Mitigation of Large Whale Entanglements in the NW Atlantic

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North Atlantic right whale (*Eubalaena glacialis*)

- Largely restricted to NW Atlantic (Florida north to Canadian maritimes)
- Population estimate now ***fewer than 440 individuals***; 105 breeding females (Pace et al, 2017)
- Since 2010 ***calving rates down 44%*** (*Pettis et al, 2017; Pace et al, 2017*) and ***no*** mom-calf pairs observed during high season (winter 2017-18)
- ***Incidence and severity of NARW entanglements up*** since mid-1990s (Knowlton et al, 2016)
- Entanglements now surpass ship strikes as main source of anthropogenic mortality
- Entanglements result in direct mortality AND lower reproductive capacity (energetic cost)

What a difference a year makes…..

2016

- NOAA : "We're making significant progress in reversing the population decline of the species, and are seeing signs of recovery"

2017

- Kraus et al, 2017: Entanglements hindering population recovery
- 17 mortalities in Canada and US!
- ALWTRT/NOAA – working groups; whale entanglement mitigation a funding priority again
- NGOs - lawsuits
- DFO – new fishing restrictions and funds for mitigating entanglements

Outline

- Review strategies
- Current gear research
- Conclusion

Gear Technique	What is it?	Some evidence to support …	… reject …	… or lacking
Minimize ratio of vertical lines to units of gear deployed	Reduces the overall number of vertical lines used in a pot or gillnet gear fishery without reducing bottom gear. "Trawling up"	Sightings data and records of fishing gear deployments did show that encounter probabilities were reduced (**Kite-Powell et al., unpublished data**)	Longer trawls results in some fishermen increasing rope diameter, which can increase entanglement persistence (**Knowlton et al. 2016**) Higher probability of having derelict gear with fewer back-up haul lines	
Reducing rope or net length	Shortening the length or area of gear, including shortening surface lines between buoys and highflyers	Maybe could end up having less rope carried by an entangled whale, which can reduce injury severity by minimizing the drag of gear (**van der Hoop et al., 2014**)		Still don't know how and where in the water column entanglements occur; will still have entanglements; reduction benefit, if any, difficult to quantify. Higher line tension may increase entanglement severity
Reducing wet storage of gear	Reducing the amount of time that gear is deployed in the water when not fishing	No gear in the water means no entanglement possibility		Still have a lot of gear in the water when whales are present; multiple days
Making buoy lines negatively buoyant	Requiring that the upper portion of buoy line is negatively buoyant			Assumes entanglement risk is highest in surface waters and when ropes deployed more parallel to the line of the water surface

Source: FAO. 2018. Report of the Expert Workshop on Means and Methods for Reducing Marine Mammal Mortality in Fishing and Aquaculture Operations, Rome, 20-23 March 2018. FAO Fisheries and Aquaculture Report No.1231. Rome, Italy.

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Visual enhancements	Changing the color and/or luminosity of gear to make it more visible to baleen whales	NARWs show earlier aversion response with black but especially red and orange ropes, at least in well-lit waters (**Kraus et al., in prep.**) Some avoidance in minke and fin whales as well (**Bischoff et. al., 2012; Kot et al., 2012; Meredith et al., 2013; Fasick et al., 2000**)		Need visual enhancement at depth; impacts on other baleen whales and sea turtles unknown What is the behavioral response of other species if they do detect gear?
Sound-emitting devices	Using active or passive acoustic devices to deter gear interactions	Acoustic devices reduced collision and entanglement rates of humpback whales in cod traps off Newfoundland (**Lien et al. 1992**).	Studies of F3 pingers have not shown any measurable avoidance response in humpback whales (**Harcourt et al., 2014; How et al., 2015**)	Issues including ensonification; noisy ocean
High tension/materially stiffened rope	Increasing rope material stiffness such as using harder lays, or increasing counter forces of flotation and bottom weight		Increasing tension can lead to more severe injury (**Woodward et al. 2006; Baldwin et al 2012**). Stiff ropes still entangle whales in W. Australia)	Can you even maintain a stiff rope?

