles with these fisheries are anticipated. There is insufficient information to quantify the number of sea turtle interactions with state water fisheries as well as the number of sea turtles injured or killed as a result of these interactions. While actions have been taken to reduce sea turtle bycatch in some state water fisheries, the overall effect of these actions is unknown, and the future effects of state water fisheries on sea turtles cannot be quantified. However, this Opinion assumes effects in the future would be similar to those in the past and are, therefore, reflected in the anticipated trends described in the *Status of the Species* and *Environmental Baseline* sections.

Vessel Interactions - NMFS's STSSN data indicate that vessel interactions are responsible for a number of sea turtle strandings within the action area each year. In the U.S. Atlantic from 1997-2005, 14.9% of all stranded loggerheads were documented as having sustained some type of propeller or collision injuries (NMFS and U.S. FWS 2007a). The incidence of propeller wounds rose from approximately 10% in the late 1980s to a record high of 20.5% in 2004 (STSSN database). Such collisions are reasonably certain to continue into the future. Collisions with boats can stun, injure, or kill sea turtles, and many live-captured and stranded sea turtles have obvious propeller or collision marks (Dwyer *et al.* 2003). However, it is not always clear whether the collision occurred pre- or post-mortem. NMFS believes that vessel interactions with sea turtles will continue in the future. An estimate of the number of sea turtles that will likely be killed by vessels is not available at this time. Similarly, we are unable at this time to assess the risk that vessel operations in the action area pose to Atlantic sturgeon. While vessel strikes have been documented in several rivers, the extent that interactions occur in the marine environment is currently unknown. However, this Opinion assumes effects in the future would be similar to those in the past and are, therefore, reflected in the anticipated trends described in the *Status of the Species* and *Environmental Baseline* sections.

Debris, Pollution, and Contaminants - Human activities in the action area causing marine debris and pollution are reasonably certain to continue in the future, as are impacts from them on sea turtles and Atlantic sturgeon. However, the level of impacts cannot be projected. Sources of contamination in the action area include atmospheric loading of pollutants, stormwater runoff from coastal development, groundwater discharges, and industrial development. Chemical contamination may have effects on listed species' reproduction and survival. Excessive turbidity due to coastal development and/or construction sites could influence sea turtle or sturgeon foraging ability. Marine debris (e.g., discarded fishing line or lines from boats, plastics) also has the potential to entangle ESA-listed species in the water or to be fed upon by them. Sea turtles commonly ingest plastic or mistake debris for food and sometimes this may lead to asphyxiation. This Opinion assumes effects in the future would be similar to those in the past and are therefore reflected in the anticipated trends described in the *Status of the Species* and *Environmental Baseline* sections.

Underwater Noise - In past consultations, NMFS has concluded that phenomena like sound do not accumulate, although phenomena like the acreage of habitat destroyed and concentrations of

toxic chemicals, sediment, and other pollutants do accumulate. Here, we have concluded that the effects of multiple exposures to active acoustic sources are not likely to accumulate through altered energy budgets caused by avoidance behavior (reducing the amount of time available to forage), physiological stress responses, or the costs of changing behavioral states (small decreases in the current and expected reproductive success of individuals exposed to the stressors) because these costs primarily occur because of avoidance behavior and altered energy budgets. The number of individuals “taken” gets larger when we accumulative them through addition, but the effect of that “take” on the survival or reproductive success of the animals themselves would not accumulate in the same way. To the contrary, we do not expect the effects of the “take” to have any additive, interactive, or synergistic effect on the individual animals, the populations those individuals represent, or the species those populations comprise.

In the future, *global climate change* is expected to continue and may impact ESA-listed species and their habitat in the action area. As noted in the *Status of the Species* and *Environmental Baseline* sections, the likely rate of change associated with climate impacts is on a century scale, which makes the ability to discern changes in the abundance, distribution, or behavior of these species in the action area as a result of climate change impacts challenging in the short term.

8.0 INTEGRATION AND SYNTHESIS OF EFFECTS

In the effects analysis outlined above, we considered the potential effects to ESA-listed species from NMFS’ implementation of gear regulations for the Virginia pound net fishery over the foreseeable future. These effects primarily include direct entrapment or entanglement of sea turtles and Atlantic sturgeon in pound net fishing gear, specifically the pounds, hearts, and leaders. In addition to these gear-related effects, we considered the potential for interactions between ESA-listed species and fishing vessels as well as impacts to their habitats and prey.

We have estimated that the Virginia pound net fishery will result in the capture of up to 806 NWA DPS loggerheads, 162 Kemp’s ridleys, 17 green sea turtles, 8 leatherbacks, and up to 13 Atlantic sturgeon from a combination of the five listed DPSs per year. Up to two loggerhead, two Kemp’s ridley, two green, four leatherback, and one Atlantic sturgeon interactions per year are expected to result in post-interaction mortality. As explained in the *Effects of the Action* section, all other effects to sea turtles and Atlantic sturgeon from the proposed action, including to their prey and habitat, will be insignificant or discountable.

In the discussion below, we consider whether the effects of the proposed action reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of the listed species in the wild by reducing the reproduction, numbers, or distribution of the listed species that will be adversely affected by the actions. The purpose of this analysis is to determine whether the proposed action, in the context established by the status of the species, environmental baseline, and cumulative effects, would jeopardize the continued existence of any listed species.

In the U.S. FWS/NMFS Section 7 Handbook (U.S. FWS and NMFS 1998), for the purposes of determining jeopardy, survival is defined as, “the species’ persistence as listed or as a recovery unit, beyond the conditions leading to its endangerment, with sufficient resilience to allow for the

potential recovery from endangerment. Said in another way, survival is the condition in which a species continues to exist into the future while retaining the potential for recovery. This condition is characterized by a species with a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, which exists in an environment providing all requirements for completion of the species' entire life cycle, including reproduction, sustenance, and shelter.”

Recovery is defined as, “Improvement in the status of listed species to the point at which listing is no longer appropriate under the criteria set out in Section 4(a)(1) of the Act.” We summarize below the status of the species and consider whether the proposed action will result in reductions in reproduction, numbers or distribution of these species and then considers whether any reductions in reproduction, numbers or distribution resulting from the proposed action would reduce appreciably the likelihood of both the survival and recovery of these species, as those terms are defined for purposes of the ESA.

8.1 Northwest Atlantic DPS of Loggerhead Sea Turtles

The Northwest Atlantic DPS of loggerhead sea turtles is listed as “threatened” under the ESA. It takes decades for loggerhead sea turtles to reach maturity. Once they have reached maturity, females typically lay multiple clutches of eggs within a season, but do not typically lay eggs every season (NMFS and U.S. FWS 2008). There are many natural and anthropogenic factors affecting the survival of loggerheads prior to their reaching maturity as well as for those adults who have reached maturity. As described in the *Status of the Species*, *Environmental Baseline*, and *Cumulative Effects* sections above, loggerhead sea turtles in the action area continue to be affected by multiple anthropogenic impacts including bycatch in commercial and recreational fisheries, habitat alteration, dredging, power plant intakes, and other factors that result in mortality of individuals at all life stages. Negative impacts causing death of various age classes occur both on land and in the water. Many actions have been taken to address known negative impacts to loggerhead sea turtles. However, many remain unaddressed, have not been sufficiently addressed, or have been addressed in some manner but whose success cannot be quantified.

The SEFSC (2009) estimated the number of adult females in the NWA DPS at 30,000, and if a 1:1 adult sex ratio is assumed, the result is 60,000 adults in this DPS. Based on the reviews of nesting data, as well as information on population abundance and trends, NMFS and U.S. FWS determined in the September 2011 listing rule that the NWA DPS should be listed as threatened. They found that an endangered status for the NWA DPS was not warranted given the large size of the nesting population, the overall nesting population remains widespread, the trend for the nesting population appears to be stabilizing, and substantial conservation efforts are underway to address threats.

In this Opinion, we have considered the potential impacts of the proposed action on the NWA DPS of loggerhead sea turtles. We have estimated that 806 loggerheads are likely to be captured as a result of the proposed action annually and that up to two of those turtles may suffer post-interaction mortality. All other effects to loggerhead sea turtles including effects to prey are expected to be insignificant and discountable.

Capture in pound net gear will temporarily prevent these sea turtles from carrying out essential behaviors such as foraging and migrating. However, these behaviors are expected to resume as soon as the turtles are returned to the water. The capture of live loggerhead sea turtles is not likely to reduce the numbers of loggerhead sea turtles in the action area, the numbers of loggerheads in any subpopulation or the species as a whole. Similarly, as the capture of live loggerhead sea turtles will not affect the fitness of any individual, no effects to reproduction are anticipated. The capture of live loggerhead sea turtles is also not likely to affect the distribution of loggerhead sea turtles in the action area or affect the distribution of sea turtles throughout their range. As any effects to individual live loggerhead sea turtles temporarily removed from the water will be minor and temporary there are not anticipated to be any population level impacts.

The lethal removal of up to two loggerhead sea turtles from the action area annually would reduce the number of loggerhead sea turtles from the recovery unit of which they originated as compared to the number of loggerheads that would have been present in the absence of the proposed action (assuming all other variables remained the same). However, this does not necessarily mean that these recovery units will experience reductions in reproduction, numbers or distribution in response to these effects to the extent that survival and recovery would be appreciably reduced. The final revised recovery plan for loggerheads compiled the most recent information on mean number of loggerhead nests and the approximated counts of nesting females per year for four of the five identified recovery units (i.e., nesting groups). They are: (1) for the NRU, a mean of 5,215 loggerhead nests per year with approximately 1,272 females nesting per year; (2) for the PFRU, a mean of 64,513 nests per year with approximately 15,735 females nesting per year; (3) for the DTRU, a mean of 246 nests per year with approximately 60 females nesting per year; and (4) for the NGMRU, a mean of 906 nests per year with approximately 221 females nesting per year. For the GCRU, the only estimate available for the number of loggerhead nests per year is from Quintana Roo, Yucatán, Mexico, where a range of 903-2,331 nests per year was estimated from 1987-2001 (NMFS and U.S. FWS 2007a). There are no annual nest estimates available for the Yucatán since 2001 or for any other regions in the GCRU, nor are there any estimates of the number of nesting females per year for any nesting assemblage in this recovery unit.

It is likely that the loggerhead sea turtles captured in Virginia pound net gear originate from several of the recovery units. Limited information is available on the genetic makeup of sea turtles in the Mid-Atlantic, where the majority of sea turtle interactions are expected to occur. Cohorts from each of the five western Atlantic subpopulations are expected to occur in the action area. Genetic analysis of samples collected from immature loggerhead sea turtles captured in pound nets in the Pamlico-Albemarle Estuarine Complex in North Carolina from September-December of 1995-1997 indicated that cohorts from all five western Atlantic subpopulations were present (Bass *et al.* 2004). In a separate study, genetic analysis of samples collected from loggerhead sea turtles from Massachusetts to Florida found that all five western Atlantic loggerhead subpopulations were represented (Bowen *et al.* 2004). Bass *et al.* (2004) found that 80% of the juveniles and sub-adults utilizing the foraging habitat originated from the south Florida nesting population, 12% from the northern subpopulation, 6% from the Yucatan subpopulation, and 2% from other rookeries. The previously defined loggerhead subpopulations do not share the exact delineations of the recovery units identified in the 2008 recovery plan.

However, the PFRU encompasses both the south Florida and Florida panhandle subpopulations, the NRU is roughly equivalent to the northern nesting group, the Dry Tortugas subpopulation is equivalent to the DTRU, and the Yucatan subpopulation is included in the GCRU.

Based on the genetic analysis presented in Bass *et al.* (2004) and the small number of loggerheads from the DTRU or the NGMRU likely to occur in the action area it is extremely unlikely that the loggerheads likely to be killed as a result of the proposed action will originate from either of these recovery units. The majority of the loggerheads captured are likely to originate from the PFRU, with the remainder from the NRU and GCRU. As explained above, only two loggerhead mortalities are expected to result due to the proposed action every year. As it is impossible to predict whether these turtles will be from the PFRU, the NRU or the GCRU without invasive genetic sampling of the captured individual, we consider below the effects of the mortality of two loggerheads per year from any of the these three recovery units.

As noted above, the most recent population estimates indicate that there are approximately 15,735 females nesting annually in the PFRU and approximately 1,272 females nesting per year in the NRU. For the GCRU, the only estimate available for the number of loggerhead nests per year is from Quintana Roo, Yucatán, Mexico, where a range of 903-2,331 nests per year was estimated from 1987-2001 (NMFS and U.S. FWS 2007a). There are no annual nest estimates available for the Yucatán since 2001 or for any other regions in the GCRU, nor are there any estimates of the number of nesting females per year for any nesting assemblage in this recovery unit; however, the 2008 recovery plan indicates that the Yucatan nesting aggregation has at least 1,000 nesting females annually. As the numbers outlined here are only for nesting females, the total number of loggerhead sea turtles in each recovery unit is likely significantly higher. The loss of two loggerheads per year represents an extremely small percentage of the number of sea turtles in the PFRU. Even if the total population was limited to 15,735 loggerheads, the loss of two individuals would represent approximately 0.013% of the population. Similarly, the loss of two loggerheads from the NRU represents an extremely small percentage of the recovery unit. Even if the total population was limited to 1,272 sea turtles, the loss of two individuals would represent approximately 0.16% of the population. The loss of two loggerheads from the GCRU, which is expected to support at least 1,000 nesting females, represents just 0.2% of the population. The loss of such a small percentage of the individuals from any of these recovery units represents an even smaller percentage of the species as a whole. As such, it is unlikely that the death of two loggerhead sea turtles will have a detectable effect on the numbers and population trends of loggerheads in these recovery units or the number of loggerheads in the population as a whole. Additionally, this action is not likely to reduce distribution of loggerheads because the action will only result in temporary delays for foraging and migrating loggerheads and will not impede any loggerheads from accessing suitable foraging grounds and or disrupt other migratory behaviors.

In general, while the loss of a small number of individuals from a subpopulation or species may have an appreciable reduction on the numbers, reproduction and distribution of the species, this is likely to occur only when there are very few individuals in a population, the individuals occur in a very limited geographic range or the species has extremely low levels of genetic diversity. This situation is not likely in the case of loggerhead sea turtles because: the species is widely

geographically distributed, it is not known to have low levels of genetic diversity, and there are several thousand individuals in the population.

Based on the information provided above, the death of no more than two loggerhead sea turtles per year as a result of the proposed action will not appreciably reduce the likelihood of survival (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect loggerheads in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring and it will not result in effects to the environment which would prevent loggerheads from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the death of up to two loggerheads per year represents an extremely small percentage of the species as a whole; (2) the loss of these loggerheads will not change the status or trends of any nesting aggregation, recovery unit or the species as a whole; (3) the loss of these loggerheads is not likely to have an effect on the levels of genetic heterogeneity in the population; (4) the loss of these loggerheads is likely to have an undetectable effect on reproductive output of any nesting aggregation or the species as a whole; (5) the actions will have no effect on the distribution of loggerheads in the action area or throughout its range; and (6) the actions will have no effect on the ability of loggerheads to shelter and only an insignificant effect on individual foraging loggerheads.

In certain instances, an action may not appreciably reduce the likelihood of a species survival (persistence) but may affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that loggerhead sea turtles will survive in the wild. Here, we consider the potential for the action to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed action will affect the likelihood that the NWA DPS of loggerheads can rebuild to a point where listing is no longer appropriate. In 2008, NMFS and U.S. FWS issued a recovery plan for the Northwest Atlantic population of loggerheads (NMFS and U.S. FWS 2008). The plan includes demographic recovery criteria as well as a list of tasks that must be accomplished. Demographic recovery criteria are included for each of the five recovery units. These criteria focus on sustained increases in the number of nests laid and the number of nesting females in each recovery unit, an increase in abundance on foraging grounds, and ensuring that trends in neritic strandings are not increasing at a rate greater than trends in in-water abundance. The recovery tasks focus on protecting habitats, minimizing and managing predation and disease, and minimizing anthropogenic mortalities.

Loggerheads have an increasing trend; as explained above, the loss of two loggerheads as a result of the proposed action will not affect the population trend. The number of loggerheads likely to die as a result of the proposed action is an extremely small percentage of any recovery unit or the DPS as a whole. This loss will not affect the likelihood that the population will reach the size necessary for recovery or the rate at which recovery will occur. As such, the proposed action will not affect the likelihood that the demographic criteria will be achieved or the timeline on which they will be achieved. The action area does not include nesting beaches; all effects to habitat will be insignificant and discountable; therefore, the proposed action will have no effect on the

likelihood that habitat based recovery criteria will be achieved. The proposed action will also not affect the ability of any of the recovery tasks to be accomplished.

In summary, the effects of the proposed action will not hasten the extinction timeline or otherwise increase the danger of extinction; further, the action will not prevent the species from growing in a way that leads to recovery and the action will not change the rate at which recovery can occur. This is the case because while the actions may result in a small reduction in the number of loggerheads and a small reduction in the amount of potential reproduction due to the loss of these individuals, these effects will be undetectable over the long-term and the actions are not expected to have long term impacts on the future growth of the population or its potential for recovery. Therefore, based on the analysis presented above, the proposed action will not appreciably reduce the likelihood that loggerhead sea turtles can be brought to the point at which they are no longer listed as endangered or threatened.

Despite the threats faced by individual loggerhead sea turtles inside and outside of the action area, the proposed action will not increase the vulnerability of individual sea turtles to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed action. We have considered the effects of the proposed action in light of other threats, including climate change, and have concluded that even in light of the ongoing impacts of these activities and conditions, the conclusions reached above do not change. Based on the analysis presented herein, the proposed action is not likely to appreciably reduce the survival and recovery of the NWA DPS of loggerhead sea turtles.

8.2 Kemp's Ridley Sea Turtles

Kemp's ridley sea turtles are listed as a single species classified as "endangered" under the ESA. Kemp's ridleys occur in the Atlantic Ocean and Gulf of Mexico. The only major nesting site for Kemp's ridleys is a single stretch of beach near Rancho Nuevo, Tamaulipas, Mexico (Carr 1963; U.S. FWS and NMFS 1992; NMFS and U.S. FWS 2015).

Nest count data provides the best available information on the number of adult females nesting each year. As is the case with the other sea turtles species discussed above, nest count data must be interpreted with caution given that these estimates provide a minimum count of the number of nesting Kemp's ridley sea turtles. In addition, the estimates do not account for adult males or juveniles of either sex. Without information on the proportion of adult males to females, and the age structure of the Kemp's ridley population, nest counts cannot be used to estimate the total population size (Meylan 1982; Ross 1996; Zurita *et al.* 2003; Hawkes *et al.* 2005; letter to J. Lecky, NMFS Office of Protected Resources, from N. Thompson, NMFS Northeast Fisheries Science Center, December 4, 2007). Nevertheless, the nesting data does provide valuable information on the extent of Kemp's ridley nesting and the trend in the number of nests laid. Estimates of the adult female nesting population reached a low of approximately 250-300 in 1985 (U.S. FWS and NMFS 1992; TEWG 2000). From 1985 to 1999, the number of nests observed at Rancho Nuevo and nearby beaches increased at a mean rate of 11.3% per year (TEWG 2000). Recent population abundance for Kemp's ridleys, based on nests and hatchling recruitment, was estimated by Gallaway *et al.* (2013). They estimated the female population size for age-2 and older in 2012 to be 188,713 (SD = $\pm 32,529$). Assuming females comprise 76%

(sex ratio = 0.76; TEWG 1998, 2000) of the population, they estimated the total population of age 2 years and over at 248,307. Based on the number of hatchlings released in 2011 and 2012 (1+ million) and recognizing mortality over the first two years is high, Gallaway *et al.* (2013) thought the total population, including hatchlings younger than 2 years, may exceed 1 million turtles (NMFS and U.S. FWS 2015).

