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**Report of the Live Large Whale Stranding
Response Workshop**

by

*Sarah M. Sharp, Michael J. Moore, Craig A. Harms, Sarah M. Wilkin
W. Brian Sharp, Kristen M. Patchett, Kathryn S. Rose*

Woods Hole Oceanographic Institution
Woods Hole, Massachusetts 02543


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Technical Report

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Carin Ashjian , Chair
Department of Biology

Report of the Live Large Whale Stranding Response Workshop

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AUTHORS:

Sarah M. Sharp¹

Michael J. Moore^{1,2}

Craig A. Harms³

Sarah M. Wilkin⁴

W. Brian Sharp¹

Kristen M. Patchett^{1*}

Kathryn S. Rose^{1*}

¹ International Fund

for Animal Welfare, Yarmouth Port, MA 02631, USA

² Woods Hole Oceanographic Institution, Woods Hole, MA 02543, USA

*³ North Carolina State University, College of Veterinary Medicine and Center for Marine Sciences and
Technology, Morehead City, NC 28557, USA*

⁴ NOAA Marine Mammal Health and Stranding Response Program, Silver Spring, MD 20910, USA

**Rapporteur*

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I. ABSTRACT

Reasoned triage and management of live large whale stranding events prompted this workshop. Safety is paramount for humans and must be mitigated for them and whales during responses. Clinical assessment is critical, with emaciation and poor prognosis often worsening welfare if released. Accurate length and estimated weight data are essential. Supportive care and treatments depend on understanding the underlying pathophysiology of stranding. Maintaining an airway, monitoring breathing, minimizing stress, protecting eyes, modulating temperature, and preventing sunburn are priorities. Additional strategies can include mild sedation, fluid administration, and flipper excavation to relieve pressure. Tools to indicate post-release survival include photographs, genetic samples, paint sticks, and identification, VHF, or satellite-linked tags. Acceptable rescue techniques included towing offshore with a tackle or lines over or under the body and around the axillae, inflatable lift bags, and trenching. Nets and towing by the flukes are unsuitable. Refloating of stranded large whales can be considered if a clinical examination suggests a favorable prognosis, and a release method could be safely undertaken without undue stress and trauma to the animal. However, in many cases euthanasia is the most humane option if practical, or letting nature take its course if need be.

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II. BACKGROUND AND NEED

Live large whale strandings present marine mammal professionals with incredibly challenging response scenarios. These events occur around the world, often in unpredictable locations and times. Due to the sheer size of the animal, live large whale strandings pose a tremendous physical test for both responders and the whale alike. In order to move whales that weigh anywhere from 10 to 60 tons, some level of mechanical advantage must be involved as well as other specialized tools to enable responders to get lines or straps under the whale. Adding to the level of difficulty, these efforts must be done while also minimizing stress to the whale, not inflicting additional harm, and not exacerbating the predicament for the animal. Maintaining human safety during large whale rescue efforts is also a significant challenge because of numerous factors including: the size of the animal, use of heavy equipment and lines or straps under tension, operations in and around water, environmental conditions, large volumes and high concentrations of veterinary drugs if used, and unpredictable behavior of the whale. These events are often strenuous and prolonged for both the whale and rescuers, posing additional safety risks and considerations.

Live large whale stranding events are additionally often quite newsworthy, bringing considerable public attention to the situation. Media outlets broadcast the story widely, increasing public scrutiny of these events and the agencies responding to them. Social media has only increased this pressure in recent years by providing real time, unfiltered information to large audiences without the benefit of interviews or explanations from expert stranding responders. With the best of intentions, the public oftentimes places an incredible amount of pressure on stranding responders to make a rescue attempt even when that effort may not be in the best interest of the animal. The public may also create additional safety issues that must be managed by responders in addition to the event itself.

In many (if not most) live large whale stranding events, the whale is in compromised health, often exhibiting signs of chronic illness such as emaciation, lethargy, and weakness. In rare cases where a whale strands and is in apparently good health, consideration must be given to the trauma inflicted by the stranding event itself and its impact on the whale's post-release survival prognosis. When a whale is deemed sufficiently healthy for a rescue attempt, there are still numerous challenges facing stranding responders. Operational windows for the response are limited by tides, surf, stranding site accessibility, weather, and daylight. Viable rescue techniques for stranded large whales are currently few in number, situationally specific, and often rely on short-notice resource availability. Many adverse effects of both whale rescue and euthanasia attempts (drowning, entanglement in rescue gear, unsuccessful euthanasia attempts) have been documented in the past, but these are typically known only to those who have experienced them directly or heard through word of mouth, leaving uninitiated responders bound to repeat others' mistakes.

The goal of the workshop was to bring stranding responders and other marine industry professionals together to discuss current response techniques used by responders around the world, how these methods can be improved upon, and what new techniques are required. The workshop reviewed historic cases of live large whale response, both coordinated and ad-hoc, and attempted to qualify success to inform decision making for future events. The scope of the workshop was from initial report to ultimate disposition (successful refloating, natural mortality or euthanasia). Species considered included baleen whales, sperm whales, and orca. Current technique categories discussed included flotation, towing, and excavation/dredging. New techniques were discussed by workshop participants to identify any that have merit and deserve further investigation. The critical need for health assessments and post-release monitoring were discussed. All options were considered, and all techniques and tools were evaluated on: 1) human safety; 2) efficacy; 3) animal health and welfare; 4) ease of use; and 5) availability of equipment. This publically available workshop report is intended to improve accessibility to the collective knowledge represented at the workshop to broadly improve outcomes for large whale strandings globally.

United States Perspective

Large whales can occasionally be found in “out of habitat” situations where they leave open ocean waters and are found in areas such as small harbors and bays, or some distance up rivers. Currently these cases are relatively rare in the United States, but they may increase with ocean changes in future years. These events can be classified as short term “explorations” (on the order of days) to longer term “stays” (weeks). Why pelagic large whales are occasionally found in these coastal areas is largely unknown, but possible explanations include an underlying disease processes or other health compromised state, new habitat exploration, or a navigational error. In most of these cases, a minimal “intervention” strategy has been employed in the USA, in which a safety perimeter is maintained around the whale to allow it to leave the area and return on its own to open water.

An example of such a situation occurred far up the Sacramento River in California in 2007, in which a mother-calf humpback pair was observed for a period of two weeks. Both animals were injured and showed signs of declining health as they remained in the freshwater environment. Efforts were undertaken to deter the animals from swimming farther upstream using acoustic recordings (predator species calls, alarm sounds), pipe banging, boat movement and engine noise, fire hose and direct contact (biopsy and antibiotic injection via dart), none of which showed an appreciable effect on the whales’ movement. Acoustic recordings of conspecifics were also employed to lure the whales closer to the ocean, with again little to no effect on their behavior. The animals did eventually leave the river (and San Francisco Bay system) but not as a direct result of human intervention (Gulland et al. 2008).

Live large whale strandings have also occurred in the United States (U.S.), with 64 cases between 2008 and 2016 (annual average seven). Circumstances are very variable between the different cases, with multiple regions, species, age class, and health states of whales represented. Of the 64 live stranded whales, 36 whales died naturally and 22 were euthanized by authorized members of the stranding network. Of the 36 animals that ultimately died on their own, 10 had been refloated after the initial stranding event; of the 22 animals that were euthanized, four had been refloated. These refloatings included efforts by trained responders, by the public, and cases where the whale refloated itself (generally on a high tide following the initial stranding event). Finally, six whales were last seen alive and swimming (three refloated by trained responders, three self-refloated on a rising tide). None of those last six were known to restrand later, nor have any of them been seen later following the release, leaving their survival highly suspect.

III. LIST OF WORKSHOP ATTENDEES

Attendee	Agency	Country
Allen, Dee	Marine Mammal Commission	USA
Alps, Diane	CICRU	USA
Berrow, Simon	Irish Whale & Dolphin Group	Ireland
Betty, Emma	Massey University	New Zealand
Bourque, Laura	CWMC	Canada
Bravo Rebolledo, Elisa	Bureau Waardenburg	Netherlands
Brownlow, Andrew	SMASS	UK
Carr, Meg	Dalhousie University	Canada
Co, Mandy	Ocean Park Conservation Foundation	Hong Kong
Costidis, Alex	VAQS	USA
Dalton, Alex	DFO	Canada
DiGiovanni, Robert	Atlantic Marine Conservation Society	USA
Doughty, Lynda	MMOME	USA
Garron, Mendy	NOAA/GARFO	USA
Goodreau, Danielle	Murdoch University	Australia

Attendee	Agency	Country
Harms, Craig	NCSU	USA
Hayslip, Craig	OSU MMI	USA
Keller, Bryn	Intel Labs	USA
Kolesnikovas, Cristiane K.M.	R3 Animal	Brazil
Larned, Lela	St. George's Univ./Murdoch Univ.	USA
Lira, Norma	OSU	USA
MacLennan, Ellie	WCMT/BDMLR	UK
Moore, Katie	IFAW	USA
Moore, Michael	WHOI/IFAW	USA
Norman, Stephanie	Marine-Med & CPSMMSN	USA
Patchett, Kristen	IFAW	USA
Pepe, Monica	Whale & Dolphin Conservation	USA
Powell, Ashley	Atlantic Veterinary College	Canada/USA
Powell, James	SR3	USA
Ramos, Eric A.	The Graduate Center - CUNY	USA
Reid, Andrew	Marine Animal Response Society	Canada
Rickard, Meghan	NY Natural Heritage Program/ NY DEC	USA
Riels, Richard	SMELTS	USA
Roncon, Giulia	University of Tasmania (IMAS)	Australia
Rose, Kathryn	IFAW	USA
Sharp, Brian	IFAW	USA
Sharp, Sarah	IFAW	USA
Stockin, Karen	Massey University	New Zealand
Szanzislo, Wendy	Vancouver Aquarium	Canada
ten Doeschate, Mariel	SMASS	Scotland, UK
Walk, Dominique	MMOME	USA
Weiler, Colleen	Whale & Dolphin Conservation	USA
Weinrich, Mason	CCS/Whale Center	USA
Wilke, Ted	Intel Labs	USA
Wilkin, Sarah	NOAA	USA
Wimmer, Tonya	Marine Animal Response Society	Canada
Wong Wai Ho, Simon	University of Hong Kong	Hong Kong
Ysseldijk, Lonneke	Utrecht University Fac. Vet. Med.	Netherlands
Zahniser, Dave	TMMC	USA
Zwamborn, Elizabeth	Dalhousie University	Canada

IV. WORKSHOP AGENDA

08:30 – 08:40	Introductions
08:40 – 09:00	Framing the Problem / Workshop Goals / Historical Perspective (Brian Sharp, IFAW)
09:00 – 09:15	US perspective (Sarah Wilkin, NOAA MMHSRP)
09:15 – 09:45	Decision Making and Clinical Assessment (Craig Harms, NCSU)
09:45 – 10:00	Treatments (Sarah Sharp, IFAW)
10:00 – 10:30	Coffee Break
10:30 – 10:45	Post-release monitoring (Michael Moore, WHOI/IFAW)
10:45 – 11:00	Case Report #1 (James Powell, SR ³) Stranded gray whale response in Washington, USA
11:00 – 11:15	Case Report #2 (Cristiane Kolesnikovas, Associação R3 Animal) Stranded right, humpback and sei whale responses in Brazil
11:15 – 12:00	Plenary Discussion
12:00 – 13:30	Lunch (on own)
12:30 – 13:30	Bayesian Belief Networks (Karen Stockin, Massey University)
13:30 – 14:00	Potential Rescue Methods Flotation (Harms) Towing (Moore) Dredging / Excavation (B. Sharp)
14:00 – 15:00	Concurrent breakout groups – (Chair – Wilkin) Flotation – (Harms) Towing – (Moore) Dredging / Excavation– (B. Sharp) Assessment / Diagnostics – (S. Sharp)
15:00 – 15:30	Coffee Break
15:30 – 16:30	Breakout group reports and plenary discussion (Wilkin)
16:30 – 17:00	Next Steps / Action Items (B. Sharp)
17:00	Adjourn

V. COMPONENTS OF RESPONSE

A. Assessment and Decision Making

Compiled by Dr. Craig Harms (NCSU) with input from Dr. Sarah Sharp (IFAW)

Common misperceptions of whale stranding events are that they are purely accidental, that stranded animals are otherwise healthy and all they need is a helpful push back into the water, that all will be well once they are returned to the water, and that refloating them is not a difficult task. The reality is more commonly the opposite in all respects. It is often not in the whale's best interest to put it through the ordeal of refloating only to drown, be predated, or to eventually die from the physiological and/or physical damage incurred during the rescue efforts. Moving multiple tons of animal in an unstable surf and shore zone without causing further damage is both challenging and hazardous. However, there are some cases where rescue attempts are indicated: when an otherwise healthy animal strands through an accident of tides, currents, shore characteristics or pursuit of food, when weather and water conditions are favorable, when the animal has not spent so long stranded that it decompensates from gravitational effects and exposure, and when risks to rescue personnel can be minimized.

