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WHALE ENTANGLEMENT RESPONSE AND DIAGNOSIS

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This chapter is dedicated to the lives of Tom Smith from Kaikoura, New Zealand, and Joe Howlett of Campobello, New Brunswick, Canada: both fishermen and conservationists who lost their lives helping whales.

Introduction

Whale entanglement is likely to occur wherever in the world large whales and fisheries coexist. The extent to which it is reported and recognized as a problem in a specific region depends upon the presence of both a reporting infrastructure, as well as concerned individuals. Such individuals may be those concerned about marine animal conservation and welfare (e.g., wildlife managers, biologists, whale watch companies) or those involved in the fishing industry and concerned about gear and harvest losses related to such entanglements. The principal problem involves whale interaction with actively fished gear or discarded gear. Although the nature of the gear at the outset of the entanglement may be unclear, in some regions, the majority is believed to originate from nonmobile gear that is either anchored or drifting but is currently in use and unattended (Song et al. 2010; Meÿer et al. 2011; Benjamins et al. 2012). Whales (as well as small cetaceans and pinnipeds) also interact with more mobile, or tended, gear. Gear loss from other causes (including storms and ships) that results in abandoned, lost, or discarded fishing gear (ALDFG) is also believed to be an important source of whale/gear interactions. Lastly, consumption of marine debris is a significant concern, especially for suction feeders such as sperm and beaked whales.

The goal of this chapter is to describe the approach that has evolved since the 1970s to safely disentangle gear from large whales (**Figure 3.1**). We also discuss the documentation

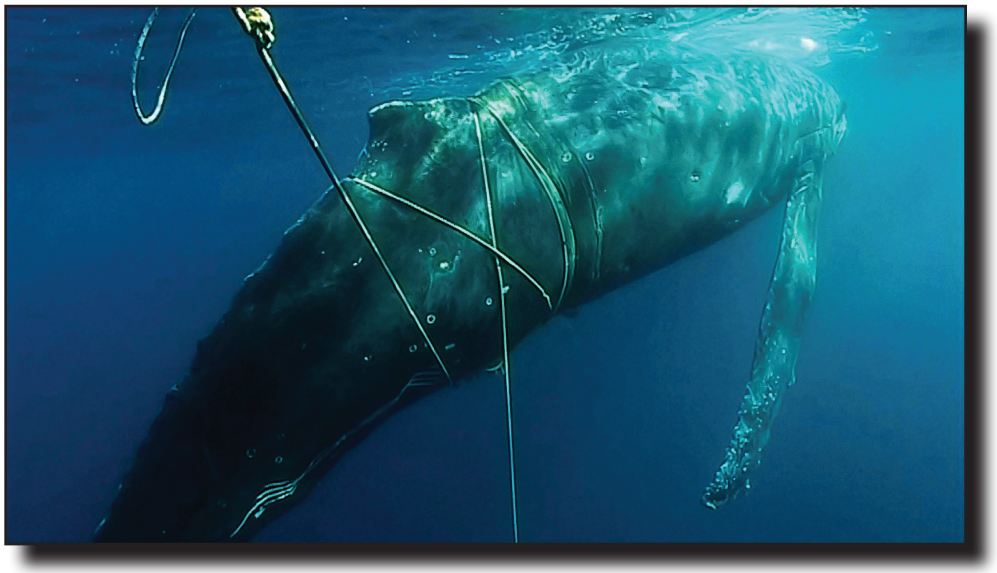

Figure 3.1 Multiple body wraps of entangling line in a humpback whale. (Courtesy of the Australian Large Whale Disentanglement Response Network.)

of such gear, the postmortem diagnosis of entanglement, and how the information gleaned from such activities can help with the ultimate goal of avoiding future entanglements, through modification of how, when, and where gear is deployed. It is vitally important to understand that treatment of entangled animals can only ever affect a small minority of cases, and prevention is the only lasting solution. *This chapter should not be taken as a manual for entanglement response, but rather, as an overview of the issue and as a starting point for subsequent training.*

The Origin of Organized Whale Disentanglement

In the 1970s, there was a major inshore trap fishery for cod in the Newfoundland and Labrador Province of Canada. The inshore capelin prey resource was dwindling, the harvest effort rising, and the humpback whale population recovering. The consequence was a major entanglement problem of humpback whales in cod traps. These required relatively large investments in time and resources, and the traps were heavily anchored, with the effect that most entangled whales were anchored in place. Jon Lien of Memorial University in St. John's Newfoundland evolved tools and techniques that he used to help regional fishermen remove the whales from the gear. Due to his efforts, the whales increasingly survived (Lien 1994), the trap damage was minimized, and rightly, Lien became a folk hero in the marine mammal and Canadian fishing communities.