The most recent five-year review of the Kemp's ridley suggests that the population growth rate (as measured by numbers of nests) stopped abruptly after 2009. Given the recent lower nest numbers, the population is not projected to grow at former rates. As a result, the status review team determined that the population is not recovering and cannot meet recovery goals unless survival rates improve (NMFS and U.S. FWS 2015). However, some positive outlooks for the species include recent conservation actions (including the protection of females, nests, and hatchlings on nesting beaches since the 1960s) and the enhancement of survival in marine habitats through the implementation of TEDs in the early 1990s and a decrease in the amount of shrimping off the coast of Tamaulipas and in the Gulf of Mexico (NMFS and U.S. FWS 2015). There is also the recent record nesting year in Mexico and Texas for Kemp's ridleys in 2017.

In this Opinion, we have considered the potential impacts of the proposed action on Kemp's ridley sea turtles. We expect the annual capture of up to 161 Kemp's ridleys in Virginia pound net hearts and pounds as well as one Kemp's ridley in pound net leaders. Up to two Kemp's ridleys per year have the potential to be killed following an interaction with pound net gear.

Capture as a result of the proposed action will temporarily prevent these sea turtles from carrying out essential behaviors such as foraging and migrating. However, these behaviors are expected to resume as soon as the turtles are returned to the water. The capture of live Kemp's ridley sea turtles is not likely to reduce the numbers of Kemp's ridley sea turtles in the action area, the numbers of Kemp's ridley sea turtles in any subpopulation or the species as a whole. Similarly, as the capture of live Kemp's ridley sea turtles will not affect the fitness of any individual, no effects to reproduction are anticipated. The capture of live Kemp's ridley sea turtles is also not likely to affect the distribution of Kemp's ridley sea turtles in the action area or affect the distribution of sea turtles throughout their range. As any effects to individual live Kemp's ridley sea turtles temporarily removed from the water will be minor and temporary there are not anticipated to be any population level impacts.

The mortality of two Kemp's ridleys annually represents a very small percentage of the Kemp's ridleys worldwide. Even taking into account just nesting females, the death of two Kemp's ridleys represents less than 0.04% of the population. While the death of two Kemp's ridleys per year will reduce the number of Kemp's ridleys compared to the number that would have been present absent the proposed action, it is not likely that this reduction in numbers will change the status of this species or its stable to increasing trend as this loss represents a very small percentage of the population (less than 0.02%). Reproductive potential of Kemp's ridleys is not expected to be affected in any other way other than through a reduction in numbers of individuals. A reduction in the number of Kemp's ridleys would have the effect of reducing the amount of potential reproduction as any dead Kemp's ridleys would have no potential for future reproduction. In 2006, the most recent year for which data is available, there were an estimated 7,000-8,000 nesting females. While the species is thought to be female biased, there are likely to

be several thousand adult males as well. Given the number of nesting adults, it is unlikely that the loss of two Kemp's ridleys per year would affect the success of nesting in any year. Additionally, this small reduction in potential nesters is expected to result in a small reduction in the number of eggs laid or hatchlings produced in future years and similarly, a very small effect on the strength of subsequent year classes. Even considering the potential future nesters that would be produced by the individuals that would be killed as a result of the proposed action, any effect to future year classes is anticipated to be very small and would not change the stable to increasing trend of this species. Additionally, the proposed action will not affect nesting beaches in any way or disrupt migratory movements in a way that hinders access to nesting beaches or otherwise delays nesting.

The proposed action is not likely to reduce distribution because the action will not impede Kemp's ridleys from accessing foraging grounds or cause more than a temporary disruption to other migratory behaviors. Additionally, given the small percentage of the species that will be killed as a result of the proposed action, there is not likely to be any loss of unique genetic haplotypes and no loss of genetic diversity.

Generally speaking, while the loss of a small number of individuals from a subpopulation or species may result in an appreciable reduction in the total numbers, reproduction, and distribution of the species, this is likely to occur only when there are very few individuals in a population, the individuals occur in a very limited geographic range, or the species has extremely low levels of genetic diversity. This situation is not likely in the case of Kemp's ridleys because: the species is widely geographically distributed, it is not known to have low levels of genetic diversity, there are several thousand individuals in the population, and the number of Kemp's ridleys is likely to be increasing and at worst is stable.

Based on the information provided above, the death of up to two Kemp's ridleys sea turtle per year as a result of the proposed action will not appreciably reduce the likelihood of survival (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The actions will not affect Kemp's ridleys in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring and it will not result in effects to the environment which would prevent Kemp's ridleys from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because (1) the death of two Kemp's ridleys annually represents an extremely small percentage of the species as a whole; (2) the loss of these Kemp's ridleys will not change the status or trends of the species as a whole; (3) the loss of these Kemp's ridleys is not likely to have an effect on the levels of genetic heterogeneity in the population; (4) the loss of these Kemp's ridleys is likely to have such a small effect on reproductive output that the loss of these individuals will not change the status or trends of the species; (5) the actions will have only a minor and temporary effect on the distribution of Kemp's ridleys in the action area and no effect on the distribution of the species throughout its range; and (6) the actions will have no effect on the ability of Kemp's ridleys to shelter and only an insignificant effect on individual foraging Kemp's ridleys.

In certain instances, an action may not appreciably reduce the likelihood of a species survival (persistence) but may affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that Kemp's ridley sea turtles will survive in the wild. Here, we consider the potential for the action to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed action will affect the likelihood that Kemp's ridleys can rebuild to a point where listing is no longer appropriate. In 2011, NMFS and U.S. FWS issued a recovery plan for Kemp's ridleys (NMFS and U.S. FWS 2011). The plan includes a list of criteria necessary for recovery. These include:

1. An increase in the population size, specifically in relation to nesting females⁸;
2. An increase in the recruitment of hatchlings⁹;
3. An increase in the number of nests at the nesting beaches;
4. Preservation and maintenance of nesting beaches (e.g., Rancho Nuevo, Tepehuajes, and Playa Dos); and,
5. Maintenance of sufficient foraging, migratory, and inter-nesting habitat.

Although Kemp's ridleys have shown a decreasing trend over the last several years, as explained above, the loss of two per year as a result of the proposed action will not affect the population trend. The number of Kemp's ridleys likely to die as a result of the proposed action is an extremely small percentage of the species. This loss will not affect the likelihood that the population will reach the size necessary for recovery or the rate at which recovery will occur. As such, the proposed action will not affect the likelihood that criteria one, two, or three will be achieved or the timeline on which they will be achieved. The action area does not include nesting beaches; therefore, the proposed action will have no effect on the likelihood that recovery criteria four will be met. All effects to habitat will be insignificant and discountable; therefore, the proposed action will have no effect on the likelihood that criteria five will be met.

The effects of the proposed action will not hasten the extinction timeline or otherwise increase the danger of extinction; further, the actions will not prevent the species from growing in a way that leads to recovery and the action will not change the rate at which recovery can occur. This is the case because while the actions may result in a small reduction in the number of Kemp's ridleys and a small reduction in the amount of potential reproduction due to the loss of two individuals per year, these effects will be undetectable over the long-term and the action is not expected to have long term impacts on the future growth of the population or its potential for recovery. Therefore, based on the analysis presented above, the proposed action will not appreciably reduce the likelihood that Kemp's ridley sea turtles can be brought to the point at which they are no longer listed as endangered or threatened.

⁸ A population of at least 10,000 nesting females in a season (as measured by clutch frequency per female per season) distributed at the primary nesting beaches in Mexico (Rancho Nuevo, Tepehuajes, and Playa Dos) is attained in order for downlisting to occur; an average of 40,000 nesting females per season over a 6-year period by 2024 for delisting to occur.

⁹ Recruitment of at least 300,000 hatchlings to the marine environment per season at the three primary nesting beaches in Mexico (Rancho Nuevo, Tepehuajes, and Playa Dos).

Despite the threats faced by individual Kemp's ridley sea turtles inside and outside of the action area, the proposed action will not increase the vulnerability of individual sea turtles to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed action. We have considered the effects of the proposed action in light of cumulative effects explained above, including climate change, and have concluded that even in light of the ongoing impacts of these activities and conditions; the conclusions reached above do not change. Based on the analysis presented herein, the proposed action, resulting in the potential mortality of up to two Kemp's ridley sea turtles annually, is not likely to appreciably reduce the survival and recovery of this species.

8.3 North Atlantic DPS of Green Sea Turtles

The North Atlantic DPS of green sea turtles is listed as threatened under the ESA. As is also the case with the other sea turtle species, North Atlantic DPS green sea turtles face numerous threats on land and in the water that affect the survival of all age classes.

The greatest abundance of green sea turtle nesting in the North Atlantic occurs on beaches in Tortuguero, Costa Rica. Nesting in the area has increased considerably since the 1970s and nest count data from 1999-2003 suggested that 17,402-37,290 females nested there per year (Seminoff *et al.* 2015). In 2010, an estimated 180,310 nests were laid at Tortuguero, the highest level of green sea turtle nesting estimated since the start of nesting track surveys in 1971. This equated to somewhere between 30,052 and 64,396 nesters in 2010 (Seminoff *et al.* 2015).

The results of genetic analyses show that green sea turtles in the Atlantic do not contribute to green sea turtle nesting elsewhere in the species' range (Bowen and Karl 2007). Therefore, increased nesting by green sea turtles in the Atlantic is not expected to affect green sea turtle abundance in other ocean basins in which the species occurs. NMFS recognizes that the nest count data available for green sea turtles in the Atlantic clearly indicates increased nesting at many sites. However, NMFS also recognizes that the nest count data, including data for green sea turtles in the Atlantic, only provides information on the number of females currently nesting, and is not necessarily a reflection of the number of mature females available to nest or the number of immature females that will reach maturity and nest in the future. Given the late age to maturity for green sea turtles (20 to 50 years) (Balazs 1982; Frazer and Ehrhart 1985; Seminoff 2004), caution is urged regarding the trend for any of the nesting groups since no area has a dataset spanning a full green sea turtle generation (NMFS and U.S. FWS 2007b).

In this Opinion, we have considered the potential impacts of the proposed action on green sea turtles. We expect that up to 17 green sea turtles will be captured as a result of the proposed action per year, 2 of which may be lethal while the other 15 will be released alive. As there will be very few mortalities to green sea turtles as a result of the proposed action and no effects to the prey base that would cause sea turtles to leave the action area to forage elsewhere, the proposed action is not likely to reduce the numbers of green sea turtles in the action area or the DPS as a whole. The proposed action will have no effects to the prey base that would cause sea turtles to leave the action area to forage elsewhere and the green sea turtle's numbers in the action area and as part of any subpopulation as a whole will not be reduced. Similarly, as the proposed action will not affect the fitness of any individuals, no effects to reproduction are anticipated.

The action is not expected to result in a reduction in the distribution of green sea turtles in the action area or throughout their range. Because effects are limited to capture, the population level impacts will be insignificant. Despite the threats faced by individual green sea turtles inside and outside of the action area, the proposed action will not increase the vulnerability of individual sea turtles to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed action. While we are not able to predict with precision how climate change will continue to impact green sea turtles in the action area or how the species will adapt to climate-change related environmental impacts, no additional effects related to climate change to green sea turtles in the action area are anticipated over the life of the proposed action. We have considered the effects of the proposed action in light of cumulative effects explained above, including climate change, and has concluded that even in light of the ongoing impacts of these activities and conditions, the conclusions reached above do not change.

As described in the *Status of the Species*, *Environmental Baseline*, and *Cumulative Effects* sections above, green sea turtles in the action area continue to be affected by multiple anthropogenic impacts including bycatch in commercial and recreational fisheries, habitat alteration and other factors that result in mortality of individuals at all life stages.

Based on the information provided above, the death of up to two green sea turtles per year as a result of the proposed action will not appreciably reduce the likelihood of survival (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The actions will not affect green sea turtles in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring and it will not result in effects to the environment which would prevent green sea turtles from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the species' nesting trend is increasing; (2) few mortalities are expected as a result of captures at present and into the future; (3) the actions will have no effect on the distribution of green sea turtles in the action area or throughout its range; and (4) the actions will have no effect on the ability of green sea turtles to shelter and only a minor and temporary effect on individual foraging green sea turtles.

In certain instances, an action may not appreciably reduce the likelihood of a species survival (persistence) but may affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that green sea turtles will survive in the wild. Here, we consider the potential for the actions to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed action will affect the likelihood that the species can rebuild to a point where listing is no longer appropriate. A recovery plan for green sea turtles was published by NMFS and U.S. FWS in 1991. The plan outlines the steps necessary for recovery and the criteria which, once met, would ensure recovery. In order to be delisted, green sea turtles must experience sustained population growth, as measured in the number of nests laid per year, over time. Additionally, "priority one" recovery tasks must be achieved and nesting habitat must be protected (through public ownership of nesting beaches) and stage class mortality must be

reduced. Here, we consider whether this proposed action will affect the population size and/or trend in a way that would affect the likelihood of recovery.

The proposed action will not appreciably reduce the likelihood of survival of green sea turtles. Also, they are not expected to modify, curtail, or destroy the range of the species since they will not cause any reductions in the number of green sea turtles in any geographic area and since they will not affect the overall distribution of green sea turtles other than to cause minor temporary adjustments in movements in the action area. As explained above, the proposed action is likely to result in only two mortalities per year, and thus is not expected to affect the persistence of green sea turtles or the species trend. The action will not affect nesting habitat and will not hasten the extinction timeline or otherwise increase the danger of extinction. Further, the action will not prevent the species from growing in a way that leads to recovery and the actions will not change the rate at which recovery can occur. Therefore, based on the analysis presented above, the proposed action will not appreciably reduce the likelihood that green sea turtles can be brought to the point at which they are no longer listed as endangered or threatened.

Despite the threats faced by individual green sea turtles inside and outside of the action area, the proposed action will not increase the vulnerability of individual sea turtles to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed action. We have considered the effects of the proposed action in light of cumulative effects explained above, including climate change, and have concluded that even in light of the ongoing impacts of these activities and conditions; the conclusions reached above do not change. Based on the analysis presented herein, the proposed action, resulting in the lethal capture of up to two green sea turtles per year, is not likely to appreciably reduce the survival and recovery of this species.

8.4 Leatherback Sea Turtles

Leatherback sea turtles are listed as “endangered” under the ESA. Leatherbacks are widely distributed throughout the oceans of the world, and are found in waters of the Atlantic, Pacific, and Indian Oceans, the Caribbean Sea, Mediterranean Sea, and the Gulf of Mexico (Ernst and Barbour 1972). Leatherback nesting occurs on beaches of the Atlantic, Pacific, and Indian Oceans as well as in the Caribbean (NMFS and U.S. FWS 2013). Leatherbacks face a multitude of threats that can cause death prior to and after reaching maturity. Some activities resulting in leatherback mortality have been addressed. There are some population estimates for leatherback sea turtles although there appears to be considerable uncertainty in the numbers. The most recent population size estimate for the North Atlantic alone is 34,000-94,000 adult leatherbacks (TEWG 2007; NMFS and U.S. FWS 2013).

Leatherback nesting in the eastern Atlantic (i.e., off Africa) and in the Caribbean appears to be stable, but there is conflicting information for some sites and it is certain that some nesting groups (e.g., St. John and St. Thomas, U.S. Virgin Islands) have been extirpated (NMFS and U.S. FWS 1995). Data collected for some nesting beaches in the western Atlantic, including leatherback nesting beaches in the U.S., clearly indicate increasing numbers of nests (SEFSC 2001; NMFS and U.S. FWS 2013). However, declines in nesting have been noted for beaches in the western Caribbean (NMFS and U.S. FWS 2013). The largest leatherback rookery in the

western Atlantic remains along the northern coast of South America in French Guiana and Suriname. More than half the present world leatherback population is estimated to nest on the beaches in and close to the Marowijne River Estuary in Suriname and French Guiana (Hilterman and Govere 2004). The long-term trend for the Suriname and French Guiana nesting group seems to show an increase (Hilterman and Govere 2004). In 2001, the number of nests for Suriname and French Guiana combined was 60,000, one of the highest numbers observed for this region in 35 years (Hilterman and Govere 2004). Studies by Girondot *et al.* (2007) also suggest that the trend for the Suriname - French Guiana nesting population over the last 36 years is stable or slightly increasing.

Increased nesting by leatherbacks in the Atlantic is not expected to affect leatherback abundance in the Pacific where the abundance of leatherback sea turtles on nesting beaches has declined dramatically over the past 30 years (NMFS and U.S. FWS 2013). Although genetic analyses suggest little difference between Atlantic and Pacific leatherbacks (Bowen and Karl 2007), it is generally recognized that there is little to no genetic exchange between these turtles.

In this Opinion, we have considered the potential impacts of the proposed action on leatherback sea turtles. We anticipate that up to eight leatherbacks will be captured in the leaders of Virginia pound net gear annually. Half of the captured leatherbacks are expected to be safely removed from the gear being used and returned to the ocean without lethal effects, while the other four are expected to suffer post-interaction mortality. All other effects to leatherback sea turtles, including effects to prey, are expected to be insignificant and discountable.

As there will be post-interaction mortality to only four individual leatherback sea turtles per year and no effects to the prey base that would cause sea turtles to leave the action area to forage elsewhere, the proposed action is not likely to significantly reduce the numbers of leatherback sea turtles in the action area, the numbers of leatherbacks in any subpopulation, or the species as a whole. In addition, the fishery will cause no effects to the prey base that would cause sea turtles to leave the action area to forage elsewhere and the leatherbacks sea turtle's numbers in the action area and as part of any subpopulation as a whole will not be reduced. Similarly, as the proposed action will affect the fitness of only a few individuals, little to no effects on reproduction are anticipated. The actions are also not likely to affect the distribution of leatherback sea turtles in the action area or affect the distribution of leatherback sea turtles throughout their range. Despite the threats faced by individual leatherback sea turtles inside and outside of the action area, the proposed action will not increase the vulnerability of individual sea turtles to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed action. While we are not able to predict with precision how climate change will continue to impact leatherback sea turtles in the action area or how the species will adapt to climate-change related environmental impacts, no additional effects related to climate change to leatherback sea turtles in the action area are anticipated over the life of the proposed action. We have considered the effects of the proposed action in light of cumulative effects explained above, including climate change, and has concluded that even in light of the ongoing impacts of these activities and conditions, the conclusions reached above do not change.