When a whale strands alive, there are commonly posed questions and suggestions from the general public and others that initially seem reasonable, lacking direct experience or knowledge of how they could go wrong or have in fact gone wrong in prior events. The first common question to address is "why don't they just save it?" by variations on pushing it back, towing it back (fishing boat, tugboat, Coast Guard boat), hoisting it back (crane, helicopter), or digging a trench to access deeper water. If the whale is in a nonsurvivable condition or situation, the question and suggestions gradually transition to "why don't they just put it out of its misery" by various means such as shooting, explosives, or euthanasia solution. And if the course of action selected is euthanasia, the question of "why don't they just let it die naturally" is logical. "Just" is not so simple though. Even if the whale is otherwise healthy and is a candidate for refloating, many strandings occur in remote locations where vehicle, heavy equipment, or boat access is difficult or impossible. The initial inclination for an attachment site for towing is often the caudal peduncle, which could be disastrous for subsequent locomotion due to caudal spinal damage or dislocation even if the whale is refloated. Some of these suggestions have been used successfully as components of either refloating or for euthanasia (e.g., pulling forward with improvised harnesses around the axillae of the pectoral fins for the former, cranial implosion with explosives for the latter), but some have resulted in distressing outcomes (e.g., rolling into a trench and drowning, or creating an entanglement after refloating with an improvised harness for the former; multiple ineffectual gunshots for the latter). These adverse outcomes are typically known only to those who have experienced them directly, or heard about them through word of mouth, so that when new people experience new strandings in new locations, the experiential learning of pitfalls to avoid is often not accessible.

Critical factors to consider in live whale strandings include personnel and public safety, working conditions, resources and capacity, and the animal's condition. Regardless of the whale's status, if weather, surf or current conditions are too hazardous, or if equipment and personnel resources and capacity are insufficient for the task, attempted rescue may not be an acceptable option. Responders must critically evaluate their ability to intervene safely for themselves and effectively for the stranded animal before proceeding. Doing nothing is sometimes the best alternative.

Hazards to personnel include but are not limited to: surf, currents, weather, flukes, rolling whales, heavy equipment, zoonotic diseases, sharps (needles, knives), and drugs including highly concentrated sedatives. These hazards could result in serious or lethal conditions for rescuers including drowning, crushing trauma, head trauma, puncture wounds or lacerations, entrapment, drug exposure or overdose, hyper- or hypothermia, exhaustion, and disease. These hazards can be mitigated by a variety of means, including by having situational awareness, first responder training and inclusion, swift water rescue training, scenario training, a designated safety officer, appropriate personal protective equipment (PPE), sharps containers, employing whale sedation, drug reversal agents (depending on drugs used, and personnel authorized to deliver them), fluke avoidance, and public

messaging to manage expectations. Situational awareness and preparation can be informed prior to the response team's arrival on site through resources such as the stranding response literature (e.g., Geraci and Lounsbury 2005, Harms et al. 2018, Simeone and Moore 2018), Google Maps (distances, terrain, access points), weather web sites and marine weather forecasts (exposure conditions for the whale and for responders, and expected wave action), surf cams on surfing web sites (actual surf conditions potentially near site of stranding), tide tables and apps, and sunrise/sunset tables and apps. With regards to tides and daylight, **the safest situation for stranding responders is low tide during daylight hours**, while the best opportunity for whale self-rescue or facilitated refloating is at high tide. Working around a live stranded whale in any depth of water at night is not recommended. Having stranding responders trained in CPR and first aid is a good precautionary measure but should not replace good judgement. Communicating and coordinating with or including emergency medical services is also prudent. Although swift water rescue training is designed primarily with river sports and floods in mind, the skills are remarkably well aligned to in-water stranding events, and such training is worth considering for stranding response organizations. Sedation of the whale can make it less responsive, and therefore somewhat less dangerous to work around, but guard against the misconception that such treatment makes the situation safe or renders the whale rapidly and completely unresponsive. Avoid working near the flukes. This is the most dangerous end of the whale, and crushing injuries inflicted by flukes can be (and have been) fatal. Another hazard near a whale in shallow water is the tendency for a trough to form alongside it, such that a person approaching it could suddenly be in deeper than expected water and at risk of foot or leg entrapment should surf roll the animal. Every stranding response is different and requires some level of improvisation, but scenario training prior to stranding events can prepare people for their roles, resulting in more efficient execution of tasks and anticipation of steps to be taken in particular circumstances. It is critical to have someone designated as safety officer whose primary or sole focus is overseeing safety of the responders, keeping track of anyone in the water, and ensuring that people are not overworking to the point of exhaustion, overheating or getting chilled, becoming hypoglycemic or dehydrated, or masking injuries. It is easy to become so engrossed in the response effort that responders don't notice how tired they have become, and they generally do not want to let up on the effort when much remains to be done; but that can come at the cost of safety to themselves and others. Depending on the situation, components of Personal Protective Equipment (PPE) in a stranding setting can include exam gloves, eye protection, hand sanitizer, close-toed shoes or wet suit booties, wet suits or dry suits, personal flotation devices (PFDs), and helmets. Having water, liquid IV or other rehydrating beverages on hand is recommended as well. Designating an individual to engage with the public is important both to keep them at a safe distance from the activities, and to explain the process and rationale behind the course of action, which can help improve public support for the response.

Self-rescue by the whale can and does occur sometimes in accidental strandings, usually on the next high tide, but sometimes as late as the third or fourth high tide after stranding. This can especially be true in some areas where tides are biphasic, with alternating lower and higher high tides, or with approaching spring tides. It is reasonable to allow one high-high tide before attempting rescue or euthanasia, as this affords the best chance for a successful outcome for an otherwise healthy whale, gives a chance with the benefit of the doubt for animals in dubious condition, and allows time for a team to assemble and plan a response. If safe to do so, care should be provided to the whale during the assessment and planning process, to help keep the whale from decompensating too far to be a release candidate (supportive care) or to keep it as comfortable as possible to ease its passing (palliative care).

Even if an animal strands in reasonably good health, the state of being stranded and lacking the buoyant support of water leads to a downward cycle of pathophysiology leading to a non-recoverable condition. The combination of exposure, loss of buoyant support, and loss of heat exchange capacity can lead to hyperthermia, dehydration, electrolyte imbalances, massive blistering and fluid loss, scavenger damage, respiratory exhaustion, cardiovascular shock, catecholamine and glucocorticoid release, organ perfusion problems, cardiac contraction band necrosis, rhabdomyolysis (muscle damage from weight and surf trauma) contributing to kidney failure, and all of these processes reinforcing each other in negative feedback loops. Death may ensue naturally within hours

to up to a week, and they may linger well past the point at which recovery could still be possible even if refloated. Conditions leading to more rapid decompensation include larger size, less buoyant support (i.e., more of body out of water), longer duration emergent, and hotter sunnier weather.

In assessing the whale's condition, the first approximation is to take in the entire scene in a visual exam from a distance, noting degree of submersion, amount of blistering and scavenger damage, presence of any physical trauma (e.g., propeller wounds, shark bites), body conformation (e.g., degree of concavity or convexity of epaxial muscles and nuchal region), muscle tone (e.g., laxity of lips), activity, and respiratory rate and quality. Start recording the time of individual breaths upon arrival so that trends can be monitored and evaluate whether the breaths are shallow and drawn out or rapid with the blowhole snapping open and shut. Determine how responsive the whale is to activities around it, whether it is following surrounding actions, or if eyes are fixed or exhibiting nystagmus. Closer in, one can assess reflexes, including blowhole, palpebral, labial, rectal (if exposed) or corneal. An alert whale responds to touch of the palpebrae or blowhole region by clenching the lids or blowhole. A decompensating whale does not respond to fingers or hand inserted into the upper blowhole or along the inner labial surface. The rectum is often not accessible or is not safe to access, either for reflex assessment or temperature measurement. The corneal reflex is the last to go and should only be tested if the palpebral and blowhole reflexes are absent. Heart rate and rhythm are more difficult to monitor in a large whale than in smaller cetaceans but can be done so readily with portable ECG equipment and stick-on or suction contacts. While useful, cardiac monitoring is not essential for decision making in a large whale rescue situation. Blood analysis using point of care analyzers can also be helpful, although blood collection from fluke vessels may be too hazardous. Blood may occasionally be collected successfully, and more safely, from pectoral flipper vessels. Exercise caution to minimize disturbance to the whale during the examination.

A reasonably accurate approximate weight is essential for planning purposes, whether for rescue or for euthanasia. Working estimates of weight can be obtained from length measurements and length-to-weight equations. Visual estimates of length are usually highly unreliable, and because a length difference of only 1 m can mean a weight difference of tons, performing actual measurements with a tape measure parallel to the whale is indispensable. Limitations of weight-to-length equations are that they do not take girth into consideration, the source populations differ and may represent stranded animals or data from whaling or different regions, and the size range used to derive the equations may not encompass the size of the particular stranded animal in question, so some clinical judgment of body condition is necessary to adjust estimates upwards or downwards, as well as for general responsiveness and strength. WhaleScale, an app compiling length-to-weight equations for multiple cetacean species, is available at no cost on both iOS and Android platforms (Harms et al. 2017, Harms et al. 2019)

Live-stranded cetaceans can be triaged as follows (also summarized in Table 1):

Category 1: Animal is sufficiently healthy and uninjured for prompt return to sea (less common in single-animal strandings). Category 1 criteria include absence of serious external wounds and fractures, alert to approach, strong reflexes, heart rate regular and with normal sinus arrhythmia coinciding with respirations, a short sharp expiration/inspiration interval (< 4 sec, "snappy"), rectal temperature 36-39°C (though note danger of obtaining this), subjective assessment of <5% dehydration, and most importantly, refloating can be performed safely for people and the whale (i.e., without causing significant injury to the whale).

Category 2: Animal requires treatment and rehabilitation prior to release. Although some one-time treatments can be options (see below), rehabilitation is not a practical consideration for a large whale, so Category 2 is exceedingly narrow.

Category 3: Animal suffers from major injury, illness, or decompensation warranting euthanasia or natural death (with palliative attention). Although singly not all of these criteria automatically warrant transitioning to planning for euthanasia, conditions supporting that decision include re-stranding after attempted

refloating (this may have occurred multiple times from initial public response), penetrating wounds to the thorax and abdomen, major external wounds (including to epaxial muscles caudal to dorsal fin), broken pectoral flipper, hemorrhage from orifices, blistering or deep scavenger damage covering greater than 25% of the body surface area, heavy cyamid load, rectal temperatures $> 40^{\circ}\text{C}$ (critical) to 42°C (terminal), signs of severe systemic infection or metabolic disease (point of care blood analysis can inform these assessments), loss of reflexes (menace, blink, blowhole, anal), neurological signs (e.g., nystagmus), unresponsiveness or minimal responsiveness to sound and touch, bilateral vision loss (e.g., trauma or cataracts), prolonged time beached ($>12 - 60$ h, variable depending on size, exposure, and stranding effects), respiratory decompensation, frequent arching, a dependent calf that cannot be reunited with parental care or rehabilitated, and absence of a safe and effective means for refloating (removing this last factor is the focus of this workshop).

Prognostic indicators have been determined for stranded short-beaked common dolphins (*Delphinus delphis*) based on post-refloating satellite tagging and follow-up stranding responses (Sharp et al. 2014) and could be extrapolated to or modified for large cetaceans. Failed animals were thinner, anemic, acidemic, hypoalbuminemic, and had blood values consistent with liver damage and exertional myopathy. Indicators of poor prognosis included hemoglobin < 13.9 g/dL, CK > 400 U/L, ALT > 500 U/L, Base Excess < 8 mmol/L, lactate > 4.5 mmol/L, TCO₂ < 34 mmol/L, length: girth ratio > 2.04 (specific value would depend on species conformation, and girth not easily measured in large whale), heart rate > 119 /min.

Table 1. A system for triaging live-stranded large whales.