Soon thereafter, at the Center for Coastal Studies (CCS), Provincetown, MA, USA, Stormy Mayo and David Mattila began developing techniques for responding to whales that were free-swimming with their entanglements. Although others (including fishermen) also freed entangled whales, the disentanglement protocols proven effective by Lien and CCS have been adopted by a network of many organizations as appropriate to use worldwide and have evolved over time (**Figures 3.2 and 3.3**). Likewise, the tools (**Figure 3.4**) and techniques first developed by native and Yankee whalers have also been relevant and adapted as required.

Global Whale Entanglement Response Network (GWERN)

The Global Whale Entanglement Response Network (GWERN) is the result of a joint partnership between the CCS and the International Whaling Commission (IWC) to mitigate human–whale impacts and to build a worldwide network of professionally trained and equipped entanglement responders. Thus, whale disentanglement response in the 2010s is coordinated by trained and authorized members of National Networks where "in country" capacity exists. Many of these National Networks have been trained by members of the IWC's entanglement expert advisory panel (https://iwc.int/entanglement-response-network), using internationally developed, consensus strategy, "best practices," and curriculum (IWC 2011). In addition to capacity building, the IWC also convenes the GWERN, and as such, facilitates communication and collaboration between National Networks; provides advice on difficult cases and experienced trainers when requested; and occasionally facilitates exchanges of resources and personnel for specific events. Collectively, these efforts aim to reduce risks associated with entanglement to both the animals and the people that respond.

Nations may request training workshops through the IWC Secretariat. Prioritizing training for countries is based on the following consensus criteria:

- *Conservation:* How endangered is the whale population, and how significant is the entanglement impact?
- *Human safety:* Are well-meaning but untrained people currently responding with dangerous techniques?

Figure 3.2 Side approach to cutting a mouth-entangled humpback whale. (Courtesy of the Center for Coastal Studies. NOAA Permit 18786.)

Figure 3.3 Approaching a North Atlantic right whale with significant entanglement injuries to tailstock and trailing line and buoys. (Courtesy of the Florida Fish and Wildlife Conservation Commission. NOAA Permit 932–1489.)

Figure 3.4 A range of disentanglement tools for mounting on a pole. (Courtesy of the Australian Large Whale Disentanglement Response Network.)

- *Animal welfare:* How many whales are likely to benefit from the states developing a response network?
- *Socioeconomic impact:* How much impact do entanglements have on the affected fishers?
- *National support:* Has the country requested, and is it supporting, the training?
- *Added impact:* Does the training fit into and/or encourage other productive initiatives?
- *Funding:* Is there logistical and financial support?

This structured, capacity-building effort was endorsed by all 88 member countries of the IWC in 2012, and between March 2012 and July 2016, the IWC and partners have provided training for over 700 participants from 26 countries. Trainees are selected in consultation with the relevant government authorities based on the following criteria:

- Levelheadedness (ability to remain calm and think clearly in stressful situations)
- Works well as a team member
- Experience with whale behavior and driving small boats around whales
- Experience with fishing gear and with handling lines under powerful "load" or strain
- Experience with small boat safety
- Physically fit
- Availability (there is no point training someone who is unavailable to respond)
- Has insurance or equivalent, and authorization of the relevant government authority

This training initiative is carried out in partnership with CCS, who shares a key staff member, provides tools and trainers, and provides a venue for 2- to 3-week apprenticeships, offered to key members of newly trained countries.

It is important to note that because disentanglement of large whales is a skilled and dangerous undertaking with the potential to harm or kill responders or whales, it should not be undertaken without prior training and appropriate permissions from relevant government agencies. Here we present a condensed version of best practices published by the IWC (2016).

