Recommended Measures to Reduce Ship Strikes of North Atlantic Right Whales

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Submitted to: National Marine Fisheries Service
Via: Northeast and Southeast Implementation Teams for the Recovery of the North Atlantic Right Whale

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Acknowledgements

The ship strike committee has been a process and not a committee in the formal sense. This has been a difficult process, a process defined as the work and the number of participants grew. A process to educate, air and solicit views, and then in the end, a report to develop and explain the rationale for recommendations on management options. The recommendations in this report are the summation of input--discussions, meetings, lunches, written comments, and telephone conversations from over two hundred participants over the span of two years. I submit this report on behalf of the ship strike committee and participants, and accept full and sole responsibility for the recommendations.

We could not have undertaken this work without the work and help of a diverse group of organizations and individuals.

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Much of the data on right whale distribution and migrations are from the New England Aquarium data bases, which in turn are a compilation of other contributors.

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Background/Premises

To reduce the risk of vessel collisions with right whales, three basic management measures, derivatives and combinations thereof are proposed to address commercial ships:

- Routing vessels around high-risk areas.
- Routing ships through a high-risk area to minimize travel distances of vessels and risks of whale-vessel interactions.
- Restricting vessel speed through high-risk areas.

For the purposes of this report, a high-risk area is defined as the convergence of either areas of high volume of shipping and right whales, or high numbers of whales and shipping. Areas of high volumes of shipping include designated shipping lanes, historic shipping routes and port approaches. Areas of high numbers of right whales include areas where right whales are aggregating, right whales are known to return in numbers on a regular basis, or critical population areas or habitats (e.g., the calving grounds off the Southeast U.S. coast).

Imposition of these measures could be seasonal, or year-round and limited to a specific high-risk area based on historical occurrence and other relevant factors. Imposition of measures could also be initiated upon the detection and / or prediction of right whales in a high-risk area, and might remain in force until right whales are no longer detected or have a low probability of remaining in the area. One or more measures could be imposed in an overall management scheme for a given area.

The success of the recommended right whale protection strategy is predicated on the mariner being educated on the seasonal distribution and occasional occurrence of right whales through education programs; licensing and personnel qualifications (e.g., trained but not necessarily additional lookouts); inclusion of right whale information in key required nautical publications; voyage planning requirements; and planning for emergency maneuvering by testing steering gear, and ensuring that engines are ready for maneuvering prior to entering right whale habitat. Several of our recommendations address these matters.

Early on in our work, the ship strike committee considered voluntary versus mandatory measures. A draft program calling for cooperative agreements of voluntary measures between NMFS and individual shipping companies was developed and presented to NMFS and the shipping advisors of the Northeast Implementation Team. This voluntary program was rejected as unworkable. Later, both Implementation Teams noted the low compliance rate for the Mandatory Ship Reporting system. The Coast Guard has renewed education efforts and directed field units to cite vessels for non-compliance though their port state control program. The low compliance rate (without an aggressive education and enforcement program) supports the view that a voluntary program would be unworkable. The low compliance rate also under scores the need for aggressive education and enforcement in future programs.

Recommended long-term routing measures conform to the International Maritime Organization's *General Provisions for Ship Routing*. The measures must not inadvertently lead to any situation that endangers a vessel or other vessels or the marine environment. For example, if a vessel is operating in a designated shipping lane recommended measures would not divert a vessel out of the lane. I do however, recommend that NMFS establish a speed restriction of 10 knots in certain situations or in areas at certain times of year. This speed limit would be imposed with the explicit understanding so as not to endanger the vessel or create a navigation safety or marine pollution hazard.

Slowing vessels down is a measure that was initially considered as a measure of last resort because of the inherent uncertainty in the effectiveness and the potential for unwarranted economic impacts. A primary focus was on routing measures and detection of whales so that a mariner could steer clear with advance notice. Aerial surveys provide a partial solution. The technology to provide adequate advance warning is under study. Right whales will occur in a specific area unpredictably, in other areas within a particular time window. They occur along shipping routes or lanes and cross port approaches during migrations. In many cases, routing vessels around known or predicted right whale locations is impossible, for example at port entrances. The only viable option, then, is for a vessel to slow. The question then becomes how slow and what discretion should be left to the mariner. The conventional way mariners are advised to proceed slowly is found in Rule 6 of the international collision avoidance regulations (COLREGS). Mariners are required to proceed at "safe speed" in uncertain conditions; the discretion left to the mariner to decide what is safe. The measure of "safe" is whether a collision is avoided.

The mariner does not know what safe speed is to avoid a whale. More importantly, the mariner does not know a safe speed that may allow a whale to avoid the vessel or to minimize the impact of a collision. It is up to the resource agency, NMFS, to make this call based on available information. This does not however imply that the mariner gives up the discretion to drive the vessel safely.

There are three studies on right whales and vessel speed, none of which is definitive; all are lacking in many respects. Nonetheless, these studies do point to slower vessel speeds being a factor in reducing whale-ship interactions. Speed restrictions should be based on the slowest safe maneuvering speed for a vessel and the slowest whale safe speed. I believe these two speed parameters converge between 8 and 13 knots. As lead author of this report, I find that I must choose among options: 8 knots, 10 knots, 13 knots, or leave speed to the mariners' discretion. I do not believe the latter option is prudent. I would defer if I thought additional studies on vessel speed and whales would shed more light, but I do not. There are too few records of ship strikes to study. The uncertainty and unknowns of how an individual right whale will react to or be drawn into a ship suggests that an answer to what precisely is a safe speed for each vessel type is very, very far off.

After listening to all the arguments, there is no consensus on the matter of speed, ***I am recommending that NMFS determine that safe speed is 10 knots.*** Ten knots is at the lower end of what is safe for some large vessels many conditions. A speed restriction

could be imposed as follows: mariners limit vessel speed over ground to 10 knots or less, so as not to endanger the vessel or create a navigation safety or marine pollution hazard. Thus, a vessel that cannot operate at 10 knots in certain conditions would operate at a slow safe speed (defined in accordance with Rule 6 of the Collision Avoidance Regulations (COLREGS)) at the discretion of the Master. Other qualifying factors should also be established: a mariner could exceed the slow speed, 10 knots, for suitable reasons such as search and rescue, medical emergencies, storm avoidance, and adverse weather/sea conditions.

