

Appendix I: Maine DMR Risk Assessment Tool

In the absence of a way to quantitatively assess the risk reduction gained by incorporating weak points into vertical lines in Maine, ME DMR developed its own risk assessment tool utilizing many of the same principals and data inputs as NMFS' Decision Support Tool. However, the ME DMR risk assessment tool does not incorporate the results of the gear severity poll. Instead, the DMR calculation relies on data collected by its own vertical line research initiative and peer reviewed literature stating that gear which breaks under 1700lbs of force should significantly reduce the risk of serious injury and mortality in right whales (Knowlton 2015). The primary definition of risk that was presented and discussed at the October 2018 and April 2019 ALWTRT meetings remain the same:

$$\text{Risk} = \text{Whales} \times \text{Vertical Lines} \times \text{Threat}$$

ME DMR is proposing measures for vertical line reductions, as well as the insertion of weak points in vertical lines in a manner that differentiates measures by distance from shore. Therefore, the areas calculated in this risk assessment are broken up and presented as follows:

- Exemption line – 3 miles (Ex-3) or non-exempt state waters
- 3 miles – 12 miles (3-12); this combines measures from 3-6 and 6-12 miles
- 12 miles to the Area 1/3 line (12+)

Whales

To populate the whale portion of the above risk equation, ME DMR used the annual summed number of right whales per area above from the expanded Duke whale model in the NMFS Decision Support Tool. This is the latest version of the Duke right whale habitat model available. The expanded version of the model pushes right whales inshore past the original extent of the model, which may be inflating numbers in the nearshore areas. This component can easily be updated as changes are made to that input. Up-to-date numbers were received from the Northeast Fishery Science Center at the time of submission of this Plan. Using this method, less than 1% of annual right whale presence in Maine non-exempt waters occurs in state waters between the exemption line and the 3-mile line. Maine federal waters from the 3-mile line out to 12 miles constitutes 11% of Maine's annual right whale occurrence and 88% of Maine's right whale presence is contained beyond 12 miles. This is consistent with ME DMR's strategy to tailor the measures to more offshore areas where there the risk is higher.

It is important to note that ME DMR is evaluating the risk reduction gained by proposed measures for the portion of risk that Maine represents. The annual total of whale days presented above only includes those whales showing up in Maine's portion of the LMA1 in the expanded Duke model. For context, the total number of annual whale days in the domain within the Decision Support Tool is 222,129. As such, Maine represents less than 10% of this total.

Vertical Lines

The number of vertical lines in this risk assessment is taken from the Industrial Economics gear model, which is also used for Maine's portion of LMA1 in the NMFS Decision Support Tool. The total used in the calculation is the annual sum of vertical lines present by distance from shore and, therefore, does not represent the number of vertical lines in the water at any one time (the Industrial Economics model is often presented as a monthly average). Using this dataset, 63% of the vertical lines in the non-exempt

portion of the Maine lobster fishery are within state waters where most of the fleet is permitted. 29% of non-exempt gear occurs between 3 and 12 miles, while just 8% are fished outside 12 miles.

Threat

The calculation of the threat score is where this methodology departs from the NMFS Decision Support Tool. In this analysis the threat of a vertical line to a right whale is assessed as a binary value. The vertical line either poses a risk (breaks higher than 1700lbs) and is assigned a value of 1, or it does not pose a risk (breaks lower than 1700lbs) and is assigned a zero. Vertical lines that break at 1700lbs or less are considered to be zero risk of serious injury or mortality to right whales to maintain consistency with Knowlton (2015). ME DMR's science staff worked collaboratively with the fishing industry in Maine to collect and break more than 200 samples of vertical lines in 2018 and 2019 to determine the functional breaking strength of the gear as it is tied or spliced together in the fishery. The results of that study show that rope of a diameter of 5/16" or less can be considered weak, or reliably breaking below 1700lbs in a variety of vertical line configurations and rope material types (Figure 1).

