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A Review of Gear Measures to Reduce Entanglements of NARWs (*Eubalaena glacialis*)

Consortium for Wildlife Bycatch Reduction

Anderson Cabot Center for Ocean Life at the New England Aquarium

New England Aquarium
Protecting the blue planet

BOSTON UNIVERSITY

Zero G Presentation: No Gillnets, Groundlines, or Gear marking

Whale entanglement mitigation gear modifications

Weak links
Zap link
Thwartable bottom link
Braided sleeve rope
Colored Rope
Glow-in-the-dark rope
Whale-release rope
Slippery rope
Lipid soluble rope
Stiff ("Viagra") rope
Sinking groundline
Neutrally buoyant groundline
No wet storage

Whale-free buoy
Timed whale release
Galvanic release
Time tension line cutter
Buoy line trigger device
Buoy line messenger system
Reducing knots
Decreasing ratio of verical ines:bottom gear ("trawling up")
Decreasing length of ropes
Submerging surface gear
Pingers
Clangers
Grappling and …. other forms of ropeless fishing

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data and records of fishing gear deployments did show that encounter probabilities were reduced (**Kite-Powell et al., unpublished data**)	Longer trawls results in some fishermen increasing rope diameter, which can increase entanglement persistence (**Knowlton et al. 2016**) Higher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
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
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 plane of the water's surface

Gear Technique	What is it?	Some evidence to support … ✅	… reject … ❌	… or lacking !
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
Materially stiffening rope	Increasing rope material stiffness such as using harder lays			These ropes entangle whales in other fisheries (e.g., Western Australia)
High tension rope	Increasing rope stiffness by increasing counter forces of flotation and bottom weight		Increasing tension can lead to more severe injury (**Woodward et al. 2006; Baldwin et al 2012**)	Can you even maintain a stiff rope?

Gear Technique	What is it?	Some evidence to support … ✅	… reject … ❌	… or lacking !
Reducing the use of knots in ropes	Avoid knotting ropes			Might decrease ropes becoming lodged in baleen but using them also lowers breaking strength!
Whale free buoy	Elongated trombone-shaped buoy			Might reduce entanglements if point of initial contact is a flipper but it is often the mouth region and this buoy might lodge more readily in baleen
Slippery rope	Having a rope or rope coating that increases its slipperiness			Highly impractical for fishing if you could even make it
Post-entanglement release mechanisms (for example, weak links, time tension line-cutters, whale-release rope, galvanic release)	Several devices designed to free 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

Ropeless fishing

"Complete removal of buoy lines is recognized as the most 'whale safe' technique for utilization of fixed gear"

NMFS, 2000

"...the only certain method that we can imagine to eliminate deadly entanglements of right and other large whales is the complete removal of ropes from the water column."

