

## Functional Breaking Strength of Vertical Lines in the Gulf of Maine

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The population of endangered North Atlantic right whales, *Eubalaena glacialis*, is in decline and new federal regulatory measures for fixed gear fisheries aim to reduce the rate of serious injuries and mortalities due to entanglement. In 2018, the Maine Department of Marine Resources (DMR) was awarded funding through the Section 6 Species Recovery Grants to State program to develop a baseline of information for vertical line distribution, functional breaking strength, and hauling strain. To assess the functional breaking strength of ropes used in the Gulf of Maine, project partners collected and broke over 200 vertical line samples from fishermen throughout the Maine, New Hampshire, Massachusetts, Rhode Island, and offshore lobster fisheries. The manufacturers and types of rope varied and the average age of the rope ranged from three to six seasons. Preliminary findings show that rope diameter, age, and modifications (presence of knots and splices) significantly affect rope breaking strength. Project partners also hosted a rope breaking workshop in summer 2019, where lobster license holders tested the functional breaking strength of more than 20 vertical line modifications that might meet 1700lb breaking strength requirements. After the workshop, DMR identified seven rope modifications for further development and tested 10 samples of each. We will present the findings of the functional breaking strength of new and used rope in the Gulf of Maine and how these data, along with the outputs of the rope workshop, can be integrated into the regulatory measures to reduce vertical line entanglements.

# Functional breaking strength of vertical lines in the Gulf of Maine

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[www.maine.gov/dmr](http://www.maine.gov/dmr)

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# Project collaborators

NOAA's Section 6 Grants to States Program

- ▶ State agency partners: RI, MA, NH, ME
- ▶ Industry partners:
  - Maine Lobstermen's Association
  - Massachusetts Lobstermen's Association
  - Atlantic Offshore Lobstermen's Association
- ▶ Other:
  - FB Environmental Associates
  - University of Maine



# The Why

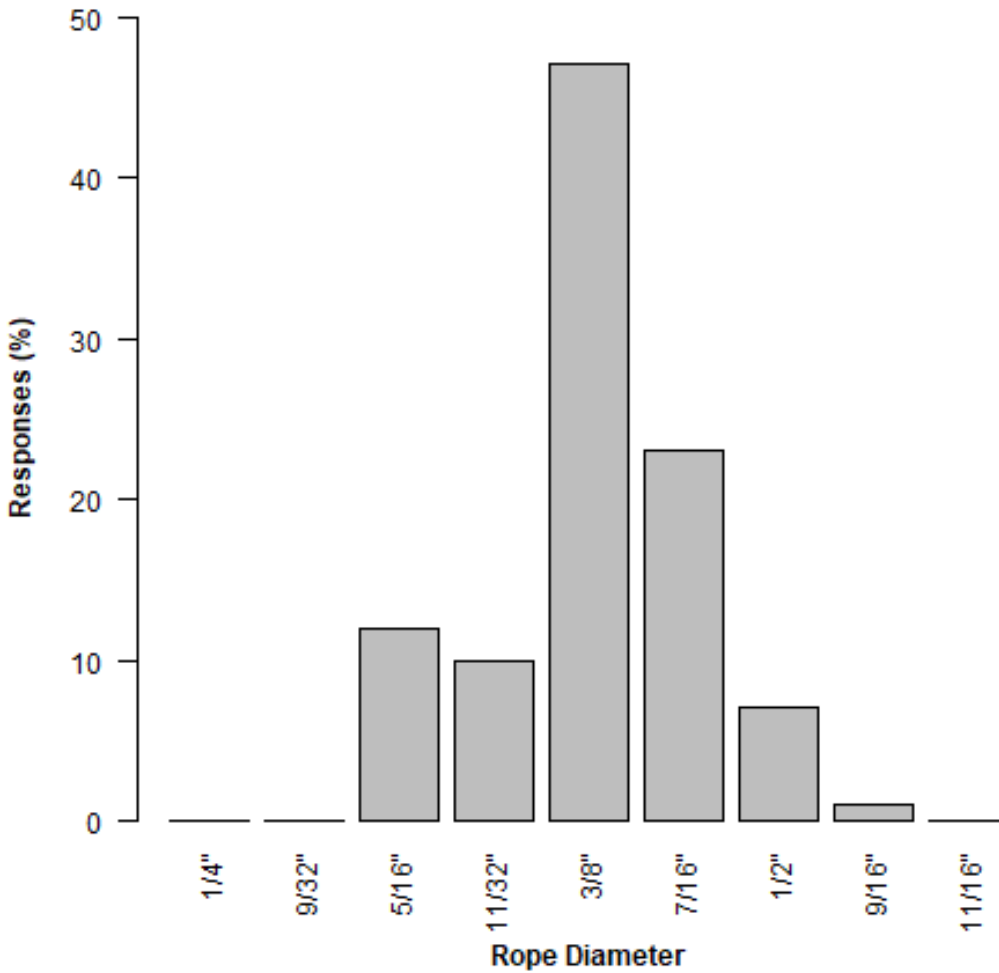
- ▶ “Weak” or 1700lb breaking strength line gained traction with some members of the Atlantic Large Whale Take Reduction Team as a gear modification
  - ▶ What is the fishery currently using in their gear?
  - ▶ How can this be implemented safely into the fishery while keeping costs low?
  - ▶ Gear modification an integral component to Maine DMR’s pending risk reduction proposal to NMFS
  - ▶ Provides a level of risk reduction for all ropes remaining in water after any vertical line reductions are put in place
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# Methods: Vertical line breaking strength