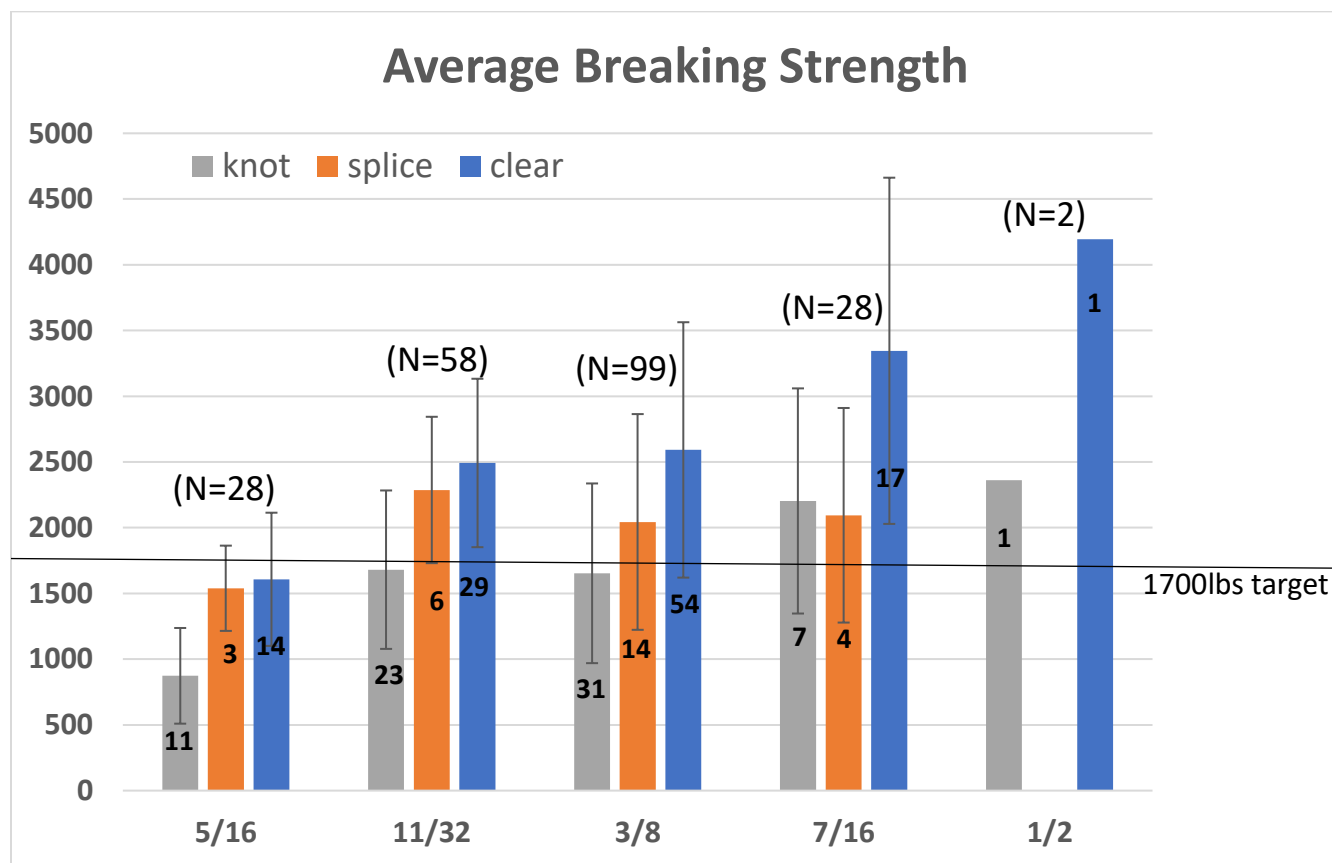


Figure 1. Breaking strength results of over 200 sample breaks from vertical lines donated by fishermen throughout the Gulf of Maine region. Results are presented in the pounds of force needed to break the line. Results are organized by rope diameter ranging from 5/16" to 1/2". The varying sample sizes for each diameter and sample type are denoted in the figure. Sample breaks included the knots (grey) or splices (orange) used to attach pieces of rope together to make up the vertical line. Unaltered (no knots or splices) lengths of lines were also broken to show how much a knot or splice reduces the breaking strength. Those breaks are labeled as "clear" in blue.