Finally, I considered the impact of such a speed restriction on vessels entering East Coast ports. After a fairly detailed analysis, documented in previous discussion drafts, I find that the typical worst case scenario would mean a planned delay of one hour for an inbound vessel; most vessel operators would have to plan for less

Several "short-hand" phrases used in the recommendations follow:

> *Vessel:* all vessels engaged in commerce, with length greater than or equal to 65 feet or 20 meters, all commercial tugs and tows regardless of length, and all recreational vessels, with length greater than or equal to 65 feet or 20 meters. Some tugs are less than 65 feet, and tow larger barges or vessels and therefore are included in this definition. The one ship strike resulting in a fatal blow to a right whale, a calf, where the vessel is identified was 82 feet. In this case, the fatal blow was not from the hull rather it was from the propeller. There is evidence of vessel strikes by smaller vessels (scarring on whales back) that could have been fatal if this happened to a calf. There is an argument that large planing vessels be exempt because of their operating at a shallower draft, but this does not address the problem of large propellers.
>
> *Geographically-targeted re-routing*:
> Routing measures implemented and adjusted on a short-term basis in response to continually updated data and analyses of right whale occurrences or aggregations.
>
> *Regional/seasonal re-routing*:
> Routing measures implemented based on several years analyses of right whale distribution.
>
> *Speed restrictions:*
> Requirement that mariners limit their vessel speed over ground to 10 knots or less, so as not to endanger the vessel or create a navigation safety or marine pollution hazard. Other factors should be established so that a mariner could exceed the slow speed, 10 knots, for suitable reasons such as search and rescue, medical emergencies, storm avoidance, and weather/sea conditions.
>
> *Geographically-targeted vessel speed restrictions*:
> Restrictions implemented and adjusted on a short-term basis in response to continually updated data and analyses of right whale occurrences or aggregations.

Regional/seasonal speed restrictions:
Restrictions implemented on a longer-term basis (in some areas, several weeks; in other areas, 3-4 months) based on analyses of several year of right whale survey / detection data.

Port entrance and approaches:
An area measured from the mouth of the entrance to a harbor along a line generally following the coast, and then approximately 20 nautical miles seaward. In ports where there are multiple approaches, the area would be defined by an arc drawn from the mid-point of a line across the harbor mouth. The Block Island Sound entrance and approaches is defined as an area approximately 20 nautical miles seaward of a line between Montauk Point, NU and Nomans Land, MA.

The U.S. has the ability to institute vessel-operating measures within the exclusive economic zone. As a priority, NMFS should look to instituting most of the recommended vessel operating restrictions as a matter of port entry. There is precedent. Transiting foreign flagged vessels would not be subject to these rules. This approach may require specific authorizing legislation. Several of the recommendations, in particular mandatory routing and areas to be avoided in international waters, may require approval by the International Maritime Organization (IMO). The question is not whether the U.S has the ability to protect right whales from ship strikes: NMFS, working with the U.S. Coast Guard has demonstrated or indicated that they have or will seek authority both internationally and through Congress to protect right whales with due consideration of the interests of the shipping industry, freedom of navigation and international law. An interpretation of the Endangered Species Act provides authority for imposing operating restrictions on all U.S. and foreign flagged vessels. ***We strongly encourage responsible agencies to start working on matters of domestic and international authority as soon as possible***.

Some of the measures recommended require additional studies. These are so noted and elaborated further in other sections of this report. For example, several recommendations propose the establishment of designated mandatory or recommended shipping lane(s) or routes through critical habitat. These recommendations are predicated on the conduct of a detailed risk assessment to ensure actual risk reduction and to examine alignments that would minimize risk to right whales. In turn, proposals that affect ship routing requires that the Coast Guard conduct a Port Access Route Study (PARS) in accordance with 33 USC 1223; navigation safety is the primary concern in these studies.

There are several recommended measures that could be enhanced by new technology or improved methodologies. For example, real-time passive acoustic detection may serve as a viable resource in alerting vessels to the occurrence of right whales along a vessel's route.

There are recommendations to examine unproven technology that may or may not hold promise and that may pose environmental safety problems, for example active acoustic (sonar) detection and acoustics deterrence.

Recreational vessels, yachts and small passenger vessels for hire whose propellers turn at high rpm can seriously injure or kill a young right whale. I recommend that the Implementation Teams, NMFS, working with the boating, recreational fishing and conservation community, develop collaborative education and outreach programs, and regulations for targeted speed restrictions.

Finally, several recommendations address U.S. Naval operations in the Northeast U.S. (Hampton Roads area and north) and other maritime operating agencies, specifically the U.S. Maritime Administration of the Department of Transportation and the U.S. Military Sealift Command. Naval operations represent 5% of the total traffic moving in and out of the Chesapeake Bay. The U.S. Maritime Administration (MARAD) bases part of its fleet in the mid-Atlantic area. The U.S. Military Sealift Command operates 28 vessels in the Atlantic area. This represents a significant volume of traffic.

Summary of recommendations*

*See Appendices for rationale and amplifying information, and detailed discussions.

Vessel operating restrictions

Dynamic Management Areas: Establish a regulatory mechanism applicable to vessels operating along the U.S. East coast north of Port Canaveral, Florida which would enable the agencies to impose measures, including geographically-targeted re-routing and / or geographically-targeted vessel speed restrictions. Enhanced aerial surveillance techniques, expanded surveys, and other means of detection, for example real-time passive acoustics, will increase the effectiveness of this measure. Legislative authority may be required. See Appendix I for rationale and amplifying information and the recommendations on *Research, Studies and Projects*.

Designate the Cape Cod Bay critical habitat as a seasonal area to be avoided (ATBA). Effective dates could be determined based on historical data and other factors. Exceptions could include vessels providing fuel oil and ferry service to Provincetown. MA, subject to operating restrictions for example daytime transit, posting of lookouts, or speed restrictions; also, vessel operators must have access to real time whale sightings and be familiar with the high use area and seasonal presence of whales. Designation may require a PARS.