Triage Category	General Description	Health Criteria	Rescue Options	Outcome
1	Animal is sufficiently healthy and uninjured for prompt return to sea (less common in single-animal strandings)	Absence of serious external wounds and fractures, alert to approach, strong reflexes, heart rate regular and with normal sinus arrhythmia coinciding with respirations, a short sharp expiration/inspiration interval (< 4 sec, "snappy"), rectal temperature 36-39°C (though note danger of obtaining this), subjective assessment of <5% dehydration	Refloating can be performed safely for people and the whale (i.e., without causing major injury)	Rescue attempt could be undertaken
2	Animal requires treatment and rehabilitation prior to release.	Some more minor criteria of Triage Category 3 apply.	Although some one-time treatments can be administered (see below), rehabilitation is not a practical consideration for a large whale, so Category 2 is exceedingly narrow.	Depends on resources, rescue attempt may be undertaken after treatments/rehabilitation
3	Animal suffers from major injury, illness, or decompensation	Although singly not all of these criteria automatically warrant transitioning to planning for euthanasia, conditions supporting that decision include restranding after attempted refloating (this may have occurred multiple times from initial public response), penetrating wounds to the thorax and abdomen, major external wounds (including to epaxial muscles caudal to dorsal fin), broken pectoral flipper, hemorrhage from orifices, blistering or deep scavenger damage covering greater than 25% of the body surface area, heavy cyamid load, rectal temperatures > 40°C (critical) to 42°C (terminal), signs of severe systemic infection or metabolic disease (point of care blood analysis can inform these assessments), loss of reflexes (menace, blink, blowhole, anal), neurological signs (e.g., nystagmus), unresponsiveness or minimal responsiveness to sound and touch, bilateral vision loss (e.g., trauma or cataracts), prolonged time beached (>12 – 60 h, variable depending on size, exposure, and stranding effects), respiratory decompensation, frequent arching, a dependent calf that cannot be reunited with parental care or rehabilitated	Absence of a safe and effective means for refloating (removing this last factor is the focus of this workshop)	Euthanasia or natural death

B. Supportive Care and Treatments

Compiled by Dr. Sarah Sharp (IFAW) with input from Dr. Craig Harms (NCSU) & Dr. Lesanna Lahner (SR3) Acknowledgements for treatment suggestions go to Dr. Frances Gulland (TMMC), Dr. Michael Walsh (UF), and Dr. Michael Moore (IFAW/WHOI)

In order to establish an appropriate treatment plan, an understanding of stranding pathophysiology is essential. The most pertinent stranding-induced conditions include: compression of internal organs from supporting weight on land, poor end-organ perfusion due to recumbency and vascular shunting; poor respiratory exchange due to compression of thorax and exhaustion of respiratory muscles while on land; dehydration if stranding is prolonged; rhabdomyolysis (muscle damage) from thrashing, compression on land, exertional myopathy, damage from pounding surf; and shock, when the body's demand for oxygen exceeds the capability of its delivery, leading to the transition from illness to death if no treatment is instituted. Treatment regimens for large whales are designed, in part, to minimize the effects of these conditions and will be discussed further below.

Treatments can be administered to a stranded large whale at nearly any point in the process between report and final disposition (whether release, natural mortality, or euthanasia). The goals of supportive care and treatment are: 1) to make the animal more comfortable and reduce stress; 2) prevent or treat stranding-related pathologies;

and 3) improve post-release survival, if applicable. As such, it is appropriate to treat whales when responders are waiting for the tide to change or for rescue equipment to arrive, during the assessment process, or as part of palliative care to keep the animal more comfortable while waiting for either euthanasia equipment to arrive or a natural death to occur.

Safety

When considering supportive care and treatment options, human safety must always be the first priority, without exception. Treatments must not be undertaken if it is not safe to do so. The safest time to operate around a stranded large whale is at low tide during daylight hours. It is not advisable to operate around the animal at night unless ample artificial lighting can be provided. Rough surf conditions, strong currents, and other environmental factors can also make operating around a stranded whale extremely dangerous and must be considered prior to implementing a care plan. General safety rules for operating around a stranded large whale are as follows:

- 1) Stay clear of the blowhole (do not inhale what the whale exhales)
- 2) Whenever possible, approach the whale from a direction that it can see you so as to reduce a possible startle reflex
- 3) Do not operate around the peduncle or tail region, try to always stay cranial to the dorsal fin (or mid-body)
- 4) Extra care should be taken around humpback whale pectoral flippers, considering their length
- 5) Wear proper Personal Protective Equipment (PPE):
 - a. Helmets with face shields and chin strap
 - b. Exam gloves or neoprene gloves
 - c. Drysuit or wetsuit, depending on the climate
 - d. Personal Flotation Device, when water is present
 - e. Proper foot protection (closed-toe shoes)
 - f. Face masks or face shields
 - g. Safety goggles
- 6) The team leader should develop and communicate the plan prior to approaching the whale to ensure that movements around the whale and time next to the animal are minimized.
- 7) Never approach a whale alone, always designate a spotter (at least one) that is focusing on the animal's behavior and the environmental conditions when any person is working close to the whale.
- 8) Plan an escape route to ensure that you have a quick path to safety should anything go awry.
- 9) Avoid proximity to thrashing whales. If you are near a whale that starts to thrash, move away immediately, without exception. This is incredibly dangerous and can result in extensive trauma to the responder or even death.
- 10) Ensure proper communications (cell phones, two-way radios) between the people working closely with the whale and support staff farther away.
- 11) Ensure that any treatment you undertake does not compromise the whale's safety. For instance, make sure that if you put sheets on the whale to protect it from the sun, you assign a monitor to ensure that the sheet does not end up shifting to cover the blowhole, causing suffocation.
- 12) Take care of yourself and your team members. Be vigilant about safety and be mindful of your and others' location with respect to the whale.

Supportive Care

Make sure the blowhole is clear of water, sand, and debris such that the animal can properly breathe without inhaling foreign materials. Cetaceans have a clear viscous protective film that is secreted to protect their eyes. If there is debris in the film, be sure to clear it away with eyewash. In small delphinids, IFAW has found that doing so tends to minimize their stress during response. If there is obvious nearby material that has the potential to injure the whale, try to remove it if possible and safe to do so.

Exposure to the sun and wind can be extremely damaging to cetacean skin. Protection from the sun can be provided in various forms, including sheets applied directly over the animal's exposed surface, tents or tarps that are suspended over the animal in a safe manner, or zinc oxide application directly to the skin to function as a physical sunblock. To protect from the wind, commercial wind blocks can be used, or wind blocks can be improvised with locally available materials. With all these protection methods, it is important not to compromise human safety (consider escape routes and exposure to exhalants under tents or tarps) and animal safety (inhalation of sheets, irritation of eyes from melting zinc oxide, etc). The safety and efficacy of these measures should be reassessed in the light of changing environmental conditions (wind direction or speed change, darkness, incoming/outgoing tide, etc).

With regards to the animal's posture, it is best if they are lying in sternal recumbency, meaning that they are lying on their ventral surface with their dorsal fin (if present) straight up in the air. The primary reason for this is to minimize the potential for lung collapse of the dependent lung, which would result in worsening of the animal's respiratory exchange. Additionally, this helps protect the eyes from trauma and potentially minimizes unilateral impingement of cranial nerves (affecting the blowhole, eyes, and vestibular system). If possible and applicable (for certain species), attempt to dig holes for the pectoral flippers allowing them to sit in a more natural resting position, ventral to the body rather than being pushed dorso-laterally by the substrate.

Cetaceans' ability to thermoregulate out of the water is limited, and therefore it is important to monitor their temperature and regulate appropriately. Hyperthermia (elevated body temperature) is more common than hypothermia (low body temperature) in stranded large whales. Obtaining a rectal temperature is not advised due to human safety concerns and accessibility difficulties when the animal is lying in sternal recumbency. However, pectoral flippers can be palpated to obtain an approximate temperature and monitor trends. Thermal imaging of the blowhole may be another option with a high-quality thermal camera, but this method has not been validated in large whales yet. Thermal imaging or surface laser thermometers might be useful at a minimum to monitor temperature trends. To keep the animal cool, wet towels or sheets can be employed as well as buckets of water or low velocity hoses, while avoiding the eyes and blowhole. It is important to minimize the startle response in these animals by not dumping a large volume of water on them suddenly (slow gentle pours are advised).

Additionally, stranded whales have virtually no defenses with regards to avian, terrestrial or even marine predators and scavengers. Efforts should be undertaken to keep them away from the whale and minimize the potential trauma and stress they could inflict.

Finally, it is very important to minimize stress experienced by the animal during the response. Inevitably, the stranding event itself is an extremely stressful experience for the whale. However, the way the response is conducted can help to minimize the stress the whale experiences. Minimizing handling, noise and activity directly around the animal is a good first step. Actions that can help this include holding briefings and conversations away from the whale, establishing a wide perimeter around the animal to keep the public at a distance, keeping vessels and vehicles at a safe distance, and coordinating supportive care, treatment and rescue activities among the team members to minimize walking back and forth and the number of times the whale is disturbed.

Treatments

Empirical treatments employed by IFAW in live small delphinids include intravenous (IV) fluids and intramuscular Vitamin E / Selenium. These treatments were derived from Dr. Michael Walsh's work with cetacean rescue and rehabilitation in Florida, USA (SeaWorld Orlando). Additional treatments that are administered on an as-indicated basis (based on physical exam findings and at the direct order of the attending veterinarian) include non-steroidal anti-inflammatories (NSAIDS) and long-acting antibiotics. Pharmacokinetic studies have been done on the use of meloxicam in bottlenose dolphins (Simeone et al. 2014) and Ceftiofur CPA in California sea lions (Meegan et al. 2013).

To be able to dose treatments, a weight is needed but obtaining an actual weight in a stranded large whale is usually not possible. Previous publications have made the estimation of weight based on length and/or girths possible through the development of equations (Lockyear 1976). These equations have been made easily available in an app called WhaleScale (24 species are available from small delphinids to large balaenopterids). The weight derived from this app or calculated with the appropriate equations should be considered an estimate and must be evaluated in real life with regards to its likely accuracy. For many of the large whale species, the equations are derived from whaling data, and may represent larger and healthier animals compared to stranded whales. Body condition, health, and age class should be considered when determining an estimated weight.

Injection Sites

Intravenous (IV) fluids can be administered in the vessels of the pectoral flippers or dorsal fin of large, stranded whales. On the pectoral flipper, approximately one-third the flipper length distal to the anterior insertion, a depression can be felt between the radius and ulna on the dorsal surface (approximately one-quarter to one-third the flipper width medial to the leading edge) (Fig. 1). Depending on the

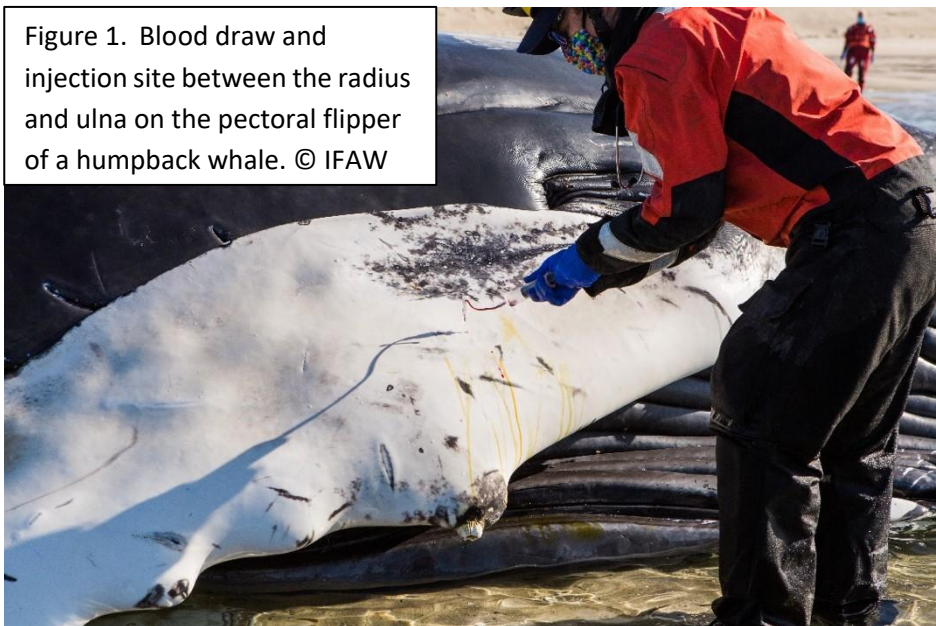


Figure 1. Blood draw and injection site between the radius and ulna on the pectoral flipper of a humpback whale. © IFAW

Figure 2. Depressions indicating location of superficial dorsal fin vessels in a common dolphin. © IFAW



size of the whale, a 5 – 12.7 cm (2-5

inch) hypodermic needle can be inserted perpendicular to the flipper surface at this site until blood is aspirated. An extension set is recommended for safety and to minimize the impact of minor flipper movements on needle placement. On the dorsal fin, the central vein can be used for blood draw and IV injections but is usually a blind stick without substantial anatomical landmarks to assist needle placement (Fig. 2). Attempts have been made to draw blood and administer drugs using the ophthalmic vascular plexus with no success (Harms, pers. comm.). While vessels in the flukes and caudal peduncle may provide adequate vascular access, these are too dangerous to attempt in a large whale.

When considering intramuscular (IM) injection sites, attention should be given to muscle mass and human safety. Caudal to the skull dorsally and in the dorsal cranial epaxial muscles can be safe locations with adequate musculature to facilitate IM injection and proper drug absorption. The length of the IM needle required depends on the size of the whale and the thickness of their blubber layer, but diameter should be large bore (14 – 18 gauge), ideally with a stylet to prevent a tissue core from blocking IM injection. For most minke whales, 25 cm (10 inch) needles are sufficient. For larger whales, hypodermic needles of up to 58.5 cm (23 inch) have been used. In vitro fertilization (IVF) needles used in bovine and equine medicine are a possible source of long needles. Longer needles allow multiple drug infusion locations with a single injection, injecting volumes at varying depths within the musculature as the needle is extracted. In animals where release is the goal, every effort should be made to

minimize potential for the introduction of pathogens with these injections. In these cases, needles should be sterile and the skin should be aseptically prepared prior to injection. Prior to response, a large sharps container appropriate for the needle lengths should be prepared (PVC pipe with screwed on end caps can be made to a specific length) (Fig. 3).