Therefore, ropes already known to be used the fishery that are 5/16" diameter or smaller were considered to already be weak and were removed from the baseline threat score. The use of 5/16" or smaller diameter line was documented by DMR science staff in a survey done collaboratively with the lobster fishery in 2018 on how vertical lines are rigged and fished by area. With more than 800 responses received, DMR was able to document that 14%, 9%, and 6% of respondents reported using 5/16" or smaller diameter line in non-exempt state waters, 3-12 miles, and 12+ miles respectively (Figure 2).

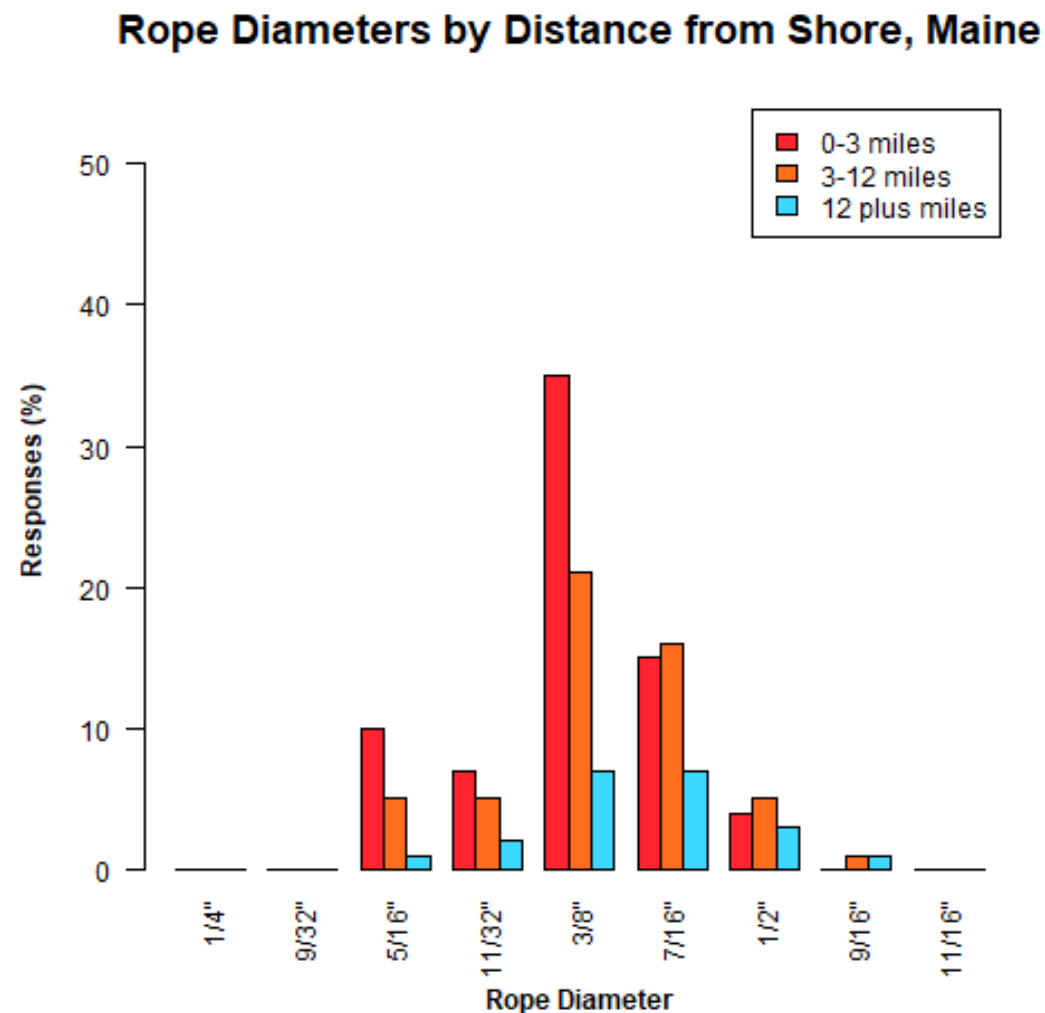


Figure 2. The percentage of responses to the ME DMR vertical line gear survey in 2018 that reported fishing with specific diameters of rope arranged by distance from shore.