Based on the information provided above, the annual post-interaction mortality of up to four leatherback sea turtles as a result of the proposed action will not appreciably reduce the

likelihood of survival of this species (i.e., it will not increase the risk of extinction faced by this species). The actions will not affect leatherbacks in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring and it will not result in effects to the environment which would prevent leatherbacks from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the death of up to four leatherbacks annually represents an extremely small percentage of the species as a whole; (2) the loss of these leatherbacks will not change the status or trends of any nesting aggregation, recovery unit, or the species as a whole; (3) the loss of these leatherbacks is not likely to have an effect on the levels of genetic heterogeneity in the population; (4) the loss of these leatherbacks is likely to have an undetectable effect on reproductive output of any nesting aggregation or the species as a whole; (5) the actions will have no effect on the distribution of leatherbacks in the action area or throughout its range; and (6) the actions will have no effect on the ability of leatherbacks to shelter and only an insignificant effect on individual foraging leatherbacks.

In certain instances, an action that does not appreciably reduce the likelihood of a species' survival might affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the leatherback sea turtle species will survive in the wild. Here, we consider the potential for the action to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Section 4(a)(1) of the ESA requires listing of a species if it is in danger of extinction throughout all or a significant portion of its range (i.e., "endangered"), or likely to become in danger of extinction throughout all or a significant portion of its range in the foreseeable future (i.e., "threatened") because of any of the following five listing factors: (1) the present or threatened destruction, modification, or curtailment of its habitat or range, (2) overutilization for commercial, recreational, scientific, or educational purposes, (3) disease or predation, (4) the inadequacy of existing regulatory mechanisms, (5) other natural or manmade factors affecting its continued existence.

The proposed action is not expected to modify, curtail, or destroy the range of the species since it will not result in a significant reduction in the number of leatherback sea turtles and since it will not affect the overall distribution of the species other than to cause minor temporary adjustments in movements in the action area. The proposed action will not use leatherback sea turtles for recreational, scientific, or commercial purposes or affect the adequacy of existing regulatory mechanisms to protect this species. The proposed action is not likely to result in any reductions in fitness or future reproductive output and therefore, are not expected to affect the persistence of the species. There will not be a change in the status or trend of the species. As there will be only a minor reduction in future reproduction, the actions would not cause any reduction in the likelihood of improvement in the status of leatherback sea turtles. The effects of the proposed action will not delay the recovery timeline or otherwise decrease the likelihood of recovery since the actions will not cause any reduction of overall reproductive fitness for the species. The effects of the proposed action will also not reduce the likelihood that the status of the species can improve to the point where it is recovered and could be delisted. Therefore, the proposed action will not appreciably reduce the likelihood that leatherback sea turtles can be brought to the point at which they are no longer listed as endangered. Based on the analysis presented herein, the proposed action is not likely to appreciably reduce the survival and recovery of this species.

8.5 Atlantic Sturgeon

As explained above, the proposed action is likely to result in the capture of up to 13 Atlantic sturgeon and the mortality of one Atlantic sturgeon annually. We expect that the Atlantic sturgeon captured will be either adults or subadults, although juveniles could be captured on rare occasions. No capture of eggs or larvae is anticipated. All other effects to Atlantic sturgeon, including effects from vessel traffic and effects to habitat and prey resources due to the Virginia pound net fishery and its associated gear regulations, will be insignificant and discountable. The 13 Atlantic sturgeon captured in Virginia pound net gear per year are anticipated to come from a mix of the five listed DPSs, and as such, we will assess the impacts of those takes annually in the DPS proportions as determined in the effects analysis by the mixed stock approach.

8.5.1 Gulf of Maine DPS

The GOM DPS is listed as threatened, and while Atlantic sturgeon occur in several rivers of the Gulf of Maine region, recent spawning has only been physically documented in the Kennebec River. However, spawning is suspected to occur in the Androscoggin, Piscataqua, and Merrimack Rivers. No estimate of the number of Atlantic sturgeon in any river or for any life stage or the total population is available although the ASSRT stated that there were likely less than 300 spawners per year. Gulf of Maine origin Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. While there are some indications that the status of the GOM DPS may be improving, there is currently not enough information to establish a trend for any life stage or for the DPS as a whole.

We have estimated that the proposed action may result in the capture of up to one GOM DPS Atlantic sturgeon per year. We anticipate the mortality of up to one individual every ten years; no post-interaction mortality of any other captured GOM DPS Atlantic sturgeon is anticipated.

With the exception of up to one GOM DPS Atlantic sturgeon mortality in pound net gear every ten years, all sturgeon captured in pound net gear are anticipated to fully recover from entrapment without any impact on fitness or future reproductive potential. The short duration of most captures and handling will not cause a delay or disruption of any essential behavior including spawning and there will be no reduction in individual fitness or any future reduction in numbers of individuals. Additionally, given the location of the action area, we do not anticipate the capture or handling of any spawning individuals. The proposed action will also not affect their spawning habitat in any way and will not create any barrier to pre-spawning sturgeon accessing foraging or overwintering sites or the spawning grounds. Any effects to distribution will be minor and temporary and limited to the temporary capture and handling of individuals.

Here, we consider the effect of the loss of up to one Atlantic sturgeon from the GOM DPS every ten years. The reproductive potential of the GOM DPS will not be affected in any way other than through a reduction in numbers of individuals. The loss of up to one individual each decade would have the effect of reducing the amount of potential reproduction as any dead GOM DPS Atlantic sturgeon would have no potential for future reproduction. However, this small reduction

in potential future spawners is expected to result in an extremely small reduction in the number of eggs laid or larvae produced in future years and similarly, an extremely small effect on the strength of subsequent year classes. Even considering the potential future spawners that would be produced by the individual that would be killed as a result of the proposed action, any effect to future year classes is anticipated to be extremely small and would not change the status of this species. As noted above, reproductive potential of Atlantic sturgeon captured and not killed is not expected to be affected in any way. Additionally, we have determined that any impacts to behavior of captured fish will be minor and temporary and that there will not be any delay or disruption of any normal behavior including spawning; there will also be no reduction in individual fitness or any future reduction in numbers of individuals. The proposed action will also not affect the spawning grounds within the rivers where GOM DPS fish spawn. The action will also not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds used by GOM DPS fish.

Because we do not have a population estimate for the GOM DPS, it is difficult to evaluate the effect of the mortality caused by this action on the species. However, because the proposed action will result in the loss of no more than one individual every ten years, it is unlikely that this death will have a detectable effect on the numbers and population trend of the GOM DPS.

The proposed action is not likely to reduce distribution because the actions will not impede Atlantic sturgeon from accessing any seasonal concentration areas, including foraging areas within the action area that may be used by GOM DPS subadults or adults. Further, the action is not expected to reduce the river by river distribution of Atlantic sturgeon. Any effects to distribution will be minor and temporary and limited to the temporary avoidance of the area where suspended sediment levels are high.

Based on the information provided above, the death of up to one GOM DPS Atlantic sturgeon each decade, will not appreciably reduce the likelihood of survival of the GOM DPS (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect GOM DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and it will not result in effects to the environment which would prevent Atlantic sturgeon from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the death of up to one GOM DPS Atlantic sturgeon in any ten-year period will not change the status or trends of the species as a whole; (2) the loss of this GOM DPS Atlantic sturgeon is not likely to have an effect on the levels of genetic heterogeneity in the population; (3) the loss of this GOM DPS Atlantic sturgeon is likely to have such a small effect on reproductive output that the loss of this individual will not change the status or trends of the species; (4) the action will have only a minor and temporary effect on the distribution of GOM DPS Atlantic sturgeon in the action area and no effect on the distribution of the species throughout its range; and, (5) the action will have no effect on the ability of GOM DPS Atlantic sturgeon to shelter and only an insignificant effect on any foraging GOM DPS Atlantic sturgeon.

In certain instances, an action that does not appreciably reduce the likelihood of a species' survival might affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the GOM DPS will survive in the wild. Here, we consider the potential for the action to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed action will affect the likelihood that the GOM DPS can rebuild to a point where listing is no longer appropriate. No Recovery Plan for the GOM DPS has been published. The Recovery Plan will outline the steps necessary for recovery and the demographic criteria, which once attained would allow the species to be delisted. We know that in general, to recover, a species must have a sustained positive trend over time and an increase in population. To allow those things to happen, a species must have enough habitat in suitable condition that allows all normal life functions to occur (i.e., spawning, foraging, resting) and have access to enough food. Here, we consider whether the proposed action will affect the population size and/or trend in a way that would affect the likelihood of recovery.

We do not expect the proposed action to modify, curtail, or destroy the range of the species since it will result in an extremely small reduction in the number of GOM DPS Atlantic sturgeon and since it will not affect the overall distribution of GOM DPS Atlantic sturgeon. Any effects to habitat will be insignificant and discountable and will not affect the ability of Atlantic sturgeon to carry out any necessary behaviors or functions. Any impacts to available forage will also be insignificant. The proposed action will result in an extremely small amount of mortality (up to one individual every ten years) and a subsequent small reduction in future reproductive output. For these reasons, we do not expect the action to affect the persistence of the GOM DPS of Atlantic sturgeon. This action will not change the status or trend of the GOM DPS of Atlantic sturgeon. The very small reduction in numbers and future reproduction resulting from the proposed action will not reduce the likelihood of improvement in the status of the GOM DPS of Atlantic sturgeon. The effects of the proposed action will not delay the recovery timeline or otherwise decrease the likelihood of recovery. The effects of the proposed action will also not reduce the likelihood that the status of the species can improve to the point where it is recovered and could be delisted. Therefore, the proposed action will not appreciably reduce the likelihood that the GOM DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as threatened. Based on the analysis presented herein, the proposed action is not likely to appreciably reduce the survival and recovery of this species.

Despite the threats faced by individual GOM DPS Atlantic sturgeon inside and outside of the action area, the proposed action will not increase the vulnerability of individual sturgeon to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed action. We have considered the effects of the proposed action in light of cumulative effects explained above, including climate change, and have concluded that even in light of the ongoing impacts of these activities and conditions; the conclusions reached above do not change. Based on the analysis presented herein, the proposed action, resulting in the mortality of up to one GOM DPS Atlantic sturgeon every ten years, is not likely to appreciably reduce the survival and recovery of this species.

8.5.2 New York Bight DPS

The NYB DPS is listed as endangered, and while Atlantic sturgeon occur in several rivers in the New York Bight, recent spawning has only been physically documented in the Hudson and Delaware Rivers. The capture of age-0 Atlantic sturgeon in the Connecticut River in 2014 indicates that spawning may also occur in this river. However, as these young sturgeon represent the only evidence of spawning since the population began being studied in the 1980s, and we do not have any information on the genetic identity of these individuals, we do not know if these represent a unique Connecticut River population or were spawned by migrants from the Hudson River. Spawning may also occur in the Housatonic River due to the presence of features necessary to support reproduction and recruitment (82 FR 39160; August 17, 2017). Nonetheless, based on existing data, we expect any NYB DPS Atlantic sturgeon in the action area to originate from the Hudson or Delaware River. There is limited information on the demographics of the Hudson River population of Atlantic sturgeon. Spawning still occurs in the Delaware River, however, there are no abundance estimates for this population of Atlantic sturgeon (ASSRT 2007). An annual mean estimate of 863 mature adults (596 males and 267 females) was calculated for the Hudson River based on fishery-dependent data from 1985-1995 (Kahnle *et al.* 2007). As discussed in Section 4.2.2, the NEAMAP based methodology estimates a total of 34,566 sub-adult and adult NYB DPS Atlantic sturgeon in the ocean.

We have estimated that the proposed action may result in the capture of up to seven NYB DPS Atlantic sturgeon annually. We anticipate the mortality of up to five individuals every ten years; no post-interaction mortality of any other captured NYB DPS Atlantic sturgeon is anticipated. Effects are anticipated when fish encounter or are trapped by the pound net gear. These effects consist of alterations in normal behavior, such as a temporary startle or avoidance of the sampling area; minor physiological stress; and minor physical injury from abrasion associated with physically interacting with the trap, main lead or wings. Non-lethal behavioral responses are expected to be temporary and spatially limited to the area and time fish interact with or are restricted by pound net gear.

With the exception of up to five NYB DPS Atlantic sturgeon mortalities in pound net gear per decade, all sturgeon captured in pound net gear are anticipated to fully recover from capture without any impact on fitness or future reproductive potential. The short duration of most captures and handling will not cause a delay or disruption of any essential behavior including spawning, there will be no reduction in individual fitness or any future reduction in numbers of individuals. Additionally, given the location of the action area, we do not anticipate the capture or handling of any spawning individuals. The proposed action will also not affect their spawning habitat in any way and will not create any barrier to pre-spawning sturgeon accessing foraging or overwintering sites or the spawning grounds. Any effects to distribution will be minor and temporary and limited to the temporary capture and handling of individuals.

Here, we consider the effect of the loss of up to five Atlantic sturgeon from the NYB DPS every ten years. The reproductive potential of the NYB DPS will not be affected in any way other than through a reduction in numbers of individuals. The loss of up to five individuals every ten years would have the effect of reducing the amount of potential reproduction as any dead NYB DPS Atlantic sturgeon would have no potential for future reproduction. However, this small reduction

in potential future spawners is expected to result in an extremely small reduction in the number of eggs laid or larvae produced in future years and similarly, an extremely small effect on the strength of subsequent year classes. Even considering the potential future spawners that would be produced by the individual that would be killed as a result of the proposed action, any effect to future year classes is anticipated to be extremely small and would not change the status of this species. As noted above, reproductive potential of Atlantic sturgeon captured and not killed is not expected to be affected in any way. Additionally, we have determined that any impacts to behavior of captured fish will be minor and temporary and that there will not be any delay or disruption of any normal behavior including spawning; there will also be no reduction in individual fitness or any future reduction in numbers of individuals. The proposed action will also not affect the spawning grounds within the rivers where NYB DPS fish spawn. The action will also not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds used by NYB DPS fish.

Because we do not have a population estimate for the NYB DPS, it is difficult to evaluate the effect of the mortality caused by this action on the species. However, because the proposed action will result in the loss of no more than five individuals per decade, it is unlikely that this death will have a detectable effect on the numbers and population trend of the NYB DPS.

Based on the information provided above, the death of up to five NYB DPS Atlantic sturgeon every ten years will not appreciably reduce the likelihood of survival of the NYB DPS (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect NYB DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and it will not result in effects to the environment which would prevent Atlantic sturgeon from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the death of five NYB DPS Atlantic sturgeon every ten years will not change the status or trends of the species as a whole; (2) the loss of these NYB DPS Atlantic sturgeon is not likely to have an effect on the levels of genetic heterogeneity in the population; (3) the loss of these NYB DPS Atlantic sturgeon is likely to have such a small effect on reproductive output that the loss of these individuals will not change the status or trends of the species; (4) the action will have only a minor and temporary effect on the distribution of NYB DPS Atlantic sturgeon in the action area and no effect on the distribution of the species throughout its range; and, (5) the action will have no effect on the ability of NYB DPS Atlantic sturgeon to shelter and only an insignificant effect on individual foraging NYB DPS Atlantic sturgeon.

In certain instances, an action that does not appreciably reduce the likelihood of a species' survival might affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the NYB DPS will survive in the wild. Here, we consider the potential for the action to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed action will affect the likelihood that the NYB DPS can rebuild to a point where listing is no longer appropriate. No Recovery Plan for the NYB DPS has been published.

The Recovery Plan will outline the steps necessary for recovery and the demographic criteria which once attained would allow the species to be delisted. We know that in general, to recover, a species must have a sustained positive trend over time and an increase in population. To allow those things to happen, a species must have enough habitat in suitable condition that allows all normal life functions to occur (i.e., spawning, foraging, resting) and have access to enough food. Here, we consider whether the proposed action will affect the population size and/or trend in a way that would affect the likelihood of recovery.

The proposed action is not expected to modify, curtail, or destroy the range of the species since it will result in an extremely small reduction in the number of NYB DPS Atlantic sturgeon and since it will not affect the overall distribution of NYB DPS Atlantic sturgeon. Any effects to habitat will be insignificant and discountable and will not affect the ability of Atlantic sturgeon to carry out any necessary behaviors or functions. Any impacts to available forage will also be insignificant. The proposed action will result in a small amount of mortality (no more than five individuals every ten years) and a subsequent small reduction in future reproductive output. For these reasons, it is not expected to affect the persistence of the NYB DPS of Atlantic sturgeon. These action will not change the status or trend of the NYB DPS of Atlantic sturgeon. The very small reduction in numbers and future reproduction resulting from the proposed action will not reduce the likelihood of improvement in the status of the NYB DPS of Atlantic sturgeon. The effects of the proposed action will not delay the recovery timeline or otherwise decrease the likelihood of recovery. The effects of the proposed action will also not reduce the likelihood that the status of the species can improve to the point where it is recovered and could be delisted. Therefore, the proposed action will not appreciably reduce the likelihood that the NYB DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as threatened. Based on the analysis presented herein, the proposed action is not likely to appreciably reduce the survival and recovery of this species.

Despite the threats faced by individual NYB DPS Atlantic sturgeon inside and outside of the action area, the proposed action will not increase the vulnerability of individual sturgeon to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed action. Based on the analysis presented herein, the proposed action, resulting in the mortality of up to five NYB DPS Atlantic sturgeon every ten years, is not likely to appreciably reduce the survival and recovery of this species.

8.5.3 Chesapeake Bay DPS

The CB DPS is listed as endangered, and while Atlantic sturgeon occur and may potentially spawn in several rivers of the Chesapeake Bay, recent spawning has only been physically documented in the James River. Chesapeake Bay origin Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range. There is currently not enough information to establish a trend for any life stage, for the James River spawning population, or for the DPS as a whole.

We have estimated that the proposed action will result in the capture of up to two CB DPS Atlantic sturgeon annually. We anticipate the mortality of up to one individual every ten years; no post-interaction mortality of any other captured CB DPS Atlantic sturgeon is anticipated.

With the exception of up to one CB DPS Atlantic sturgeon mortality in pound net gear every ten years, all sturgeon captured in pound net gear are anticipated to fully recover from capture without any impact on fitness or future reproductive potential. The short duration of most captures and handling will not cause a delay or disruption of any essential behavior including spawning, there will be no reduction in individual fitness or any future reduction in numbers of individuals. Additionally, given the location of the action area, we do not anticipate the capture or handling of any spawning individuals. The proposed action will also not affect their spawning habitat in any way and will not create any barrier to pre-spawning sturgeon accessing foraging or overwintering sites or the spawning grounds. Any effects to distribution will be minor and temporary and limited to the temporary capture and handling of individuals.

Here, we consider the effect of the loss of up to one Atlantic sturgeon per decade from the CB DPS. The reproductive potential of the CB DPS will not be affected in any way other than through a reduction in numbers of individuals. The loss of up to one individual every ten years would have the effect of reducing the amount of potential reproduction as any dead CB DPS Atlantic sturgeon would have no potential for future reproduction. However, this small reduction in potential future spawners is expected to result in an extremely small reduction in the number of eggs laid or larvae produced in future years and similarly, an extremely small effect on the strength of subsequent year classes. Even considering the potential future spawners that would be produced by the individual that would be killed as a result of the proposed action, any effect to future year classes is anticipated to be extremely small and would not change the status of this species. As noted above, reproductive potential of Atlantic sturgeon captured and not killed is not expected to be affected in any way. Additionally, we have determined that any impacts to behavior of captured fish will be minor and temporary and that there will not be any delay or disruption of any normal behavior including spawning; there will also be no reduction in individual fitness or any future reduction in numbers of individuals. The proposed action will also not affect the spawning grounds within the rivers where CB DPS fish spawn. The action will also not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds used by CB DPS fish.