The Large Whale Entanglement Working Group, 2008

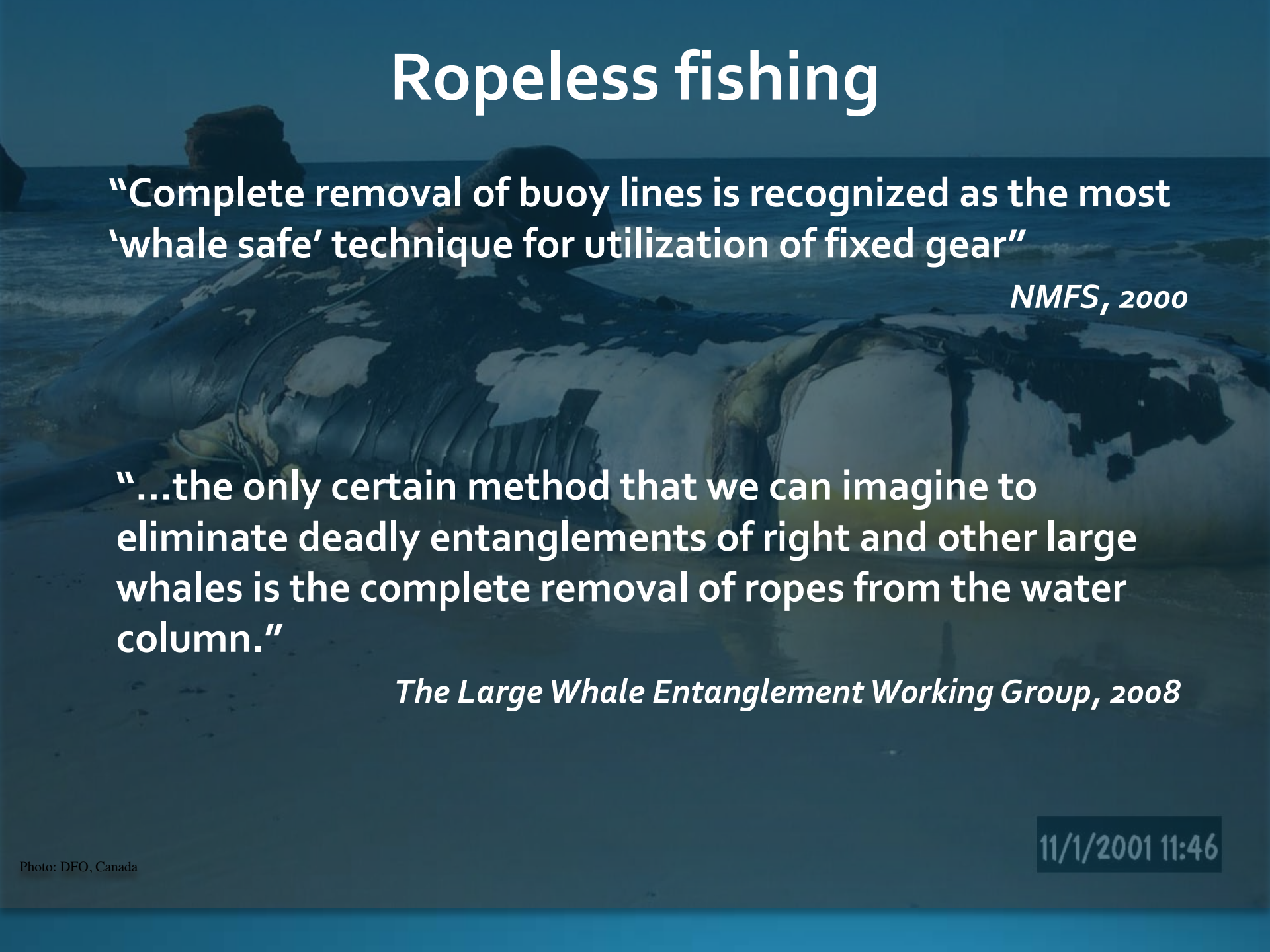
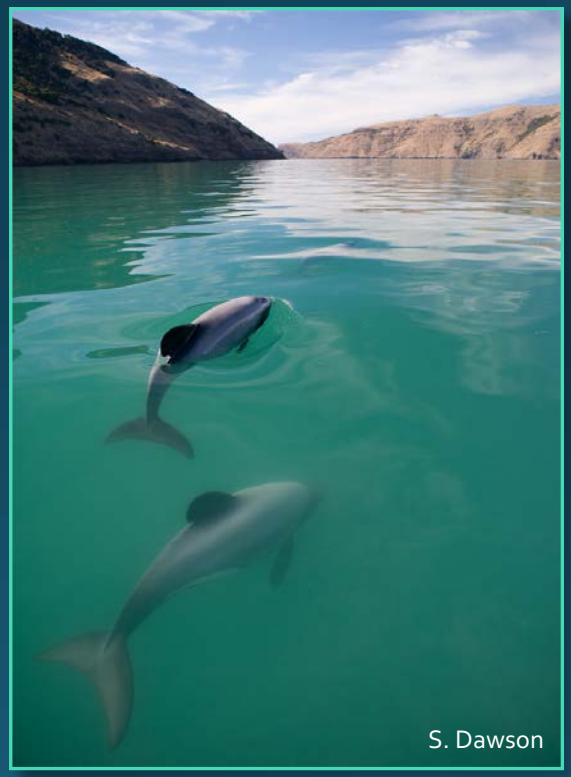


Photo: DFO, Canada

POP-UP BUOYS IN USE!

Demonstrates commercial viability

Several US trials demonstrated functionality: DeAlteris 1999; Hopkins and Hoggard 2006; Allen and DeAlteris 2007



AREA CLOSURES

To conserve or recover a species or population, they need to be large enough, located in the right areas, effectively managed, and avoid introducing new threats (see Gerrodette and Rojas-Bracho 2011; Gormley et al 2012; Slooten 2013)

Can protect animals within particular close areas but need to consider population-level effect!

And need them to be established at the appropriate times

EFFORT REDUCTION

Western Australia – 235 vessels over 560nm (as the crow flies) (WA Fisheries, 2014); Maine: **6000 licensed fishermen over 200nm** (DMR, 2016)

But remember, even with reduced effort:

"…any lines [sic] rising in to the water column has [sic] the potential to entangle a whale."

NMFS, 2005

CATCH SHARES AND BYCATCH

Not much data on protected, endangered and threatened species

Complicated: maybe fewer discards, extended fishing seasons… many confounding factors

Whale quota trigger?
So low (1.4 PBR in US)
it would effectively close the fishery almost immediately

Ban/boycott products; Promote "whale-safe" fisheries

Do boycott's work?

How do we know product came from a "safe fishery"?

Can enough fisheries be certified to influence others in time to avoid population declines?

Need domestic and international strategies - product origin, product destination; supply chain

Tuna-dolphin - unintended consequence of shift from setting on dolphins to using FADs, with increases in shark bycatch (among other species) and addition of a new whale entanglement risk from FADs

MMPA Import Rule – influential incentive for change?