Entanglement Response Considerations

Some critical and common assumptions that occur when an entangled whale is encountered are as follows:

- *Most observers project their emotions onto the whale, assume it is drowning, and therefore act rashly without gathering resources and thinking things through.* If the whale can reach the surface to breath, it is very unlikely to be in "immediate danger."
- *Do not get in the water.* This is how people have died or been seriously injured.
- *Do not cut or remove anything (especially visible buoys), puncture, or free the whale from its anchor to the bottom, as this will usually seal its fate (a very slow painful death).* Rather, report immediately to the nearest response station and stand by until trained responders arrive.
- *Do not assume the whale "knows" that you are there to help (unfortunately, this notion continues to be reinforced by social media).* There appear to be some instances where whales may tolerate or even appear to cooperate, but most of the time, this is likely to be an expression of shock or capture myopathy. Also, species and individuals can be quite different in their responses to humans trying to help them. Whales often tend to regard responders as predators and may react negatively to close approaches.
- *Not all entanglements are lethal.* In fact, many entanglements may not require a response beyond detailed assessment and documentation.

The primary goal of entanglement response is to remove all detrimental entangling gear safely from the whale. Additionally, entanglement response seeks to minimize risk through public and responder safety, improve large whale welfare and population conservation, and mitigate, if not ultimately prevent, entanglement in the first place. Yet, actions by well-meaning untrained persons can worsen an entanglement, through a lack of subject knowledge and experience. For example, removing only the easily accessible trailing gear from entangled whales may leave the most critical components on a whale, making future, organized disentanglements more difficult or even impossible, potentially resulting in severe harm or death to the animal. Likewise, regional entanglement

response scenarios and complexities may require specific techniques and strategies, and well-meaning responders may also fail to collect necessary data. Data collection is necessary to identify key fisheries and whale populations, to assess the severity of injuries caused by the entanglement, and to better detect regional entanglement problems that may assist with mitigation and prevention.

Entangled whales are most often reported by fishers, recreational boaters, whale watch and research vessels, governmental vessels, and other ocean users. Prompt reporting is critical to successful response triage. Helpful information in those reports includes time, position, species, assessment of the animal and gear, and images of the sighting from a safe and legal distance. If a response is appropriate and it is safe for the reporting party to stand by, they should be encouraged to stay in the area until an authorized disentanglement response team arrives. In too many cases, when visual contact of the whale is lost, the disentanglement team is looking for a big needle in a vast haystack.

Authorized, Trained Response

Safety

Human safety is the number one priority. At no time should an individual enter the water. It is not necessary or safe, given the proper disentanglement training, tools, and techniques available. Over a thousand successful disentanglements have occurred with an approved boat-based technique without significant human injury, whereas human life has been lost during in-water disentanglement attempts. The whale's rescue should never supersede human safety at any time. Only trained, certified, and authorized operators should participate in disentanglement activities, which must be thoroughly thought through and planned, with full briefing to all participants and team members.

All participants need to be clear on aims, objectives, operational procedure and roles. Never secure a line from the whale to the vessel, or coil a line in the vessel. Pay careful attention to the overall environment, avoiding pressure to act by considerations of weather, time of day, onlookers, media, one's emotions, or the perceived need to act. When in doubt about safety or the success of the operation, stand down; if possible, attach a satellite telemetry device for tracking; and alert the community for a resight in order to try again on another day with better support, environmental conditions, and/or resources.

Personnel

Appropriately trained, experienced, and authorized personnel should be used for the roles required; actions/efforts must be based on the qualifications of personnel on hand. Roles must be assigned to team members based on their experience, training, and overall qualifications. Personnel should be monitored (e.g., for fatigue, dehydration, emotional state) at all times and encouraged to speak up if they are not comfortable with a particular action or the general situation. Leaders must respect any concerns raised and not instruct personnel to take a role or action that they are not comfortable with. Responders should also actively seek input from more experienced responders when possible.

Personal Equipment

Personnel working near or with entangling gear must carry emergency safety knives on their persons at all times, in case a responder is caught in a line or netting during a response, to cut the line/netting and prevent injury or death. Gloves must be used when handling lines or netting under load (i.e., attached to whale). Helmets must be worn by personnel operating near the whale and/or using poles, and appropriate attire and personal floatation/protection must be worn at all times. Examples include personal floatation devices (PFDs), wet suits, dry suits, and work suits that are snag-free (without straps, D rings, and clips that can act as snag points for lines/gear). Cutting poles must have protection stoppers fitted at their ends to prevent injuries during "kickbacks." Proper communication tools must be available (e.g., waterproof VHF handheld, cellular phones, GPS). Vessels must carry sufficient water and food.