Because we do not have a population estimate for the CB DPS, it is difficult to evaluate the effect of the mortality caused by these action on the species. However, because the proposed action will result in the loss of no more than one individual every ten years, it is unlikely that this death will have a detectable effect on the numbers and population trend of the CB DPS.

The proposed action is not likely to reduce distribution because the actions will not impede Atlantic sturgeon from accessing any seasonal concentration areas, including foraging areas within the action area that may be used by CB DPS subadults or adults. Further, the action is not expected to reduce the river by river distribution of Atlantic sturgeon. Any effects to distribution will be minor and temporary and limited to the temporary avoidance of the area where suspended sediment levels are high.

Based on the information provided above, the death of up to one CB DPS Atlantic sturgeon every ten years will not appreciably reduce the likelihood of survival of the CB DPS (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient

resilience to allow for the potential recovery from endangerment). The action will not affect CB DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and it will not result in effects to the environment which would prevent Atlantic sturgeon from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the death of one CB DPS Atlantic sturgeon every ten years will not change the status or trends of the species as a whole; (2) the loss of this CB DPS Atlantic sturgeon is not likely to have an effect on the levels of genetic heterogeneity in the population; (3) the loss of this CB DPS Atlantic sturgeon is likely to have such a small effect on reproductive output that the loss of this individual will not change the status or trends of the species; (4) the action will have only a minor and temporary effect on the distribution of CB DPS Atlantic sturgeon in the action area and no effect on the distribution of the species throughout its range; and, (5) the action will have no effect on the ability of CB DPS Atlantic sturgeon to shelter and only an insignificant effect on any foraging CB DPS Atlantic sturgeon.

In certain instances, an action that does not appreciably reduce the likelihood of a species' survival might affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the CB DPS will survive in the wild. Here, we consider the potential for the action to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed action will affect the likelihood that the CB DPS can rebuild to a point where listing is no longer appropriate. No Recovery Plan for the CB DPS has been published. The Recovery Plan will outline the steps necessary for recovery and the demographic criteria, which once attained would allow the species to be delisted. We know that in general, to recover, a species must have a sustained positive trend over time and an increase in population. To allow those things to happen, a species must have enough habitat in suitable condition that allows all normal life functions to occur (i.e., spawning, foraging, resting) and have access to enough food. Here, we consider whether the proposed action will affect the population size and/or trend in a way that would affect the likelihood of recovery.

We do not expect the proposed action to modify, curtail, or destroy the range of the species since it will result in an extremely small reduction in the number of CB DPS Atlantic sturgeon and since it will not affect the overall distribution of CB DPS Atlantic sturgeon. Any effects to habitat will be insignificant and discountable and will not affect the ability of Atlantic sturgeon to carry out any necessary behaviors or functions. Any impacts to available forage will also be insignificant. The proposed action will result in an extremely small amount of mortality each year and a subsequent small reduction in future reproductive output. For these reasons, we do not expect the action to affect the persistence of the CB DPS of Atlantic sturgeon. This action will not change the status or trend of the CB DPS of Atlantic sturgeon. The very small reduction in numbers and future reproduction resulting from the proposed action will not reduce the likelihood of improvement in the status of the CB DPS of Atlantic sturgeon. The effects of the proposed action will not delay the recovery timeline or otherwise decrease the likelihood of recovery. The effects of the proposed action will also not reduce the likelihood that the status of the species can improve to the point where it is recovered and could be delisted. Therefore, the proposed action will not appreciably reduce the likelihood that the CB DPS of Atlantic sturgeon

can be brought to the point at which they are no longer listed as threatened. Based on the analysis presented herein, the proposed action is not likely to appreciably reduce the survival and recovery of this species.

Despite the threats faced by individual CB DPS Atlantic sturgeon inside and outside of the action area, the proposed action will not increase the vulnerability of individual sturgeon to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed action. We have considered the effects of the proposed action in light of cumulative effects explained above, including climate change, and have concluded that even in light of the ongoing impacts of these activities and conditions; the conclusions reached above do not change. Based on the analysis presented herein, the proposed action, resulting in the mortality of up to one CB DPS Atlantic sturgeon every ten years, is not likely to appreciably reduce the survival and recovery of this species.

8.5.4 Carolina DPS

The Carolina DPS is listed as endangered and consists of Atlantic sturgeon originating from at least five rivers where spawning is still thought to occur. Carolina DPS origin Atlantic sturgeon are affected by numerous sources of human induced mortality and habitat disturbance throughout the riverine and marine portions of their range.

We have estimated that the proposed action will result in the capture of up to one Carolina DPS Atlantic sturgeon annually. We anticipate the mortality of only one individual every ten years; no post-interaction mortality of any other captured Carolina DPS Atlantic sturgeon is anticipated.

With the exception of up to one Carolina DPS Atlantic sturgeon mortality in pound net gear per decade, all sturgeon captured in pound net gear are anticipated to fully recover from capture without any impact on fitness or future reproductive potential. The short duration of most captures and handling will not cause a delay or disruption of any essential behavior including spawning, there will be no reduction in individual fitness or any future reduction in numbers of individuals. Additionally, given the location of the action area, we do not anticipate the capture or handling of any spawning individuals. The proposed action will also not affect their spawning habitat in any way and will not create any barrier to pre-spawning sturgeon accessing foraging or overwintering sites or the spawning grounds. Any effects to distribution will be minor and temporary and limited to the temporary capture and handling of individuals.

Here, we consider the effect of the loss of up to one Atlantic sturgeon from the Carolina DPS every ten years. The reproductive potential of the Carolina DPS will not be affected in any way other than through a reduction in numbers of individuals. The loss of up to one individual every ten years would have the effect of reducing the amount of potential reproduction as any dead Carolina DPS Atlantic sturgeon would have no potential for future reproduction. However, this small reduction in potential future spawners is expected to result in an extremely small reduction in the number of eggs laid or larvae produced in future years and similarly, an extremely small effect on the strength of subsequent year classes. Even considering the potential future spawners that would be produced by the individual that would be killed as a result of the proposed action, any effect to future year classes is anticipated to be extremely small and would not change the

status of this species. As noted above, reproductive potential of Atlantic sturgeon captured and not killed is not expected to be affected in any way. Additionally, we have determined that any impacts to behavior of captured fish will be minor and temporary and that there will not be any delay or disruption of any normal behavior including spawning; there will also be no reduction in individual fitness or any future reduction in numbers of individuals. The proposed action will also not affect the spawning grounds within the rivers where Carolina DPS fish spawn. The action will also not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds used by Carolina DPS fish.

Because we do not have a population estimate for the Carolina DPS, it is difficult to evaluate the effect of the mortality caused by this action on the species. However, because the proposed action will result in the loss of no more than one individual every ten years, it is unlikely that this death will have a detectable effect on the numbers and population trend of the Carolina DPS.

The proposed action is not likely to reduce distribution because the action will not impede Atlantic sturgeon from accessing any seasonal concentration areas, including foraging areas within the action area that may be used by Carolina DPS subadults or adults. Further, the action is not expected to reduce the river by river distribution of Atlantic sturgeon. Any effects to distribution will be minor and temporary and limited to the temporary avoidance of the area where suspended sediment levels are high.

Based on the information provided above, the death of up to one Carolina DPS Atlantic sturgeon every ten years will not appreciably reduce the likelihood of survival of the Carolina DPS (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect Carolina DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and it will not result in effects to the environment which would prevent Atlantic sturgeon from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the death of one Carolina DPS Atlantic sturgeon every ten years will not change the status or trends of the species as a whole; (2) the death of this Carolina DPS Atlantic sturgeon will not change the status or trends of the species as a whole; (3) the loss of this Carolina DPS Atlantic sturgeon is not likely to have an effect on the levels of genetic heterogeneity in the population; (4) the loss of this Carolina DPS Atlantic sturgeon each decade is likely to have such a small effect on reproductive output that the loss of this individual will not change the status or trends of the species; (5) the action will have only a minor and temporary effect on the distribution of Carolina DPS Atlantic sturgeon in the action area and no effect on the distribution of the species throughout its range; and, (6) the action will have no effect on the ability of Carolina DPS Atlantic sturgeon to shelter and only an insignificant effect on any foraging Carolina DPS Atlantic sturgeon.

In certain instances, an action that does not appreciably reduce the likelihood of a species' survival might affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the Carolina DPS will survive in the wild. Here, we consider the potential for the action to reduce the likelihood of recovery. As noted above, recovery is defined as the

improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed action will affect the likelihood that the Carolina DPS can rebuild to a point where listing is no longer appropriate. No Recovery Plan for the Carolina DPS has been published. The Recovery Plan will outline the steps necessary for recovery and the demographic criteria, which once attained would allow the species to be delisted. We know that in general, to recover, a species must have a sustained positive trend over time and an increase in population. To allow those things to happen, a species must have enough habitat in suitable condition that allows all normal life functions to occur (i.e., spawning, foraging, resting) and have access to enough food. Here, we consider whether the proposed action will affect the population size and/or trend in a way that would affect the likelihood of recovery.

We do not expect the proposed action to modify, curtail, or destroy the range of the species since it will result in an extremely small reduction in the number of Carolina DPS Atlantic sturgeon and since it will not affect the overall distribution of Carolina DPS Atlantic sturgeon. Any effects to habitat will be insignificant and discountable and will not affect the ability of Atlantic sturgeon to carry out any necessary behaviors or functions. Any impacts to available forage will also be insignificant. The proposed action will result in an extremely small amount of mortality per year (one individual) and a subsequent small reduction in future reproductive output. For these reasons, we do not expect the action to affect the persistence of the Carolina DPS of Atlantic sturgeon. This action will not change the status or trend of the Carolina DPS of Atlantic sturgeon. The very small reduction in numbers and future reproduction resulting from the proposed action will not reduce the likelihood of improvement in the status of the Carolina DPS of Atlantic sturgeon. The effects of the proposed action will not delay the recovery timeline or otherwise decrease the likelihood of recovery. The effects of the proposed action will also not reduce the likelihood that the status of the species can improve to the point where it is recovered and could be delisted. Therefore, the proposed action will not appreciably reduce the likelihood that the Carolina DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as threatened. Based on the analysis presented herein, the proposed action is not likely to appreciably reduce the survival and recovery of this species.

Despite the threats faced by individual Carolina DPS Atlantic sturgeon inside and outside of the action area, the proposed action will not increase the vulnerability of individual sturgeon to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed action. We have considered the effects of the proposed action in light of cumulative effects explained above, including climate change, and have concluded that even in light of the ongoing impacts of these activities and conditions; the conclusions reached above do not change. Based on the analysis presented herein, the proposed action, resulting in the mortality of up to one Carolina DPS Atlantic sturgeon every ten years, is not likely to appreciably reduce the survival and recovery of this species.

8.5.5 South Atlantic DPS

The SA DPS is listed as endangered and consists of Atlantic sturgeon originating from at least six rivers where spawning is still thought to occur. Schueller and Peterson (2006) estimate that there were 343 adults spawning in the Altamaha River, Georgia, in 2004 and 2005. This represents a percentage of the total adult population for the Altamaha River. Males spawn every

1-5 years and females spawn every 2-5 years; thus, the total Altamaha River adult population, assuming a 2:1 ratio of males to females as seen in the Hudson River, could range from 457-1,715. Spawning occurs in at least five other rivers in this DPS. Therefore, the number of Atlantic sturgeon in the Altamaha River population is only a portion of the total DPS. No estimate of the number of Atlantic sturgeon in any of the other spawning rivers or for the DPS as a whole is available.

We have estimated that the proposed action will result in the capture of up to three SA DPS Atlantic sturgeon annually. We anticipate the mortality of up to two individuals every ten years; no post-interaction mortality of any other captured Atlantic sturgeon is anticipated.

With the exception of up to two SA DPS Atlantic sturgeon mortalities in pound net gear every ten years, all sturgeon captured in pound net gear are anticipated to fully recover from capture without any impact on fitness or future reproductive potential. The short duration of most captures and handling will not cause a delay or disruption of any essential behavior including spawning, there will be no reduction in individual fitness or any future reduction in numbers of individuals. Additionally, given the location of the action area, we do not anticipate the capture or handling of any spawning individuals. The proposed action will also not affect their spawning habitat in any way and will not create any barrier to pre-spawning sturgeon accessing foraging or overwintering sites or the spawning grounds. Any effects to distribution will be minor and temporary and limited to the temporary capture and handling of individuals.

Here, we consider the effect of the loss of up to two Atlantic sturgeon from the SA DPS each decade. The reproductive potential of the SA DPS will not be affected in any way other than through a reduction in numbers of individuals. The loss of up to two individuals every ten years would have the effect of reducing the amount of potential reproduction as any dead SA DPS Atlantic sturgeon would have no potential for future reproduction. However, this small reduction in potential future spawners is expected to result in an extremely small reduction in the number of eggs laid or larvae produced in future years and similarly, an extremely small effect on the strength of subsequent year classes. Even considering the potential future spawners that would be produced by the individual that would be killed as a result of the proposed action, any effect to future year classes is anticipated to be extremely small and would not change the status of this species. As noted above, reproductive potential of Atlantic sturgeon captured and not killed is not expected to be affected in any way. Additionally, we have determined that any impacts to behavior of non-lethally captured fish will be minor and temporary and that there will not be any delay or disruption of any normal behavior including spawning; there will also be no reduction in individual fitness or any future reduction in numbers of individuals. The proposed action will also not affect the spawning grounds within the rivers where SA DPS fish spawn. The action will also not create any barrier to pre-spawning sturgeon accessing the overwintering sites or the spawning grounds used by SA DPS fish.

Because we do not have a population estimate for the SA DPS, it is difficult to evaluate the effect of the mortality caused by this action on the species. However, because the proposed action will result in the loss of no more than two individuals every ten years, it is unlikely that this death will have a detectable effect on the numbers and population trend of the SA DPS.

The proposed action is not likely to reduce distribution because the action will not impede Atlantic sturgeon from accessing any seasonal concentration areas, including foraging areas within the action area that may be used by SA DPS subadults or adults. Further, the action is not expected to reduce the river by river distribution of Atlantic sturgeon. Any effects to distribution will be minor and temporary and limited to the temporary avoidance of the area where suspended sediment levels are high.

Based on the information provided above, the death of up to two SA DPS Atlantic sturgeon every ten years will not appreciably reduce the likelihood of survival of the SA DPS (i.e., it will not decrease the likelihood that the species will continue to persist into the future with sufficient resilience to allow for the potential recovery from endangerment). The action will not affect SA DPS Atlantic sturgeon in a way that prevents the species from having a sufficient population, represented by all necessary age classes, genetic heterogeneity, and number of sexually mature individuals producing viable offspring, and it will not result in effects to the environment which would prevent Atlantic sturgeon from completing their entire life cycle, including reproduction, sustenance, and shelter. This is the case because: (1) the death of two SA DPS Atlantic sturgeon every ten years will not change the status or trends of the species as a whole; (2) the loss of these SA DPS Atlantic sturgeon is not likely to have an effect on the levels of genetic heterogeneity in the population; (3) the loss of these SA DPS Atlantic sturgeon annually is likely to have such a small effect on reproductive output that the loss of these individuals will not change the status or trends of the species; (4) the action will have only a minor and temporary effect on the distribution of SA DPS Atlantic sturgeon in the action area and no effect on the distribution of the species throughout its range; and, (5) the action will have no effect on the ability of SA DPS Atlantic sturgeon to shelter and only an insignificant effect on any foraging SA DPS Atlantic sturgeon.

In certain instances, an action that does not appreciably reduce the likelihood of a species' survival might affect its likelihood of recovery or the rate at which recovery is expected to occur. As explained above, we have determined that the proposed action will not appreciably reduce the likelihood that the SA DPS will survive in the wild. Here, we consider the potential for the action to reduce the likelihood of recovery. As noted above, recovery is defined as the improvement in status such that listing is no longer appropriate. Thus, we have considered whether the proposed action will affect the likelihood that the SA DPS can rebuild to a point where listing is no longer appropriate. No Recovery Plan for the SA DPS has been published. The Recovery Plan will outline the steps necessary for recovery and the demographic criteria, which once attained would allow the species to be delisted. We know that in general, to recover, a species must have a sustained positive trend over time and an increase in population. To allow those things to happen, a species must have enough habitat in suitable condition that allows all normal life functions to occur (i.e., spawning, foraging, resting) and have access to enough food. Here, we consider whether the proposed action will affect the population size and/or trend in a way that would affect the likelihood of recovery.

We do not expect the proposed action to modify, curtail, or destroy the range of the species since it will result in an extremely small reduction in the number of SA DPS Atlantic sturgeon and since it will not affect the overall distribution of SA DPS Atlantic sturgeon. Any effects to habitat will be insignificant and discountable and will not affect the ability of Atlantic sturgeon

to carry out any necessary behaviors or functions. Any impacts to available forage will also be insignificant. The proposed action will result in an extremely small amount of mortality (up to two individuals every ten years) and a subsequent small reduction in future reproductive output. For these reasons, we do not expect the action to affect the persistence of the SA DPS of Atlantic sturgeon. These action will not change the status or trend of the SA DPS of Atlantic sturgeon. The very small reduction in numbers and future reproduction resulting from the proposed action will not reduce the likelihood of improvement in the status of the SA DPS of Atlantic sturgeon. The effects of the proposed action will not delay the recovery timeline or otherwise decrease the likelihood of recovery. The effects of the proposed action will also not reduce the likelihood that the status of the species can improve to the point where it is recovered and could be delisted. Therefore, the proposed action will not appreciably reduce the likelihood that the SA DPS of Atlantic sturgeon can be brought to the point at which they are no longer listed as threatened. Based on the analysis presented herein, the proposed action is not likely to appreciably reduce the survival and recovery of this species.

Despite the threats faced by individual SA DPS Atlantic sturgeon inside and outside of the action area, the proposed action will not increase the vulnerability of individual sturgeon to these additional threats and exposure to ongoing threats will not increase susceptibility to effects related to the proposed action. We have considered the effects of the proposed action in light of cumulative effects explained above, including climate change, and have concluded that even in light of the ongoing impacts of these activities and conditions; the conclusions reached above do not change. Based on the analysis presented herein, the proposed action, resulting in the mortality of up to two SA DPS Atlantic sturgeon every ten years, is not likely to appreciably reduce the survival and recovery of this species.

9.0 CONCLUSION

After reviewing the best available information on the status of endangered and threatened species under our jurisdiction, the environmental baseline for the action area, the effects of the proposed action, and the cumulative effects, it is our biological opinion that the proposed action may adversely affect but is not likely to jeopardize the continued existence of NWA DPS loggerhead sea turtles, Kemp's ridley sea turtles, North Atlantic DPS green sea turtles, leatherback sea turtles, or the GOM, NYB, CB, Carolina, and SA DPSs of Atlantic sturgeon.