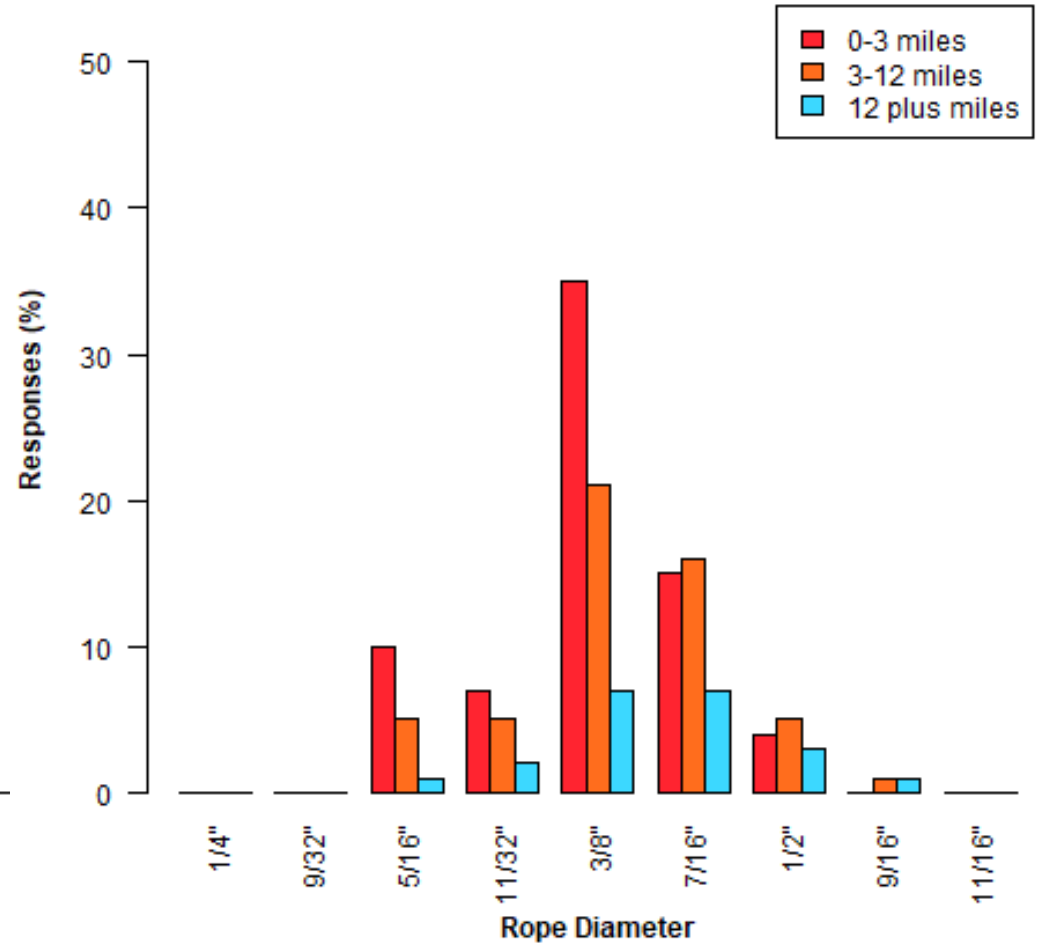
- ▶ Collecting vertical line samples from fishermen throughout New England
- ▶ Data collected:
  - Location fished
  - Average traps per trawl
  - Rope type
  - Rope diameter
  - Seasons fished