Designate the Boston Approach shipping lane as a mandatory route, and *designate the Great South Channel right whale critical habitat east of the shipping lane as an area to be avoided (ATBA).* Vessels allowed to operate in the ATBA could include fishing vessels subject to operating restrictions for example posting of lookouts or speed restrictions. Also, vessel operators must have access to real time whale sightings and be familiar with the high use area and seasonal presence of whales. Both designations will be subject to a risk assessment, possibly a PARS, and may require approval by the International Maritime Organization. Legislative authority may be required. The risk assessment is already funded.

Establish a seasonal management area to encompass parts of the Boston Approach Sea Lane to the west, east and south of Race Point, Cape Cod, MA. This is a high-risk area during the departure of right whales from Cape Cod Bay after their winter-feeding in the Bay and the subsequent dispersal of right whales to the Gulf of Maine, including the Great South Channel. Vessels would be required to avoid this area or transit this area at no more than 10 knots. Effective dates could be determined based on historical data and other factors. Legislative authority may be required. Designation may require a PARS. Implementation and enforcement would be a condition of port entry. See Appendix II for rationale and amplifying information

Establish seasonal management areas at major port entrances and approaches from Block Island, RI, south to and including Savannah, GA. Port approaches are high-risk

areas during the northern and southern migrations of right whales from/to the Southeast critical habitat when right whales cross port entrances. Vessels would be required to approach ports from approximately 20 nautical miles to the harbor entrance at no more than 10 knots. Legislative authority may be required. Designation may require a PARS. Implementation and enforcement would be a condition of port entry. See Appendix II for rationale and amplifying information, and the recommendations on *Research, Studies and Projects*.

Establish mandatory or designated recommended routes for the ports of Brunswick, GA, Jacksonville, FL and Fernandina Beach, FL. Deep draft north-south traffic would be required to stay east of the critical habitat and areas of high right whale occurrences with the exception of coast-wise tug and barge traffic, large recreational vessels and small passenger vessels. These shallow draft vessels would be subject to operating restrictions for example speed restrictions; also, vessel operators must have access to real time whale sightings and be familiar with the high use area and seasonal presence of whales. These designations and restrictions in conjunction with the speed restriction below, preclude the need to manage this area using the dynamic management area mechanism. Each route would be conditional on a risk assessment to determine impact and recommended alignment and a PARS. Legislative authority may be required. This recommendation may require approval by the International Maritime Organization. The risk assessment is already funded. Lead authors note: I forward this recommendation with reservations. See Appendix III for rationale and amplifying information.

Establish a seasonal 10-knot speed restriction for vessels calling at the ports of Brunswick, GA, Jacksonville, FL and Fernandina Beach, FL. This restriction in conjunction with the designations and restrictions above precludes the need to manage this area using the dynamic management area mechanism. Implementation and enforcement would be a condition of port entry. Legislative authority may be required. See Appendix III for rationale and amplifying information.

Require for each recommended measure above that each vessel, prior to entering critical habitat or dynamic or seasonal management area, check steering, ensure engines are ready for maneuvering, and post trained lookouts (not necessarily additional lookouts). . Legislative authority may be required. Implementation and enforcement would be a condition of port entry.

Should acoustic/sonar-detection technology prove effective and environmentally safe and become available, NMFS should offer use of this equipment subject to certain conditions as an option, instead of routing around or slowing. An unproven technology that is currently under research and development is a vessel-mounted forward-looking active-sonar device. Port authorities and the shipping industry have embraced the concept as a technologic solution instead of or in addition to other management options. Government acoustic experts have examined the use of active sonar and have dismissed the approach as unworkable. However, before additional funds are expended on this R&D, an evaluation of concept review should be conducted. See research recommendations and Appendix IV.

Voyage planning, personnel qualifications, merchant mariner education

Develop voyage planning guidelines for domestic and foreign flagged vessels calling at U.S. east coast ports for inclusion in required voyage planning documentation, and manning standards and qualifications as appropriate. The International Chamber of Shipping publishes a bridge manual, which may be a good vehicle, in addition to other means.

Work with the U.S. Coast Guard and IMO on merchant personnel qualifications to address protection of the environment and endangered / protected species, including the North Atlantic right whale.

Ensure that relevant information and requirements are included in equivalent required charts and nautical publications, including British Admiralty publications.

Develop a merchant mariner education program as part of the ship strike program. Merchant mariner education must be an integral part of the implementation strategy and program management plan.

Recreational vessels, yachts and small passenger vessels for hire **(**Vessel propellers turning at high rpm can cause serious injury to or death of a young right whale.)

Develop an education and outreach program targeted at large recreational vessels, yachts and small passenger vessels for hire. It is essential that owners and operators be made aware of the occasional aggregations and seasonal occurrence of rights whales in coastal areas, in particular those operating from the smaller coastal inlets. Vessel propellers turning at high rpm can tear apart a young right whale. Develop of right whale education programs in collaboration with one or more regional or national conservation groups, the Coast Guard Auxiliary, the US Power Squadron, and sport fishing associations.

The Implementation Teams, NMFS and the Coast Guard should work with state boating safety law administrators to develop and institute program(s) of geographically and seasonally targeted speed restrictions.

U.S. Navy operations

The U.S. Navy should conduct a Section 7 consultation on naval operations (air and sea) for areas under the jurisdiction of NMFS Northeast Region. DoD's Atlantic fleet maritime operations pose potential adverse impact on right whales and humpback whales off the mid-Atlantic coast. Recent ship-strike data compiled from a variety of sources including the New England Aquarium, the marine mammal stranding networks, and the Smithsonian Institution's Marine Mammal Events Program (MMEP), identify as many as

nine fatal humpback whale ship-strikes and five fatal right whale ship-strikes in the Virginia Capes area in recent years. The case records substantiate the requirements for immediate fleet-wide remedial actions, and consultation with the National Marine Fisheries Service. Recent studies have identified the Virginia Capes area as a winter feeding ground for juvenile humpback whales, an endangered species. The responsibilities of the Northeast Implementation Team include humpback whales.

There is a belief among a range of participants that the Navy's policy *not to* conduct generic consultations, rather to approach "these matters on a case-by-case basis" does not work, nor is it consistent with the intent of the ESA. In spite of written assurances by DoD leadership on behalf of the Navy that the Navy would assess Naval operations and institute "appropriate remedial actions," there is no obvious record of an assessment of impacts of Naval operations in the Norfolk / Hampton Roads area and certainly no record of resulting remedial actions.