Platforms

Response efforts are generally conducted from two vessels, a primary response vessel (PRV) and a support/safety vessel (SSV). The PRV is the main operational platform to assess, perform the entanglement removal, and monitor the situation. It is essential that only disentanglement staff and essential equipment be carried. It should be operated by a qualified helmsperson and two crewmembers trained in line handling, one at the bow and another to ensure trailing lines are clear of the engine lower unit and to assist the crew at the bow. Its deck must be kept clear and free of loose objects and any other materials or equipment that may potentially interfere with the safe deployment of running lines during the operation. The SSV is needed to carry necessary personnel to document the event and record data, equipment, and adequate redundancy in communication systems (i.e., "two is one, and one is none"). This includes human first aid and resuscitation equipment, and qualified staff to deal with possible emergencies.

Assessment

Specific conditions outlined by the IWC (Appendix IV: 2010) are used to determine if the entanglement is life threatening to the animal and an acceptable operation for responders. For example, animal risk assessment, size, species, temperament,

behavior, health condition, body profile, cyamid coverage, general skin condition, and coloration are all important factors to consider. Other factors include the specific nature of injuries, presence of other cohorts (e.g., pod members, calves), or the presence of sharks or other predators. Mobility of the entangled whale (whether anchored, small circles, big circles, free-swimming), type and nature of gear (rope, line, pot, netting, chain, etc.), body part(s) affected, and configuration, as well as condition of gear, all contribute to the nature of the response plan. High-quality photo/video is valuable to properly assess entanglement and attached gear. Long lenses (telephoto and zoom) are essential for obtaining good photos from a safe distance. However, GoPro-type point-of-view cameras are also useful if the trained responders can get sufficiently close to deploy one on long poles in-water or overhead to provide wide-angle video. Unmanned aerial and aquatic systems will also be of increasing use for this assessment task as they become more user-friendly. Other information needed for the operational risk assessment of the response plan are current and forecasted weather; sea state; navigational constraints (e.g., rocks, ice, bathymetry); time of day (i.e., remaining daylight); remoteness of location; and availability of resources. Visibility of the event, media or public presence, surrounding vessel traffic, military operations, and high recreational use areas are also all-important considerations.

Safety Considerations on Approaching an Entangled Whale

Time spent in the danger zone (area immediately in front of and beside an animal that is in range of tail flukes and/or flippers) must be avoided, and, if there is no alternative, should be minimized. Motorized vessel approaches should be slow and methodical, typically from the animal's rear quarter. A swimming entangled whale must never be approached from directly behind under power, as unseen trailing gear may foul the approaching vessel's propellers. Even when the rescue boat is pulling up the control line, with motor off and tilted up, responders should be aware of the trailing lines and insure that they do not snag on the vessel's hull. Only the minimum required equipment and personnel should be present on the PRV (i.e., store all nonimmediate gear on the SSV). The PRV must also be kept "clean" in order to minimize the risk of lines getting caught on the boat or gear stowed on the boat. Slow boat approaches are critical; sudden boat maneuvers (e.g., gear shifting or sudden velocity changes) must be avoided as these have a higher probability of startling the whale. Because animals may avoid and respond unpredictably to any perceived threat, it should be assumed that an animal might react to protect itself during approaches. Thus, it is beneficial to know and heed the signs or indicators of a stressed animal, such as the following: swishing of the tail, which may be subtle; head rises; head and tail rises into a "banana" or "S" shape as a prelude to a roll and fluke slap or slash; trumpeting or whistling blows on boat approach (note that some whales whistle routinely as they blow); bubble streams and bursts; turning the belly toward responders (can be curiosity behavior, but if strong and directive, could be the whale assessing range and should be heeded); changes in respiration; changes in behavior (dives or direction); and surface active behaviors (pectoral slaps, tail lobs—err on safe side in interpretation). Standing down and avoiding any further approaches is a viable "approach."