### Rope Diameters, Maine



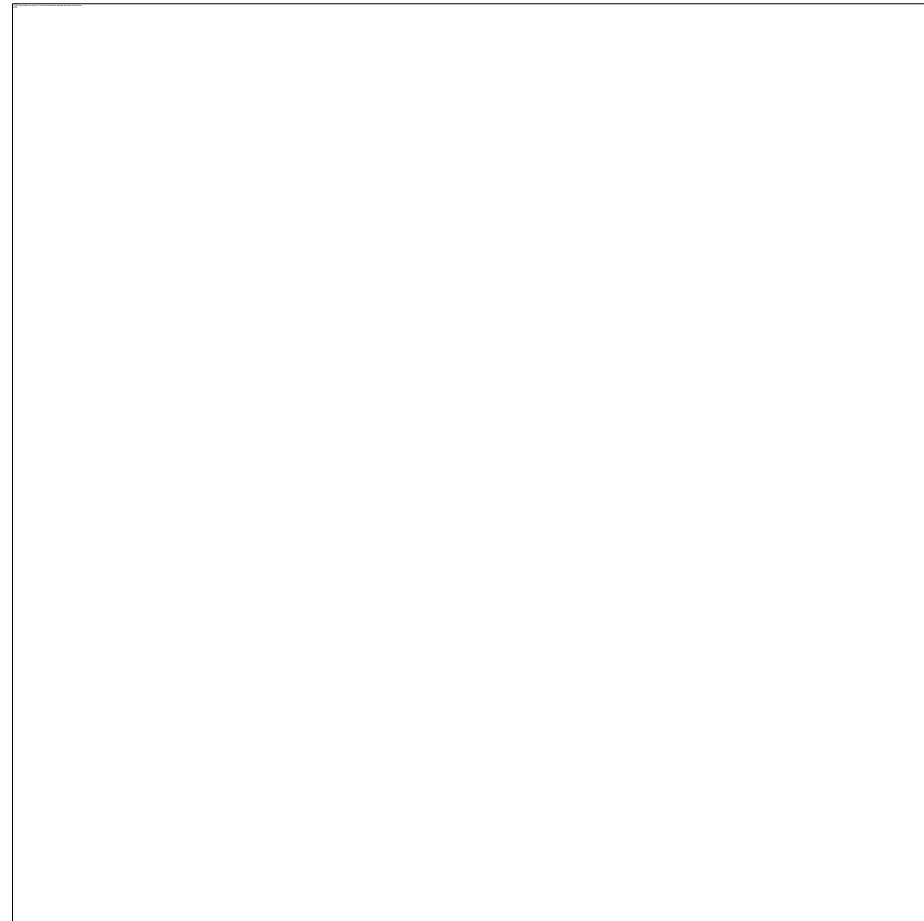
### Rope Diameters by Distance from Shore, Maine