The Navy should issue specific operating procedures for vessel operations in the Norfolk / Hampton Roads area similar to those issued for operations off the Southeast U.S. Naval operations represent 5% of the total traffic moving in and out of the Chesapeake Bay. The U.S. Military Sealift Command operates 28 vessels in the Atlantic area. This represents a significant volume of traffic.

The Navy should issue specific operating procedures for air operations for its Brunswick, ME Naval Air Station similar to those issued for operations off the Southeast U.S. This recommendation should address practice bombing in the Gulf of Maine, pre-bombing surveys, education of regular and reserve personnel in nautical references. Written procedures and education should include at a minimum: consulting the Coast Pilot and Notice to Mariners on seasonal distributions and real-time occurrences of right whales, aerial survey techniques at proper altitude and speed). Alternative bombing ranges should be examined.

U.S. Department of Transportation, Maritime Administration (MARAD)

MARADMARAD should conduct a section 7 consultation for theMARAD should conduct a section 7 consulta DefenseDefense Reserve Fleet located at Ft. Eustis, Virginia (conducting periodic sea trials off tthethe mouth of Chesapeake Bay), and its eighty six domestically-stationed ships operatthe mouth of Che off the U.S. east coast. This agency should participate on the Implementation Teams.

The U.S. Military Sealift Command (MSC)

MSCMSC should conduct a section 7 consultation for thMSC should conduct a section 7 consultation for in the Atlantic area. This agency should participate on the Implementation Teams.

Research, Studies and Projects (See Appendix IV for detailed discussions)

Regional risk assessments. Conduct risk assessments off the Southeast US, in the Great South Channel and Gulf of Maine to determine how many vessel miles can be removed

from the high density whale areas by safely routing ships into and out of whale areas using the shortest route possible.

Economic impact analysis. Conduct more detailed treatments of port-specific economic effects by enhancing and providing more accurate data into a model currently under development.

Assess temporal and spatial extent of the mid Atlantic migratory corridor. Analyze existing data and survey data from targeted surveys and other surveillance techniques to determine statistical probabilities of occurrence (time and location) of right whales during migrations off port approaches from Block Island, RI to Savannah, GA. Additional aerial surveys may be necessary.

Integrate all available information into a management system. Continue and expand the ongoing development of a comprehensive information management system using Geographic Information Systems (GIS) software. This system will be used to monitor the health of the population and the efficacy of and effectiveness of management measures designed to reduce human impacts on whales.

Merchant mariner education. Continue, enhance and accelerate the development of a program and outreach strategy to assist mariners, worldwide, in voyage planning, qualifications and licensing programs, and in shipboard safety management planning.

Right whale detection research/monitoring.

- Expand aerial surveys to cover port approaches from Block Island sound, RI to Savannah, GA.
- Evaluate and improve the effectiveness of aerial survey techniques.
- Continue passive acoustics detection research and investigate automation of a real-time system suitable for deployment offshore.
- Continue research into the biological and oceanographic predictors of right whale distribution on suitable scales in support of an "expert system" to predict right whale occurrences in high-risk areas.
- Evaluate the effectiveness, methods and safety (to the animal) of satellite tagging and if appropriate develop and implement a program to address specific information gaps on the occurrence of right whales in high-risk areas.

Right whale behavior in relation to ships. Develop a research program to improve the understanding of how right whales react to approaching vessels. Characteristics of changes in a vessel's sounds may enable a whale to hear an approaching vessel to realize that there is a threat of a collision. From reviewing anecdotal evidence about right whale reactions to approaching vessels, it seems that some right whales may be reacting to changes in the sound emanating form the vessel. For example, small changes in propeller speed or pitch (for variable pitch propellers) or small changes in the rudder angle.

Active sonar detection; evaluation of concept proof. Before further discussion on the potential use of this technology, the practical application of active sonar detection needs to be realistically presented, including, for example, realistic time frames for the required technological development and careful consideration of possible environmental impacts. Several researchers have advertised an unproven technology that *could* detect right whales ahead of ship using active sonar. Port authorities and the shipping industry have embraced the concept as a technologic solution instead of or in addition to other management options. In contrast, acoustic experts have examined the use of active sonar and have dismissed the approach as unworkable.

Mortality: Assess propeller cuts to determine if vessel size can be estimated.

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Russell, Bruce A., Leaper, R., Mathews, J., July 2001. Discussion Draft: Dynamic Management Areas..

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Record of meetings

26 May 1999: NEIT ship strike sub-committee meeting Boston, MA

14 December 1999: briefing to Boston Port Operators group

22 March 1999: NEIT ship strike sub-committee meeting, Boston, MA

5 May 2000: SEIT meeting (initiated southeast efforts), Brunswick, GA.

10 May 2000: briefing to Portland Maine Port operators group & City of Portland port director.

24 May 2000: oral presentation to Marine Transportation System Advisory Council, Alexandria, VA.

6 June 2001: briefing to North Atlantic Port Authorities, Inc., Portland, ME.

13-14 July 2000: meeting with Bath Iron Works, and Brunswick, NAS

13 September 2000: Ship Strike Committee (SSC) and NMFS liaison presentation and briefing, Newark, NJ.

14 September 2000: SSC and NMFS liaison presentation and briefing, NOAA HQ, Silver Spring, MD.

28 September 2000: SSC and NMFS liaison presentation and briefing, Savannah, GA.

5 October 2000: SSC and NMFS liaison presentation and briefing, Gloucester, MA.

4 August 2000: presentation briefing to American Association of Port Authorities, Maryland Port Authority, Baltimore, MD.