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Reducing the use of knots in ropes	Avoid knotting ropes			Might decrease ropes becoming lodged in baleen but using them also lowers breaking strength by half!
Post-entanglement release mechanisms (for example, weak links, time tension line-cutters, whale-release rope, galvanic release)	Several devices designed to assist the self-release of a whale if entangled	Ropes of 1700lb breaking strength do not tend to be found entangling NARWs (**Knowlton et al. 2016**)		Weak links observed on entangled whales, but might help
Time/area closures, including gear restrictions	Prohibiting fishing within critical habitats for all or parts of the year, or restricting the type of gear used within them Includes real time "trigger" closures (DFO)	If no gear, no entanglement, if well enforced		To conserve or recover a ***species*** or ***population***, they need to be **large enough**, **located in the right areas**, **effectively managed**, **avoid introducing new threats**, **and established at the right times** (see **Gerrodette and Rojas-Bracho 2011; Gormley et al 2012; Slooten 2013**) Whale sightings always possible and timely to avoid entanglements?

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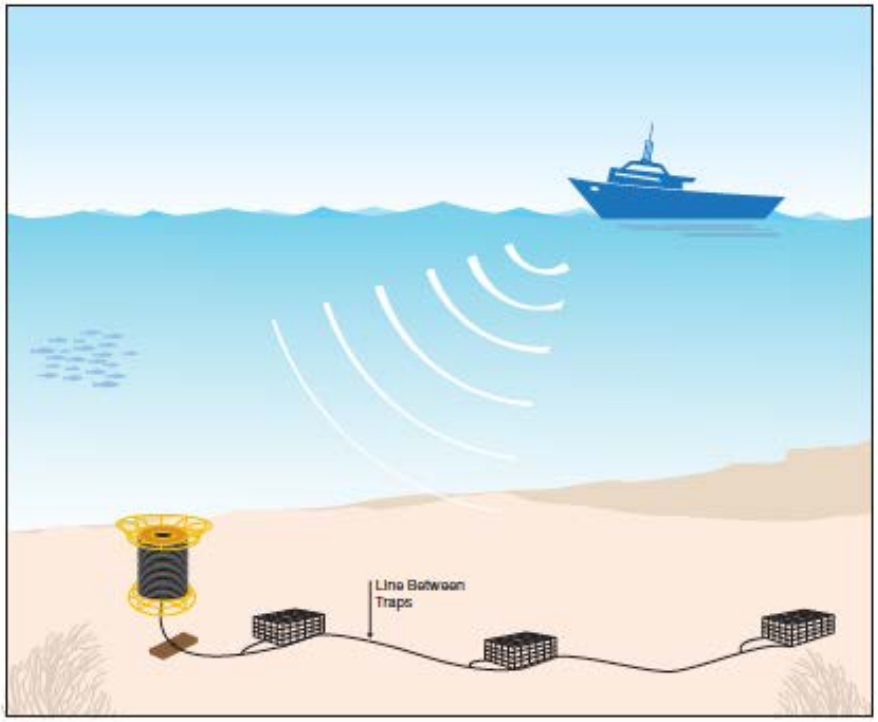
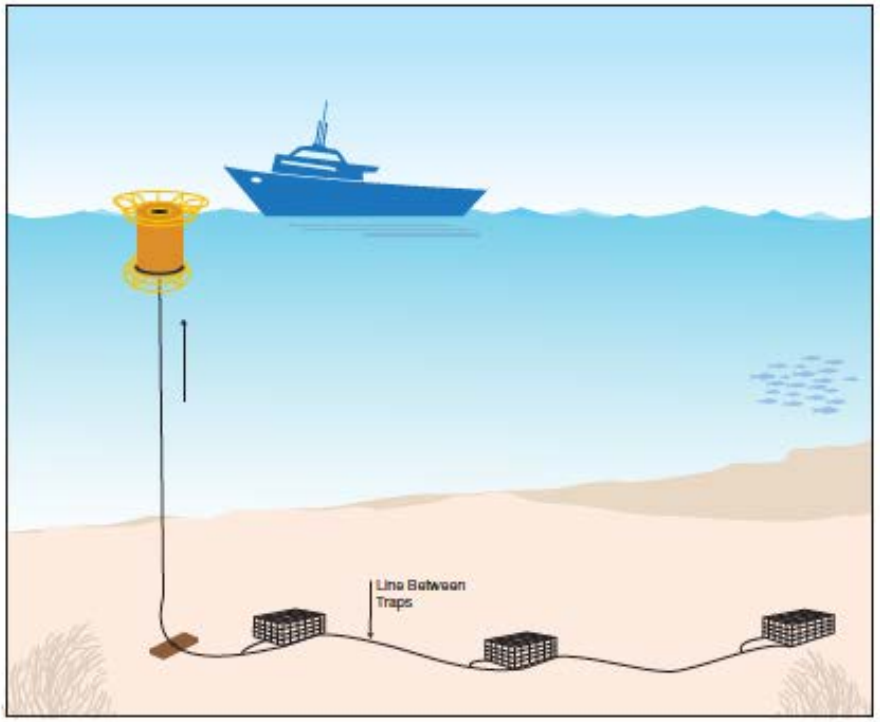
How about ropeless fishing?