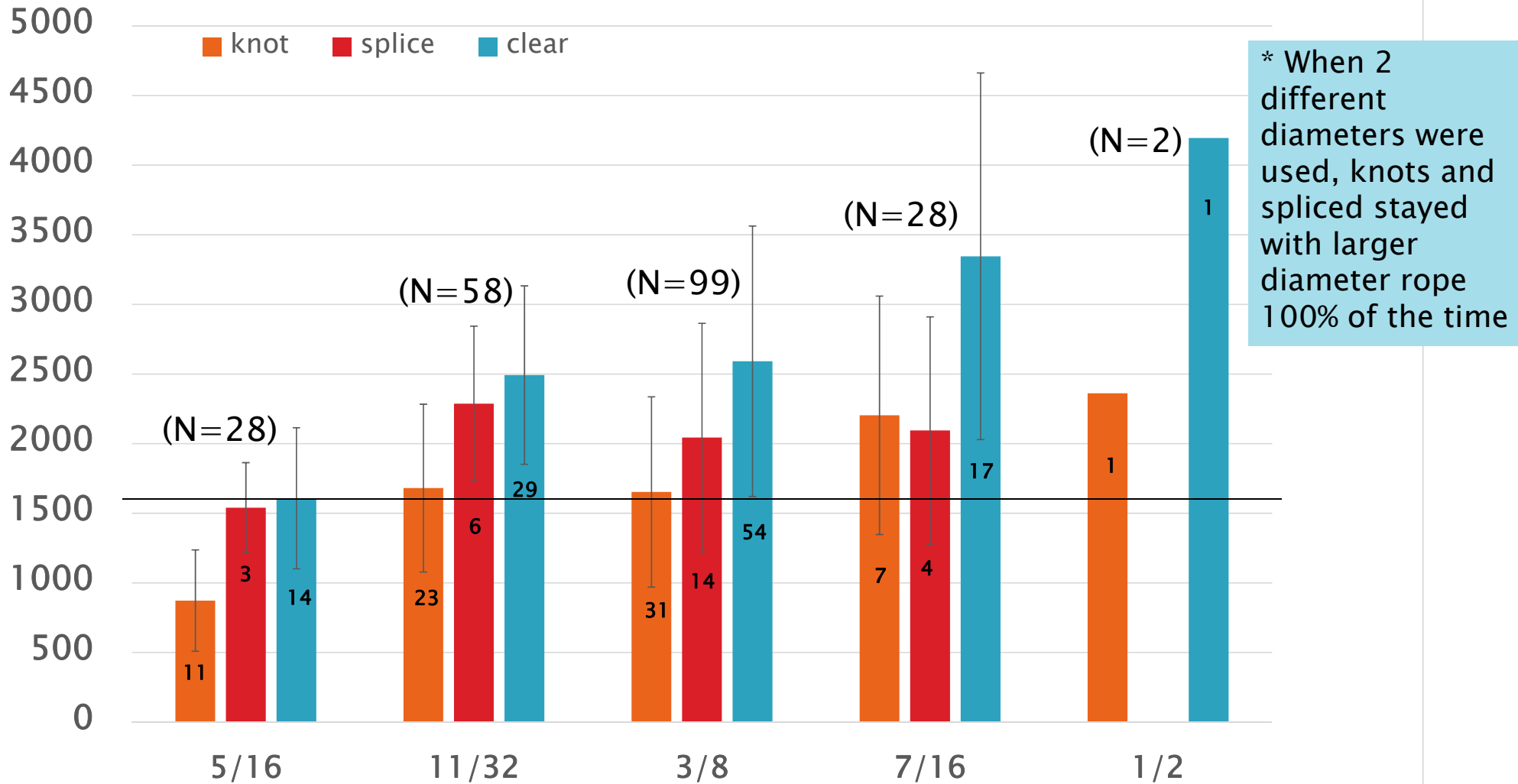


# Methods: Vertical line breaking strength

- ▶ 215 tests
  - 115 lengths of line
  - 73 knots
  - 27 splices
- ▶ Age of rope generally ranged from 3–6 seasons
- ▶ Samples included a variety of manufacturers and types of rope