12 October 2000: presentation to Marie Mammal Commission annual meeting, St Petersburg, FL.

26 October 2000: update of NEIT, Gloucester, MA

27 October 2000: presentation to right whale consortium, Boston, MA

3 November 2000: update of SEIT, Jacksonville, FL.

6 December 2000: presentation to Hampton Roads Maritime Association MTS meeting, Norfolk, VA

13 December 2000: NEIT ship strike committee meeting, Boston, MA.

13 December 2000: presentations to National Association of Maritime Organizations, Boston, MA.

28 February 2001: SSC and NMFS liaison meeting with Thames River Coalition, New London, CT

10-11 April 2001: Ship Strike Committee workshop, Coast Guard Academy, New London, CT

4 May 2001: Ship Strike Committee workshop follow-on, Jacksonville, FL.

20 June 2001: NEIT ship strike committee meeting, Boston, MA.

18 July 2001: SSC and NMFS liaison meeting with NY/NJ Harbor Safety Committee, Port Authority of NY/NJ.

7 August 2001: SSC meeting with Jacksonville Harbor Safety Committee, Jacksonville Port Authority.

Appendix I
Dynamic Management Areas (DMA)

Rationale and amplifying information for recommendations on vessel operations: aggregations of right whales

A. <u>Objective</u>: To reduce the risk of harmful whale-ship interactions when right whale(s) are found aggregating in an area by:

- Reducing the probability of whale-ship interactions (by i.e. routing ships away from whales[1])
- Increase the probability that a whale-ship interaction (by slowing ships down to 10 knots) that will:
  a) not harm the whale, or
  b) provide the whale the opportunity to react with sufficient time to avoid the ship, or
  c) provide the ship the opportunity to sight whales and react with sufficient time to avoid a whale or group of whales.

B. <u>Trigger</u>: Right whale(s) are determined to be in an area with vessel traffic. Right whales are known to aggregate when foraging and / or feeding, and in courtship groups. These aggregations have been seen as far south as New Jersey, Block Island Sound and in throughout the Gulf of Maine, including the Great South Channel. Courtship aggregations are occasionally seen in the southeast U.S. Resident mother /calf (new born) pairs of right whales have been found north and east of the designated critical habitat in the Southeast U.S.; for example off the approaches to the ports of Savannah, GA and Charleston, SC

NMFS has established criteria for dynamic area management for fisheries closures to prevent entanglements when feeding or foraging whales are detected in the Northeast U.S. in an April 2001 report "*Defining Triggers for Temporary Area Closures to Protect Right Whales from Entanglements: Issues and Options,*" (Northeast Fisheries Science Reference Document 01-06). Aspects of this approach may be appropriate to prevent ship strikes with several exceptions as noted. This study is based on right whales in the Gulf of Maine area, and its applicability to other areas should be used only as a guide to assist in determining residency of right whales in an area.

Vessel operating restrictions shall be imposed in an area when three or more right whales are observed resident in an area of size such that the right whale density in this area is 0.04 right whales per nm^2. This equals four right whales observed in a 10x10 nm square. Operationally, this may be applied as follows:

1. A resident right whale is defined as a right whales determined to be actively feeding or in a courtship group. Observation of a dense patch of right whales' primary food, the copepod *calanus,* is good indication that right whales are resident in an area. Successive observations obviously indicate residence. It

[1] Routing vessels around areas where whales are known or determined to be located in aggregation or densities to areas of no known whale aggregations or lower densities will reduce the probability of whale-vessel interactions. There are many circumstances however that routing vessels is not an option. The only other option currently available is the reduction in vessel speed.

does not appear that residence is not explicitly defined in the trigger mechanism for fisheries. For example a foraging whale, that is a whale searching for food, will not necessarily remain in a specific area, whereas a feeding whale is likely to remain in a management area. The concern is that the basis for the science center's analysis should be used only as an indicator of residence. Other factors should be considered, if available.

2. A circle of a radius equal to three nautical (nm) per animal shall be drawn around each individual sighting. This radius will be adjusted to account for the number of animals seen in the sighting, so that the density of 0.04 animals per nm^2 is maintained. This is a nonlinear relationship (the area is circular) so that to maintain this density, the radius of the circle for a sighting of a single animal would be 2.77 nm, for 2 whales in the sighting the radius would be 3.99 nm, for 3 whales the radius would be 4.89 nm, and so on &
3. If any circle or group of contiguous circles includes three or more animals, the area shall be a candidate for dynamic management.

Having identified a group of 3 or more resident right whales as candidates for protection to adequately protect these animals for the duration of the event, it is necessary to expand the original area of sighting to provide a buffer for movement within the DMA. Determination of residency is of course subjective. This will define the actual DMA, and operationally could be applied as follows:

1) A **buffer zone** of radius of up to 15 nm, shall be drawn from the boundary of the individual sighting area triggering a DMA.
2) The DMA shall then be defined by east-west (latitude) and north-south (longitude) lines, which demarcate the outer periphery of the defined circles.

Exceptions:

1) When two or more animals are seen actively feeding on a patch of food in a designated shipping lane a DMA shall be imposed. Rationale: Actively feeding right whales are believed to be the most vulnerable. Designated shipping lanes carry more shipping traffic and therefore the probability of whale-ship interaction is higher than other areas.
2) When a non-migrating mother/calf pair is sighted within 15 nm of shipping lanes, and no other operating restrictions apply, a DMA shall be imposed. Mother / calf pairs are the most vulnerable (they are restricted in their abilities to maneuver) and mature breeding females are the most critical to survival of the species. Non-migration could be defined as any time after the northern migration from the Southeast calving grounds to the Great South Channel area.
3) A single right whale when in the immediate vicinity of a port entrance or a port area, or in or near the entrances to Cape Cod Canal, may trigger a DMA or imposition of operating restriction by the US Army Corps of Engineers (e.g., the Cape Cod Canal) or by the Coast Guard. Compliance by a vessel with the 500 yard no approach rule 50 CFR.224.103 can create a navigation safety hazard.

C. <u>Proposed vessel operating restrictions in a DMA</u>: The responsible agency would impose one or more measures that could include, for example: 1) establishment of a

temporary area to be avoided, and / or 2) impose a speed restrictions to 10 knots speed for vessels unable to avoid the area; or 3) provide the option to the mariner proceed at 10 knots through the area in lieu of avoiding the area. Mariners would also be required to check their steering, ensure that their engines are ready for maneuvering and to post look-out(s) (not necessarily additional persons) familiar with spotting whales.