10.0 INCIDENTAL TAKE STATEMENT

Section 9 of the ESA prohibits the take of endangered species of fish and wildlife. "Fish and wildlife" is defined in the ESA "as any member of the animal kingdom, including without limitation any mammal, fish, bird (including any migratory, non-migratory, or endangered bird for which protection is also afforded by treaty or other international agreement), amphibian, reptile, mollusk, crustacean, arthropod or other invertebrate, and includes any part, product, egg, or offspring thereof, or the dead body or parts thereof" (16 U.S.C. 1532(8)). "Take" is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Harm is further defined by NMFS to include any act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation that actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns including breeding, spawning, rearing, migrating, feeding, or sheltering. Incidental take

is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. “Otherwise lawful activities” are those actions that meet all State and Federal legal requirements except for the prohibition against taking in ESA section 9 (51 FR 19936; June 3, 1986), which would include any state endangered species laws or regulations. Section 9(g) makes it unlawful for any person “to attempt to commit, solicit another to commit, or cause to be committed, any offense defined [in the ESA].” (16 U.S.C. 1538(g)). A “person” is defined in part as any entity subject to the jurisdiction of the U.S., including an individual, corporation, officer, employee, department, or instrument of the Federal government (see 16 U.S.C. 1532 (13)). Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not the purpose of carrying out an otherwise lawful activity is not considered to be prohibited under the ESA provided that such taking is in compliance with the terms and conditions of this ITS. In issuing ITSs, NMFS takes no position on whether an action is an “otherwise lawful activity.”

The measures described below are non-discretionary, and must be undertaken by NMFS so that they become binding conditions for the exemption in section 7(o)(2) to apply. NMFS has a continuing duty to regulate the activity covered by this ITS. If NMFS (1) fails to assume and implement the terms and conditions or (2) fails to require Virginia pound net fishermen and responders to adhere to the terms and conditions of the ITS through enforceable terms that are added to permits as appropriate, the protective coverage of section 7(o)(2) may lapse. In order to monitor the impact of incidental take, NMFS must report the progress of the action and its impact on the species to the NMFS as specified in the ITS [50 CFR §402.14(i)(3)] (See U.S. FWS/NMFS Joint Endangered Species Act Section 7 Consultation Handbook (1998) at 4-49).

10.1 Anticipated Amount or Extent of Incidental Take

Even with the implementation of the proposed action, which sets forth gear regulations and protected species conservation measures for the Virginia pound net fishery, the incidental take of sea turtles and Atlantic sturgeon in the fishery may still occur. Incidental takes of these species may take the form of live or lethal takes of individuals in the pounds, hearts, or leaders. While it is difficult to ascertain future take of sea turtles and Atlantic sturgeon in the fishery, we have based the anticipated take levels on previous takes in pound net gear in Virginia waters, the previous level of takes in leaders, and the distribution and estimated number of sea turtles and Atlantic sturgeon in Virginia nearshore and coastal waters, inclusive of Chesapeake Bay.

We anticipate that the following level of incidental take will occur annually in the pound and heart portions of the pound net gear set throughout the action area:

- Up to 805 loggerhead sea turtles (up to 1 lethal),
- Up to 161 Kemp’s ridley sea turtles (up to 1 lethal),
- Up to 16 green sea turtles (up to 1 lethal), and
- Up to 11 Atlantic sturgeon (none lethal).

Nearly all of these takes are anticipated to be live animals. Sea turtles may be killed due to interactions with the pounds and hearts, but at a rate of no more than one mortality per sea turtle species per year. No incidental take of leatherback sea turtles in the pounds and hearts is anticipated or exempted.

We anticipate that the following level of incidental take of sea turtles and Atlantic sturgeon will occur in pound net leaders each year:

- Up to 1 loggerhead sea turtle (up to 1 lethal),
- Up to 1 Kemp's ridley sea turtle (up to 1 lethal),
- Up to 1 green sea turtle (up to 1 lethal),
- Up to 8 leatherback sea turtles (up to 4 lethal); and
- Up to 2 Atlantic sturgeon (up to 1 lethal).

All of the hard-shelled sea turtle captures in pound net leaders are assumed to result in mortality, while half of the leatherback and Atlantic sturgeon takes are expected to be lethal.

In summary, based on the information presented in the Opinion, we anticipate that the Virginia pound net fishery and its associated regulations will result in the annual capture of:

- Up to 806 NWA DPS loggerhead sea turtles (up to 2 lethal);
- Up to 162 Kemp's ridley sea turtles (up to 2 lethal);
- Up to 17 North Atlantic DPS green sea turtles (up to 2 lethal);
- Up to 8 leatherback sea turtles (up to 4 lethal);
- Up to 13 Atlantic sturgeon (up to 1 lethal) from a combination of the five listed DPSs as follows¹⁰:
 - 7 from the NYB DPS (5 lethal every 10 years)
 - 3 from the SA DPS (2 lethal every 10 years)
 - 2 from the CB DPS (1 lethal every 10 years)
 - 1 from either the GOM or Carolina DPS (1 lethal for both DPS every 10 years).

Again, we have determined that this level of anticipated take is not likely to result in jeopardy to any species of sea turtle or any DPS of Atlantic sturgeon.

10.2 Reasonable and Prudent Measures, Terms and Conditions, and Justifications

We believe the following reasonable and prudent measures (RPMs) and associated terms and conditions listed in Table 14 below are necessary and appropriate to minimize and monitor impacts of incidental take resulting from the proposed action. In order to be exempt from prohibitions of section 9 of the ESA, NMFS must comply with all terms and conditions identified below, which implement the RPMs and outline required reporting/monitoring requirements. These terms and conditions are non-discretionary. Any taking that is in compliance with the terms and conditions specified in this ITS shall not be considered a prohibited taking of the species concerned (ESA section 7(o)(2)).

¹⁰ It should be noted that monitoring of Atlantic sturgeon takes by DPS will not be required under the Reasonable and Prudent Measures and Terms and Conditions of this opinion, as most pound net fishermen and responders are not trained in genetic sampling techniques. Only those with sufficient training and/or an ESA section 10 permit for sturgeon sampling will be permitted to take fin clip samples of Atlantic sturgeon to determine the DPS origin of the fish. Instead, we will use the best available mixed stock analysis to estimate which DPSs the incidentally taken sturgeon come from and will assume that all reported takes occur under those percentages. In the event new information becomes available on the DPS by DPS distribution of takes, we would consider that in our monitoring scheme as to whether any triggers for reinitiation of consultation have been met.

The RPMs, with their implementing terms and conditions, are designed to minimize and monitor the impact of incidental take that might otherwise result from the proposed action. Specifically, these RPMs and Terms and Conditions will keep us informed of when and where sea turtle and Atlantic sturgeon interactions with Virginia pound nets are taking place and will require fishermen and/or responders to report any takes in a reasonable amount of time, as well as implement measures to monitor for entrapment or entanglement in specific components of pound net gear. The third column below explains why each of these RPMs and Terms and Conditions are necessary and appropriate to minimize or monitor the level of incidental take associated with the proposed action and how they represent only a minor change to the proposed action.

In order to effectively monitor the effects of the proposed action, it is necessary to monitor the impacts of the action to document the amount of incidental take (i.e., the number of sea turtles and Atlantic sturgeon captured, injured, or killed) and to assess any sea turtles or Atlantic sturgeon that are captured during this monitoring. Monitoring provides information on the characteristics of sea turtles and Atlantic sturgeon encountered and may provide data which will help develop more effective measures to avoid future interactions with ESA-listed species. We do not anticipate any additional injury or mortality to be caused by handling, assessing, and ultimately releasing sea turtles and Atlantic sturgeon as required in the RPMs listed below. Unless pound net fishermen or responders have received the proper disentanglement training or are under the direct guidance of regional stranding or disentanglement experts, all live animals are to be released back into the water following the required documentation.

We will be sending out a permit holder bulletin to all Virginia pound net licensees soon after this Opinion is signed, so that they are aware of their responsibilities under this Opinion and our protected species regulations. Similar to our previous March 6, 2017, mailing to them, this bulletin will contain updated protective measures and reporting guidelines for both sea turtles and Atlantic sturgeon. We will also be sharing a copy of this Opinion with the VMRC and the Virginia Aquarium Stranding Response Program (VAQS) so that they are also aware of their continuing responsibilities in responding to protected species takes in pound net gear.

Table 14: RPMs, Terms and Conditions, and Justifications

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (T&Cs)	Justifications for RPMs and T&Cs
1. <u>PROTECTED SPECIES DISENTANGLEMENT TRAINING MATERIALS</u>: NMFS must ensure that Virginia pound net fishermen and responders who intend to disentangle sea turtles from pound net gear receive or possess sea turtle disentangling training materials to be provided by NMFS, VAQS, or VMRC. Individuals from these three agencies are routinely the ones responding to sea turtle entanglements in Virginia pound net gear.	1. GARFO PRD must ensure that sea turtle disentangling responders and pound net fishermen intending to disentangle sea turtles on their own receive or possess adequate sea turtle disentangling training materials. Responders or fishermen with adequate disentangling training materials are authorized through this Opinion to disentangle sea turtles according to the Northeast Atlantic Coast STDN Disentangling Guidelines at http://www.greateratlantic.fisheries.noaa.gov/protected/stranding/disentangling/turtle/stdn.html. Responders or Virginia pound net fishermen should contact the NMFS Greater Atlantic Region Sea Turtle Stranding and Disentangling Coordinator (Kate Sampson; 978-282-8470) or the GARFO PRD Sea Turtle Program (978-281-9328) for information on required disentangling protocols and equipment. All disentangling must be done in accordance with protocols in the Disentangling placard provided or the procedures described in “Careful Release Protocols for Sea Turtle Release with Minimal Injury” (NOAA Technical Memorandum 580; http://www.sefsc.noaa.gov/turtles/TM_580_SEFSC_CRP_2008.pdf).	RPM #1 and the accompanying Term and Condition establishes the sea turtle disentangling training materials that responders and Virginia pound net fishermen must receive or possess prior to responding to the incidental take of sea turtles in Virginia pound net fishing gear. These training materials will provide responders and fishermen with adequate experience in the handling, resuscitation, release, and reporting of sea turtles that may be incidentally captured over the course of the proposed action.

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (T&Cs)	Justifications for RPMs and T&Cs
2. <u>HANDLING AND RESUSCITATION</u>: Any sea turtles or Atlantic sturgeon caught and retrieved in Virginia pound net fishing gear covered under this Opinion must be handled and resuscitated (if unresponsive) according to established protocols and whenever environmental conditions are safe for those handling and resuscitating the animal(s) to do so.	2. GARFO PRD must ensure that all Virginia pound net fishermen and disentanglement responders have copies of the sea turtle handling and resuscitation requirements found at 50 CFR 223.206(d)(1) and in Appendix A (and as reproduced in the wheelhouse card in Appendix B) prior to the start of the next fishing season. Virginia pound net fishermen or responders must carry out these handling and resuscitation procedures any time a sea turtle is incidentally captured and brought onboard a vessel during the proposed action. If possible, it is requested that only trained fishermen or responders perform the handling and resuscitation of captured sea turtles. 3. GARFO PRD must ensure that fishermen and responders give priority to the handling and resuscitation of any sea turtles that are captured or entangled in pound net fishing gear, if environmental conditions are safe to do so. Handling times for sea turtles should be minimized (i.e., kept to 15 minutes or less) to limit the amount of stress placed on the animals. 4. For sea turtles encountered in Virginia pound net fishing gear that appear injured, sick, distressed, or dead (including stranded or entangled individuals), fishermen or	RPM #2 and the accompanying Terms and Conditions establish the requirements for handling and resuscitating sea turtles and Atlantic sturgeon captured in Virginia pound net fishing gear in order to avoid the likelihood of injury or mortality to these species from the hauling, handling, and emptying of the gear.

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (T&Cs)	Justifications for RPMs and T&Cs
	responders must immediately contact the Greater Atlantic Region Marine Animal Hotline at 866-755-NOAA (6622) for further instructions and guidance on handling, retention, and/or disposal of the animal. If unable to contact the hotline (e.g., due to distance from shore or lack of ability to communicate via phone), the USCG should be contacted via VHF marine radio on Channel 16. If required, hard-shelled sea turtles (i.e., non-leatherbacks) may be held onboard a vessel for up to 24 hours provided that conditions during holding are approved by GARFO PRD and safe handling practices are followed. If the hotline or an available veterinarian cannot be contacted and the injured animal cannot be taken to a rehabilitation center, fishermen or responders must cease activities that could further stress the animal, allow it to rest and recuperate as conditions dictate, and then return the animal to the sea. 5. GARFO PRD must ensure that fishermen and responders who attempt to handle and resuscitate any entangled Atlantic sturgeon are aware of the NMFS guidelines for doing so, which are included in Appendix C. If an entangled Atlantic sturgeon is determined to be unresponsive or comatose, fishermen or responders should attempt to resuscitate the	

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (T&Cs)	Justifications for RPMs and T&Cs
	fish by placing it in oxygenated water or providing a running source of water over the gills. Resuscitation should be attempted on all nonresponsive fish for at least 30 minutes. If the fish remains nonresponsive after 30 minutes, the fish should be considered dead and the carcass returned to the water.	
3. <u>DATA COLLECTION, SAMPLING, AND TAGGING</u>: Any sea turtles or Atlantic sturgeon caught or retrieved in Virginia pound net fishing gear covered under this Opinion must first be identified to species or species group. Each ESA-listed species caught or retrieved must then be properly documented using appropriate equipment and data collection forms provided by NMFS, VAQS, or VMRC. Finally, biological, external tagging, and gear description data must be collected or estimated for all sea turtles and Atlantic sturgeon caught and retrieved from Virginia	6. GARFO PRD must ensure that fishermen and responders are educated as to the identification of sea turtles and Atlantic sturgeon. Although the NEFOP training manuals found at http://www.nefsc.noaa.gov/fsb/training/ are the best resource for species identification, we have also provided information in Appendix D to assist fishermen and responders. 7. GARFO PRD must ensure that all fishermen and responders take or estimate measurements of and either photograph or video all sea turtles or Atlantic sturgeon incidentally captured in pound net gear. The condition of each animal and any potential injuries must be documented to the best of the individual's ability. These data must be entered into the species specific reporting forms provided in Appendix E (sea turtles) or F (Atlantic sturgeon) for each incidental take.	RPM #3 and the accompanying Terms and Conditions specify the collection of information for any sea turtles or Atlantic sturgeon observed captured in Virginia pound net fishing gear. This is essential for monitoring the impacts of the proposed action and level of incidental take associated with them. Sampling of sea turtle and Atlantic sturgeon tissue is used for genetic sampling. The taking of biopsy samples for sea turtles and fin clips for Atlantic sturgeon allows us to fund or conduct genetic analysis to determine the nesting beach/DPS origin of sea turtles and the DPS origin of Atlantic sturgeon. This allows us to determine if the actual level of take has been exceeded. These procedures do not harm sea turtles or Atlantic sturgeon and are a

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (T&Cs)	Justifications for RPMs and T&Cs
pound net fishing gear. Internal or external tags may be applied to the animals if it is determined that they have not been tagged already and the responder is permitted to do so. Biological samples may also be taken if the responder has a permit to do so.	8. Any invasive sampling (e.g., biopsy samples, fin clips) or tagging (e.g., flipper, PIT) of incidentally captured sea turtles and Atlantic sturgeon can only be performed by individuals possessing a valid ESA section 10 permit authorizing those activities. Fin clip sampling procedures for Atlantic sturgeon must be done in accordance with the protocols in Appendix G.	common practice in fisheries science. Tissue sampling does not appear to impair an animal's ability to swim and is not thought to have any long-term adverse impact. We have received no reports of injury or mortality to any sea turtles or Atlantic sturgeon sampled in this way.
4. <u>RELEASE OR RETENTION</u>: Any <u>live</u> sea turtles or Atlantic sturgeon caught and retrieved in Virginia pound net fishing gear covered under this Opinion must ultimately be released according to guidance provided by our Marine Animal hotline or established protocols and whenever environmental conditions are safe for those releasing the animal(s) to do so. Injured sea turtles may be transferred to an appropriately permitted facility identified by and at the suggestion of the NMFS Marine Animal hotline or	9. All live, uninjured sea turtles and live Atlantic sturgeon that are incidentally captured in Virginia pound net fishing gear must be released from the gear and back into the water as quickly as possible to minimize stress to the animal. All injured sea turtles should be reported to the NMFS Marine Animal hotline or Virginia stranding network partner for further guidance on handling and transport, if necessary, to a rehabilitation facility. 10. In the event of any lethal takes of sea turtles or Atlantic sturgeon, any dead specimens or body parts retained by individuals with appropriate permits should be preserved (frozen is preferred, although refrigerated is permitted as well if a freezer is not available) until retention or disposal procedures are discussed with GARFO PRD. In the event a permitted stranding or salvage	RPM #4 and the accompanying Terms and Conditions establish the requirements for releasing or retaining sea turtles and Atlantic sturgeon captured in Virginia pound net fishing gear in order to provide live animals with the best chance for survival post-capture and to gather additional information on the cause of death of dead animals.

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (T&Cs)	Justifications for RPMs and T&Cs
Virginia stranding network partner. Any <u>dead</u> sea turtles or Atlantic sturgeon must be retained, if logistically feasible and instructed by GARFO PRD to do so, and then transferred to an appropriately permitted research facility either GARFO PRD will identify so that a necropsy can be undertaken to attempt to determine the cause of death and/or other appropriate examinations can take place. Sea turtle and Atlantic sturgeon carcasses should be held in cold storage until shipping or transfer.	network recipient is not available or the carcass is severely damaged or decayed to the point at which a necropsy would not be feasible, the animal should be disposed of at sea. It is up to the fisherman or responder to contact the Marine Animal hotline for assistance in determining the state of damage/decay and to see whether a necropsy or salvage of the carcass is needed. The form included as Appendix G (sturgeon salvage form) should be completed and submitted to us for any dead sturgeon captured.	
5. <u>REPORTING</u>: GARFO PRD must be notified of all observed takes of sea turtles and Atlantic sturgeon resulting from Virginia pound net fishing activities covered under this Opinion.	11. NMFS must ensure that GARFO PRD is notified within 24 hours of any interaction with a sea turtle or Atlantic sturgeon. These reports, included in Appendices E and F, must be sent via e-mail to Incidental.take@noaa.gov (preferred), sent by fax to (978) 281-9394, or called in to GARFO PRD. <u>The report must include at a minimum</u>: (1) reporter name and affiliation; (2) GPS coordinates (in decimal degrees or degrees/minutes/seconds) or a geographic	RPM #5 and the accompanying Terms and Conditions specify protocols for the reporting of information to GARFO PRD for any sea turtles and Atlantic sturgeon observed captured in Virginia pound net fishing gear. This is essential for monitoring the level of incidental take associated with the proposed action and ensuring that we can track any exceedance of the ITS.