Figure 3. Needle containers. Red PVC tube for long sharps.

Intravenous (IV) Fluids

Intravenous fluids can be administered to stranded whales if IV access can be established. The primary purpose of fluid administration is to treat shock, and therefore large boluses of isotonic fluids such as lactated ringers or 0.9% NaCl should be delivered at a high flow rate. A standard shock dose for dogs is 90 ml/kg, which is considered replacement of total blood volume, and for marine mammals it is estimated to be approximately 80 ml/kg (Sweeney et al. 1990). Accepted veterinary emergency practice is to administer ¼ shock dose initially (in marine mammals, this would be 20 ml/kg) over 20 minutes, then monitor response to the bolus. If there is no response (decreased heart rate, improved perfusion, etc.), the bolus can be repeated up to 3 – 4 times in a day. In an example humpback that is 900 cm in total straight length, its estimated weight would be 10,759 kg, and therefore a ¼ shock bolus would be 236 L. This is a very large volume and would require many 5 L IV fluid bags that are used in equine or farm animal practice. Large animal fluid administration sets would allow for adequate flow. Consideration should also be given to the mechanism by which to safely hang the fluids in the vicinity of the whale. Multiple fluid lines could be established by utilizing both pectoral flippers and the dorsal fin, if safe to do so. In most situations and with larger stranded whales, appropriate IV fluid boluses would likely not be practical or feasible.

IV fluids can also be used to treat dehydration if the animal is stranded over a long period of time. Typically, the fluid rate is much lower and the volume to be administered would be maintenance fluid requirements (estimated to be 40 ml/kg/day in marine mammals by Sweeney 1990) plus ongoing losses and replacement for estimated % dehydration.

Medications

Vitamin E and selenium are antioxidants that can help treat reperfusion injury. The dose is 0.06 mg Se/kg and can be administered intramuscularly. For the same humpback whale example above, 258 ml of 2.5 mg Se/ml would need to be administered, keeping in mind a general rule of 20 ml/injection site to maximize drug absorption and to prevent pressure necrosis at any one site. Calcium gluconate can be administered as a cardioprotective agent in patients with hyperkalemia (elevated blood potassium concentrations). The dose is 20 ml/kg injected intramuscularly. In the same humpback example, 935 ml of 23% calcium gluconate would be administered. The large volumes of these medications needed for an effective dose must be taken into consideration when evaluating the ability to treat a stranded large whale. Most of these medications are not cost-prohibitive, but access to the

large volumes may be a challenge. We recommend reaching out to your local veterinary community, especially farm animal and equine practices that are more likely to have larger volumes of these medications.

B vitamins play important roles in many physiologic processes, such as nervous system regulation, red blood cell formation, immune function, energy absorption, gastrointestinal function, and vision. Administering Vitamin B Complex could treat a suspected B vitamin deficiency with a dose of 1 – 2 ml per 45 kg body weight (based on cattle dose of Vitamin B complex injection containing: 12.5mg/ml Thiamine Hydrochloride, 2 mg/ml Riboflavin, 12.5mg/ml Niacinamide, 5 mg/ml Pyridoxine Hydrochloride, 5 mg/ml d-Panthenol, 5 mcg/ml Cyanocobalamin). For a 10,000 kg whale that would equate to 220 – 440 ml, meaning an allometrically scaled dosage may result in a more appropriate volume for injection. While administering Vitamin B Complex without a specific indication may not be advisable in all circumstances, it is also unlikely to cause any deleterious effects.

Dexamethasone or other medium or short-acting glucocorticoid steroids may be employed to reduce inflammation. Through various mechanisms, steroids may also help to restore organ dysfunction and may help to stabilize lysosomal membranes (Plumb 2015). Potential side effects of steroid administration include immunosuppression (usually limited to repeated high doses), worsening of certain disease processes such as fungal infections, gastrointestinal ulceration/bleeding/perforation, and muscle weakness. Corticosteroids may have potential adverse effects on the fetus of a pregnant female. When given in low dose as burst therapy, glucocorticoids are unlikely to cause significant harmful effects. Use of glucocorticoids in shock treatment regimes for humans and in small animal medicine have fallen out of favor in recent years. Use can be at the clinician's discretion.

Light sedation may also be considered in order to reduce anxiety, cause muscle relaxation, and improve human and animal safety during the response. Midazolam, butorphanol, xylazine and acepromazine are considered here. Based on past experiences and published work (Moore et al. 2010, Harms et al. 2013), the preferred sedative is midazolam as a sole agent at a dose range between 0.02 – 0.05 mg/kg IM. Midazolam is available as a highly concentrated formulation (50 mg/ml ZooPharm) or commercially available 5 mg/ml. This dose can be administered even if rescue and release are still being considered as a potential option for the animal, but consideration must be given to the ability of the animal to navigate and swim appropriately after release. As a result, timing of the sedative as well as the dose are important details to deliberate prior to administering any sedatives. Flumazenil can be used to reverse midazolam, but its duration of action is considerably less than that of midazolam. Midazolam is a benzodiazepine with no analgesic effects, if analgesia is desired, other medications should be used.

Butorphanol, a partial opioid agonist/antagonist available in highly concentrated forms (compounded by ZooPharm up to 50 mg/ml) or commercially available concentrations (5 or 10 mg/ml) and can be administered to stranded whales at low doses (0.05 – 0.1 mg/kg). It does not offer as much analgesia as the pure opioids, but has potentially less risk to scavengers, less sedation, and is slightly safer for responders (although extreme caution should be taken with highly potent concentrations, especially in remote locations). This is an appropriate secondary agent to add to midazolam for increased sedation and/or pain relief. Butorphanol can be partially reversed with naltrexone or naloxone, but naltrexone has a longer duration of action. Reversal should not be solely relied upon to ensure the animal is not too sedate for release but can be administered as an added precaution.

Xylazine is an alpha2-adrenergic agonist used for sedative and analgesic purposes. While xylazine may be helpful as a secondary agent in sedating stranded whales, it has elicited excitatory responses in certain cetacean species, and is therefore not recommended as a sole or initial sedative in any stranded cetaceans. As part of a three-drug pre-euthanasia cocktail, a dose of 3 mg/kg has been used (Harms et al. 2013), but a significantly lower dose would be recommended if there is potential of rescue and release (0.2 – 1 mg/kg). Harms et al. (2013) demonstrated low bioavailability of IM injection in cetaceans. Xylazine can be reversed with atipamezole or yohimbine, but again, sedative reversals should not be solely relied upon to reverse sedation.

Acepromazine is a phenothiazine sedative, anxiolytic, and chemical restraint agent that is also part of the reported three drug pre-euthanasia cocktail with a dose of 0.2 mg/kg IM (or IV). A considerably lower dose would be indicated if a rescue is desired (0.01-0.05 mg/kg). Acepromazine is not reversible.

As with any drug administration, contraindications from existing pathology must be considered and negative drug interactions must be avoided. A licensed veterinarian with appropriate federal and local licensing must be present if such drugs will be used and all controlled substances must be documented and reported according to the appropriate regulations.

In summary, human safety must always be the priority when deciding a treatment regime for a stranded large whale. Treatments may improve animal health and welfare and potentially increase the likelihood of survival post-release. Post-release monitoring must be included as part of the treatment plan in order to evaluate the survival of the animal after release and evaluate different components of the treatment regimen, especially the use of sedatives in later released stranded whales.

C. Post-Release Monitoring

Compiled by MJ Moore & S Sharp

Gathering data on the survival of large whales that have been released after a live stranding is an essential part of such events, in that without such data one cannot assess the value of the overall response, nor evaluate the combined suite of protocols employed. The tools available range from re-sighting of natural or applied markings, to VHF/satellite tag tracking. Estimated sighting rates for large whale carcasses range from only 3.4% for sperm whales, <5% for grey whales, up to 17-36% for North Atlantic right whales (Pace et al. 2021, Rockwood et al. 2017), indicating that relying on re-sightings alone for outcome data may lead to incorrect assumptions (never seeing an animal again after release does not necessarily indicate that the animal survived).

Re-sighting of the released individual involves recognizing natural markings, such as fluke, callosity and other skin marking depending on the species involved, or via cattle paint stick markings or cattle ear tags that have been added to the animal before release. Paint stick marks only last hours to days, cattle ear tags in the dorsal fin can last for months, while natural markings tend to persist and have lasting value, especially where the individual's markings are already in, or are archived from stranding event images, with a photo-ID catalog for that species or population. In this way, they can be recognized years after release if they have survived. It is important to acquire a comprehensive series of species relevant images of all such marks before release to enable recognition later, that are submitted to the relevant catalog(s) along with the notation that the animal stranded, was released, and details on whatever marks or tags that were applied in terms of appearance and location on the body.

VHF tags are relatively affordable and would allow radio tracking in the days and weeks after the release. Satellite tags would potentially yield detailed tracking for weeks or months after the release. Tag options include single pin attachments in the trailing edge of the dorsal fin, LIMPET tags in or at the base of the dorsal fin, or transdermal, intramuscular tags.

Challenges include having: an appropriate tag available with a trained applicator; a suitable permit to tag in hand; funding for the tag acquisition or replacement; and time to focus on the tagging plan while the rescue process is ongoing. The rarity of tag-based survival information for released large whales suggests that the above challenges are very real.

Opportunistic sightings of rescued stranded whales have very infrequently occurred and cannot be relied upon for timely information regarding their fate. An example of the tracking of a released whale without a tag is a humpback whale named Humphrey that stranded twice in San Francisco Bay in 1985 and was opportunistically seen for at least 6 years after his rescue. More recently, there was a report of a refloated stranded humpback whale in Brazil that was opportunistically biopsy darted eight years later and matched genetically (Neves et al. 2020).

Since this workshop, IFAW has satellite tagged and refloated two stranded minke whales. One whale travelled over 11,000 km after release, including to acoustically identified minke whale habitat to the northeast of Turks and Caicos. The whale returned north with the Gulf Stream and the tag battery became depleted with transmissions ceasing off New York 83 days after its rescue. To our knowledge this is the first documented survival of a satellite tagged, refloated, and released stranded large whale. The second stranded minke whale was refloated with a satellite tag and tracked to a remote marsh location, 25 km from the release site within 16 hours of rescue. The whale was found dead, but its fate likely would never have been known without the satellite tag. These recent cases validate the need for telemetry attachment on any stranded whale prior to attempting rescue to help inform future disposition decisions for stranded whales.

VI. CASE REPORT SUMMARIES

Case reports from recent stranded live large whale rescue attempts were presented by James Powell from Sealife Response, Rehabilitation and Research (SR³, USA) and Cristiane Kolesnikovas from Associação R3 Animal (Brazil).

Powell described a collaborative rescue of a juvenile gray whale that stranded in Olympic National Park, Washington, USA in August 2017. The animal was initially monitored with hopes of self-rescue on subsequent increasing high tides, but on the third day a rescue was attempted and was successful in releasing the animal. Responders made a harness and pulley system meant to anchor the whale to prevent it from moving farther up the beach and allowing it to be redirected with its head seaward and assist in its movement toward the sea (Appendix A, Fig. A1). It was not a system intended to tow the whale. The system, which was designed spontaneously was comprised of two pulleys, a harness, anchors, a harness quick release pin (marlinspike), and 15 people for pulling (Appendix A, Fig. A1 & A2). A safety officer was assigned for the stranding site. There were some complications with the marlinspike quick release spinning (Appendix A, Fig. A3), safety concerns regarding operating in the dark, and desire to satellite tag released whales in the future to evaluate post-release survival. From the discussion, points that were brought up were the need to devise a soft shackle (rope) quick release mechanism (due to concerns for load bearing capacity and the prohibitively large size of an appropriate shackle). Also, when using a pulley system, the direction of the pull must not be at an oblique angle due to loss of mechanical advantage. Additionally, a 2:1 pulley system may have been more ideal.

Kolesnikovas reported on multiple multi-agency live large whale stranding responses that have occurred over the years in Brazil. Rescues were attempted in strandings of a juvenile Southern right whale (SRW) (2003), a sei whale (2004), a juvenile SRW (2011), an adult/calf pair SRW (2014) and a humpback whale (2017). The rescues utilized a rope harness (bowline loop on one end with the bitter end threaded through the loop) that was placed under the pectoral flippers with jet skis (Appendix A, Figs. A4, A5 & A6). The line was then tied to a cable attached to a tugboat or Navy vessel offshore, and the whales were towed forward (headfirst) with the harness line coming from under the whale to the towing vessel. The sei whale died and the humpback whale re-stranded and later died. The other whales were refloated, but none were tagged, so post-release survival is unknown. During the towing process, when the whales first became buoyant, they rolled 360 degrees, but recovered and swam off. The tow line was cut near the boat for release and the remaining line was left on the whale, with the hope that it would self-release. Nets were not used during these efforts due to the likelihood of the animal becoming entangled in them. Fast release techniques are now being considered but there is concern about responders having to be close to the whale to accomplish this.