D. Regulatory Approach and Notification of Mariners: As the lead Federal agency that regulates ship operations, it would be best that that the Coast Guard be the regulating agency. NMFS would make a determination that a DMA is necessary and request that the Coast Guard impose and enforce these restrictions. We also suggest that NMFS establish a discretionary consultation process with the purpose to coordinate advice on geographic extent, estimated time limit and specific measures. We propose that NMFS and the Coast Guard model the regulatory approach to that already used by the Coast Guard to impose operating restrictions on vessels on an emergency basis, an emergency safety zone, see 33 CFR Part 165. This general authority extends through the contiguous zone and is somewhat limited in its scope, unless specifically amended. (An interpretation suggests that this authority, under the Ports and Waters Safety Act, does not apply to the protection of right whales. This authority was specifically amended to implement the MSR, and in this case in waters beyond the contiguous zone.) Detailed establishment procedures, geographic coordinates, seasonal occurrence, vessel operating requirements and general regulation, notification, shipboard log keeping could all be specified.

E. Implementation and enforcement: Unlike NMFS' Dynamic Area management program for fisheries, direction of shipping can be accomplished relatively quickly--there is no gear in the water, no gear to reset. A vessel can still move cargo or get from point A to point B. Existing communications systems can be used to relay the order or rule. If used in combination with other measures, for example mandatory shipping lanes and areas to be avoided, detection and emergency actions need only focus on/adjacent to the lanes. Port authorities, ships' agents, national and international industry associations, and pilots associations should be partners in this education. Coast Pilots, British Admiralty publications, and Port Guides to Entry should include information on the need for mariners to be alert to emergency Dynamic Management Areas. Regular Coast Guard port-state control boardings could include examination of ship's logs and random checks of these logs by NMFS and NOAA personnel should suffice. (Mariners are required to log course and speed changes). Sovereign immune vessels, and foreign flagged transiting and not calling at any U.S. port would not be subject to this measure.

E. Note: There may be circumstances when vessels will be unable to avoid an area or, reduce speed: for example, a deep-draft vessel in harbor approaches when other vessels are in proximity, or the channel is restricted (e.g., depth), the seas, current and winds are unfavorable and pose a navigation safety risk. The ultimate decision on the handling of a vessel, is always that of the master or mate on watch. Another example is when a vessel is in a designated shipping lane; in this case a mariner's only option would be to slow.

Appendix II
Seasonal Management Areas (SMA)

Rationale and amplifying information for recommendations on vessel operations: predictable seasonal occurrences of right whales during migrations

A. Objective: To reduce the risk of harmful whale-ship interactions when right whale(s) are predicted to seasonally occur (e.g., when migrating) in a specific geographic area by:

1. decreasing the probability that a whale-ship interaction by slowing ships down to 10 knots or less.
2. providing the whale the opportunity to react with sufficient time to avoid the ship, and / or
3. providing the ship the opportunity to sight whales and react with sufficient time to avoid a whale or group of whales.

B. Triggers: Right whale(s) are predicted to occur seasonally when migrating across or through designated shipping lanes or port approaches. Rather than the density of right whales in an area determining the need to impose vessel- operating restrictions, the motivation is the relative high density of shipping coincidental with known migrations of right whales. Three migrations of concern are identified:

1) The departure of right whales from Cape Cod Bay after their winter feedings in this area and the subsequent dispersal of right whales to the Gulf of Maine, including the Great South Channel. This departure of many animals often occurs abruptly over several days in mid to late April. In leaving Cape Cod Bay, right whales cross the Boston Approach Sea Lane. A GIS study is currently underway to study/map this departure. With this information, a probable geographic range through the sea lanes, approximate duration of the dispersal and mean date and duration for the dispersal with a high confidence level for each, can be determined.
2) The northern migration of right whales from the Southeast critical habitat as right whales cross port entrances. As many as 90 individual right whales were seen in the Southeast calving grounds in the winter of 1996 migrating northward in late winter/early spring. Good information exists on the dates whales depart the southeast and arrive in the northeast. Tagged whale data and opportunistic sightings provide information on speed and some information on path. Vessel sighting data in the mid-Atlantic area from Block Island Sound to and including Savannah, GA is sparse or absent. Statisticians, GIS experts, and others consulted believe that a model can be constructed that can predict the mean date of the peak occurrence of right whales at port entrances. The peak date in any given year could be estimated with a high degree of confidence based on real-time observations as long as surveillance levels in the northeast and southeast are maintained. Theoretically then, seasonal vessel operating restrictions could be imposed for port approaches around the peak date of migration past each port. The geographic extent is more problematic. Survey data for the mid-Atlantic is virtually absent. However, records of opportunistic sightings and tracks of tagged whales may provide sufficient information to establish a zone; researchers at the New

England Aquarium estimate that as many as 85% of migrating whales are within 20 nm from the coast. Statisticians and others are working to determine the confidence level we can attribute to an analysis of these data.

3) The southern migration of right whales to the calving grounds will include pregnant females, as well as other adults and juveniles. The departure time for animals leaving the northern area is not as well identified, however arrival time in the southeast is fairly well documented. A calculation based on travel speed might allow for a peak probability of migration past mid Atlantic ports. A similar calculation for the geographic extent can be made, and it is not expected to be different than for the southern migration.

C. Proposed vessel operating restrictions: The responsible agency would notify mariners that on or about a certain date, for a specified period and in accordance with published regulations that a speed restriction of 10 knots is in force. The exact dates could be linked to real-time sightings. Mariners would also be required check their steering, to ensure that their engines are ready for maneuvering, and to post look-out(s) familiar with spotting whales (not necessarily additional persons). This process is akin to the Coast Guard's regulated navigation area

D. Regulatory Approach and Notification of Mariners: As the lead Federal agency that regulates ship operations, we propose that the Coast Guard be the regulating agency. In our view, NMFS would make a determination that a SMA is necessary in an area and request that the Coast Guard impose and enforce these restrictions. We also suggest that NMFS establish a discretionary consultation process with the purpose to coordinate advice on the date of implementation, estimated duration and estimated limit and specific measures. The geographic coordinates and approximate imposition dates would be published in advance in regulation(s), with specific imposition subject to determination by NMFS and the Coast Guard, with subsequent notification through regular notice to mariners and NAVTEX. We propose that NMFS and the Coast Guard model the regulatory approach to that already used by the Coast Guard to impose operating restrictions on vessels in a specific area on a regular or permanent basis, a regulated navigation area (RNA), see 33 CFR Part 165. This general authority extends through the contiguous zone and is somewhat limited in its scope, unless specifically amended. (An interpretation suggests that this authority, under the Ports and Waters Safety Act, does not apply to the protection of right whales. This authority was specifically amended to implement the MSR, and in this case in waters beyond the contiguous zone.) Detailed establishment procedures, geographic coordinates, seasonal occurrence, vessel operating requirements and general regulations, notification, and shipboard log keeping could all be specified.