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (T&Cs)	Justifications for RPMs and T&Cs
	description describing the specific location of the interaction; (3) portion and details of the gear involved (e.g., leader, heart, pound); (4) time and date of the interaction; and (5) identification of the animal to the species level. We also request the following information be provided: (1) a link to or acknowledgement that a clear photograph or video of the animal was taken (multiple photographs are suggested, including at least one photograph of the head scutes); (2) exact or estimated length/width of the animal; (3) ID numbers of external or internal tags either recorded from or applied to the animal; (4) condition of the animal upon retrieval and release/retention (e.g., alive uninjured, alive potentially injured, comatose or unresponsive, fresh dead, decomposed); and (5) a description of any care or handling provided. If reporting within 24 hours is not possible (e.g., due to distance from shore or lack of ability to communicate via phone, fax, or email), the interaction must be reported as soon as the fisherman or responder is in a position to do so and absolutely no later than 24 hours after the vessel returns to port. 12. NMFS must ensure that the Greater Atlantic Region's Sea Turtle Stranding and Disentanglement coordinator and Atlantic	

Reasonable and Prudent Measures (RPMs)	Terms and Conditions (T&Cs)	Justifications for RPMs and T&Cs
	sturgeon coordinator provide GARFO PRD section 7 staff with tabular summaries of sea turtle and Atlantic sturgeon interactions that were reported to them or documented in the Virginia pound net fishery each year.	

11.0 CONSERVATION RECOMMENDATIONS

In addition to section 7(a)(2), which requires agencies to ensure that proposed actions are not likely to jeopardize the continued existence of listed species, section 7(a)(1) of the ESA places a responsibility on all Federal agencies to use their authorities in furtherance of the purposes of the ESA by carrying out programs for the conservation of endangered and threatened species. Conservation Recommendations are discretionary activities designed to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information. The following additional measures are recommended regarding incidental take and conservation of sea turtles and Atlantic sturgeon:

1. NMFS and VMRC should advise Virginia pound net fishermen before the start of each fishing season about: (a) the presence of sea turtles and Atlantic sturgeon in the action area, (b) care to be taken when hauling gear to avoid damage to sea turtles and Atlantic sturgeon that may be caught in the gear but are not visible upon retrieval of the gear, and (c) the need to routinely check gear and haul it as quickly as possible in order to determine whether sea turtles or Atlantic sturgeon are present in the gear.
2. NMFS should continue to explore alterations of modified pound net leaders to reduce leatherback sea turtle interactions in the gear.
3. NMFS should expand education and outreach and establish an award program to promote incentives to assist in prevention activities. Outreach focuses on providing information to fishermen and the public about conditions, causes, and solutions to protecting endangered species and continuing commercial fishing. Involvement engages people to solicit their ideas and comments to help direct conservation ideas and participate meaningfully in decision-making processes. Parties that demonstrate innovation and leadership in resource protection should be rewarded and used as models for others.
4. NMFS should continue to support research on the seasonal distribution, abundance, movements, and health of both sea turtles and Atlantic sturgeon in Chesapeake Bay to better understand the ecology of the animals incidentally captured in pound net gear.
5. NMFS should work with the state of Virginia and pound net fishermen to determine the catch species composition in pounds and hearts and the bottom substrate types where pound nets are usually set to better assess the potential motivation for sea turtles and Atlantic sturgeon to enter and/or interact with pound nets.
6. NMFS should continue to support research to better understand the ecological function of Chesapeake Bay and sea turtle and Atlantic sturgeon prey availability over time. This information may provide information on the foraging ecology of these species and the potential for increased foraging in and around pound net gear.
7. Due to a lack of long-term data on the seasonal presence of Atlantic sturgeon in the lower Chesapeake Bay, and their use of it, NMFS should continue to coordinate and collaborate with U.S. FWS on sturgeon research efforts in Virginia waters.

12.0 REINITIATION OF CONSULTATION

This concludes formal consultation on the NMFS gear regulations for the Virginia pound net fishery. As provided in 50 CFR 402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is

authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) the agency action is subsequently modified in a manner that causes an effect to the listed species or critical habitat not considered in this Opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In the event that the amount or extent of incidental take is exceeded section 7 consultation must be reinitiated immediately.

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APPENDIX A

Sea turtle handling and resuscitation measures as found at 50 CFR 223.206(d)(1).

(d) (1) (i) Any specimen taken incidentally during the course of fishing or scientific research activities must be handled with due care to prevent injury to live specimens, observed for activity, and returned to the water according to the following procedures.

(A) Sea turtles that are actively moving or determined to be dead as described in (d)(1)(i)(C) of this section must be released over the stern of the boat. In addition, they must be released only when fishing or scientific collection gear is not in use, when the engine gears are in neutral position, and in areas where they are unlikely to be recaptured or injured by vessels.

(B) Resuscitation must be attempted on sea turtles that are comatose, or inactive, as determined in paragraph (d)(1) of this section by:

(1) placing the turtle on its bottom shell (plastron) so that the turtle is right side up, and elevating its hindquarters at least 6 inches (15.2 cm) for a period of 4 up to 24 hours. The amount of the elevation depends on the size of the turtle; greater elevations are needed for larger turtles. Periodically, rock the turtle gently left to right and right to left by holding the outer edge of the shell (carapace) and lifting one side about 3 inches (7.6 cm) then alternate to the other side. Gently touch the eye and pinch the tail (reflex test) periodically to see if there is a response.

(2) sea turtles being resuscitated must be shaded and kept damp or moist but under no circumstance be placed into a container holding water. A water-soaked towel placed over the head, neck, and flippers is the most effective method in keeping a turtle moist.

(3) sea turtles that revive and become active must be released over the stern of the boat only when fishing or scientific collection gear is not in use, when the engine gears are in neutral position, and in areas where they are unlikely to be recaptured or injured by vessels. Sea turtles that fail to respond to the reflex test or fail to move within 4 hours (up to 24, if possible) must be returned to the water in the same manner as that for actively moving turtles.

(C) A turtle is determined to be dead if the muscles are stiff (rigor mortis) and/or the flesh has begun to rot; otherwise the turtle is determined to be comatose or inactive and resuscitation attempts are necessary.

SEA TURTLE HANDLING AND RESUSCITATION REQUIREMENTS

IF YOU ENCOUNTER AN ENTANGLED, INJURED OR UNRESPONSIVE SEA TURTLE,
please immediately call the National Marine Fisheries Service Northeast Region Hotline:

866-755-NOAA (6622)

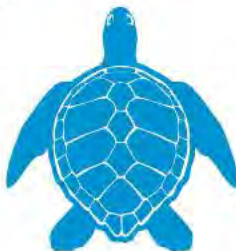


Any sea turtle taken incidentally during fishing must be handled with care to prevent injury, observed for activity, and returned to the water according to the following procedures:

A A SEA TURTLE THAT IS ACTIVELY MOVING OR IS DEAD (THAT IS, IF MUSCLES ARE STIFF AND/OR THE FLESH HAS BEGUN TO ROT) MUST BE RELEASED OVER THE VESSEL'S STERN ONLY:

- When fishing gear is not in use,
- When the engine is in neutral, and
- In areas where the turtle is unlikely to be recaptured or injured by vessels.

OTHERWISE, YOU MUST CONSIDER THE TURTLE UNRESPONSIVE AND ATTEMPT RESUSCITATION AS DESCRIBED IN **B**.



You are strongly encouraged to read the full regulation, which can be found at 50 CFR 223.206(d)(1).

B YOU MUST ATTEMPT RESUSCITATION ON SEA TURTLES THAT ARE UNRESPONSIVE AS FOLLOWS:



1 Place the turtle top shell up* and elevate its hindquarters at least 6" (or 15-30°) for at least 4 hours and up to 24 hours.

- The amount of elevation depends on the turtle's size; larger turtles require greater elevation.
- In warm weather (over 60 °F), keep the turtle shaded and moist, preferably by placing a damp towel over the head, shell, and flippers. You must NOT place the turtle into a container of water.

2 Periodically rock the turtle gently side to side by holding the outer edge of the shell and lifting one side about 3", then alternate to the other side.

3 Periodically gently touch the eye and pinch the tail (reflex tests) to see if there is a response.

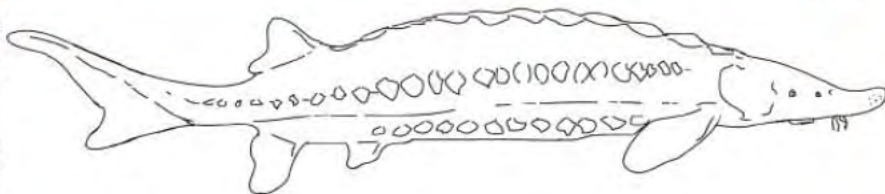
C IF THE TURTLE REVIVES AND BECOMES ACTIVE DURING RESUSCITATION EFFORTS, you must release it over the vessel's stern as described in **A**.

If the turtle does not respond to the reflex test (as described in **B 3**) or move within 4 hours (up to 24 hours, if possible), you must return the turtle to the water in the same manner.



Atlantic Sturgeon

ESA Listed Species



Atlantic Sturgeon are Protected

If you incidentally catch an Atlantic sturgeon which is responsive and lively, return the fish to the water immediately. However:

- **If the fish is nonresponsive, it is important that you try to resuscitate the fish**

Atlantic sturgeon that have appeared nonresponsive, have been successfully resuscitated after being placed in oxygenated water or set up with a hose of water running out and over the gills for at least 30 minutes.

For a complete description of the prohibitions and exemptions for Atlantic sturgeon, call NOAA's National Marine Fisheries Service Northeast Region Protected Resources Division at 978-281-9328, or visit the Atlantic sturgeon recovery website at http://www.nero.noaa.gov/prot_res/atlsturgeon/.

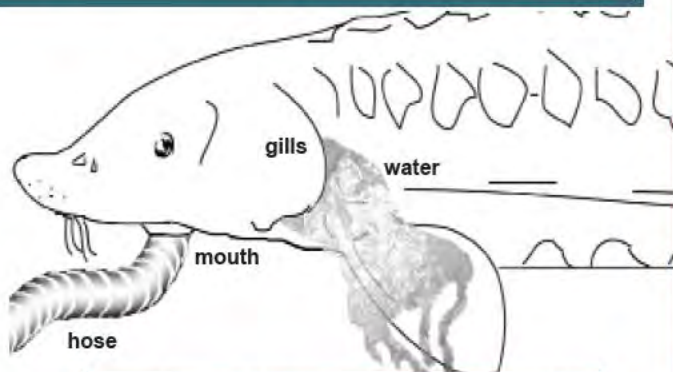


Atlantic Sturgeon

ESA Listed Species



Atlantic sturgeon removed from fishing gear may be nonresponsive. It is often possible to resuscitate these fish by flushing water, over the gills until recovery is obvious. The most effective way to resuscitate fish is through the mouth, as if the fish were swimming forward.



Hose inserted up through mouth and to the side to allow water to flow over gills.

Resuscitation with a Hose

- Use wet hands or wet rag and support the belly when handling.
- Use a pump and hose with water (For example: 1 1/2" engine-driven wash down pump).
- Place the hose into the mouth and to the side, using a soft piece of sponge/cloth to keep the metal/hard plastic from injuring the inside of the fish's mouth.
- Use enough water pressure to gently flush water over gills. Heavy water pressure can harm the fish.
- Make sure water is running out and over the gills and NOT down the throat into the digestive tract.

Resuscitation should be attempted on all nonresponsive fish for at least 30 minutes. If the fish remains nonresponsive after 30 minutes, the fish should be considered dead and the carcass returned to the water.

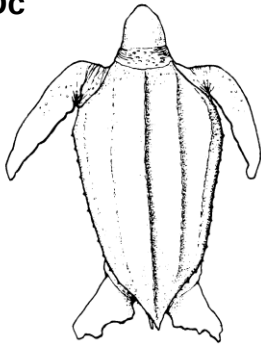
For a complete description of the prohibitions and exemptions for Atlantic sturgeon, call NOAA's National Marine Fisheries Service Northeast Region Protected Resources Division at 978-281-9328, or visit the Atlantic sturgeon recovery website at http://www.nero.noaa.gov/prot_res/atlsturgeon/.

APPENDIX D

Identification Key for Sea Turtles and Sturgeon Found in Northeast U.S. Waters

SEA TURTLES

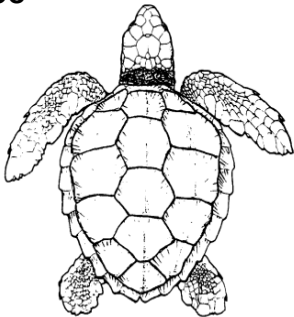
Dc



Leatherback (*Dermochelys coriacea*)

Found in open water throughout the Northeast from spring through fall. Leathery shell with 5-7 ridges along the back. Largest sea turtle (4-6 feet). Dark green to black; may have white spots on flippers and underside.

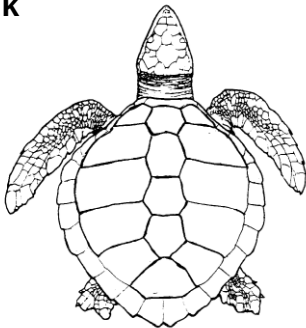
Cc



Loggerhead (*Caretta caretta*)

Bony shell, reddish-brown in color. Mid-sized sea turtle (2-4 feet). Commonly seen from Cape Cod to Hatteras from spring through fall, especially in southern portion of range. Head large in relation to body.

Lk

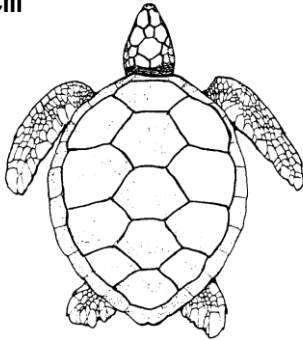


Kemp's ridley (*Lepidochelys kempi*)

Most often found in Bays and coastal waters from Cape Cod to Hatteras from summer through fall. Offshore occurrence undetermined. Bony shell, olive green to grey in color. Smallest sea turtle in Northeast (9-24 inches). Width equal to or greater than length.

APPENDIX D, continued

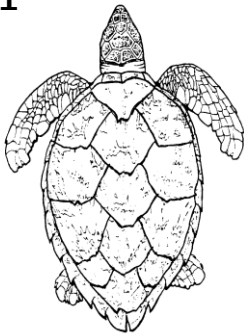
Cm



Green turtle (*Chelonia mydas*)

Uncommon in the Northeast. Occur in Bays and coastal waters from Cape Cod to Hatteras in summer. Bony shell, variably colored; usually dark brown with lighter stripes and spots. Small to mid-sized sea turtle (1-3 feet). Head small in comparison to body size.

Ei

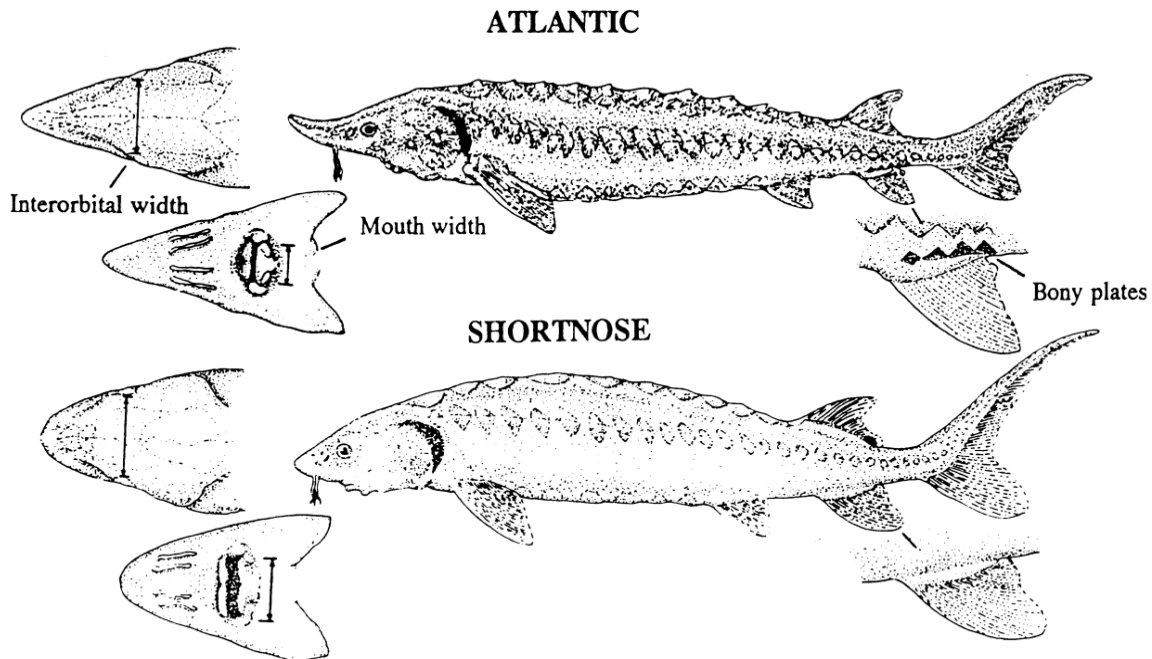


Hawksbill (*Eretmochelys imbricata*)

Rarely seen in Northeast. Elongate bony shell with overlapping scales. Color variable, usually dark brown with yellow streaks and spots (tortoise-shell). Small to mid-sized sea turtle (1-3 feet). Head relatively small, neck long.

APPENDIX D, continued

SHORTNOSE AND ATLANTIC STURGEON



Distinguishing Characteristics of Atlantic and Shortnose Sturgeon

Characteristic	Atlantic Sturgeon, <i>Acipenser oxyrinchus</i>	Shortnose Sturgeon, <i>Acipenser brevirostrum</i>
Maximum length	> 9 feet/ 274 cm	4 feet/ 122 cm
Mouth	Football shaped and small. Width inside lips < 55% of bony interorbital width	Wide and oval in shape. Width inside lips > 62% of bony interorbital width
*Pre-anal plates	Paired plates posterior to the rectum & anterior to the anal fin.	1-3 pre-anal plates almost always occurring as median structures (occurring singly)
Plates along the anal fin	Rhombic, bony plates found along the lateral base of the anal fin (see diagram below)	No plates along the base of anal fin
Habitat/Range	Anadromous; spawn in freshwater but primarily lead a marine existence	Freshwater amphidromous; found primarily in fresh water but does make some coastal migrations

* From Vecsei and Peterson, 2004

SEA TURTLE STRANDING AND SALVAGE NETWORK – STRANDING REPORT

OBSERVER'S NAME / ADDRESS / PHONE:

First _____ M.I. _____ Last _____

Affiliation _____

Address _____

Area code/Phone number _____

STRANDING DATE:

Year 20____ Month ____ Day ____

Turtle number by day ____

State coordinator must be notified within 24 hrs;

this was done by ☐ phone☐ email ☐ fax☐ stranding hotline

SPECIES: (check one)

☐ CC = Loggerhead☐ CM = Green☐ DC = Leatherback☐ EI = Hawksbill☐ LK = Kemp's Ridley☐ LO = Olive Ridley☐ UN = Unidentified*Check Unidentified if not positive. Do Not Guess.*Carcass necropsied? ☐ Yes ☐ NoPhotos taken? ☐ Yes ☐ NoSpecies verified by state coordinator? ☐ Yes ☐ No

SEX:

☐ Undetermined☐ Female ☐ Male

Does tail extend beyond carapace?