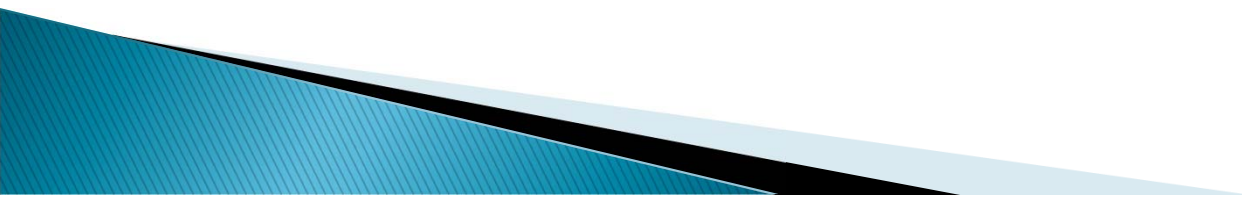
# Average Breaking Strength



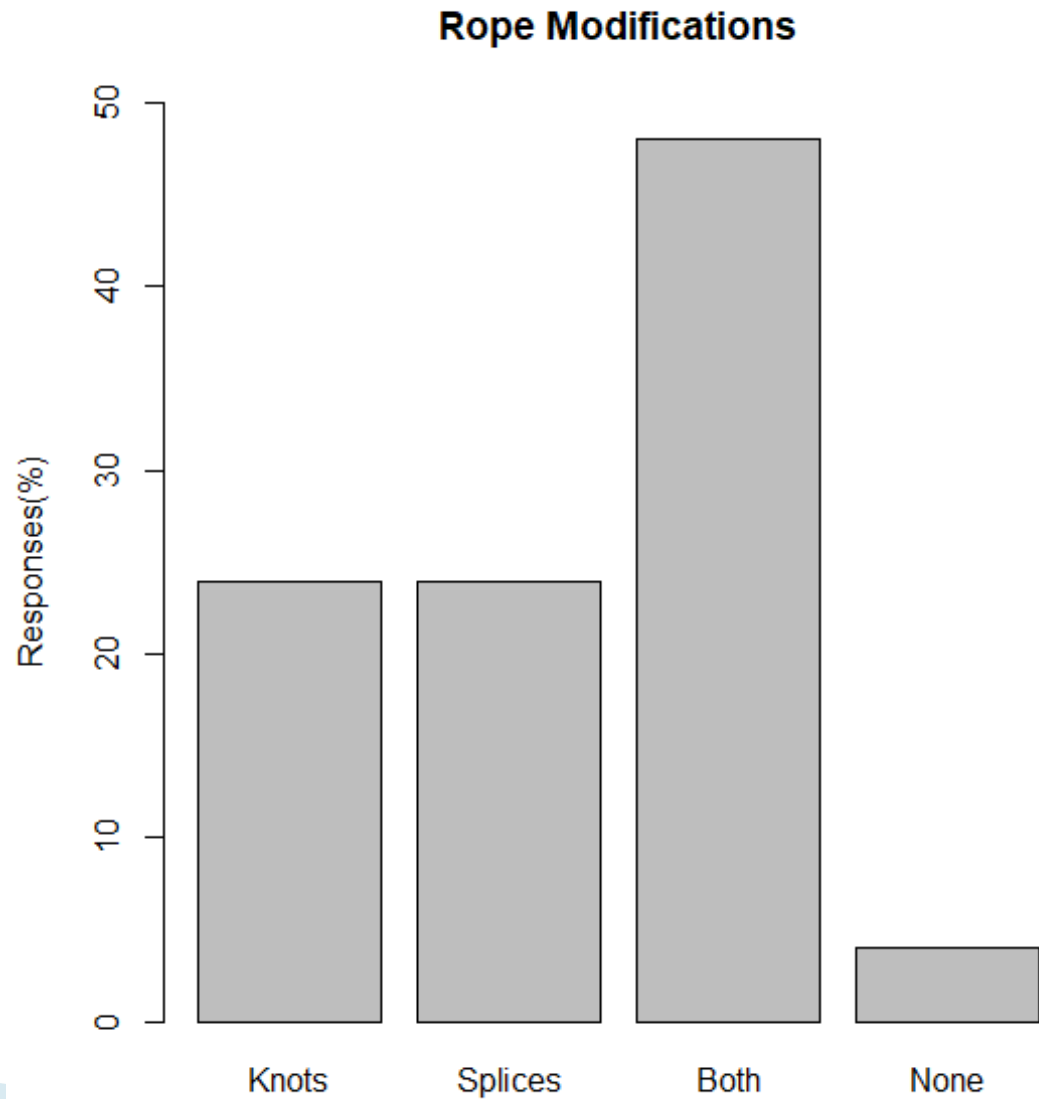


# Preliminary Results – Rope breaking

- ▶ There is a relationship between diameter and the breaking strength of the line
- ▶ Knots and splices weaken the line and breaks will occur at these points
- ▶ Where 2 different diameters of rope are knotted or spliced together the rope will break on the smaller diameter side