Audience suggestions included using a pole knife (like existing whale disentanglement tools) to cut the line closer to the whale, a cutting safety knife on a buoy that cuts the line when drag is applied, or a different harness configuration with no knots to allow for release and clearing of all lines.

Diagrams of the rescue techniques utilized are included in Appendix A.

VII. RESCUE METHODS

A. Flotation Technique (*Harms*)

There is a narrow window of opportunity for implementing a rescue attempt following a live stranding. It is reasonable to allow at least one or two high tides following a stranding for the whale to self-rescue and for mobilizing a rescue team and equipment to the site, and before the whale decompensates from stranding-associated pathophysiology (depending on the size and condition of the whale). It is least hazardous for personnel working near a whale during daylight and low tide, and most hazardous during low light conditions and high tide when the whale has greater mobility. Conversely, high tide is when the whale has the best chance to free itself, or to refloat with assistance. Light sedation (e.g., midazolam) may improve safety for personnel, reduce anxiety for the whale (for both the stranding situation and having people working near it), and reduce cardiac and muscle damage. Published work on at-sea sedation for disentanglement provides a good starting point for doses that have effect without compromising swimming and surfacing ability (Moore et al. 2010). The primary consideration following personnel safety is to minimize chances for further damage to the whale. Flotation techniques may need to produce only a small amount of lift to achieve clearance from the bottom and allow the whale to be moved, they need not lift the entire whale to the surface. Successful techniques will likely blend marine mammal science, veterinary medicine, and salvage operations knowledge. Planning and practicing before a rescue is needed and likely to improve response time and success rate, versus the more common situation where rescue efforts ramp up nearly from scratch with each event when the need becomes glaringly obvious.

In one proposed idea, North Carolina, USA marine mammal stranding network participants met with a commercial boat towing company, TowBoat US, in Morehead City to discuss techniques and equipment, and conducted a parking lot drill with an inflatable right whale model. The sequence of events simulated in the drill entailed administering light sedation followed by tunneling several broad straps of sufficient load bearing capacity under the whale using standard boat salvage protocol. These straps were fastened to tubular lift bags forming a sling. No straps or lines encircled the whale or any appendages, minimizing entanglement risk. These steps could be taken at low tide to be pre-positioned as water depth increases with incoming tide. Lift bags can be rapidly inflated to lift the whale off the substrate. Towing would then commence sideways initially, to prevent the sling from being pulled out from beneath the whale. The inflated tube would not be able to pull through under the whale. Direction of towing could be changed to head forward once completely clear of substrate. Once clear of stranding-depth water and away from greatest re-stranding risk, floats can be rapidly purged in less than a minute to fall quickly away along with the straps, allowing the whale to swim free (with post-release monitoring device or marking in place). Advantages to this approach are that it utilizes existing capacity and equipment, with equipment inventory and maintenance schedules already in place, is rapidly deployable to considerable distances, puts no traction on flukes or pectoral flippers, and allows for quick release with no encircling lines. A lift bag rated to 10,000 pounds lift costs around 3000 USD, with a shelf life of only about 5 years, so acquiring and maintaining such equipment for expected infrequent use in whale rescue would be cost-inefficient, versus engaging with boat salvage operators. Expected challenges would include establishing lines of communication and authority for the different components of the response, positioning straps around the pectoral flippers without causing interference (although pinning them to the whale's sides could be advantageous), and improving the mechanism to tighten the supporting straps quickly and safely to bring the lift floats close to the sides of different sized whales.

Another idea proposed during the breakout session (Richard Reil) was to use a flat mat worked under the whale from the rostrum caudally by fluidizing substrate along the leading edge. The buoyant mat would prevent the whale from settling deeper as the fluidized excavation works caudally. Once positioned, the mat could be pulled forward from D-ring tow straps. Concerns include potential for the whale tipping off the mat, or the whale tipping in such a way that the blowhole is forcibly submerged. Potential solutions would be to strap the whale to the mat with a quick release mechanism (but concerns were expressed for any encircling gear at all), hybridizing the mats

with cylindrical floats on either side, or building a mat to the desired shape with a V-trough thereby avoiding any fixed attachments. This equipment would need to be fabricated, bench-tested, and disseminated.

It was noted that Marine Animal Response Society (MARS), Nova Scotia, Canada used a pilot whale pontoon system with a mat, developed by Project Jonah, New Zealand to successfully to refloat a stranded fin whale. They could work the mat under the whale because of the water depth. One was set from under the rostrum and one from caudally. The technique would have worked better if the mats had been bound together, because they separated during deployment. Rapid purging in order to release the whale may be a problem.

Testing refloating techniques on dead whales prior to deploying them in a live whale stranding situation is strongly recommended, should the opportunity arise with support available. Measures of success of a technique used in a live whale would be: 1) no people are injured, 2) the whale is safely refloated without clinically significant injury or severe undue stress, 3) the whale survives a particular period of time after refloating, and 4) ideally, valuable or specialized equipment is not damaged beyond reasonable repair. Note: Category 3 animals (see Section V. A. Table 1) should not be put through the added distress of refloating since there is an exceedingly high likelihood that they will succumb shortly afterwards.

Figures of flotation exercise can be found in Appendix B.

B. Towing Techniques (*Moore*)

Considerations in planning a tow of a stranded whale include: potential trauma to whale and humans; need to remove gear on release; and need to float tow vessel close to shore (good tugboats have deep drafts, thus adequate line length to reach from the whale to where the boat can float must be available, as well as a method of getting the line from the whale to the tow vessel). It is also important to consider the likely friction between the whale and substrate. Wet cobbles have far less friction than sand. Consider laying a sheet of plastic on the path the whale has to be dragged on, possibly with a coating of mild liquid detergent such as Dawn® dishwashing liquid. While hauling a whale on beach, under load, be sure people are not located where a rope or cable snapped under tension could recoil into them. If flotation bags can be added to the whale, the beach-induced trauma will be reduced. If a line or strap must be passed under an animal, attaching the end of the line or strap to a curved tube with a water jet may help move the sand or gravel aside to create a passage for the rope or strap. Towing a whale should be undertaken slowly to avoid excess stress and trauma to the animal and gear.

Experience of towing dead whales with a strap wrapped around the flukes has shown risk of subluxation of the lumbocaudal intervertebral joint (Fig. 4). Additionally, with long-flipped whales such as humpbacks, this may also damage the flippers (the flippers may also act as giant anchors preventing a backwards tow).



Figure 4. Sperm whale carcass peduncle after towing at sea. Note constriction and expansion of the lumbocaudal joint.

Given the significant risk of damage to the peduncle and related tendons, ligaments, and musculature, the workshop concluded that towing a whale off the beach by the flukes is inappropriate.

Various methods of attaching straps to a whale for towing were discussed. Two rigging options that would allow rapid removal without residual entangling straps are shown below (Figure 5). For Figure 5A, release one end only and pull the line from the other end through the strap eyes to release the strap. For Figure 5B, release one end of one line and pull through the eye, then pull in both ends of the other line to pull the strap off the whale.

For the towing configurations in Figure 5, the strap to wrap around the whale behind the axilla would need to be 20 to 40 feet (6-12 m) in length for Figure 5A configuration and 15 to 25 feet (4.6 – 7.6 m) for Figure 5B.

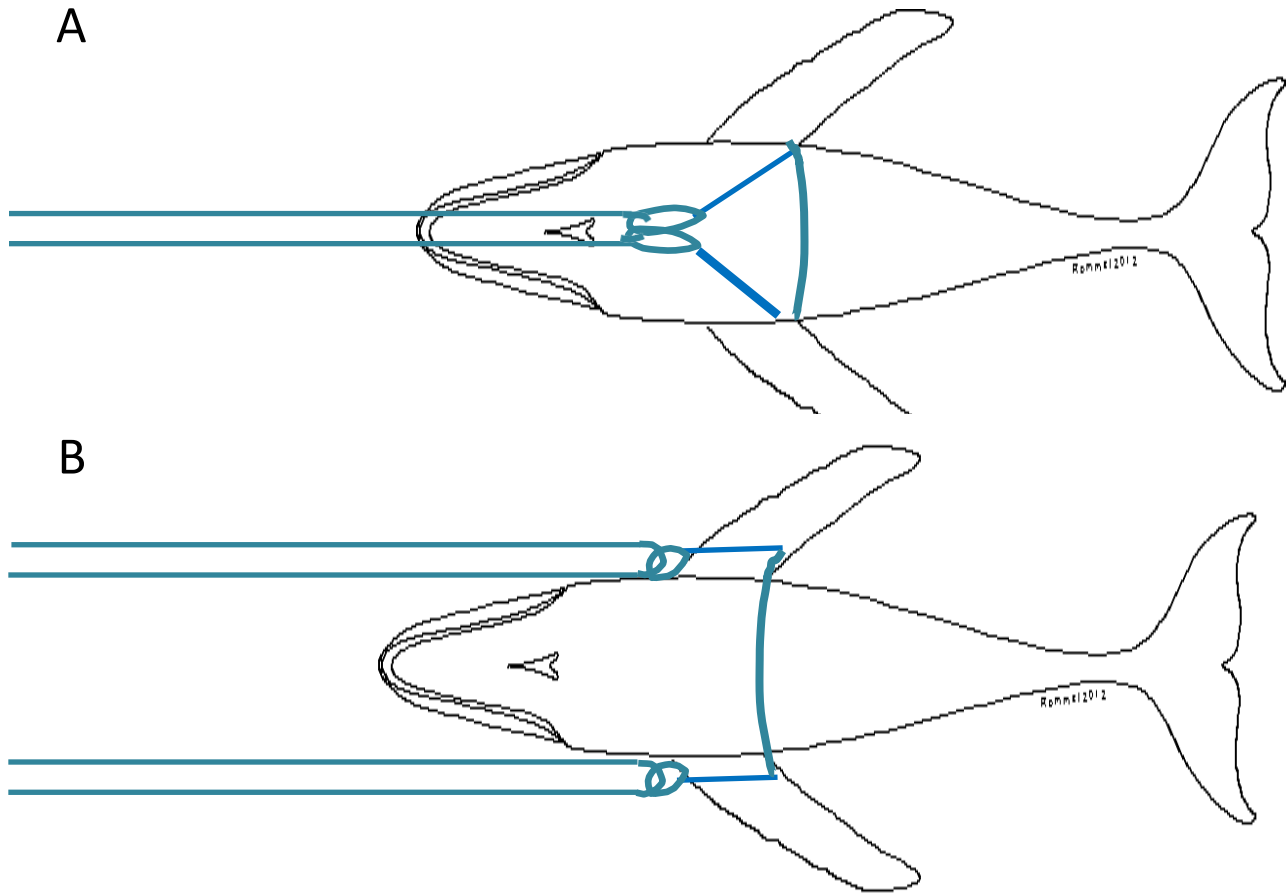


Figure 5. Proposed quick release forward towing configurations A) Strap under the ventrum of the whale at the level of the axilla, attaching over the dorsal head/body to two separate towing lines. B) Strap over the dorsal body and under each pectoral flipper, connecting to two separate tow lines extending cranially from the flippers. Quick release is accomplished by releasing one of the tow lines and retaining the other allowing the strap under the whale to drop off.

Nets were discussed, but concern about entanglement of appendages, and towing the animal upside down unable to breathe were considered as reasons for not using this method.

Knowledge of rope characteristics is important in terms of breaking strength and stretch. For instance, nylon stretches well, which is valuable to avoid snapping on the whale during a tow at sea, but if it were to break during hauling on the beach, the recoil would be substantial. Dyneema[®] rope is perhaps the best for beach hauling, as it has minimal stretch.

A 1 ½ inch (1.3 cm) diameter [Amsteel[®] blue](#) rope has hauled a dead large adult right whale on sand. This hawser should have large eye splices on either end of the hawser, to attach to tow boat (Fig. 6). Metal shackles and other hardware of equivalent strength are too heavy to handle by hand. Soft shackles, or hawsers with end eye splices can be joined by passing one eye through the other and then the other end of the first hawser through the first eye.



Figure 6. Example of Amsteel® hawser looped through the end eye splice around a dead whale's peduncle. *Note: live whales should never be towed by their flukes.*

Skill sets that should be developed include rigging safety, line handling, knot tying, rigging and hoisting. Mechanical purchases using blocks and tackles could help, although they will be heavy to move around. Local contractors equipped for recovering heavy vehicles and other industrial riggers would be a major asset.