A comprehensive merchant mariner education program will be essential. Port authorities, ships' agents, national and international industry associations, and pilots associations should be partners in this education. Coast Pilots and Port Guides to Entry, and equivalent foreign publications and charts should include information on the need for mariners to be alert seasonal management areas. Regular Coast Guard port-state control boardings could include examination of ship's logs and random checks of these logs by NMFS and NOAA personnel should suffice. (Mariners are required to log course and speed changes.)

Appendix III
Southeast U.S. Calving Area

Rationale and amplifying information for recommendations on vessel operations: management measures off the Southeast U.S. coast from Port Canaveral, Florida to just north of Brunswick, GA

Ten seasons of sighting data were compiled and superposed these on nautical charts. The data used are not corrected for effort (sightings per unit effort, SPUE), as the SPUE analysis is not yet complete. For the purposes of this report, a conservative approach was chosen to determine the approximate geographic extent of operating restrictions. These of course should be reviewed as the SPUE analysis is completed later this year.

We found that, based on the occurrence of whales to the east of the critical habitat, operating restrictions could extend to 80□55' W off Brunswick, 8.3 miles east of the critical habitat near buoy "28"; to 80□57' W off Fernandina, 7 miles east of the critical habitat off the St Mays Entrance; to 80□57' W off Jacksonville 7 miles east of the eastern approach to the St Johns River; and extending five miles south of the "jog" or the existing southern limit of the "15 miles from the coast extension" of the critical habitat (at 30□15'N) to 30□10'N.

In order to determine the time delays imposed by any routing and/or speed limits, we spoke to the Brunswick Bar, Cumberland Sound and St. Johns Bar pilots association to understand vessel approaches, pilot boarding points and vessel speed (8-10 knots) for boarding pilots. We also reviewed an extract of data from the mandatory ship reporting system and found average speed (15.9 knots) and median speed (16.5) and the range of speeds (7-22.8 knots) for vessels entering the MSR area. The MSR area is bounded to the east at 81□51.6'W.

We then laid track lines to the pilot boarding points for a NE, E and SE approach to each port. We defined a "maximum" delay using Jacksonville as an example. The worst case was the imposition of a single eastern approach to minimize travel distance in the critical habitat (and taking into account fish havens) and a seasonal speed restriction of 10 knots (so as not to endanger the vessel) to the pilot boarding point. We assumed the vessel would ordinarily travel at 20 knots right to the pilot boarding point (note that the average and median speed is about 16 knots, and that vessels take a mile or so to slow their speed). The maximum delay time is about an hour for an inbound vessel.

Lead authors note: I forward the recommendation on mandatory routes with reservations. The risk reduction from minimizing travel distances may be minimal, as transit distance through historic right whale habitat is relatively small. Current port approaches cross; that is the approaches to Fernandina cross the approaches to Brusnwick and Jacksonville. After studying the channel alignments, location of deep water and the area need to establish mandatory routes in accordance with the General Provisions for Ship Routing may raise navigation safety concerns.

Appendix IV
Research, Studies and Projects

Detailed discussions

Regional risk assessments. Risk assessments off the Florida and Southern Georgia coast, in the Great South Channel and north of Cape Cod, Massachusetts will be used to determine the probability of interactions between whales and ships for each area by whale behavior, season, and shipping traffic characteristics and to determine how many vessel miles can be removed from the high density whale areas by routing ships into and out of whale areas using the shortest route possible, or routes in general. Navigation safety, port access concerns and competition with other ocean users (e.g. fisherman) must be assessed as part of or in support of each assessment. If for example, a risk assessment finds that a particular route would reduce risk, the Coast Guard would be required to conduct a port access route study, in order to ensure safe access routes for the movement of vessels...navigation safety is the primary concern in these studies. This is partially funded by the Northeast Consortium.

Assess temporal and spatial extent of mid Atlantic migratory corridor. Analyze existing data and survey data from targeted surveys and other surveillance techniques to determine statistical probabilities of occurrence (time and location) of right whales during migrations off port approaches from Block Island, RI to Savannah, GA. Survey effort and photo-id data from the mid Atlantic are sparse; however, animals are often sighted within the same year in the southeast in the winter/early spring and in Cape Cod Bay or Great South Channel in the spring. By looking at these two data endpoints and factoring in speed of travel long the coast and distances to major port entrances, it will be possible to assess the time frame that the majority of these animals would be passing by the major port entrances along the mid Atlantic and to see how much this time frame could vary on an annual basis. An assessment of available survey effort, satellite tagging data, and photo id records from the mid Atlantic should also be made to determine whether the geographic extent of this migratory corridor can be well defined.

Economic impact analysis. Conduct more detailed treatments of port-specific economic effects by enhancing and providing more accurate data into a model currently under development. An ongoing project is examining economic impacts of risk reduction strategies on the regulated industries. These economic impacts may ultimately extend down the supply chain to consumers. It is therefore important for regulators and others to understand the complexity of the shipping industry and to consider the potential economic impact before implementing management options. For example, many shipping companies are foreign owned, port authorities have limited management control over vessel and waterfront activities (except those managed directly by the port authority), management practices and labor contracts put pressure on schedules and on masters that have ripple effects. The effects may translate across transportation modes, may affect the entire East Coast and may extend to inland distributors and manufacturers. The shipping industry and associated inter-modal transportation (truck, rail and pipeline) could incur additional costs due to the management measures under consideration. This

is particularly important to address, as long-term viability of some ports may be further threatened if there is a perception of higher transaction costs and /or real significant costs to trade at one port over another competitor port. This was partially funded by NMFS.

Integrate all available information into a management system
Continue and expand the ongoing development of an effective information management system using GIS. Survey data, ship routing data, data from the right whale catalogue on individual whales, for example scarring and lesions, could be used to monitor the health of the population and the effectiveness of management measures designed to reduce human impacts on whales. Maps, graphs, and tables generated from these management systems must be backed up by proper analysis of the data

Merchant mariner education

Continue, enhance and accelerate the development of a program and outreach strategy to assist mariners, worldwide, in voyage planning, qualifications and licensing programs, and in their shipboard safety management planning. The focus should be on understanding: existing and new regulations on right whale protection; the seasonal occurrence of right whales on their routes; and prudent measures to avoid high-risk areas or other means (e.g. speed reduction) to reduce their risk of collision.

