

WHALE RESEARCH NEEDS and THE ATLANTIC LARGE WHALE TAKE REDUCTION PLAN

September 2015

WORKING DRAFT MATRIX

Provided to the Atlantic Large Whale Take Reduction Team

Background

Coordination between whale research and management is critical in order to help NMFS and the Atlantic Large Whale Take Reduction Team (ALWTRT) effectively reduce the serious injury and mortality of right, humpback and fin whales in commercial fisheries. This matrix identifies and prioritizes research needs (based on management needs) regarding aspects of large whale behavior including habitat usage, as well as foraging, migrating and breeding ecology.

Whale Research Needs

The research questions and needs outlined in this matrix were taken from modifications presented and discussed at ALWTRT meetings and NMFS/Marine Mammal Commission workshops, amongst other sources. NMFS has incorporated suggestions made by the ALWTRT as appropriate. Also, NMFS intends to continue to modify and /or update the matrix yearly.

Select Whale Research Priorities

- Research on the distribution of large whales throughout their range in US waters (including behavior on the migratory corridor [for large whales] and breeding grounds [for right whales]).
- Information on the temporal and spatial distribution of large whales (e.g. utilizing aerial surveys, vessel surveys, passive acoustics).
 - Occupancy of large whales in coastal waters of Maine and in the mid-Atlantic, from the coast to EEZ
 - Discovery of the principal wintering area for non-calving right whales
- Research on the vertical distributions of both the processes and the prey organisms related to large whale foraging for habitat characterization and predictive modeling.
- Develop technical advances/improvements for disentanglement including sedatives and tools (also including the investigation of behavioral issues that may affect and should be considered during disentanglement)
- Research on the development of non-invasive, long-term tracking tags.

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NOTE: Please see the companion “Gear Research Needs and the Atlantic Large Whale Take Reduction Plan” for identified and prioritized gear research needs related to reducing risks associated with vertical lines and groundlines.

Research Activity	Research Topic	Questions	Suggested By	Applicable Strategy	Gear strategy	Lead NMFS Office	Management Priority	Implementation		
								Current Status of Research	How to Accomplish	Current or Potential Funding Sources
Copepod distribution and abundance	Obtain a better understanding of vertical distributions of both the processes and the prey organisms related to right whale foraging for habitat characterization and predictive modeling.	General	"Improving Right Whale Management and Conservation through Ecological Research" Workshop	Gear	Both	NEC	High	Begun in CCB and GSC; needs to expand	Coop research between NEC, WHOI and others	NMFS
		What is the near-bottom profile (0-200 cm off the bottom) of the food resource in the habitats where right whales are known to feed?	ALWTRT Meetings	Gear	Ground	NEC	Med	Begun In CCB and GSC; needs to expand	Coop research between NEC, WHOI and others	NMFS
		Do copepods concentrate in patches over rocky bottom habit?	ALWTRT Meetings	Gear	Ground	NEC	Med	Begun In CCB and GSC; needs to expand	Coop research between NEC, WHOI and others	NMFS
		Correlate right whale distribution and diving depths with bottom type data. For example, determine whether bottom layers of prey occur over rough bottom.	"Improving Right Whale Management and Conservation through Ecological Research" Workshop	Gear	Both	NEC	Med	Begun In CCB and GSC; needs to expand	Coop research between NEC, WHOI and others	NMFS
		How does the zooplankton distribution and concentration change in various current energies between rocky and sandy habitats and do right whales feed in the very near bottom environment?	ALWTRT Meetings	Gear	Ground	NEC	Med	Begun In CCB and GSC; needs to expand	Coop research between NEC, WHOI and others	NMFS
Large whale distribution -vertical and horizontal	Horizontal Distribution	Fund survey for large whales from Cape Charles (Chesapeake Bay) to Cape Hatteras, from the shoreline out to 60 nm (depending on position of the Gulf Stream) from October 1 to June 1 approximately weekly. Expand surveys to other areas as data suggest.	ALWTRT Meetings	Gear	Both	NEC, SEC, GARFO	High	New	Contract	NMFS
		Occupancy of large whales in coastal waters of Maine.	Other	Both	Both	NEC	High	Ongoing; needs to expand	Contract or Grant	NMFS
		Use passive acoustics to detect the presence of large whales throughout their range (to include mid and south Atlantic) (note: consider next research question).	NEFSC; Other	Both	Both	NEC & SEC	High	3+ yrs of work to date	Contract and Grant	NMFS
		Examine the ecological context of sounds used in the automated schemes proposed for passive acoustic monitoring used to detect large whales and it potential to influence detectability.	NEFSC & SERO	Both	Both	NEC	High	Ongoing; needs to expand	Contract or Grant	NMFS
		Research on the development of non-invasive, long term tracking tags.	Other	Both	Both	NEC	High	Begun; needs to expand	Contract or Grant	NMFS
		Track individual animals (using satellite telemetry) to determine habitat utilization (both known and unknown areas) (e.g. discovery of the principal wintering area for non-calving right whales).	NEFSC	Both	Both	NEC	High	In abeyance	Grants	NMFS
		Assessment of abundance and population identity of humpback whales wintering off the US mid-Atlantic states	Other	Both	Both	SEC/NEC	Med	Begun in 2003	Contract	NMFS