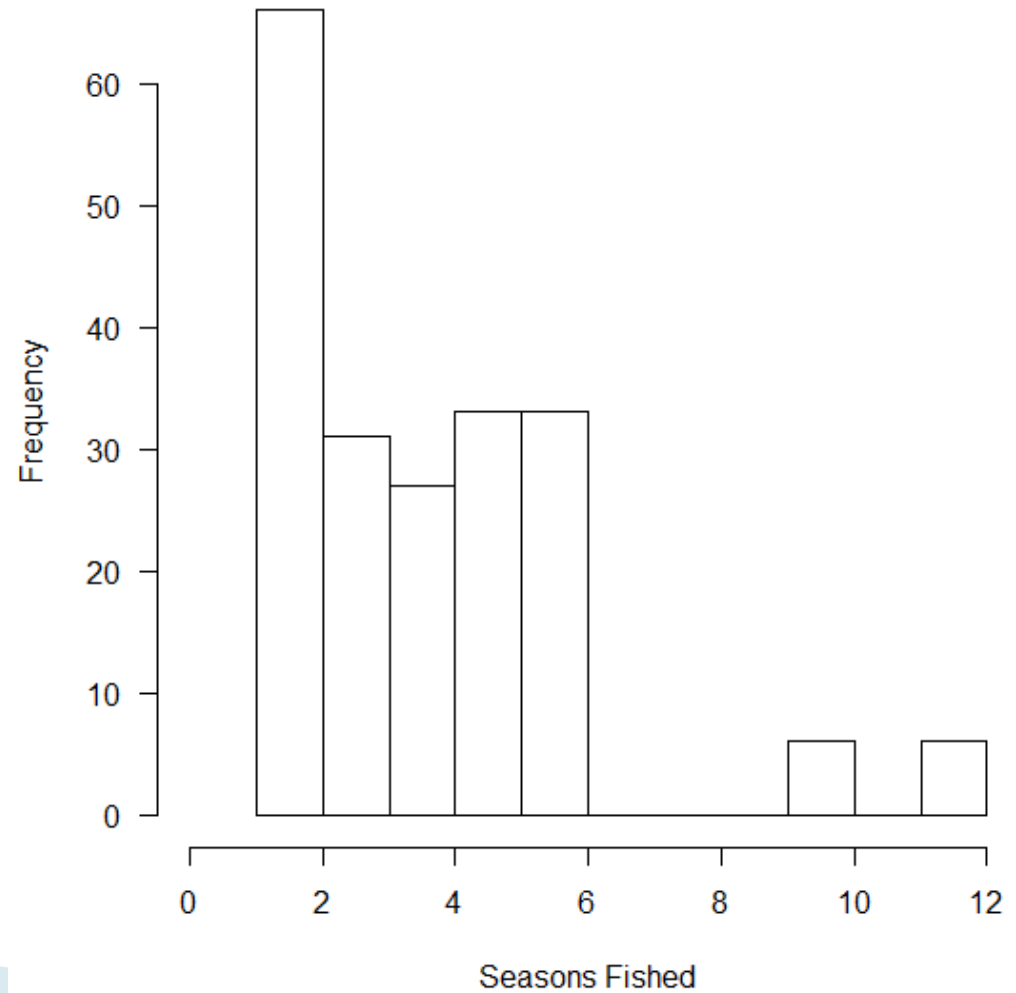


\* The majority of rope being fished is modified with both knots and splices.