OPTIONS SUMMARY

NO EVIDENCE REQUIRED

- Terminate pot fishing
- Fish without ropes

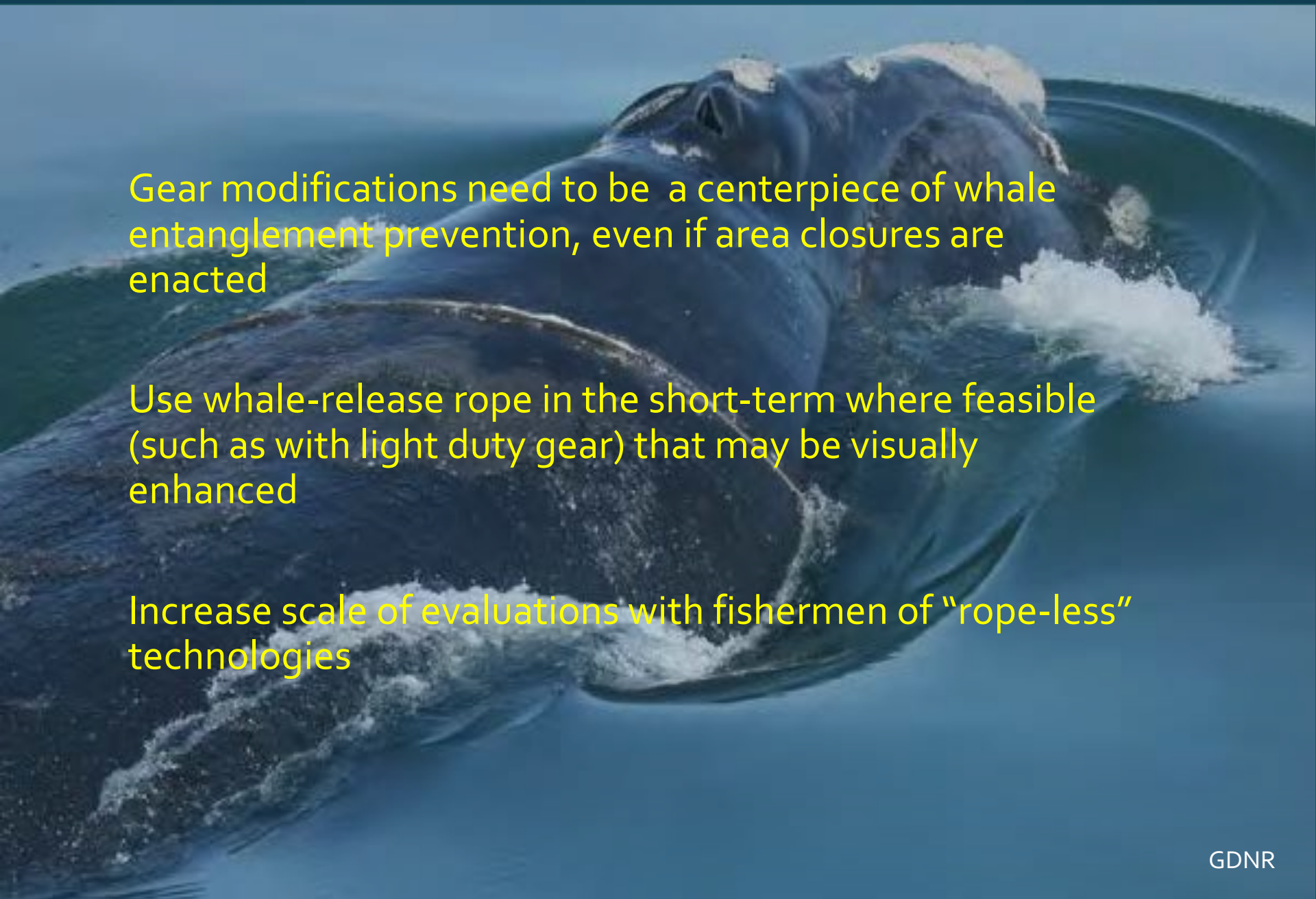
SOME SUPPORTING EVIDENCE

- Whale-release ropes
- Colored ropes
- Gear reduction

MORE EVIDENCE NEEDED

- Impacts of permanent, seasonal, or dynamic area closures at the population level
- Reduced effort
- Catch shares
- Promoting "sustainable" fisheries; boycotts/bans of products from fisheries that entangle whales
- Other gear modifications

Our Working Strategy



Gear modifications need to be a centerpiece of whale entanglement prevention, even if area closures are enacted

Use whale-release rope in the short-term where feasible (such as with light duty gear) that may be visually enhanced

Increase scale of evaluations with fishermen of "rope-less" technologies

GDNR

Disentanglement versus prevention

Katharine Jackson/Florida Fish and Wildlife Conservation Commission

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