☐ Yes; how far? _____ cm / in☐ No

How was sex determined?

☐ Necropsy☐ Tail length (adult only)STRANDING LOCATION: ☐ Offshore (Atlantic or Gulf beach) ☐ Inshore (bay, river, sound, inlet, etc)

State _____ County _____

Descriptive location (be specific) _____

Latitude _____ Longitude _____

CONDITION: (check one)

☐ 0 = Alive☐ 1 = Fresh dead☐ 2 = Moderately decomposed☐ 3 = Severely decomposed☐ 4 = Dried carcass☐ 5 = Skeleton, bones only

FINAL DISPOSITION: (check)

☐ 1 = Left on beach where found; painted? ☐ Yes* ☐ No(5)☐ 2 = Buried: ☐ on beach / ☐ off beach;
carcass painted before buried? ☐ Yes* ☐ No☐ 3 = Salvaged: ☐ all / ☐ part(s), what/why? _____☐ 4 = Pulled up on beach/dune; painted? ☐ Yes* ☐ No☐ 6 = Alive, released☐ 7 = Alive, taken to rehab. facility, where? _____☐ 8 = Left floating, not recovered; painted? ☐ Yes* ☐ No☐ 9 = Disposition unknown, explain _____**If painted, what color? _____*TAGS: *Contact state coordinator before disposing of any tagged animal!!*Checked for flipper tags? ☐ Yes ☐ No

Check all 4 flippers. If found, record tag number(s) / tag location / return address _____

PIT tag scan? ☐ Yes ☐ No

If found, record number / tag location _____

Coded wire tag scan? ☐ Yes ☐ No

If positive response, record location (flipper) _____

Checked for living tag? ☐ Yes ☐ No

If found, record location (scute number & side) _____

CARAPACE MEASUREMENTS: (see drawing)

Using calipers

Circle unit

Straight length (NOTCH-TIP) _____ cm / in

Minimum length (NOTCH-NOTCH) _____ cm / in

Straight width (Widest Point) _____ cm / in

Using non-metal measuring tape

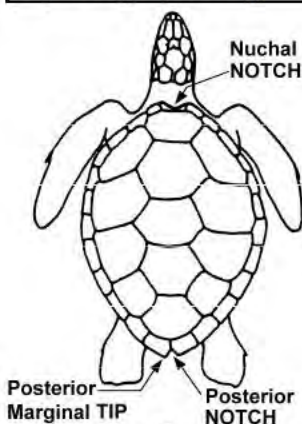
Circle unit

Curved length (NOTCH-TIP) _____ cm / in

Minimum length (NOTCH-NOTCH) _____ cm / in

Curved width (Widest Point) _____ cm / in

Circle unit

Weight ☐ actual / ☐ est. _____ kg / lb

Mark wounds / abnormalities on diagrams at left and describe below (note tar or oil, gear or debris entanglement, propeller damage, epibiota, papillomas, emaciation, etc.). Please note if no wounds / abnormalities are found.



SEA TURTLE ENTANGLEMENT REPORT FORM

OMB Control No. 0648-0496; Exp Date: 08/31/2020

FIELD #: _____

Shaded area for NOAA Fisheries Service (NMFS) use only EVENT CONFIRMATION: ☐ Confirmed ☐ Probable ☐ Not confirmed

INITIAL OBSERVATION: Observer name: _____ Phone: _____

Observer affiliation: _____

Observation date: _____ (mm / dd / yyyy) Time: _____ ☐ am ☐ pmTurtle condition: ☐ Alive ☐ Fresh dead ☐ Moderately decomposed ☐ Severely decomposed ☐ Dried carcass ☐ Skeleton ☐ Unknown

EXAMINATION / RESPONSE: Responder name: _____ Phone: _____

Responder affiliation: _____

Response date: _____ (mm / dd / yyyy) Time responder arrived on scene: _____ ☐ am ☐ pmTurtle condition: ☐ Alive ☐ Fresh dead ☐ Moderately decomposed ☐ Severely decomposed ☐ Dried carcass ☐ Skeleton ☐ UnknownPHOTO DOCUMENTATION: Photos taken: ☐ Yes ☐ No Video taken: ☐ Yes ☐ NoDocumentation of: ☐ Turtle in gear ☐ Injuries / entanglement site ☐ Buoy colors, numbers and any other identifiable feature(s)

LOCATION: State: _____ County: _____ Nearest port / town: _____

Locality details: _____ Stranded ashore: ☐ Yes ☐ No

Latitude: _____ N Longitude: _____ W

TURTLE DATA: Species or description: _____

Straight carapace length:** _____ ☐ cm ☐ in ☐ actual ☐ est.Sex: ☐ Male ☐ Female ☐ Not examined ☐ CBDCurved carapace length:** _____ ☐ cm ☐ in ☐ actual ☐ est.Does tail extend beyond carapace? ☐ Yes ☐ No

**Carapace length is measured from nuchal notch to posterior tip (see diagram in instructions)

If Yes, how far? _____ ☐ cm ☐ in ☐ actual ☐ est.Weight: _____ ☐ kg ☐ lb ☐ actual ☐ est.Sex determined by: ☐ Necropsy ☐ Tail length (adults only) ☐ N/A

GEAR TYPE: Indicate the primary (in contact with turtle) entangling gear with a "P" and secondary gear with an "S". Fill out all applicable details.

____ Vertical Line with Surface Buoy

Line attached to bottom gear: ☐ Yes ☐ No If Yes, bottom gear: ☐ Pot(s) ☐ Net ☐ Unknown ☐ Other: _____Length of line between turtle and surface buoy: _____ ☐ cm ☐ in ☐ actual ☐ est.

____ Line Only (no buoy)

Type: ☐ Monofilament ☐ Multifilament (e.g. nylon or poly rope) ☐ UnknownHook(s) present: ☐ Yes ☐ No If Yes, where attached to turtle: ☐ Not attached ☐ Mouth ☐ Ingested (past mouth) ☐ Soft tissue (not mouth)Line attached to bottom gear: ☐ Yes ☐ No If Yes, bottom gear: ☐ Pot(s) ☐ Net ☐ Unknown ☐ Other: _____

____ Net

Type: ☐ Monofilament ☐ Multifilament (e.g. nylon) ☐ Unknown

____ Fish Trap (pound net / weir)

Location: ☐ Free-swimming in trap ☐ Entangled in leader ☐ Entangled in trap ☐ Other (describe in Additional Remarks)

____ Other Describe: _____

GEAR DETAILS:

Net Estimated stretched mesh size: _____ ☐ cm ☐ in ID number(s): _____

Pot(s) Number of pots: _____ ID Number(s): _____

Buoy(s) Number of buoys: _____

Buoy 1Buoy 2Buoy 3

Type

Color/Pattern

ID Number(s) / Letter(s)

Line(s)

Number of lines: _____ Color 1: _____ Color 2: _____ Color 3: _____

Biofouling present on gear: ☐ Yes ☐ No If Yes, % of visible gear covered by biofouling: _____ % (describe type of biofouling in Additional Remarks)Gear retrieved: ☐ Yes- all ☐ Yes- partially ☐ No If Yes, disposition: ☐ Initial observer ☐ STDN member ☐ State agency ☐ NMFS Gear Team

DISENTANGLEMENT OUTCOME: (Check one)

☐ Disentangled and released☐ Entangled / no action taken☐ Relocated to: _____☐ Partially disentangled and released☐ Entangled / not relocated☐ Euthanized☐ Collected for treatment at: _____☐ Lost during disentanglement☐ Other: _____

CARCASS / SAMPLE DISPOSITION: (Check all that apply)

☐ Left at site☐ Necropsied☐ Biopsied☐ Towed ashore☐ Scientific collection☐ Other: _____☐ Buried ☐ Off beach ☐ On beach☐ Educational collection☐ Unknown

TAG / MARK DATA: Checked for flipper tags: ☐ Yes ☐ No Scanned for PIT tags: ☐ Yes ☐ No				
Tag / mark type	Numbers	Location on animal	Applied	Present
			☐	☐
			☐	☐
			☐	☐

ENTANGLEMENT / WOUND DESCRIPTION: *Use table below to describe the entanglement configuration and any wounds associated with the entanglement site. Check all that apply. Note the specific location, # wraps, partial or complete circumference, tight vs. loose, etc).*

Body area involved	Movement impaired	Indentation	Skin abraded	Muscle exposed	Bone exposed	Swelling	Discoloration	Tissue necrotic/sloughing
☐ Head / neck	☐ Description:	☐	☐	☐	☐	☐	☐	☐
☐ Front flippers	☐ Description:	☐	☐	☐	☐	☐	☐	☐
☐ Carapace / plastron	☐ Description:	☐	☐	☐	☐	☐	☐	☐
☐ Rear flippers	☐ Description:	☐	☐	☐	☐	☐	☐	☐

BEHAVIORAL OBSERVATIONS
Response to Approach and Handling: *Check one.*

☐ Vigorous movement
☐ Movement slow, sluggish, or weak
☐ Unconscious / Unresponsive
☐ Could not evaluate

Response Upon Release: *Check one from each row below.*

☐ Vigorous movement
☐ Movement slow, sluggish, or weak
☐ Movements abnormal (e.g. uncoordinated, circling, listing)
☐ Could not evaluate

☐ Dives and/or swims away within 1 minute
☐ Remains at surface and/or does not swim deliberately away within 1 minute

Describe Behavior:

EVENT SUMMARY AND ADDITIONAL REMARKS:

DISCLAIMER

These data should not be used out of context or without verification. This should be strictly enforced when reporting signs of human interaction.

The collection of information on sea turtle entanglement is necessary to ensure sea turtles are being conserved and protected, as mandated by the Endangered Species Act of 1973, as amended. Your voluntary collection and submission of this information will help achieve this objective. The public reporting burden for this collection of information is estimated to average one hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Notwithstanding any other provision of the law, no person is required to respond to, nor shall any person be subject to a penalty for failure to comply with, a collection of information subject to the requirements of the Paperwork Reduction Act, unless that collection of information displays a currently valid OMB Control Number. Personal identifiers and any commercial information will be kept confidential to the extent permitted under the Freedom of Information Act (FOIA) (5 U.S.C. 552), the Department of Commerce FOIA regulations (15 CFR Part 4, Subpart A), the Trade Secrets Act (18 U.S.C. 1905), and NOAA Administrative Order 216-100. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to (NMFS, Greater Atlantic Regional Fisheries Office Protected Resources Division, 55 Great Republic Drive, Gloucester, MA 01930).

Northeast Region Sea Turtle Disentanglement Network

Instructions for Completing the Sea Turtle Entanglement Report Form

FIELD #: Indicate the field number given to the animal / event by the response organization. This number should be a unique identifier. It is possible for more than one agency to respond to an individual animal, in which case a single event may have more than one field number.

Shaded area is for NOAA Fisheries Service (NMFS) use only

EVENT CONFIRMATION: NMFS will determine if an event was confirmed, probable, or not confirmed and describe how that decision was made. *Please leave this section blank.*

INITIAL OBSERVATION: The initial observation is the first time the entangled turtle was sighted. The observer is the individual who encountered the entangled turtle first-hand and reported it to the Sea Turtle Disentanglement Network (STDN) or NMFS either directly or through another individual or agency.

- **Observer name and phone number:** Record the full name and contact phone number for the initial observer. If the report was relayed to the STDN by an intermediate source, do not put the intermediate source as the initial observer.
- **Observer affiliation:** Record the affiliation, if applicable, for the initial observer. If no affiliation, please indicate a general description of the initial observer (e.g., recreational boater, commercial fisherman, etc.).
- **Observation date and time:** Record the full date and time of the initial observation, i.e., the time the animal was actually sighted. This is *not* the date and time of the report, i.e., when the initial observer contacted the STDN or NMFS.
- **Turtle condition:** Check the box for the condition code that best describes the turtle during the initial observation. If the turtle was dead and seemed intermediate between two codes, choose the most appropriate option. Fresh dead turtles should have no foul smell; moderately decomposed turtles have a foul smell, but skin and scutes are intact or only beginning to peel, internal organs are still distinguishable; severely decomposed turtles have scutes lifting or gone and skin beginning to peel or liquefy, with hard to distinguish internal organs; dried carcasses are leathery, with internal organs completely decomposed. If uncertain about the condition check unknown and provide a description of the turtle's condition in Event Summary and Additional Remarks (herein Additional Remarks) on back.

EXAMINATION / RESPONSE: The responder is the person who examined, handled, disentangled and/or collected data on the turtle in the field or attempted to do so.

- **Responder name and phone number:** Record the full name and contact phone number for the responder. The responder may be the initial observer if the initial observer also disentangled the turtle, either on their own or with direction from the STDN.
- **Responder affiliation:** Record the affiliation of the responder.
- **Response date and time responder arrived on scene:** Please record the full date and time when the response team arrived on scene, i.e., the disentanglement or examination was initiated.
- **Turtle condition:** Check the box for the condition code that best describes the turtle when the response team arrived on scene. See Turtle Condition above for more details.

PHOTO DOCUMENTATION:

- **Photos taken:** Please indicate if photos were taken. All photos and video should be sent to NMFS at the same time as submission of the STERF.
- **Video taken:** Please indicate if video was taken. Documentation of turtle behavior through video is invaluable in post interaction mortality determination.
- **Documentation:** The following list indicates the photos that should be taken during each entanglement event. Please check the appropriate boxes to indicate that these photos were taken.
 - o The sea turtle in the entangling gear, showing overall gear configuration and confirming species;
 - o Close-ups of the entanglement site(s), showing any injuries and detailed gear configuration; and
 - o Any identifiable features of the gear, e.g., buoy color, tags and/or numbers.

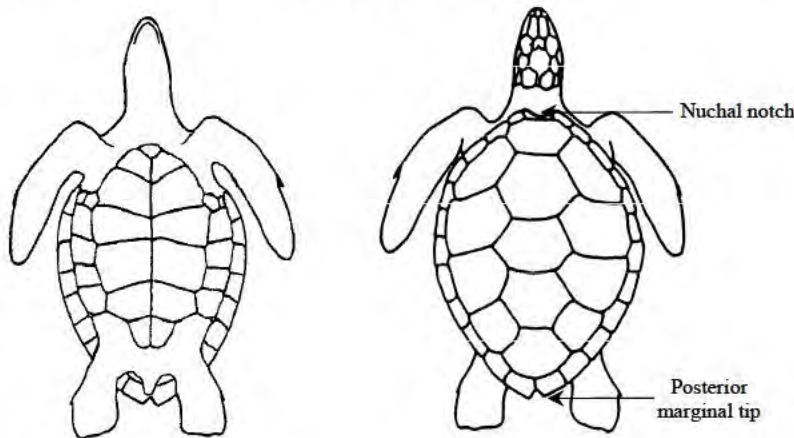
LOCATION: Fill in all fields in this section.

- **State:** Provide the two letter abbreviation for the state where the entanglement occurred. If the entanglement occurred in the EEZ, outside the three-mile boundary of state waters, indicate the closest state to the entanglement location.
- **County:** Indicate the county where the entanglement occurred. If the entanglement occurred in the EEZ, indicate EEZ waters.

- **Nearest port / town:** Indicate the nearest port or town.
- **Locality details:** Include a general description of the event location, including proximity to land. Please only reference places that can be readily found on maps; do not use "local" names.
- **Stranded ashore:** Please check "yes" if the animal stranded on land naturally. Please check "no" if the animal was in the water and was not brought to shore or if the animal was collected from the water and brought to a rehab or necropsy facility. If this was the case, make sure you indicate that the animal was collected for treatment or necropsy under Disentanglement Outcome or Carcass Disposition.
- **Latitude and longitude:** Make every effort to collect the GPS location for all entanglement events. Provide latitude / longitude in decimal degrees (e.g., 42.5321°N). If you are given Loran units by the initial observer, please convert it to latitude / longitude, but also provide the original Loran numbers.

TURTLE DATA:

- **Species or description:** Record the turtle species only if *definitively* identified by a trained responder or photo documentation. If species is unknown or not confirmed by one of the two above methods, please provide a description of the turtle (including features such as coloration and number of vertebral and/or costal scutes). Every effort should be made to take photos of the turtle for species verification. Photos of the carapace and head are most useful. If you are unsure about the species ID, take several photos from different angles. Do not guess. Please contact NMFS if you need sea turtle identification materials.
- **Straight carapace length:** Straight carapace length is measured using calipers from the nuchal notch to the posterior marginal tip (see drawing below). Indicate whether measurement is in inches or centimeters and whether it is actual or estimated. Please indicate that length is an estimate if the reporting party provides a total length rather than a carapace length.



- **Curved carapace length:** Curved carapace length is measured using a soft tape measure from the nuchal notch to the posterior tip, following the curvature of the dorsal centerline.
- **Weight:** Indicate the turtle's weight, as well as whether weight is in kilograms or pounds and whether it is actual or estimated. Please leave blank if unsure.
- **Sex:** Check whether the turtle was male or female; check unknown if you are unsure. Immature sea turtles cannot be sexed externally, so please check unknown if dealing with a live immature turtle. Adult male turtles have a tail that extends well beyond the posterior tip of the carapace. Check whether the tail extends beyond the carapace. If you document a turtle with a long tail, please measure the length of the tail beyond the carapace and record the measurement. Please be aware that juvenile males may not show this characteristic; therefore, if unsure about the age class of the animal, do not use tail length for sex determination. Indicate how sex was determined; if sex was marked unknown, check N/A in this field.

GEAR TYPE: Please indicate the primary entangling gear by putting a "P" in the space next to the appropriate gear type. Primary entangling gear is that which was *in direct contact* with the turtle. There can be more than one set and/or type of primary gear. Please indicate any secondary gear by putting an "S" in the space next to the appropriate gear type. Secondary gear is any gear that was present, but *not* in direct contact with the turtle. For example, if a turtle was entangled in vertical line, which itself was tangled with monofilament, you would put a "P" next to Vertical Line with Surface Buoy and an "S" next to Line Only and check Monofilament.

- **Vertical Line with Surface Buoy:** Indicate this gear type if the entangling gear included line and a surface buoy. Check whether or not the buoy and line were attached to gear on the bottom, meaning that the line was attached to something heavy below the surface. If yes, indicate whether it was weighted by a pot, net, other item (please

describe), or it is unknown. Indicate the length of line between the turtle (i.e., the entanglement site) and the surface buoy, as well as whether this length is in centimeters or inches and whether it is actual or estimated.

- **Line Only (no buoy):** Indicate this option if the entangling gear was only an expanse of line with no buoys attached. Check whether the line was monofilament, multifilament (such as nylon or polypropylene rope), or unknown. Check whether there was a hook(s) associated with the entangling line and, if so, if and where it was attached to the turtle. As above, check whether or not the buoy and line were attached to gear on the bottom, meaning that the line was attached to something heavy below the surface. If yes, indicate whether it was weighted by a pot, net, other item (please describe), or it is unknown.
- **Net:** Indicate this option if the entangling gear was netting or mesh. Check whether the net was monofilament (e.g., gillnet) or multifilament (e.g., nylon or poly mesh as in a trawl net). *NOTE: If turtle was entangled in the vertical line of a gill net, you should check Vertical Line with Surface Buoy and then indicate that the gear was weighted with a net.*
- **Fish Trap (pound net / weir):** Indicate this gear type if the turtle was caught in any part of a fish trap. Check whether the turtle was free-swimming in the trap, entangled in the trap leader, entangled in the trap, or other. If other, please describe nature of the interaction in Additional Remarks.
- **Other:** Indicate this option if the entangling gear did not fit into any of the above categories. Describe the gear as much as possible; continue in Additional Remarks, if necessary.