C. Dredging and Trenching/Excavation Techniques (B. Sharp)

Digging substrate from around a stranded whale is a common rescue method, but it is not without significant challenges or drawbacks and will likely not be the sole method needed for a successful rescue. Excavators can be used on land to dig out around a stranded whale that is high and dry if they can safely get close to the animal. The goal of doing this is to provide a deeper pocket of water in which the whale can float as the water comes in. Excavators can also be used to dig trenches between the whale and the water, allowing water to reach the whale earlier in the tidal cycle and providing a deeper exit route for the whale once the water comes in. Excavators can also go into water up to the level of the cab, however operators or owners may be hesitant to do this in salt water given the corrosion this may cause on the lower portion of their equipment. Alternatively, excavators can be operated from a dedicated barge in even just a few feet of water. Access to the animal with a barge-based excavator would only be possible if the animal was not in any appreciable surf, since this platform must remain stable. The barge would also have to get close to the animal as well, which may be difficult in areas with extensive shoaling.



Figure 7. An excavator was used to dig out around a stranded humpback whale on Cape Cod, MA, USA in 2002. Dredging is the term used to refer to the excavation of substrate below the water. Most commercial suction dredging operations (such as those used to dredge channels in harbors) require piping that must be put together and laid with heavy equipment. The challenges of getting this to occur within a short window of time likely render this method logistically prohibitive for most whale rescue efforts. However, if a whale happens to strand in an area where a suction dredging operation is already set up nearby, this may become a viable option. There are also smaller units that can be operated out of the stern of a vessel or more deployable industrial units, which may be better suited to whale rescue.

Logistical challenges with excavation and dredging include equipment availability on short notice, cost, and access to the site. These challenges may vary in magnitude depending on where these strandings occur. Environmental impacts of the operation, including coastal erosion and disruptions to sensitive ecosystems are additional concerns as well as impacts on other species, especially those that are threatened or endangered. Land ownership may also provide hurdles for dredging or excavation approval, depending on whether private, local, state, or federal entities are involved. Dredging activities oftentimes require local governmental approval or permitting, which may not be available within the operational timeframe of the rescue.

Human safety is also a significant consideration when using heavy equipment for whale rescue. To conduct these operations in the safest manner possible, there should be a single experienced lead who is the only person communicating with and directing the heavy equipment operator. All non-essential personnel must stand at a safe distance from the heavy equipment's operational space and helmets and other appropriate PPE should be worn by at all times by those working around heavy equipment.

Animal safety is another consideration. Excavating directly around the whale may cause stress to the animal or even direct harm from the equipment. Heavy equipment operators are also not likely experienced in working around live animals, making clear communication between the rescuers and the equipment operators imperative in ensuring the animal's safety. Creating trenches around the whale may also indirectly lead to further injury to the animal, and even result in death. When substrate is dug out from around and underneath a large whale, this will inevitably create a peak of substrate directly underneath the body that is difficult, if not impossible to extract. This can cause "tabling" of the whale, which increases the pressure on the thorax, potentially expediting cardiopulmonary collapse and death. This was suspected to have happened with a stranded humpback whale on Cape Cod, Massachusetts, USA in 2002 (Figs. 7 & 8). Additionally, when substrate is dug out around the animal,

and especially as the tide comes in, it may create a situation where the animal rolls laterally and could potentially aspirate sea water or suffocate on the substrate. Other dredging methods that work to liquefy the sand underneath the whale may cause the whale to sink deeper into the sand, risking suffocation and/or drowning unless mitigation measures are undertaken.

In summary, excavation and dredging may be components of a large whale rescue effort, but likely will not be the sole methods, and are not without considerable logistical, human and animal safety, and permitting challenges.



Figure 8. An example of tabling, where a mound of substrate remains under the animal after excavation (visible just caudal to the pectoral flipper in this image), potentially leading to further cardiac and pulmonary compromise.

VIII. WORKING GROUP NOTES

After the plenary session, workshop attendees broke into four separate working groups for focused discussions on four topics: 1) flotation, 2) towing, 3) dredging/excavation, and 4) health assessment and treatment.

A. Flotation Working Group Notes (*Harms/Rose*)

a. Suggestions of other techniques:

- i. Pontoon system
 - a) Pontoon system, designed for pilot whale rescue, was used to refloat a 35 foot fin whale
 - b) The pontoon system can be used for animals that are high and dry
 - c) Employ typical stretcher method to get whale onto stretcher
 - d) Need to tighten stretcher to prevent dorsal folding in of stretcher or floats
 - e) In the MARS fin whale case, slight issue of pontoons not staying in place because they were not attached to each other and the caudal pontoon became stuck on flukes
- ii. Mat/bag inflated under whale: ‘Whalecuzzi’ - currently a concept in design by Rich Riels

- a) Bag designed to inflate and act like an air hockey puck
- b) The bag has an excavation bar on the front of it and clears away a path for the bag as it goes
- c) Once the bag is in place, it is inflated with air and the sand collapses under the bag and the whale becomes neutrally buoyant
- d) The bag is then pulled and not the whale
- e) The rigidity of the bag is modeled after inflatable standup paddle boards
- f) The system can be very cheap to make. The fabric is readily available, easy to work with and inexpensive - a complete unit would cost ~4,000 USD for humpback whale size
- g) Bags could be adapted for different species, flipper pillows could be an option
- h) Some suggestions were made for modifications
- i) Incorporate some containment/stabilizer feature to prevent rolling or premature release

b. Equipment needs:

- i. Many harbor & shoreline areas have some salvage or recovery operations
- ii. The pontoon systems are bulky and heavy, expensive to purchase and repair and require air tanks for filling
- iii. The inflation bag proposed could be fabricated from local, inexpensive supplies

c. Feasibility issues

- i. #1 thing is to do no harm – minimize the impacts of the process
- ii. Both of the above suggestions require sandy substrate, what about rocky areas?
- iii. There could be a cache of pontoons located strategically, but they are initially expensive to buy
- iv. Salvage equipment and operators can be expensive (~10,000 USD)
- v. Equipment and operators could be available in a reasonable timeframe to locations

d. Safety

- i. Strapping components can be a safety issue for both humans and whales
- ii. Humans would have to be in close proximity to whale when affixing or removing lines
- iii. A system designed to not leave any straps or lines on whale, with failsafe, is ideal

e. How will success be measured? Success would be defined as:

- i. Human safety maintained throughout the operation and no one was hurt
- ii. Whale successfully floated with minimal impacts and was observed alive at later times in good condition / tagged and transmitting for duration

B. Towing Working Group Discussion (Moore/Patchett)

a. Configurations (see Appendix A for images of mock configurations)

- i. Webbing slings with eyes on ends
 - a) Amsteel® blue rope* run through eye to enable remote disconnection
 - b) *Amsteel® rope: <http://www.samsonrope.com/> - floats, does not absorb water, but ultraviolet light UV and sand degrades it
- ii. Two loop strap dorsally with double towline through (Fig. 5A)
 - a) Need extension forward to prevent rolling
- iii. Over back (dorsum) behind pectoral flippers (Fig 5B)
 - a) Apply with jet skis if in water or if high and dry put apparatus on first- throw line over whale
 - b) Need some whale flotation to prevent damage to the animal when towing

b. General Notes

- i. To get the line under the animal, attach the line to a water hose on a pole and use the hose to push through sand.

- ii. Need low tech solutions for where high tech is not possible.
 - iii. Use of acoustic deterrents when tide in should be considered. Rev motor to ‘scare’ the whale and motivate it to swim away into deeper water.
 - iv. Various previously employed towing configurations were discussed (Appendix A). Humpback whales can be towed without the knot on top and just the rope underneath and looped around pec fins.
 - v. Whenever possible, towing harnesses must be completely released from the whale in order to prevent a retained entanglement, which may further compromise the animal. An alternative method to that which was employed in Brazil to rescue a stranded Southern right whale was suggested that would allow for a quick release of the harness, preventing the whale from swimming off with lines wrapping its body (Appendix A Fig. A7).
- c. What techniques need to be developed?**
- i. Knot tying, rigging, splicing experience
 - a) Look into rigging classes offered locally
 - b) Build this capacity within stranding networks, education needed for more people
 - c) Practice and experience on a regular basis
 - ii. Consult with salvage operators on what we’ve come up with
 - a) Sketches
 - b) Need to find suitable use blocks (fishing industry?)
 - c) Blocks get jammed up with gravel and sand – need to fabricate a sledge arrangement for them to sit on
 - iii. Modifications to Washington technique: Use of winches instead of humans pulling – maybe. But many humans may be more flexible
 - iv. Will it have the same pulling capacity as the number of people you could have?
 - v. Towing vessels
 - a) Recommendations for capacity/ draft etc.
 - vi. Equipment / other needs:
 - a) Curved jetting pole
 - b) Interval between strandings makes it difficult to keep contacts
 - c) How much equipment should you stockpile for the occasional live whale?
 - d) Recommend doing practice runs/ drills, and contact other local professionals (dredging, towing, salvage operators) periodically
 - e) Basic equipment
 - i. Lines / rigging
 - ii. Use equipment from other orgs - need to go with what you can get
 - vii. Feasibility
 - a) Depends on location and availability of resources
 - i. At least 1 day
 - b) Cost
 - i. 0 - 25,000 USD?
 - c) Safety concerns and mitigation
 - i. What is acceptable in some places is not in others
 - 1. Adequate safety officers
 - 2. Training
 - 3. Preplanning
 - 4. Communication
 - ii. Whale safety concerns
 - 1. Damage from type of method - is it an acceptable risk
 - 2. How you tow is important - low gear, slow

3. Lead person - needs to make the call if towing is not working
4. Incident Command System (ICS) plan

viii. Measurement of success

- a) Tag - cooperation with other regions/countries for access to tags
- b) Dorsal fin tagging of large whales may not be readily available - may not have the tagging equipment
 - i. USA: national repository for large whale tags?
 - ii. Suction cup tags?
 - iii. Low Impact Minimally Percutaneous Electronic Transmitter (LIMPET) tags?
 - iv. Global numbering system for released large whales?
 1. Marine Animal Identification (MAIN) site for tag recognition
 - v. Natural marking identification may be sufficient for certain re-sights – e.g. for some gray whales in the Northwest US Region, (but does not provide feedback on protocols or outcomes if the animal is never re-sighted)

C. Dredging & Excavation Working Group Notes (B. Sharp)

a. Pros and cons of dredging verses excavation

- i. Excavation should only be attempted in sandy substrates as muddy or rocky substrates are prohibitive.
- ii. The challenges of tabling and rolling during excavation were discussed further, but no solutions were determined. Need to involve experts in marine excavation/dredging to further discuss.

b. Cost & Logistical Challenges

- i. High cost of specialized equipment and difficulty in maintaining operational status with unpredictable events were discussed.
- ii. Due to this and the needed timeliness of needed equipment specialized caches of equipment may be problematic and prohibitive.
- iii. Backpack pumps were brought up as an idea for small scale moving of substrate, but no examples of these units could be found.
- iv. Scallop dredging was discussed as an idea for coastal communities that have fisheries that fish in that manner, but it was unknown by the group present if that equipment could be adapted for these purposes.

c. Permitting and Environmental Considerations

- i. In many areas dredging, and in some cases excavation, may be limited by extensive permitting processes.
- ii. It was also acknowledged that some stranding areas may contain fragile habitat limiting access by equipment or of the activity of dredging itself.

d. Experienced Heavy Equipment Operators

- i. The need to have experienced equipment operators and experienced responders directing them was stressed, especially in cases of operating equipment such as excavators near live animals and responders.
- ii. One way for these relationships to be formed between stranding teams and heavy equipment operators could be using heavy equipment for large whale necropsies, when appropriate.

e. Dredging/Excavating requires additional rescue techniques

- i. The group could not conceptualize a situation where dredging and excavation could be effective without the additional use of flotation and/or towing.

f. Future Steps

- i. It was agreed that any further discussion of dredging and excavation ideas, or potential use in conjunction with other methods, should involve experts in those fields in-person. This was attempted for this workshop but was unable to be achieved.

D. Health Assessment & Treatments Working Group Notes (*S. Sharp*)

a. Physical Assessment

- i. Are there additional parameters to examine during physical examination?
 - a) How to get temperature readings
 - i. Intel and Stephanie Norman (Marine-Med) to potentially collaborate to validate the use of an infrared camera for blowhole temperatures in whales
 - ii. Possible use of laser thermometer? Concerns that it may not be accurate, but could potentially be used to monitor trends
 - iii. Arterial line thermometer? Is there a current product that does this? Potential complication of countercurrent heat exchange affecting temperature readings.
 - ii. Also be sure to consider the environmental configuration in the overall assessment. For instance, animals that are hard aground may have more significant rhabdomyolysis than those that are resting on small cobble and have almost a “water mattress” providing support
 - iii. Body Condition Score (BCS)
 - a) This is an incredibly important part of the physical examination. There is agreement that attempting to release a thin or emaciated whale would almost inevitably not be in their best interest.
 - b) Also discussed the importance to reach out to your local whale biologists who may be able to provide more insight into body condition and life history of certain animals (e.g. normalizing BCS based on time of year, prey availability, age class of the individual, etc.)
 - iv. Discussed challenges with doing a complete examination, such as when a whale is in a few feet of water – may not be able to see wounds or lesions below the water line. This point emphasized the importance of doing a complete physical examination and maybe employing an underwater video or camera on a pole to obtain that information if it is safe and possible.

b. Diagnostics

- i. What diagnostics would be ideal to have prior to making a disposition decision?
 - a) Complete blood count, chemistry, blood gas, electrocardiogram (ECG)
 - b) Also recommended to collect sloughed/scraped skin for genetics and other studies, feces (if safe) for biotoxin analysis, etc., and blow for hormone or other testing
 - c) Emphasized the utility of collecting samples including blood even if not being used immediately for diagnostic purposes, but for sending out to a reference lab or archiving for future studies. Large whale blood is a rare sample to get!
 - d) Also discussed that these samples may not be safe or accessible in every case
 - e) Point of care analyzers include iSTATs, Vetscan, HM2, manual hematocrit
 - f) Possibility of using point of care analyzers or running samples to nearby veterinary clinics to have them run in real time. Important to identify your local resources ahead of time.
- ii. What additional diagnostics should be developed?