Entanglement Response Procedures

Disentanglement procedures generally involve some control of the animal, cutting away gear using specialized tools, and documentation and follow-up of the event. The details of disentangling a whale involve a specialized protocol with some inherent degree of flexibility due to the unique complexities of each entanglement configuration. Disentanglement procedures should be addressed through a thorough and strict training program (see Annex F, IWC 2011). Overall, responders should seek to reduce proximity and time with the whale, wherever possible.

Documentation and Debriefing

Documentation gathered during entanglement response efforts offers one of the best and only opportunities to understand not only the scope and extent of the impact of global entanglement, but also the risks involved with the response. This may include the following: photographs of operations and of the animal before, during, and after a response; video from cameras on long poles or point-of-view cameras mounted to safety helmets; collection and documentation of gear removed; biological sampling (biopsy, sloughed or abraded skin in gear); and field observations (such as operational and behavioral logs). This information should be assembled into a full entanglement response case study (including operational errors) and shared with regional and international entanglement response networks. Every attempt should be made to build documentation/data gathering into operational procedures. This should include postdisentanglement behavior and survival through the use of telemetry, genetics, and/or photo identification of individual animals.

Chemical Moderation of Behavior

In the interests of minimizing human safety risks as well as pain and suffering of the entangled whale, a ballistic method (Paxarms, 37 Kowhai St., Timaru, New Zealand) that administers intramuscular anxiolytic and analgesic medications was developed (Brunson et al. 2002; Moore et al. 2010, 2013; van der Hoop et al. 2013b; **Figure 3.5**). The ballistic delivery of drugs reduces whale evasiveness of an approaching boat and can improve both the likelihood of successful removal of gear

Figure 3.5 Disentanglement of a North Atlantic right whale 1 hour after drug administration had desensitized it to boat approach. (Courtesy of the Georgia Department of Natural Resources and Wildlife Trust. NOAA Permit 932–1905.)

and efficiency. However, using the technique is not without some challenges, such as the following: choice of drug combination and dose; estimation of body weight to deliver desired dose; and the real logistic, legal, and operator safety concerns of deploying concentrated narcotics at sea in a small boat. To this end, photogrammetric aerial images enable calculation of body weight (Barratclough et al. 2014), based on stranded and necropsied animals. The current drug combination is 0.1 mg/kg of both midazolam and butorphanol formulated to 50 mg/ml (ZooPharm, Box 2023, Fort Collins, CO, USA—http://www.zoopharm.net/; Moore et al. 2010). Also, naltrexone (ZooPharm 50 mg/ml) has been used to reverse the effects of butorphanol in other cetaceans (Walsh, Gearhart, and Chittick 2006) at 0.005–0.3 mg/kg IM (intramuscular). The goal is to enable disentanglement without compromising the animal's ability to swim, respire, and maintain equilibrium. Thus, although the use of drugs during disentanglement operations is currently unusual, as the challenges above are overcome, more routine use of these drugs could potentially enable quicker, safer, less stressful disentanglement operations.

Postmortem Diagnosis

Accurate postmortem diagnosis of whale entanglement is important both for understanding the role that the entangling gear may have played in the morbidity and mortality of the animal and for recognition of the source and nature of the fishing gear. It is necessary to evaluate the condition of the carcass to determine if the entanglement occurred while the whale was alive. Crude documentation of the body parts affected and apparent resulting trauma can be obtained at sea using aerial and underwater cameras. Unmanned aerial systems (i.e., drones) should also prove useful for this as they become more readily used. Examining beached carcasses provides more detailed observations than water recoveries allow. Often, the entangling gear is absent, but careful examination of the skin surface in a variety of lights and angles can reveal quite cryptic, but diagnostic, markings (**Figure 3.6**). This is especially true for animals that die peracutely underwater, where they are discarded from gear. When animals have been cut out from gear, remnants of the entangling material can often be found inside the mouth or embedded elsewhere. At times, chronically constricting wraps of gear can lacerate soft tissues down to underlying bone (**Figure 3.7**), where the host attempts to wall off the foreign body with massive fibro-osseus proliferative tissue (**Figure 3.8**). Thus, a complete necropsy, where practical, is necessary to place the entanglement in the broader condition of the animal. Necropsies are also excellent illustrations of the challenges facing disentanglement. **Figure 3.9** shows the extent of rope fouling of the inner face of a rack of right whale baleen that would have been close to impossible to diagnose, let alone remove, in the living animal. Criteria sufficient for the diagnosis of