GEAR DETAILS: Record any of the applicable gear details.

- **Net**
 - o Estimated stretched mesh size: Record the length between opposite corners / knots of the mesh when pulled taut, as well as whether this measurement is in centimeters or inches.
 - o ID number(s): Document any net numbers that were present.
- **Pot(s)**
 - o Number: Provide the number of pots involved with the entanglement, with as specific information as possible. If there was a pot trawl, but the exact number of pots is unknown, write ">1" or "trawl".
 - o ID Number(s): Document any pot numbers that were present.
- **Buoy(s)**
 - o Number: Record the number of buoys associated with the entanglement.
 - o Space is available to provide addition buoy information for up to three buoys. Provide any further information in Additional Remarks.
 - Type: Please specify the buoy shape: Bullet, Acorn, Round, Polyball, Other. Also note whether it is a single or double buoy (Double Bullet, Double Acorn, or Bullet/Acorn) and whether there is a stick, flag, and/or radar reflector present on the buoy(s).
 - Color/Pattern: Please provide an overall description of the buoy coloration / pattern, in particular noting the color on the bottom (side attached to the vertical line) of the buoy.
 - ID Number(s) / Letter(s): Please record the ID number(s) / letter(s) on the buoy.
- **Line(s)**
 - o Number: Provide the number of different lines involved in the entanglement.
 - o Space is available to provide the line color for up to three lines. Provide any further information in Additional Remarks.
- **Biofouling present on gear:** Check whether there was biofouling (e.g., sponges, tunicates, bivalves, algae, etc.) visible on the entangling gear. If so, estimate the percentage of the visible gear that was covered by biofouling. Please describe the type of biofouling present in Additional Remarks.
- **Gear retrieved:** Check if all, some, or none of the gear was collected. If gear was collected, indicate its disposition, i.e., where the gear is located at the time this form is submitted to NMFS. If the location of the gear changes after the form is submitted, please contact NMFS with the updated gear location or update this information on the STERF and resubmit.
 - o Gear collected from endangered or threatened sea turtles requires a Chain of Custody form.
 - o Every effort should be made to send gear to NMFS *immediately* with the chain-of-custody form (address below).

Unless otherwise authorized, gear should only be collected if it is not actively fishing (i.e., only collect derelict, incomplete or displaced gear). Do not create derelict gear by collecting surface buoys, thereby leaving bottom gear unmarked.

DISENTANGLEMENT OUTCOME: This section pertains to LIVE animals only; if the event involved a dead sea turtle, leave this section blank and go to Carcass Disposition. Please check ONE of the listed options to describe the disposition of the live animal at the time of this report being submitted to NMFS. If the turtle was disentangled by the reporting party and it is not clear whether it was completely freed of gear, check unknown and describe in Additional Remarks. If the turtle

was collected for treatment, please provide the name of the rehabilitation facility. If the turtle was relocated, please provide the latitude and longitude and/or locality details of the release site.

CARCASS DISPOSITION: This section pertains to DEAD animals only; if the event involves a live sea turtle, leave this section blank and go to Disentanglement Outcome. Please choose one *or more* of the listed options to describe the disposition of the carcass and/or samples at the time of this report being submitted to NMFS. In the marine environment, biopsy samples are only authorized to be collected from dead turtles.

TAG / MARK DATA: Space is provided for three tags / marks; if necessary continue in Additional Remarks.

- **Checked for flipper tags:** Please indicate whether or not all four flippers of the turtle were examined for the presence of flipper tags.
- **Scanned for PIT tags:** Please indicate whether or not the turtle was scanned, using a PIT tag scanner, for the presence of PIT tags.
- **Tag / mark type:** In this column, please indicate the type of any tags or marks that were either applied during response or discovered upon examination. Examples include, but are not limited to, inconel tag, PIT tag, paint mark, living tag, or satellite tag.
- **Numbers:** In this column, please indicate any numbers associated with tags or marks that were either applied during response or discovered upon examination.
- **Location on animal:** Use this column to indicate the location on the animal of tags or marks that were either applied during response or discovered upon examination.
- **Applied or Present:** Check whether the tag or mark referred to in that row was applied during response or present at the time of examination.

ENTANGLEMENT / WOUND DESCRIPTION:

Use the table to describe the entanglement configuration and any wounds associated with the entanglement site.

- **Body area involved:** In this column, please check the box(es) corresponding to the areas of the body directly involved with the entanglement.
- For each body area, there are eight boxes (see below) that may be checked to describe the nature of injury at the entanglement site. In addition, there is space for a description of the entanglement configuration and wounds. Use this space to describe the exact location of wraps in that body area, the number of wraps, whether they were complete or partial circumference, whether they were tight (i.e., no space between tissue and gear) or loose (some space between tissue and gear), and any other details that describe the entanglement. Continue in Additional Remarks if necessary.
 - o **Movement impaired:** movement in this body area is abnormal.
 - o **Indentation:** a depression in the tissue at the entanglement site; skin was not missing or broken.
 - o **Skin abraded:** wearing away / erosion of the upper layer of skin at the entanglement site as a result of friction from the gear; an abrasion involves only the skin and not the underlying tissue.
 - o **Muscle exposed:** muscle is visible at the entanglement site.
 - o **Bone exposed:** bone is visible at the entanglement site.
 - o **Swelling:** tissue swollen at the entanglement site.
 - o **Discoloration:** skin is discolored pale, white, brown, red, green, or anything beyond normal limits.
 - o **Tissue necrotic / sloughing:** tissue necrotic, i.e. skin and underlying tissue discolored (pale, white, brown, red, or green) and easily falling apart or splitting.

BEHAVIORAL OBSERVATIONS

- **Response to Approach and Handling:** Choose one of the four options to best describe the turtle's behavior during approach and disentanglement. If behavior is unknown, please check Could not evaluate.
- **Response Upon Release:**
 - o Choose one of the four options in the first row to best describe the turtle's behavior once the gear was removed. If behavior is unknown, please check Could not evaluate.
 - o Choose one of the two options in the second row to best describe how soon the turtle swam away after disentanglement.
- **Describe Behavior:** Use this space to elaborate on behavior during disentanglement or upon release. Use the Additional Remarks section if need be.

EVENT SUMMARY AND ADDITIONAL REMARKS: *Do not leave this section blank!* Please provide a summary of the disentanglement event, including progression of events, overall behavior of the animal and amount of time spent on scene. Detail any other unusual circumstances, entanglement configuration, behavior, gear description, tag information or wounds not yet accounted for. Include any other information or remarks on the case.

NMFS CONTACT INFORMATION:**Electronic submission of photos, video and STERFs (preferred means of submission):**Kate.Sampson@noaa.gov**Mailing address:**

NOAA Fisheries Service, Greater Atlantic Regional Fisheries Office, Protected Resources Division

55 Great Republic Drive, Gloucester, MA 01930

Fax: 978-281-9394

Photos, video, STERFs, and/or biopsy samples: Attn: Kate Sampson, Sea Turtle Disentanglement Coordinator**Gear with chain of custody forms:** Attn: David Morin, Atlantic Entanglement Response Program**Please address any questions to:**Ph: 978-282-8470, Kate.Sampson@noaa.gov

The collection of information on sea turtle entanglement is necessary to ensure sea turtles are being conserved and protected, as mandated by the Endangered Species Act of 1973, as amended. Your voluntary collection and submission of this information will help achieve this objective. The public reporting burden for this collection of information is estimated to average one hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Notwithstanding any other provision of the law, no person is required to respond to, nor shall any person be subject to a penalty for failure to comply with, a collection of information subject to the requirements of the Paperwork Reduction Act, unless that collection of information displays a currently valid OMB Control Number. Personal identifiers and any commercial information will be kept confidential to the extent permitted under the Freedom of Information Act (FOIA) (5 U.S.C. 552), the Department of Commerce FOIA regulations (15 CFR Part 4, Subpart A), the Trade Secrets Act (18 U.S.C. 1905), and NOAA Administrative Order 216-100. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to (NMFS, Greater Atlantic Regional Fisheries Office Protected Resources Division, 55 Great Republic Drive, Gloucester, MA 01930)

OMB Control No: 0648-0496; Exp Date: 08/31/2020

APPENDIX F

Incident Report: ESA Listed Species Take

Photographs should be taken and the following information should be collected from all listed fish and sea turtles (alive and dead) collected.

Observer's full name: _____

Reporter's full name: _____

Species Identification: _____

Type of Gear and Length of deployment:

Date animal observed: _____ Time animal observed: _____

Date animal collected: _____ Time animal collected: _____

Environmental conditions at time of observation (i.e., tidal stage, weather):

Water temperature (°C) at site and time of observation: _____

Describe location of animal and how it was documented (i.e., observer on boat):

Sturgeon Information:

Species _____

Fork length (or total length) _____ Weight _____

Condition of specimen/description of animal

Fish Decomposed: NO SLIGHTLY MODERATELY SEVERELY

Fish tagged: YES / NO Please record all tag numbers. Tag # _____

Photograph taken: YES / NO

(please label species, date, geographic site and vessel name when transmitting photo)

Genetics Sample taken: YES / NO

Genetics sample transmitted to: _____ on ____/____/20____

APPENDIX G

Procedure for obtaining fin clips from sturgeon for genetic analysis

1. Wash hands and use disposable gloves. Ensure that any knife, scalpel, or scissors used for sampling has been thoroughly cleaned and wiped with alcohol to minimize the risk of contamination.
2. For any sturgeon, after the specimen has been measured and photographed, take a one-cm square clip from the pelvic fin.
3. Place fin clips in small screw top vials (2 mL screw top plastic vials are preferred) with preservative. Avoid using glass vials.
4. Label each vial with fish's unique ID number that matches the ID number you record on the metadata sheet. This is critical for accurate tracking and record keeping.
5. RNAlater™ is the preferred preservative and is not hazardous. Ninety-five percent absolute ETOH (un-denatured) is an accepted alternative. Note that ETOH is a Class 3 Hazardous Material due to its flammable nature.
6. If non-screw top vials are used, seal individual vials with leak proof positive measure (e.g., tape).
7. Package vials together (e.g., in one box) with an absorbent material within a double-sealed container (e.g., zip lock baggie).
8. If using excepted quantities of ETOH, follow DOT and IATA packaging regulations, including affixing ETOH warning label to air package. Accepted quantities of ETOH is 30 mL per inner package and 1 L for the total package.
9. A sub-sample of the fin clip must be sent to the sturgeon genetics archive at the USGS facility in Leetown, WV.
 - a. Submit sample metadata to rjohnson1@usgs.gov with a cc to incidental.take@noaa.gov. Electronic metadata must be provided in order to properly identify and archive samples. A copy of the electronic metadata was emailed to the Federal agency point of contact for this Opinion and a list of the metadata fields is included below. Retain a copy of metadata sheets for your records.
 - b. Mail samples to:

Robin Johnson
U.S. Geological Survey
Leetown Science Center
Aquatic Ecology Branch
11649 Leetown Road
Kearneysville, WV 25430
10. Send a subsample and associated metadata to the NMFS-approved lab for processing to determine DPS or river of origin per the agreement you have with that facility.

Metadata to be recorded for each genetic sample submitted to USGS and other NMFS-approved lab:

- Collection Date
- Species (ATS/SNS)
- Collector
- Collector Email
- Collector Phone Number
- Permit/Biological Opinion Number
- Permit Holder, Responsible Party (RP), or Principal Investigator (PI)
- Holder, RP, or PI Email
- Holder, RP, or PI Phone Number
- Unique Fish ID
- PIT Tag Number
- Location Collected
- Latitude
- Longitude
- Fork Length (mm)
- Total Length (mm)
- Weight (g)
- Sex
- Preservative
- Tag Info Available (Y/N)
- Tag Info
- Mortality (Y/N)
- Mortality Type
- Release of Information to Interested Party
- Recapture (Y/N)
- Comments

APPENDIX H

STURGEON DATA COLLECTION FORM

For use in documenting dead sturgeon in the wild under ESA permit no. 17273 (version 7-24-2015)

INVESTIGATORS'S CONTACT INFORMATION Name: First _____ Last _____ Agency Affiliation _____ Email _____ Address _____ _____ Area code/Phone number _____	UNIQUE IDENTIFIER (Assigned by NMFS) DATE REPORTED: Month Day Year 20 DATE EXAMINED: Month Day Year 20

SPECIES: (check one) ☐ shortnose sturgeon ☐ Atlantic sturgeon ☐ Unidentified <i>Acipenser</i> species <i>Check "Unidentified" if uncertain .</i> See reverse side of this form for aid in identification.	LOCATION FOUND: ☐ Offshore (Atlantic or Gulf beach) ☐ Inshore (bay, river, sound, inlet, etc) River/Body of Water _____ City _____ State _____ Descriptive location (be specific) _____ _____ Latitude _____ N (Dec. Degrees) Longitude _____ W (Dec. Degrees)

CARCASS CONDITION at time examined: (check one) ☐ 1 = Fresh dead ☐ 2 = Moderately decomposed ☐ 3 = Severely decomposed ☐ 4 = Dried carcass ☐ 5 = Skeletal, scutes & cartilage	SEX: ☐ Undetermined ☐ Female ☐ Male How was sex determined? ☐ Necropsy ☐ Eggs/milt present when pressed ☐ Borescope	MEASUREMENTS: Circle unit Fork length _____ cm / in Total length _____ cm / in Length ☐ actual ☐ estimate Mouth width (inside lips, see reverse side) _____ cm / in Interorbital width (see reverse side) _____ cm / in Weight ☐ actual ☐ estimate _____ kg / lb

TAGS PRESENT? Examined for external tags including fin clips? ☐ Yes ☐ No Scanned for PIT tags? ☐ Yes ☐ No		
Tag # _____ _____	Tag Type _____ _____	Location of tag on carcass _____ _____

CARCASS DISPOSITION: (check one or more) ☐ 1 = Left where found ☐ 2 = Buried ☐ 3 = Collected for necropsy/salvage ☐ 4 = Frozen for later examination ☐ 5 = Other (describe) _____	Carcass Necropsied? ☐ Yes ☐ No Date Necropsied: _____ Necropsy Lead: _____ _____	PHOTODOCUMENTATION: Photos/video taken? ☐ Yes ☐ No Disposition of Photo/Video: _____ _____ _____

SAMPLES COLLECTED? ☐ Yes ☐ No		
Sample _____ _____ _____ _____ _____	How preserved _____ _____ _____ _____ _____	Disposition (person, affiliation, use) _____ _____ _____ _____ _____

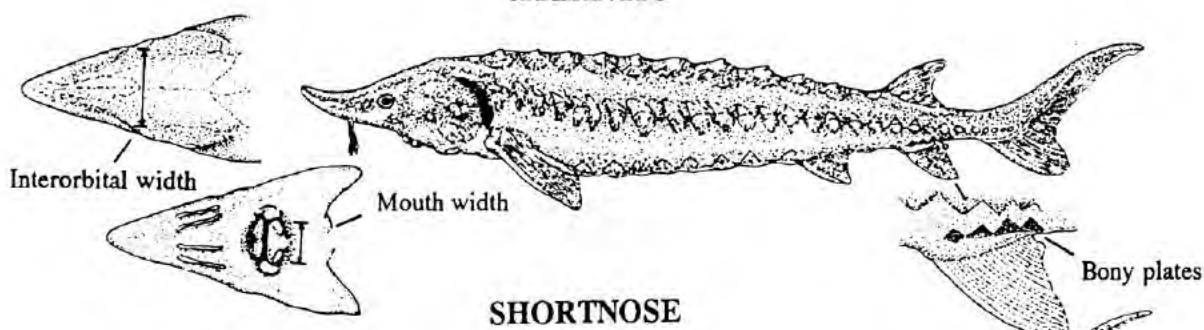
Comments:

Distinguishing Characteristics of Atlantic and Shortnose Sturgeon (version 7-24-2015)

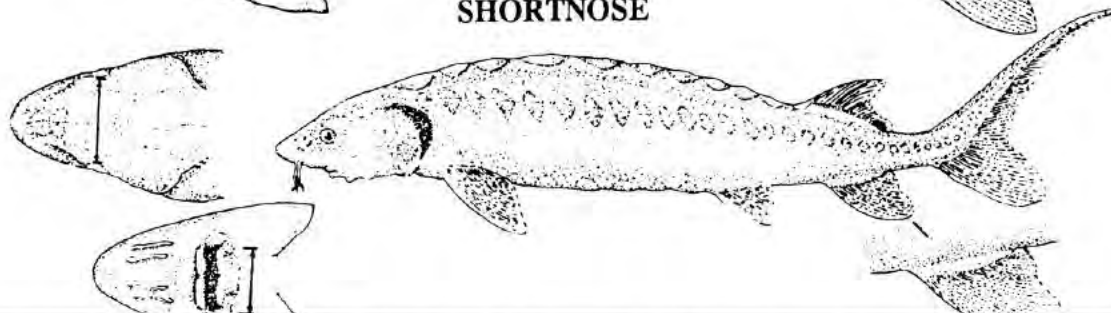
Characteristic	Atlantic Sturgeon, <i>Acipenser oxyrinchus</i>	Shortnose Sturgeon, <i>Acipenser brevirostrum</i>
Maximum length	> 9 feet/ 274 cm	4 feet/ 122 cm
Mouth	Football shaped and small. Width inside lips < 55% of bony interorbital width	Wide and oval in shape. Width inside lips > 62% of bony interorbital width
*Pre-anal plates	Paired plates posterior to the rectum & anterior to the anal fin.	1-3 pre-anal plates almost always occurring as median structures (occurring singly)
Plates along the anal fin	Rhombic, bony plates found along the lateral base of the anal fin (see diagram below)	No plates along the base of anal fin
Habitat/Range	Anadromous; spawn in freshwater but primarily lead a marine existence	Freshwater amphidromous; found primarily in fresh water but does make some coastal migrations

* From Vecsei and Peterson, 2004

ATLANTIC



SHORTNOSE



Describe any wounds / abnormalities (note tar or oil, gear or debris entanglement, propeller damage, etc.). Please note if no wounds / abnormalities are found.

Data Access Policy: Upon written request, information submitted to National Marine Fisheries Service (NOAA Fisheries) on this form will be released to the requestor provided that the requestor credit the collector of the information and NOAA Fisheries. NOAA Fisheries will notify the collector that these data have been requested and the intent of their use.

Submit completed forms (within 30 days of date of investigation) to: Greater Atlantic Regional Fisheries Office
Contacts – Edith Carson (Edith.Carson@noaa.gov, 978-282-8490) or Lynn Lankshear (Lynn.Lankshear@noaa.gov, 978-282-8473);
Southeast Region Contact- Stephania Bolden (Stephania.Bolden@noaa.gov, 727-551-5768).