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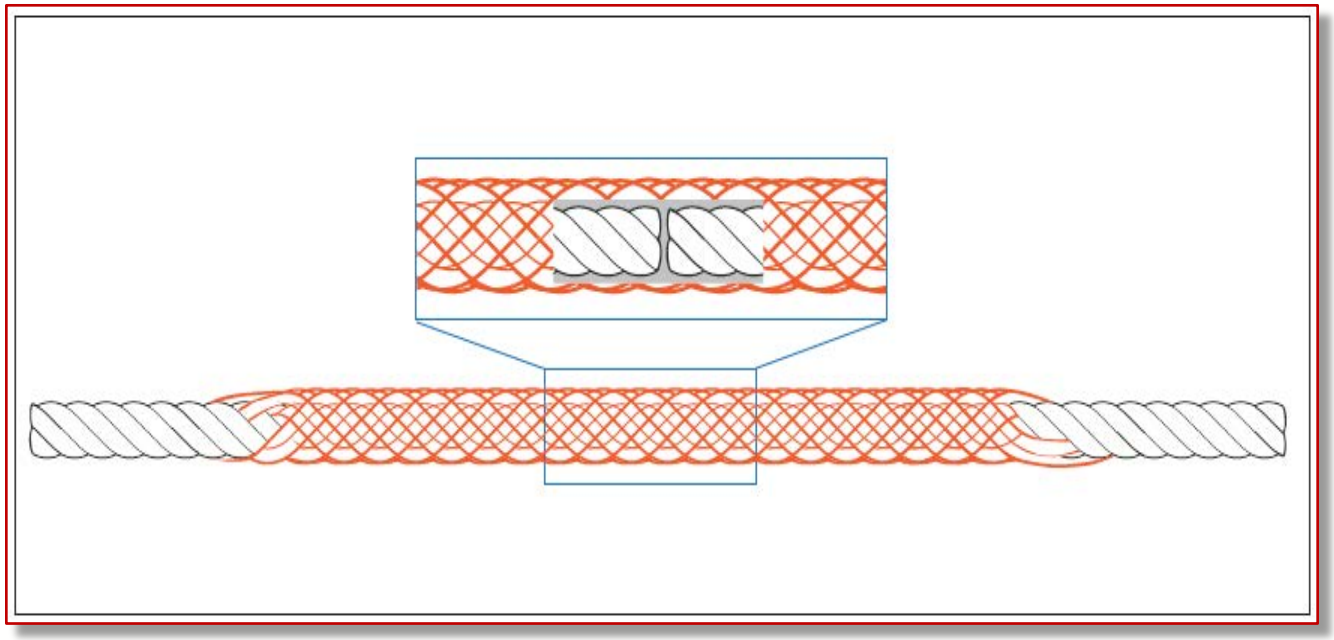
Ropeless fishing

- Already being used (SE Australia)
- Multiple evaluations in NE US have shown reliable results
- Currently being tested using multiple designs and fisheries in the US and Canada
- Issues to resolve: cost and gear conflicts
- No quick fix!