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Large whale distribution -vertical and horizontal (<i>continued...</i>)	Horizontal Distribution (<i>continued...</i>)	Obtain more information of right whales (and other species) further offshore in Southeast US	Other	Both	Both	SEC	Med	New	Grants	NMFS
		Investigate risks to large whales outside the US. For example, increase survey effort in Canadian waters where appropriate	Other	Both	Both	NEC	Med	Attempted to support in FY04 will try again in FY05	MOU with DFO	NMFS
		Conduct a sightings per unit effort analysis of right, fin and humpback whales throughout the NW Atlantic Ocean waters.	Gear Workshop & ALWTRT Meetings	Both	Both	NEC & SEC	High	Partially done	Internal and grants	NMFS
		Correlate right whale distribution with environmental conditions in Northeast and Mid-Atlantic for predictive modeling.	"Improving Right Whale Management and Conservation through Ecological Research" Workshop	Both	Both	NEC	Low	Ongoing--three projects currently underway	Grants	NMFS
		Obtain more information of right whales (and other species) past EEZ.	Other	Both	Both	NEC	Low	New	Grants or Contracts	?
	Vertical Distribution (Diving)	Identify areas where whales are feeding and/or diving close to the ocean bottom. Data gaps include behavior over rocky, coral, or wreck habitats (e.g. inshore areas and depths over 100fa). For example, attach TDRs to whales.	"Improving Right Whale Management and Conservation through Ecological Research" Workshop and Other	Gear	Both	NEC	High	New	Grants	NMFS
		GIS analysis of sediment/bottom type over whales distribution (generally and using those proxies which relate to foraging), especially for rocky, coral, or wreck habitats.	"Improving Right Whale Management and Conservation through Ecological Research" Workshop and Other	Gear	Ground	NEC	Med	Draft analyses complete	Grant	NMFS
		Investigate if there a place in the water column that poses greatest risk (e.g., bottom, mid-water, top) either because of the percentage of time spent there or the behavior while there.	Gear Workshop	Gear	Both	NEC	High	New	Grants	NMFS
		Synthesize current data (e.g. GIS analysis) including tracks of animals, dive data, bottom type, etc	ALWTRT Meetings	Gear	Both	NEC	Med	New	Grants	NMFS
		Attach TDRs to all entangled whales (attaching TDRs to entangled whales may provide insights on the dive behavior of entangled whales in contrast to non-entangled whales).	"Improving Right Whale Management and Conservation through Ecological Research" Workshop and Other	Both	Both	NEC/GARFO	Low	New	Grant or Contract	NMFS
	Obtain dive data or foraging information for right whales south of Cape Cod (notably the mid- and southern Atlantic region) to determine whether right whales forage while migrating off the U.S. mid-Atlantic states, or while in the southeastern U.S. calving area. In addition to tagging, this could involve stable isotope or fatty acid analysis.	"Improving Right Whale Management and Conservation through Ecological Research" Workshop	Gear	Both	SEC/NEC	Low	New	Grants	NMFS	