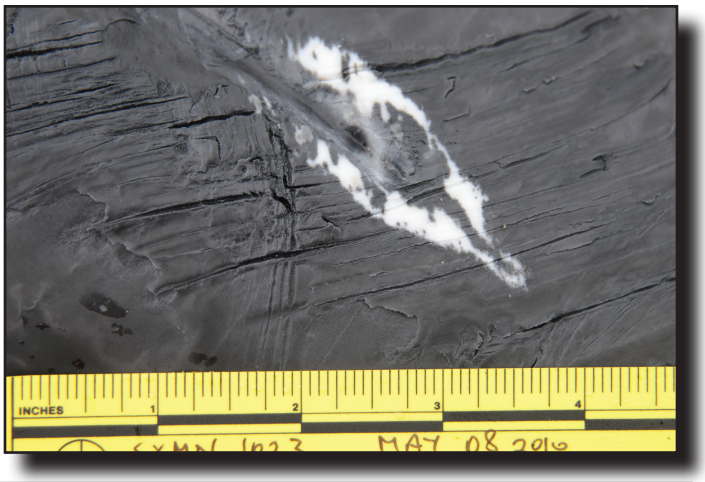

Figure 3.6 Criss-cross net pattern on the skin covering the mandible of a humpback whale from a gillnet. Note that the furrows are recent, and the white scar shows a previous entanglement. Gill net was found in the mouth of the animal. (Courtesy of Woods Hole Oceanographic Institution. NOAA Permit 18786.)

Figure 3.8 Fibro-osseus proliferation around the humerus of a North Atlantic right whale that had been chronically entangled with rope around the baleen (**Figure 3.9**), crossing the blowholes and around this flipper. (Courtesy of Virginia Aquarium. NOAA Permit 932–1905.)

Figure 3.7 Cleaned rostrum of a humpback whale showing laceration of the maxilla with entangling gear. The skeleton from this case is articulated on display, and subject of ongoing research at the Center for Coastal Studies, Provincetown, MA, U.S.A. (Courtesy of College of the Atlantic. NOAA Stranding Letter of Authorization.)

Figure 3.9 Severe rope entanglement of the left baleen rack of a North Atlantic right whale viewed from the medial aspect. (Courtesy of Virginia Aquarium. NOAA Permit 932–1905.)

suspect and confirmed acute and chronic entanglement mortality have been described in detail elsewhere (Moore et al. 2013; Jepson et al. 2013).

Mitigation

Entanglement mitigation and prevention is one of the leading aspects of whale conservation. Information gathered during entanglement and stranding response has been a critical component of this effort. There has been a long history of attempts to modify fishing gear in this regard in the Northeast waters of the United States, addressing weak links, sinking lines between fishing pots, and vertical line reduction, but with little evidence so far of success (van der Hoop et al. 2013a). However, in a limited-entry, high-value fishery, there are early signs of some progress along the Western Australian (WAUS) coast (How et al. 2015). The western rock lobster fishery on the WAUS coast had been a seasonal fishery that closed prior to peak whale migration. However, the seasonal fishery changed to a quota, market-driven, fishery in 2011–2012, with a marked increase in entanglement rate when the fishery overlapped with the whale migration season. Distinctive gear modifications and reduction of gear in the water at peak times at hot spots along the WAUS coast resulted in a marked decline in the frequency of entanglements. For example, removing ropes and lines from the water

greatly reduces the probability of entanglement, and restrictions are removed once the bulk of migrating animals have passed through the fishing grounds. Overall, the prescription is complex: time, depth, gear, color, sound, retrieval methods, whale species, and migration structure and pathways must be factored into the mitigation effort (Groom and Coughran 2012; How et al. 2015). Yet, key reasons for early success in WAUS included fishery and government willingness to make constructive changes during times of whale transit through the fishing grounds.

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References

Barratclough, A., P.D. Jepson, P.K. Hamilton, C.A. Miller, K. Wilson, and M.J. Moore. 2014. How much does a swimming, underweight, entangled right whale (*Eubalaena glacialis*) weigh? Calculating the weight at sea, to facilitate accurate dosing of sedatives to enable disentanglement. *Marine Mammal Science* 30: 1589–1599.