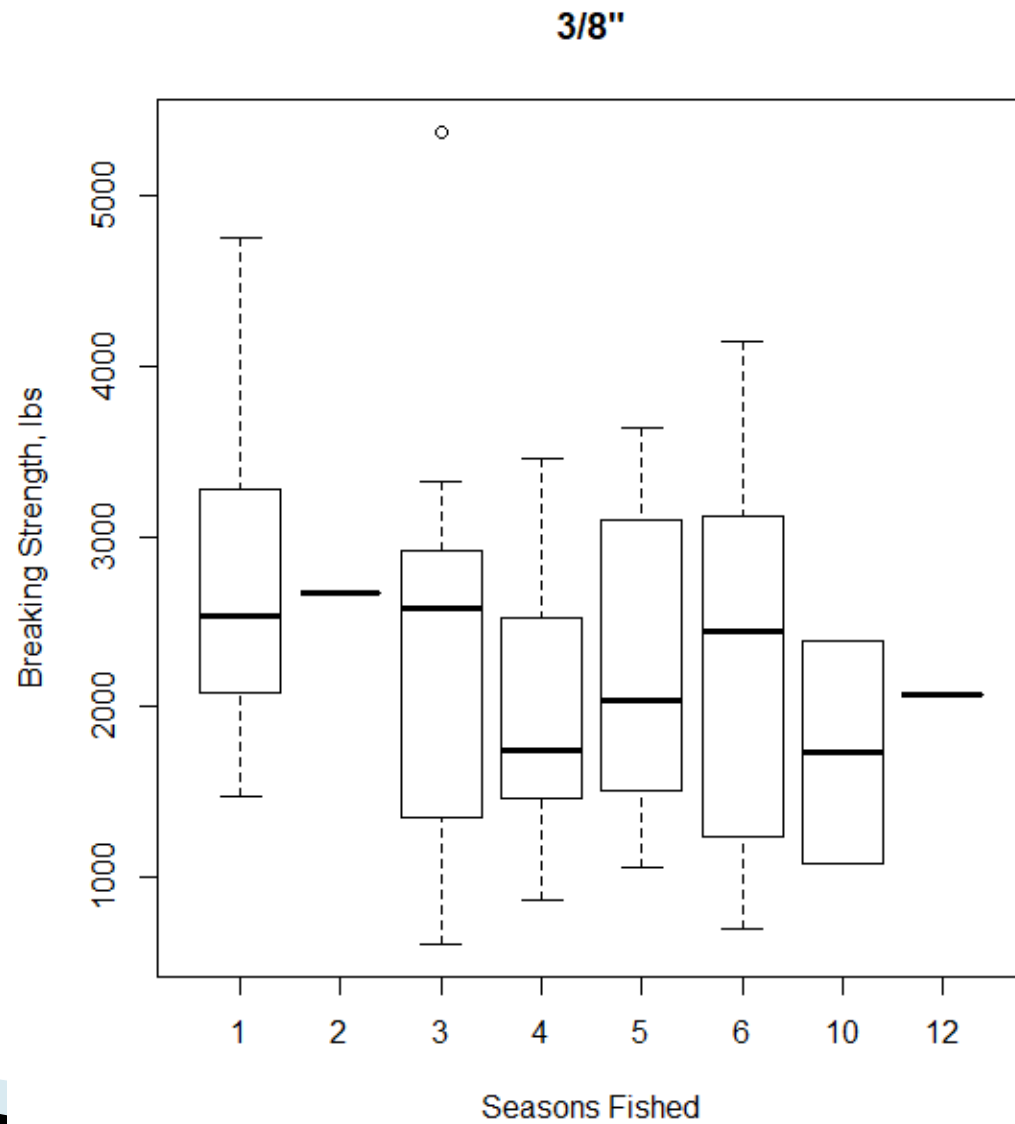


\* Most donated rope was between 1 - 6 years old.

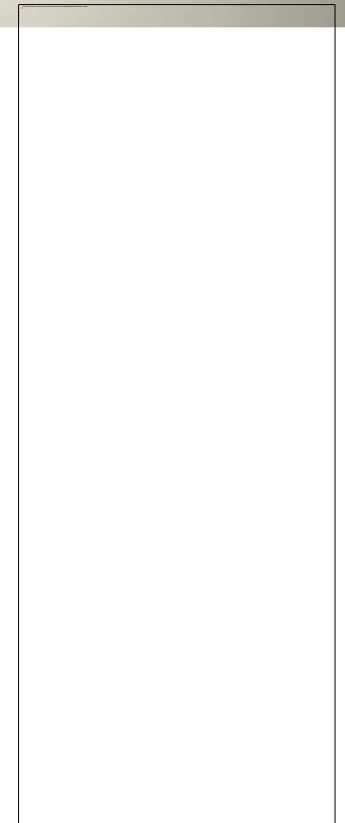
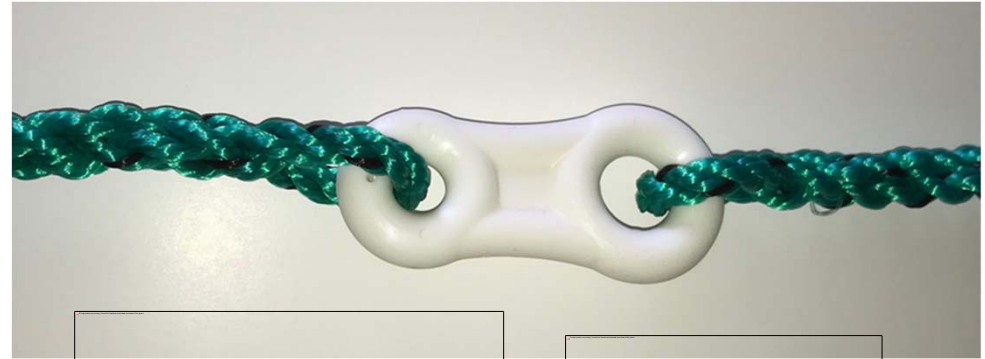
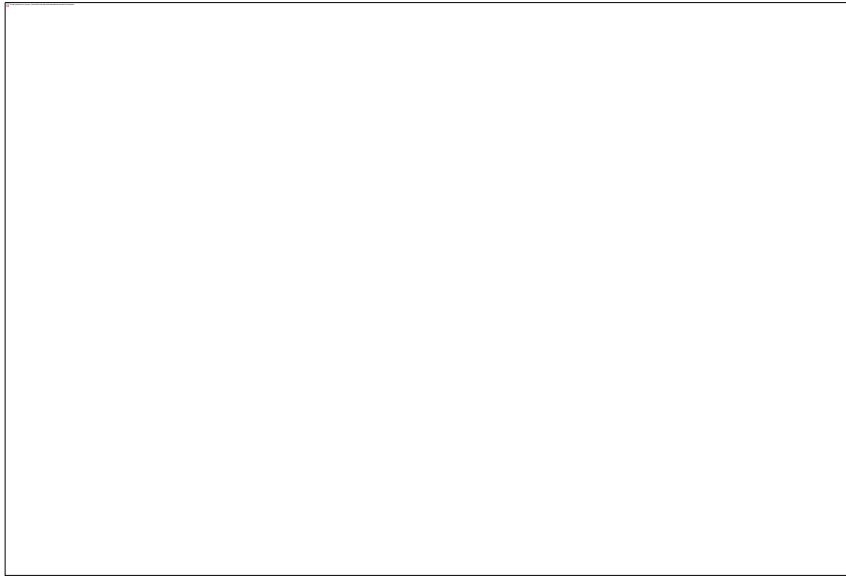
Distribution of Rope Age