- a) Ocular examination – flare, fundic, etc – discussed difficulties of doing any of these exams under field conditions, especially in sunlight, but could be useful if feasible

c. Treatments

- i. Are there additional treatments we should consider?
 - a) Discussion regarding corticosteroid utilization and their potential anti-inflammatory and membrane stabilization properties. Decision to use may be clinician-dependent, but perhaps a smaller controlled study in stranded and released delphinids may be indicated to provide further information on the topic.
 - b) Discussed what sedatives may be available in different countries
 - i. Midazolam is expensive in the United Kingdom (UK). But Xylazine is inexpensive due to its use in the farm animal industry. Discussed the potential for using Xylazine as a sole agent for sedation but based on the work done by the Virginia Aquarium, Dr. Harms and others, it is not recommended as the sole sedative for cetaceans. May be a species-specific response, but still would not recommend as the sole agent in large whales. Perhaps in combination with Acepromazine?
 - ii. Cannot give antibiotics to released cetaceans in Italy
 - 1. Discussed when we employ antibiotics on Cape Cod (USA) in our immediately released animals (usually for a clearly identified localized infection, such as an abscess or a superficial wound – mostly used in our disentangled seals to treat their wounds).
 - 2. Emphasized that this is always on a case-by-case basis, empirically based on the most likely pathogens to infect that system. The legality of it needs to be worked out with your local authorities, and use should only be directed by a veterinarian, based on physical exam findings (and when possible, culture).
 - 3. Concern for antibiotic resistance but discussed numbers of animals being extremely low with judicious use.
- ii. Considerations prior to administering treatments?
 - a) Physical exam findings
 - b) Access to animal
 - c) Safety of working around the animal
 - d) Relay toxicity of treatments (to scavengers) – likely low in most cases
 - e) Accessibility of treatments to responders
 - f) Availability of veterinarian familiar with cetaceans
 - g) Thinking through the entire process and all eventualities to ensure that you do not use all your sedatives to make the animal comfortable, but then do not have sufficient drugs for a euthanasia

d. Equipment

- i. How accessible are the discussed treatments and diagnostic equipment?
- ii. If you do not have the equipment, what are some local resources (in general) that could assist or lend equipment?
 - a) Local veterinary clinics may have to be used as a resource
 - b) Recommend if groups have not already, identify and reach out to your local resources to see if they will be willing to help as needed.

- iii. Would a regional repository of equipment be useful and feasible?
 - a) Potentially, especially since these drugs expire and it would be a waste of resources and money for every agency to have a large drug cache.
 - b) Where do we locate those caches? In New Zealand/Australia there are oil spill response kits in various locations, possible to co-locate other response gear? Make sure you check on the regulations for drug storage (in USA, must be stored at a location with a veterinarian).
- iv. Would any additional equipment be needed?
 - a) Satellite tag acquisition? Who in your area has satellite tags and would they be willing to deploy one on a live-stranded whale? Would be good to investigate this and make those contacts prior to an actual stranding.
 - b) Also discussed with several individuals outside the breakout group the possible utility of microchipping animals prior to release (may have more utility in pinnipeds and small delphinids)
 - c) Freeze branding was another tagging/marketing idea that was brought up as a potential option for a more permanent marking in whales that cannot be identified by other natural markers. It has logistical complications, however.
- v. What is the total estimated cost of diagnostics and treatments?
 - a) Depends on diagnostics and drugs used and the country in which the response is occurring.
 - b) Whatever the responding agency can reasonably afford, all treatment plans should be designed with cost in mind.
- e. **Future Directions**
 - i. What questions do we want to ask to make better decisions in the future and what information do we need to answer those questions?
 - a) Prognostic indicators
 - b) Duration of stranding/size of animal and correlation to survival
 - c) Environmental conditions
 - d) Time in tide cycle that report came in
 - e) How many tide cycles prior to release and what are the results
 - f) Necropsy findings from animals that re-stranded following release
 - ii. How can we share information among responders?
 - a) Dropbox or google docs? – will share publications on live whale rescues there
 - b) Circulate the proceedings to all participants
 - c) Plan to set up a webinar or call to discuss topics further

IX. PLENARY DISCUSSION NOTES

Following the break-out sessions, the workshop attendees re-convened as a group to present summaries of their topic discussions, promote further brainstorming, and develop action items.

A. Review of Principles of Live Large Whale Rescue Response

- a. Prioritize human safety: Hazards can be reduced by working in daylight at low tide for closest contact, avoiding flukes, and utilizing light sedation (e.g., midazolam)
- b. Practice response: Every situation differs so there will always be some level of improvisation, but it should not be all improvised.
- c. Allow at least one or two high tides for self-rescue (depending on condition and size of the animal)
- d. Don't make it worse, e.g., trench drowning, entanglement with rescue gear, fluke dislocation
- e. Provide supportive / palliative care regardless of outcome

- f. Include some form of post-release monitoring to allow outcomes assessment (suction cup telemetry tag, cattle ear tag, etc., see below)

B. Questions and Answers

- a. **Question:** Is refloating whales at night (in the dark) safe or advisable?
 - i. Answer (CH): monitoring from a distance with lighting possible on a case-by-case basis, reluctant to have anyone be right near the whale. Lights may help with keeping scavengers/ predators away, but lights could be stressful to whale
- b. **Question:** Are there other ways to obtain body temperature besides rectal insertion?
 - i. Answer (SS): In manatees, use oral but this is not defined for cetaceans
 - ii. Answer (MJM): Thermal camera on a pole into blowhole has been used for swimming whales at sea
 - iii. Comment (SS): suggests using any measures to monitor trends and not as solid numbers
 - iv. Comment (MJM): need a quality thermal camera to get good readings
 - v. **Follow-up Question:** Has the same thermal camera been used on stranded whales?
 - 1. Answer: No, we are in early days of this. Potential data source for future.
- c. **Question:** Have any animals been rescued on an increasing tide?
 - i. Not to our knowledge, working on getting a list of publications and reports of these rescues including in depth interviews.
 - ii. 64 cases in the USA, will require some interviews to piece stories together.
 - iii. Need to collect and document data, more on timing, mostly anecdotal reports that need to be collated
 - iv. **Action item:** Create a data sheet and data pull of historic events
- d. **Comment:** Keep in mind time of year and what animal should be doing that time of year with regards to body condition
- e. **Comment:** Increase safety with designated safety people, recognizing that it is ok to delay response for safety reasons
 - i. Independent person to monitor safety of the event who is not directly involved with rescue operations such as Emergency Medical Services (EMS), park service etc. can be beneficial because they won't get lost in the technical details.
- f. **Question:** How many people were used for IFAW's stranded live humpback response on a remote island (Monomoy National Wildlife Refuge)?
 - i. 8 people to start, three stayed to sample the first whale while 5 continued down the beach to the second animal to sedate and euthanize. Number of people was limited due to remote location and vessel-only access.
- g. **Question:** How many people were needed for WA gray whale response?
 - i. Answer (JP): did need more safety people to allow response to proceed.
 - ii. Comment (MJM): the number of people needed really depends on if you are managing clinically or mechanically (mechanically takes a village)
- h. **Other proposed rescue techniques:**
 - i. "Slip and slide" to help moving off beach (add Dawn® or other "safe" lubricant to minimize friction)
 - ii. Flotation
 - 1. Fluidization, excavation in a cranial to caudal direction
 - 2. Substrate type is a constraint (sand has worst friction but some equipment might not be able to operate on rocky coastlines)

C. Final Discussion

- a. How to share info among responders
 - i. IWC stranding initiative has centralized information
 - ii. You can request to opt in to the group to access the documents

- iii. Conservation tools website
 - a) Can set up something similar
 - b) Decision trees
- v. Global Marine Animal Stranding Toolkit website is up
 - a) Goal is to standardize development of stranding networks globally
 - b) Website is up, but needs to be built out more
 - c) Menu of live animal options
 - a. If resources, try to get data
- ii. VA working on large whale dissection paper
- b. Is the use of a helicopter ruled out as a rescue technique?
 - i. A logging helicopter could possibly work, but there are safety concerns regarding a live thrashing whale attached to a helicopter
 - ii. Heavy lift helicopter pilots are instructed to drop their load as soon as it starts to oscillate, which would clearly not be humane with a live whale if it started moving/thrashing. The concern is that it is too dangerous for the people in the helicopter.
 - iii. Normal helicopters would not be able to lift a whale
- c. Using Pinniped Entanglement Group as an example for where to go with this group
 - i. Would it be possible for this group to follow their lead and become a more formalized resource for members?
 - ii. It would facilitate sharing of info between members

X. PROPOSED ACTION ITEMS

- A. Create a google drive or drop box for this topic that workshop participants can access
 - i. Workshop organizers will place materials from the workshop, proceedings, references etc here and send out link to participants
 - ii. Would be good to add a list of rescue techniques already tried with outcomes on this website
 - iii. What about papers on refloating/ towing to add to the Global Marine Animal Stranding (GMAS) toolkit website
- B. Future discussions that would be helpful to have include:
 - i. How best to get accurate information to the public and media
 - ii. Develop FAQ sheets and talking points for live stranded large whales
- C. Should we see if we can create a Society for Marine Mammalogy subcommittee on strandings?
- D. Create a datasheet to share among international responders to capture the key data from each event
- E. Need to have a follow-up call after everyone processes the workshop, regarding next steps
- F. Reach out to others that did not attend the workshop to include them in the info sharing

XI. CONCLUSION

This workshop represents an important step towards improving the health assessment, treatment, and rescue techniques used to respond to live stranded large whales around the world. However, a large body of work remains to make these rescue efforts more standardized, safer, and more effective than they are currently. There was a clear need and desire expressed by numerous attendees to continue to learn from one another in the global stranding community so that stranding response agencies are starting from an informed position when faced with a live large whale on the beach. The suggestions of a digital repository of resources on the topic of live whale rescue as well as a listserv for all interested parties seem like a promising place to start. The hope is that through open communication and collaborations within the global stranding network, the burden of these infrequent and yet extraordinarily challenging events may be shared among colleagues, with the ultimate goals of improving the

outcome for healthy live stranded whales, easing suffering of those that cannot or should not be saved, while maintaining human safety as the highest priority.

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APPENDICES

Appendix A (Case Report Summary Figures & Mock Towing Configurations)