Benjamins, S., W. Ledwell, J. Huntington, and A.R. Davidson. 2012. Assessing changes in numbers and distribution of large whale entanglements in Newfoundland and Labrador, Canada. *Marine Mammal Science* 28: 579–601.

Brunson, D.B., T.K. Rowles, F. Gulland et al. 2002. Techniques for drug delivery and sedation of a free-ranging North Atlantic Right Whale (*Balaena glacialis*). In *Proceedings American Association of Zoo Veterinarians,* 320–322.

Groom, C.J., and D.K. Coughran. 2012. Entanglements of baleen whales off the coast of Western Australia between 1982 and 2010: Patterns of occurrence, outcomes and management responses. *Pacific Conservation Biology* 18: 203–214.

How, J., D. Coughran, J. Smith et al. 2015. Effectiveness of mitigation measures to reduce interactions between commercial fishing gear and whales. FRDC Project No 2013/03. *Fisheries Research Report No. 267. Department of Fisheries, Western Australia*. 120.

International Whaling Commission (IWC). 2010. Report of the Workshop on welfare issues associated with the entanglement of large whales. https://iwc.int/private/downloads/Gfdl--xvNM2BPpwF9XMuQw/Report%20of%20First%20IWC%20Workshop%20on%20Large%20Whale20Entanglement.pdf [accessed March 20, 2017].

IWC. 2011. Report of the second workshop on welfare issues associated with the entanglement of large whales, with a focus on entanglement response IWC/64/WKM&AWI REP1. https://archive.iwc.int/pages/download.php?ref=298&size=&ext=pdf&k=&alternative=1043&usage=-1&usagecomment= [accessed March 22, 2017].

IWC. 2016. Principles and guidelines for large whale entanglement response efforts. https://iwc.int/best-practice-guidelines-for-entanglement-responde [accessed February 5, 2017].

Jepson, P.D., M. Barbieri, S.G. Barco et al. 2013. Peracute underwater entrapment of cetaceans. *Diseases of Aquatic Organisms* 103: 235–239.

Lien, J. 1994. Entrapments of large cetaceans in passive inshore fishing gear in Newfoundland and Labrador (1979–1990). *Reports of the International Whaling Commission* Special Issue 15: 149–157.

Meÿer, M.A., P.B. Best, M.D. Anderson-Reade, G. Cliff, S.F.J. Dudley, and S.P. Kirkman. 2011. Trends and interventions in large whale entanglement along the South African coast. *African Journal of Marine Science* 33: 429–439.

Moore, M.J., J. van der Hoop, S.G. Barco, A.M. Costidis, F.M. Gulland, P.D. Jepson, K.T. Moore, S. Raverty, W.A. McLellan. 2013. Criteria and case definitions for serious injury and death of pinnipeds and cetaceans caused by anthropogenic trauma http://www.intres.com/abstracts/dao/v103/n3/p229-264/. *Dis Aquat Org* 103: 229–264.

Moore, M., M. Walsh, J. Bailey et al. 2010. Sedation at sea of entangled North Atlantic right whales (Eubalaena glacialis) to ,Enhance Disentanglement. PLoS One 5 (3): e9597.

Moore, M., R. Andrews, T. Austin et al. 2013. Rope trauma, sedation, disentanglement, and monitoring-tag associated lesions in a terminally entangled North Atlantic right whale (*Eubalaena glacialis*). *Marine Mammal Science* 29: E98–E113.

Song, K.J., Z.G. Kim, C.I. Zhang, and Y.H. Kim. 2010. Fishing gears involved in entanglements of minke whales (*Balaenoptera acutorostrata*) in the East Sea of Korea. *Marine Mammal Science* 26: 282–295.

van der Hoop, J., M.J. Moore, A. Fahlman et al. 2013b. Behavioral impacts of disentanglement of a right whale under sedation and the energetic cost of entanglement. *Marine Mammal Science* 30: 282–307.

van der Hoop, J., M. Moore, S. Barco et al. 2013a. Assessment of management to mitigate anthropogenic effects on large whales. *Conservation Biology* 27: 121–133.

Walsh, M., S. Gearhart, and E. Chittick. 2006. Sedation and anesthesia techniques in cetaceans. In *Proceedings American Association Zoo Veterinarians,* Orlando FL, USA, 237.