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Large Whale Behavioral Research	Summarize data on diving behavior	Do changes in orientation of right and humpback whales during feeding present particular risks of entanglement?	ALWTRT Meetings	Gear	Both	NEC	Med	New	Grants	NMFS
		Do whales open their mouths on prospecting dives. For example, use available Crittercam data and/or use Crittercams.	"Improving Right Whale Management and Conservation through Ecological Research" Workshop	Gear	Both	NEC	Med	New	Grants	NMFS
		How are right and humpback whales oriented when they feed along the bottom (i.e. do they swim parallel to the bottom or with the body angled up?). Examine photographs of whales (e.g. with mud on their heads) to see if this provides insights.	"Improving Right Whale Management and Conservation through Ecological Research" Workshop and ALWTRT meetings	Gear	Ground	NEC	Med	New	Grants	NMFS
	Investigate and compare large whale scarring rates (e.g. compare photographs, including stranded animals, of a similar portion of the body) to determine whether difference in foraging behavior relate to differences in observed entanglement rates.	Does entanglement risk vary when foraging vs. migrating?	Gear Workshop	Gear	Both	NEC	Med	New	Grants	NMFS
	Investigate and compare large whale scarring rates (e.g. compare photographs, including stranded animals, of a similar portion of the body) to determine whether difference in foraging behavior relate to differences in observed entanglement rates.	Does entanglement risk vary depending on foraging behavior?	Gear Workshop	Gear	Both	NEC	Med	New	Grants	NMFS
	Investigate the overlap of whale and fishing distribution in NW Atlantic Ocean Waters. Consider whale behavior, gear characteristics & fishing techniques, etc. where possible.		ALWTRT Meetings	Gear	Both	NEC & GARFO	High	Ongoing by NMFS & Others	Internal & Contracts	NMFS
	Investigate whale behavior, habitat and gear (e.g. density, target strength, depth set and other characteristics) by Region (e.g. Northeast, Mid-Atlantic, and Southeast) as it relates to entanglement (e.g. gear that has documented entanglements vs. those that don't).		Gear Workshop & ALWTRT Meetings	Gear	Both	NEC	High	New	Grants	NMFS
	Investigate how whales and their prey behave at night.		"Improving Right Whale Management and Conservation through Ecological Research" Workshop	Gear	Both	NEC	Low	New	Grants	NMFS
	Further investigate large whale sensory abilities (e.g. determine whether whales respond by sight to line or color).		Other	Both	Both	NEC	Low	New	Grants	NMFS
	Fishing Effort Research	Investigate trends/changes in fishing effort and method (e.g. licensing; Canada & US) in areas where right whales and their prey occur that would modify foraging behavior such that entanglement risk may have increased (e.g. increase in head wraps related to increase in a particular's fishing effort or method?)		"Improving Right Whale Management and Conservation through Ecological Research" Workshop	Gear	Both	NEC	Med	New	Contract
Investigate the distribution and gear configuration of fixed gear fishing effort (state & federal) throughout the NW Atlantic Ocean Waters. (Note this would support other research topics listed above.)			ALWTRT Meetings	Gear	Both	GARFO	High	New & Ongoing	In house & Contract	NMFS

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Entanglement Research - Gear	For US and Canada, plot locations for large whales where it was confirmed/determined where gear was set.		Gear Workshop	Gear	Both	GARFO	High	Ongoing	In house	NMFS
	Continue scarification analyses of large whales		Other	Both	Both	NEC	High	Ongoing	Contract	NMFS
	Investigate how entanglements are affecting the health, reproduction, and survival of large whales (e.g. relationship between entanglement-related scarring and serious injury/mortality).		Gear Workshop	Gear	Both	NEC	High	Additional analyses for humpback whales subject to available funds	Grant	NMFS
	Investigate the diameter of rope on whales over time to see if there is a pattern and investigate the use of various diameter in industry over time. (Note: Sample sizes may never be large enough to get at this statistically (see the Johnson et al paper)).		Gear Workshop	Gear	Both	GARFO	Med	New	Contract or Grant	NMFS or NFWF
	Simulate entanglements (e.g. flipper, mouth) through modeling, test tank work, etc. with various gear characteristics (e.g. rope stiffness, rope visibility, distance between buoys in a surface system).		Gear Workshop	Gear	Both	GARFO	Med	New	Contract or Grant	NMFS or NFWF
	Research tractive force (i.e. pulling/towing power) of large whales. Investigate how hard whales must pull to part the gear. Also, investigate the force required in the context of different entanglement scenarios (e.g., if gear is through the mouth alone versus wrapped around a flipper versus multiple body wraps).		Gear Workshop	Gear	Both	NEC/GARFO	Med	New through Arthur et al 2015 (estimating maximal force output of cetaceans using axial locomotor muscle morphology)	Contract or Grant	NMFS or NFWF
	Using the Woodward et al. model, develop a heavier system with greater tension and movement to evaluate the tension of different ropes (e.g. varying by material (new vs. old & sinking/neutral buoyant line vs. floating) and diameter) required to actually cut in.		Gear Workshop	Gear	Both	NEC/GARFO	Med	New	Contract or Grant	NMFS or NFWF
	Using beached carcass, a selection of used industry rope should be dragged through the mouth, including through the lips, baleen and over the tongue, with the mouth open and closed using a dynamometer. This should be done as a joint project with large whale necropsy Principal Investigators. Such a study would help guide gear modification efforts in the light of what is learnt about how the gear components interact with different body parts. However, it is important to consider that such a study may compromise the quality of forensic necropsy.		Gear Workshop	Gear	Both	NEC/GARFO	Med	New	Contract or Grant	NMFS or NFWF
	Using the Cavatorta et al. model, repeat the study using used rope samples, and at different positions in the baleen relative to the gum, especially at the gum level. Include the behavior of knots, weak links, and buoys (e.g. MIT's buoy).		Gear Workshop	Gear	Both	NEC/GARFO	Med	New	Contract or Grant	NMFS or NFWF
	Research whale behavior on contacting line by examining entanglements in other areas (e.g. examine entanglements in Alaska with stiff rope). (Note: Consider whether/how this could be studied.)		Gear Workshop	Gear	Both	NEC/GARFO	Low	New	Contract or Grant	NMFS or NFWF