Whale-release rope



- </= 1700 lbf
- Based on Knowlton et al (2016) study

Whale-release rope

- MA and NH
- Braided sleeves inserted every 40’ of vertical line (3/8” Everson Pro or Manline)
- 80 experimental lines fished in same area as 80 normally configured endlines (control)
- Lobster, whelk, black sea bass
- 1-20 pot strings
- Depth: 80-310’
- Report: July 2018

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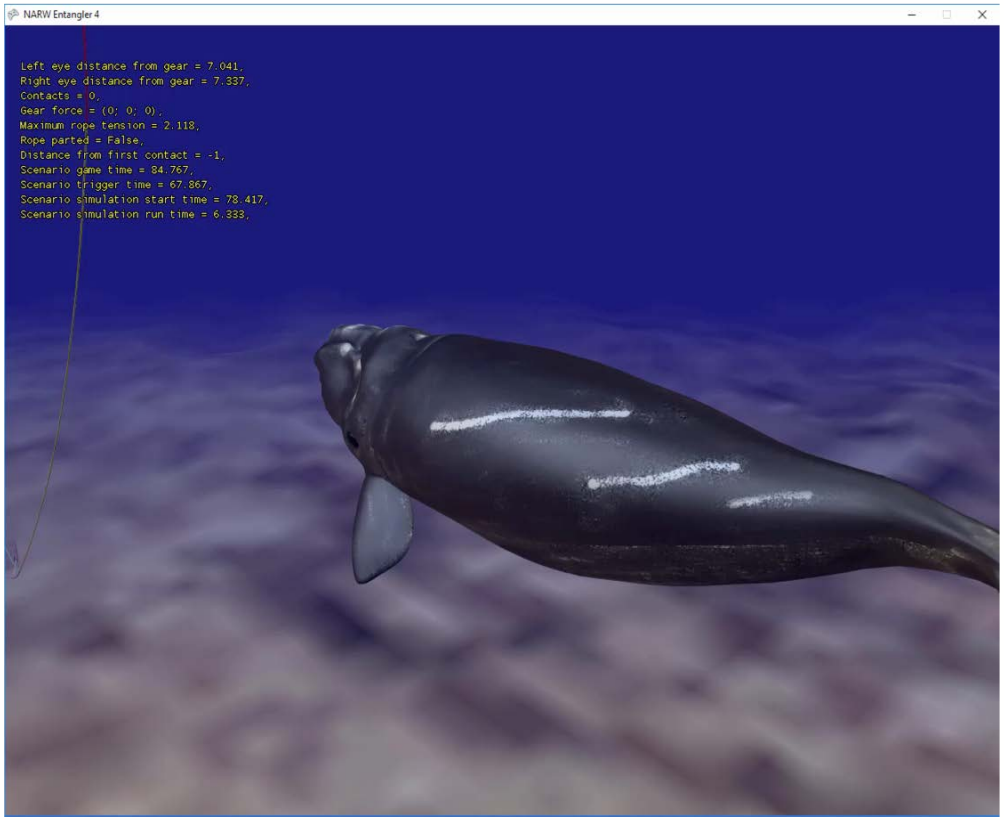
Evaluation of whale-release rope

- Pre- and post-fishing breaking strength
- Qualitative analysis of rope degradation
- Modeling rope tensions using load cells and *Orcaflex* software
- Modeling rope tensions using the Virtual Whale Entanglement Simulator



Howle et al, in press. Marine Mammal Science

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Conclusion

- Look at evidence; be wary of assumptions ("best practices")
- Some measures may "work" but the extent to which they reduce entanglements may be insufficient to sustain or recover population, or create other entanglement risks (e.g., trawling up)
- How endangered is target population? How many years until the brink of extinction? Urgency influences strategic decisions
- Local circumstances highly relevant (e.g., inshore, offshore, geography, gear, etc.)
- Create international learning network – what's working, what isn't, what's promising, what are the research priorities