\* Rope breaking strength decreases with age




# Weak Point Workshop



# Weak Point Workshop

	trial 1	trial 2	trial 3	trial 4	trial 5	trial 6	trial 7	trial 8	trial 9	trial 10	average
<b>7/16 white dog bone to 3/8</b>	<b>1470</b>	<b>1748</b>	<b>1892</b>	<b>1674</b>	<b>1835</b>	<b>1722</b>	<b>1870</b>	<b>1854</b>			<b>1758.125</b>
<b>3/8 white dof bone to 3/8</b>	<b>1121</b>	<b>1922</b>	<b>1442</b>	<b>1415</b>	<b>1742</b>	<b>1776</b>	<b>2016</b>	<b>1869</b>	<b>1798</b>	<b>1826</b>	<b>1692.7</b>
<b>7/16 lazy splice to 3/8</b>	<b>2123</b>	<b>2215</b>	<b>2101</b>	<b>2199</b>	<b>2204</b>	<b>2119</b>	<b>1715</b>	<b>2168</b>	<b>2103</b>	<b>2067</b>	<b>2101.4</b>
<b>3/8 lazy splice to 3/8</b>	<b>483*</b>	<b>1845</b>	<b>728*</b>	<b>1301</b>	<b>1365</b>	<b>1761</b>	<b>1159</b>	<b>1246</b>	<b>1654</b>		<b>1475.857</b>
<b>3/8 blackdog bone to 3/8 no hole</b>	<b>2423</b>	<b>2313</b>	<b>2476</b>								<b>2404</b>
<b>3/8 black dog bone to 3/8 3.5mm hole</b>	<b>1866</b>	<b>1876</b>	<b>2328</b>								<b>2023.333</b>
<b>7/16 black dog bone to 3/8 3.5mm hole</b>	<b>2153</b>	<b>1814</b>	<b>2105</b>	<b>2312</b>	<b>2414</b>	<b>1919</b>	<b>2497</b>	<b>2023</b>	<b>1938</b>	<b>2014</b>	<b>2118.9</b>

# Next Steps

- ▶ Continue work with weak points working with industry
  - ▶ Work with manufacturers to create new in-line weak links that would go through the hauler more easily
  - ▶ Use load cell data to ensure that the weak point gear modification can be implemented into the fishery safely
    - University of Maine work
    - Load cells integrated into the vertical line
  - ▶ Outreach
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# Acknowledgements

Thank you to staff at Maine DMR, FB Environmental, and partners  
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Area 3 for participating in the project, donating vertical lines and  
filling out surveys

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