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Entanglement Research - Biology	Investigate whether it is better to have a whale anchored in gear or not. (Note: Consider whether/how this could be studied.)		Gear Workshop	Gear	Both	NEC	Med/High	New	Grant	NMFS	
	Utilize disentanglement database (e.g. Newfoundland reports) to see if it can indicate whether more entanglements occur during the day or at night.		"Improving Right Whale Management and Conservation through Ecological Research" Workshop	Gear	Both	NEC	Med	New	Grant	NMFS	
	Research why humpbacks are observed entangled in gillnet gear more often than right whales (which are more often observed entangled in trap/pot gear).		Gear Workshop	Gear	Both	NEC	Med	New	Grant	NMFS	
	Investigate why right whales are more susceptible to lethal head and flipper entanglements (and ship strikes) than other baleen whales. Information on food distribution and foraging in 3D can help define and shape the risks.		Other		Both	Both	NEC	Med	New	Grant	NMFS
	Investigate entanglement-related scarring to determine if there is an indication of how whale free themselves from gear. (Note: Consider whether/how this could be studied.)		Gear Workshop		Gear	Both	NEC	Med	New	Grant	NMFS
	Investigate whether age is related to whether animals are carrying gear, can break away, etc.		Gear Workshop		Gear	Both	NEC	Med	New	Grant	NMFS
	Using the Woodward et al. model, develop an atlas of the lesions induced by the rubbing and sawing of different rope types.		Gear Workshop		Gear	Both	NEC	Med	New	Grant	NMFS or NFWF
	Using beached carcass, generate a 3D computer rendering of a right whale body. This could be done with a 3D Cyrax laser scanner similar to what was done for a right whale skeleton.		Gear Workshop		Gear	Both	NEC	Med	New	Grant	NMFS
	Investigate when whales strike gear are they more likely to pull and run, or to roll and struggle. Also investigate whether this changes depending on where they strike the gear (e.g., with their mouth, tail flipper).		Gear Workshop		Gear	Both	NEC	Med	New	Grant	NMFS
	Investigate entanglements by using whale parts and line modifications in a test tank, etc.		Other		Gear	Both	NEC/GARFO	Low	New	Grant	NMFS

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Disentanglement Research	Develop technical advances/improvements for disentanglement including sedatives (e.g. build syringes) and tools (e.g. ROV-mechanical line cutter). Also investigate behavioral issues that may affect and should be considered during disentanglement.	Research solutions for difficult entanglements (e.g. wraps around the mouth, multiple flipper and body wraps)	Disentanglement Workshop	Gear	Both	GARFO	High	Ongoing	Contract	NMFS
	Develop low drag tag	Research solutions for tagging entangled whales that would be further compromised by the present tagging system.	SERO	Gear	Both	GARFO	High	Ongoing	Contract/Grant	NMFS
		Identify more reliable and easy to use systems for disentanglement helmet camera to obtain more information on entanglements.	SERO	Gear	Both	GARFO	High	New	Contract/Grant	NMFS
		Develop technology to safely sedate a right whale for disentanglement.	Report of a Workshop on Large Whale Medical Intervention - Indications and Technology Development	Gear	Both	GARFO	High	Ongoing	Contract	NMFS
Other	Evaluate pollutants and their biological effects on large whales. For example, investigate issues surrounding reproduction including pollution, biotoxins, disease, nutrition, etc. Also, test prey and feces to look at contaminants. (NOTE: This item is related to the ALWTRP indirectly but is important to large whale conservation.)		Other	?	NA	NEC	Med	Ongoing	Grant	NMFS