The baseline use of weak (5/16" or smaller diameter rope) vertical lines was taken into account in the risk analysis, which acts to lower the amount of risk reduction that is received for adding weak points to lines in different areas. For example, 14% of vertical lines are already assumed to break below 1700lbs in non-exempt state waters. Therefore, no risk reduction credit is given to 14% of the vertical lines in that

area when calculating the risk benefit gained from adding weak points to vertical lines. The remaining 86% of lines in that area that are currently fished using ropes that break over 1700lbs can be used to calculate a risk reduction by adding weak points. All vertical lines using rope diameters larger than 5/16" were given a risk score of 1.

The Baseline

The baseline amount of risk associated with non-exempt waters in Maine's portion of LMA1 is calculated by area using the above definition of risk and multiplying the annual sum of whales, the annual sum of vertical lines, and the % of vertical lines breaking above 1700lbs and therefore posing a threat.

This was done by distance from shore so that different measures in those areas could be assessed against the amount of relative risk posed by that area. As seen in Table 1, non-exempt state waters accounts for 4% of Maine's relative risk of entanglement, while federal waters from 3-12 and 12+ account for 30% and 66% respectively.

Table 1. *The baseline annual sum of whales, vertical lines, and lines breaking above or below the 1700lb threshold by distance from shore in Maine non-exempt waters. Trends show that while the majority of the vertical lines are closer to shore, 88% of the annual total of whales occurs outside of 12 miles in Maine. Additionally, more of the vertical lines closer to shore utilize rope diameters 5/16" or smaller and, therefore, pose no risk to right whales. These two factors contribute to 66% of Maine's relative risk of entanglement to right whales being concentrated offshore beyond 12 miles.*

Baseline								
Whales		Vertical lines		Threat of Vertical lines		Risk		
Annual Sum	Percent	Annual Sum	Percent	Percent <= 1700	Percent > 1700	W*VL*T = R	Percent	
Ex-3	166	0.8%	934,924	63%	14%	86%	133,376,203	4%
3 to 12	2,369	11%	430,414	29%	9%	91%	932,309,353	30%
12+	18,474	88%	118,370	8%	6%	94%	2,048,096,772	66%
Totals	21,009		1,483,708				3,113,782,327	

Risk Analysis

To calculate the change in risk associated with measures in the ME DMR proposal, the same calculation can be done with a few changes to represent the impact of the proposed measures. The whale annual sum by area remains the same between the two calculations. In this scenario, the vertical line totals are reduced in each area by the percentage reduction gained by the relative trawl minimums being proposed. In the proposal this results in vertical line reductions of 25%, 21%, and 28% in non-exempt state waters, 3-12miles and outside 12miles, respectively. Lastly, the threat score is altered to account for the vertical lines that will have weak points built in to break the line at 1700lbs or less. The ME DMR proposal would implement a weak point into all vertical lines in state waters 50% of the way down the line. In federal waters from 3-12 miles, fishermen would be required to add two weak points into each

vertical line, with none being required more than 50% of the way down the line. Outside of 12 miles from shore, one weak point would be required 1/3 of the way down the vertical line. To include this measure in the calculation, all vertical lines were considered weak by the proportion of the way down the vertical line that the lowest weak point is required. The analysis assumes that any right whale entanglement in the top half of the vertical line will break the line at a designated weak point and free the whale, avoiding serious injury and mortality.

Table 2 summarizes how the risk calculation changes when proposed measures are implemented.

Table 2. *The resulting risk calculation with changes made for proposed risk reduction measures. Changes include a drop in vertical lines by area resulting from trawling-up regulations, and a gear threat in each area proportional to the location of the lowest weak point required.*

	Whales Annual Sum	Vertical Lines Annual Sum – % reduction	Threat % not Weak	Risk W*VL*T
Ex-3	166	701,193	50%	58,199,007
3 to 12	2,369	340,027	50%	402,761,703
12+	18,474	85,227	66%	1,039,153,100
	21,009	1,126,446		1,500,113,809

Relative risk reduction achieved by the proposed plan:

$$\text{Risk reduction} = 1 - (\text{Proposal Risk}/\text{Baseline Risk})$$

$$\text{Risk Reduction} = 1 - (1,500,113,809/3,113,782,327) = \underline{\underline{52\%}}$$