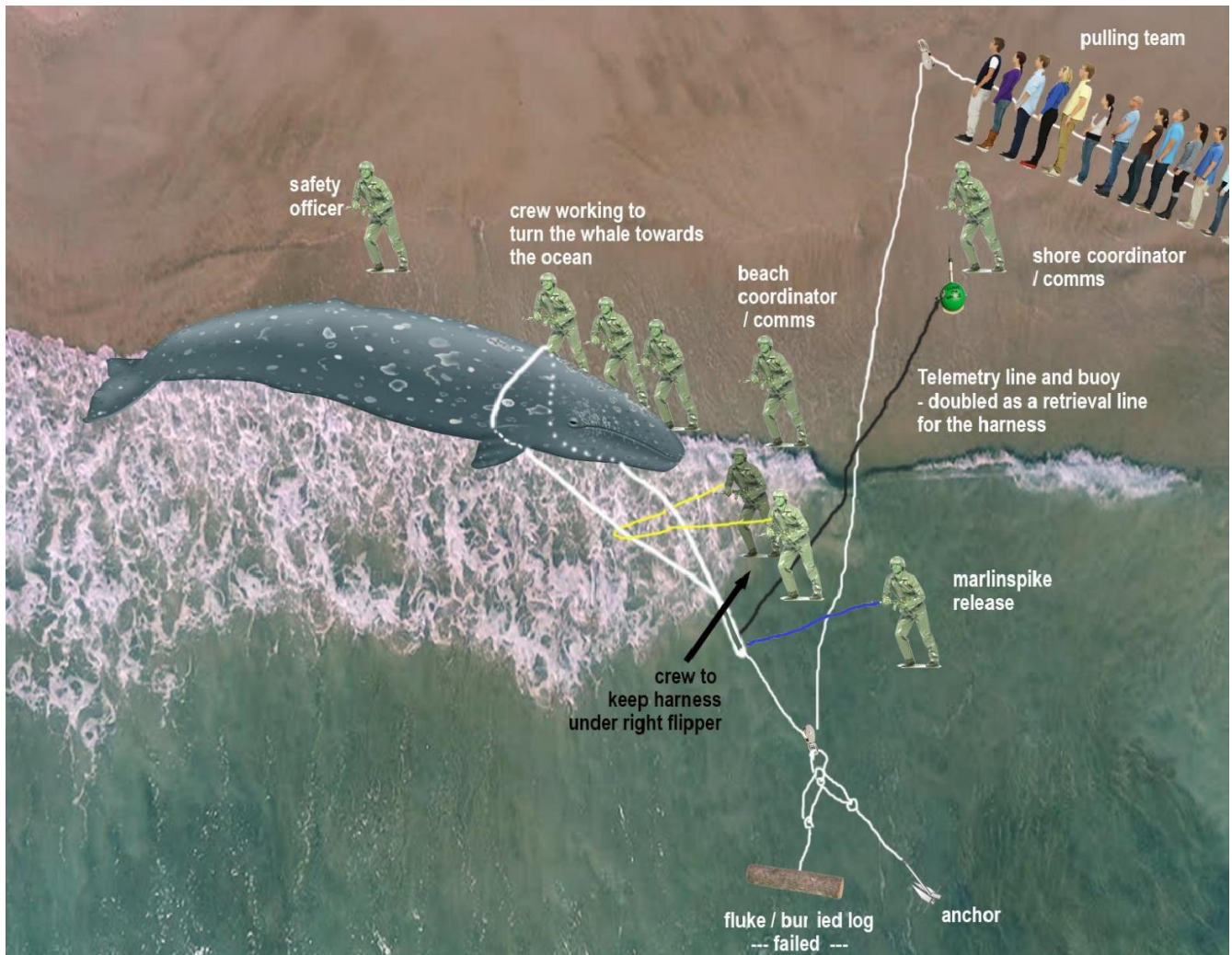


Figure A1. Overview of the harness and pulley system used to rescue a stranded gray whale in Washington, U.S. (diagram courtesy of SR³)



Figure A2. Close-up of the anchored pulley system that helped to redirect the whale back towards the water (diagram courtesy of SR³)

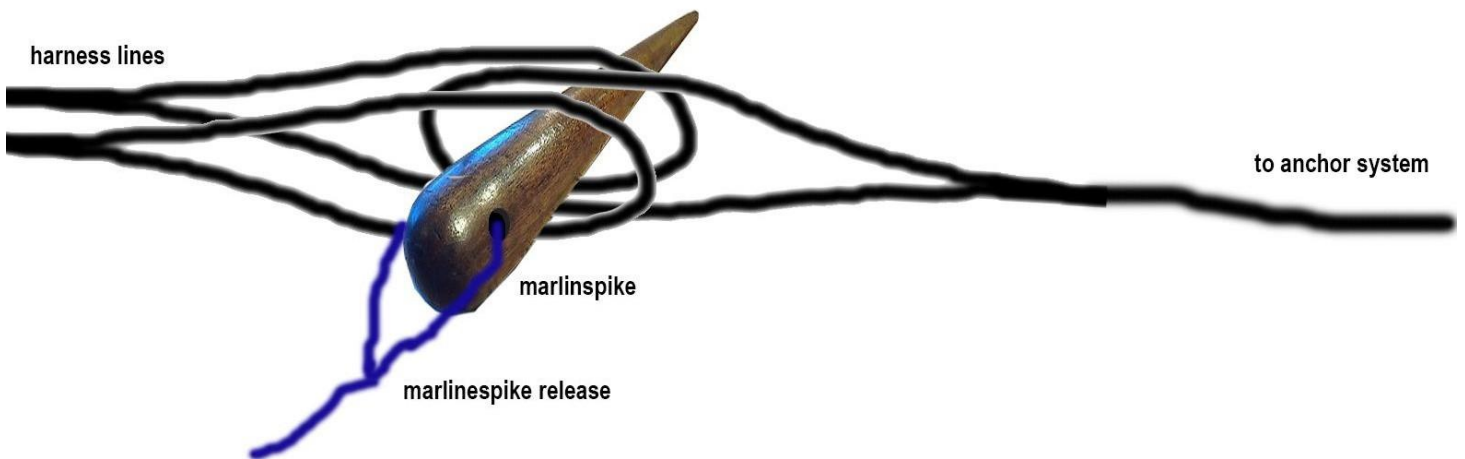


Figure A3. Close-up of the marlin spike quick release configuration that had some problems in execution (diagram courtesy of SR³)

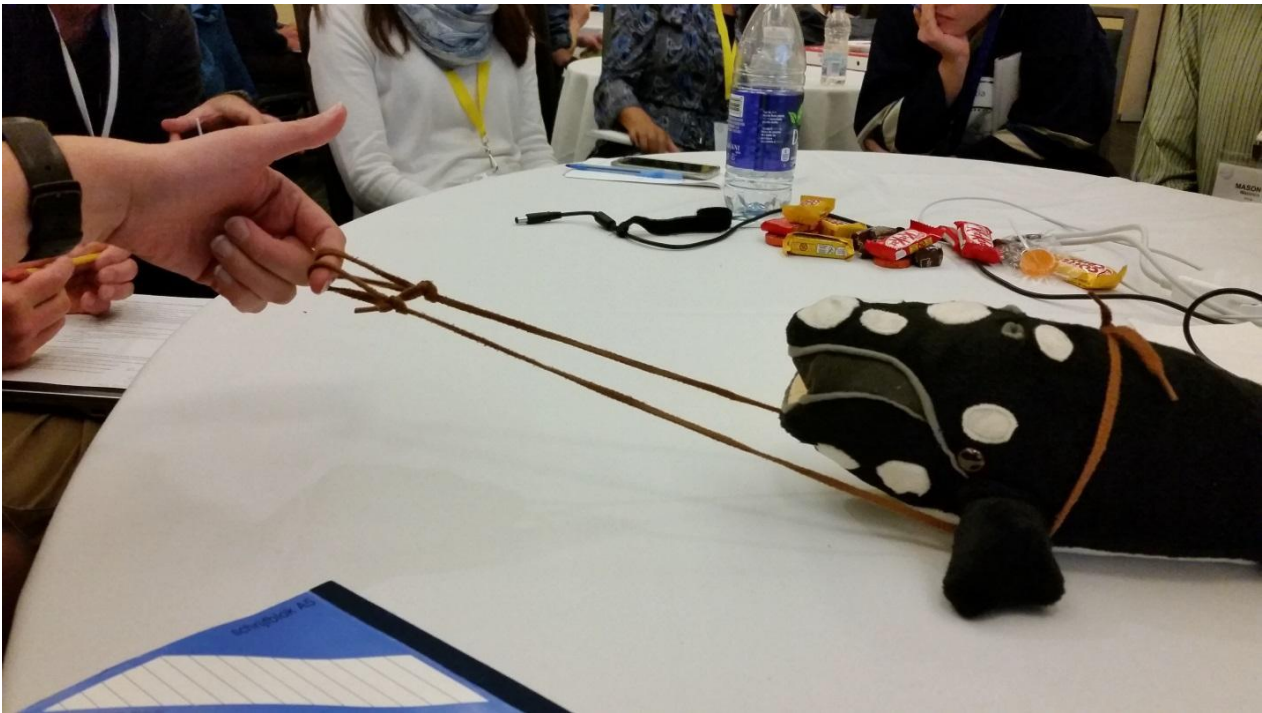


Figure A4. Towing bridle used for grey whale in Washington, USA

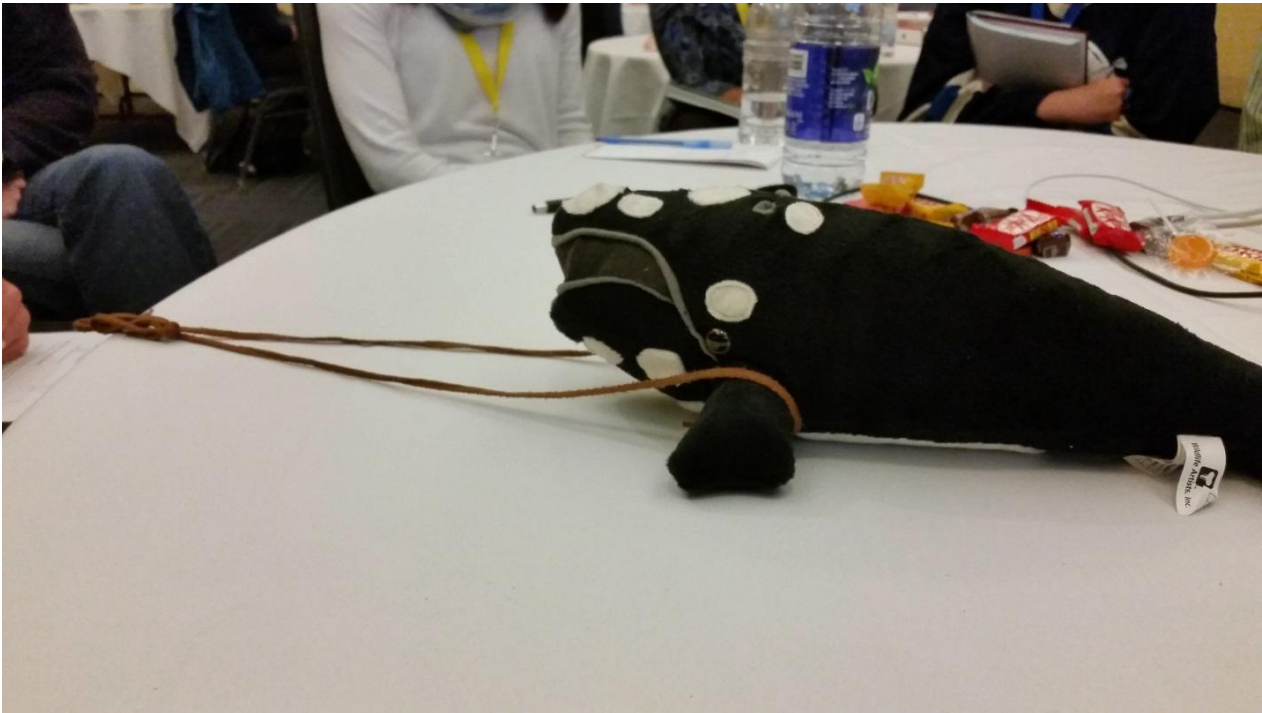


Figure A5. Towing bridle used for humpback whale rescue in Brazil. Introduce line from tail end.



Figure A6. Towing configuration used for right whale rescue in Brazil. Needs a better method of removal after towing to prevent entanglement.



Figure A7. Alternative for Brazil method that would disconnect remotely and prevent a retained entanglement after release

Appendix B. Whale Floatation Drill Figures



Figure B1. Inflatable right whale model for parking lot scenario training.



Figure B2. Right whale model inflated for training. *Note: encircling straps and cinder blocks prevent the inflatable whale from blowing away and are not a part of the proposed rescue method.*



Figure B3. Simulating administration of midazolam for light sedation. *Note: encircling straps and cinder blocks prevent the inflatable whale from blowing away and are not a part of the proposed rescue method.*



Figure B4. Straps have been positioned under the whale by simulated boat salvage techniques, and lift bags positioned and attached on either side of the whale. *Note: encircling straps and cinder blocks prevent the inflatable whale from blowing away and are not a part of the proposed rescue method.*



Figure B5. Lift bags are inflated on either side of the whale, forming a sling with the straps beneath the whale. At this stage, the floats could be pulled sideways initially to free the whale from underlying substrate and shallows, then pulled forward, then rapidly purged to fall away and allow the whale to swim free. *Note: encircling straps and cinder blocks prevent the inflatable whale from blowing away and are not a part of the proposed rescue method.*



Figure B6. Front angle view of the previous image. *Note: encircling straps and cinder blocks prevent the inflatable whale from blowing away and are not a part of the proposed rescue method.*

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16. Abstract (Limit: 200 words) Reasoned triage and management of live large whale stranding events prompted this workshop. Safety is paramount for humans and must be mitigated for them and whales during responses. Clinical assessment is critical, with emaciation and poor prognosis often worsening welfare if released. Accurate length and estimated weight data are essential. Supportive care and treatments depend on understanding the underlying pathophysiology of stranding. Maintaining an airway, monitoring breathing, minimizing stress, protecting eyes, modulating temperature, and preventing sunburn are priorities. Additional strategies can include mild sedation, fluid administration, and flipper excavation to relieve pressure. Tools to indicate post-release survival include photographs, genetic samples, paint sticks, and identification, VHF, or satellite-linked tags. Acceptable rescue techniques included towing offshore with a tackle or lines over or under the body and around the axillae, inflatable lift bags, and trenching. Nets and towing by the flukes are unsuitable. Refloating of stranded large whales can be considered if a clinical examination suggests a favorable prognosis, and a release method could be safely undertaken without undue stress and trauma to the animal. However, in many cases euthanasia is the most humane option if practical, or letting nature take its course if need be.		14.	
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