Develop a right whale ship strike curriculum module for mariners in training (i.e., service and maritime academies, pilots programs), continuing education, and licensing upgrades.

Right whale detection research/monitoring. At present, right whale detection relies heavily upon visual sightings. Whales can only be seen when they are at the surface during daylight hours, detecting them is highly dependant on weather conditions. Aerial surveys are currently an important method for detecting the presence of right whales in many circumstances, but there are additional ways of monitoring for right whales that are presently under consideration and require further development. The information gaps on right whale distribution are particularly acute in certain regions where ship strikes are concentrated. In addition, in certain port areas, there is very little or no data on right whale occurrence, distribution and movements (e.g. the Mid Atlantic). This is a priority for future research effort.

Detection will likely require an integrated surveillance system with a combination of aerial surveys, acoustic detection, and predictive modeling**.** Elements of an integrated surveillance system will rely on real-time information on the known or predicted location of right whales through a surveillance and predictive modeling program. Such a system may include aerial surveillance, vessel platform observations, acoustic detection arrays, GIS (historical data) and predictive modeling. Passive acoustic methods may contribute to a surveillance system. Like most marine mammals, right whales are difficult to see, and they cannot be seen at all at night or in fog. Some of the regions from which information on right whale distributions are critical are particularly difficult areas to detect right whales visually. The Great South Channel (GSC) for example, is some 50 miles offshore and right whales are found here in the spring when the weather is poor, fog is frequent and days are short. Currently, although aerial surveys are flown over the

GSC, these are expensive and can only provide intermittent coverage. These considerations have encouraged several research groups to investigate passive acoustic techniques for detecting right whales in such areas. Some of this passive-acoustic research has proceeded on two fronts. Developing an effective detector for right whale vocalizations, and assessing vocalization rates and detection ranges. In addition, simulations to explore the effectiveness of potential acoustic systems are planned. These studies will simulate detection rates and risk reduction given assumptions (and increasingly data) on vocalization rates, source levels, background noise, and right whale and vessel distributions. Due to the low and intermittent vocalization rates in the GSC, it is already clear that it will never be possible to give accurate up to the minute information on the locations of right whales. On the other hand, it may still be possible to provide useful information on a larger temporal and spatial scale. For instance, if whales were heard predominantly in one particular area one day, it is likely that they would still be in the same area the next day and diverting ships away from that area on subsequent days may significantly reduce the probability of a strike. In situations where there are a large number of unknown parameters, a common practice is to develop a simulation, which can be easily (and relatively cheaply) manipulated to study the effects of different detection systems and management strategies on the numbers of vessel strikes. Simulations can also be helpful in prioritizing future data collection effort. For example, developing a better understanding of day to day movements of groups of animals may be as important as improving our knowledge of their vocalization rates and detection ranges. As improved information on right whale behavior becomes available, it can then be fed back into the model to improve its effectiveness. Such a simulation need not necessarily be confined to acoustic monitoring, but could also be used to study relative merits of aerial surveys, and other methods.

Aerial surveillance

Systematic surveys of port approaches: There are major gaps in knowledge of the occurrence of right whales in the mid-Atlantic and northern parts of Southeast U.S. from Block Island Sound to Savannah, GA. Survey data for these areas is virtually absent. Yet, we do know that as many as 90 whales migrate through these areas, crossing major port approaches. Predictive modeling can provide estimates of the occurrence of right whales in the port approaches. The degree of confidence in these estimates, both temporal (e.g. do the whales lead or lag the estimates, are the peak times at port approaches narrowly or broadly defined?) and geographic extent (i.e. how far offshore?), will be problematic for both right whale protection and shipping.

Evaluation of the effectiveness of aerial survey techniques: Work should be conducted to evaluate the effectiveness of aerial survey techniques in providing data on which management actions can be based. Preliminary work has indicated that air surveys are detecting only a low percentage of whales that are in a given survey area. Further studies are needed to determine with statistical confidence if increased effort and or changes in techniques would result in significantly more sightings for an area. Data on detection probabilities could be obtained directly from replicate aerial surveys using similar methods to those used for abundance estimation of other cetacean

species. However, there is a trade-off between flying replicate surveys covering a smaller area and effective surveillance of a larger area. Coincidental with this work, studies of right whale behavior, including blow rates and the proportion of time spent underwater in each unique right whale habitat will affect the probability of detection. Studies of right whale diving behavior to understand the amount of time whales spend at the surface and can be seen during aerial surveys) would also contribute to estimating detection probabilities. Right whale behavior is likely to vary between habitats and according to oceanographic conditions. Data on sightings probabilities are required for various demographic components of population (e.g. mother/calf pairs, vs. single adults, juveniles, etc.) by season and by area. Research to ascertain the time spent underwater and at the surface, over defined time intervals has been conducted, but not in all areas.

Aerial surveys in the Southeast U.S (SEUS): These surveys are flown to detect right whales and alert mariners so that they may avoid or use caution when transiting those areas. Four areas in the SEUS are surveyed at varying effort levels. The Early Warning System (EWS) surveys are flown daily (weather permitting) from 10 nautical miles (nm) north of Brunswick to 10 nm south of Jacksonville from the beaches out approximately 18 nm. Surveys are flown offshore of this area with nearly the same level of effort. Surveys are also flown just north and south of the EWS survey area with somewhat less frequency. Three aerial survey efforts in the SEUS use east-west transects flown three nm apart. The mean sighting distance for EWS surveys flown by New England Aquarium from 1994-2000 was 0.74nm. Over the past 5 years, surveys have revealed right whale distribution patterns. For instance, right whales appear to be found most often in the EWS area and ~5-10 miles just north, south, and east of the EWS area. Existing data should be analyzed to determine where most sightings occur relative to survey effort. Management goals may be better addressed by using transects that are closer together (e.g., 1-1.5 nm apart) and redistributing survey effort to concentrate on areas where most whales are likely to be observed. If the condensed survey area and refined survey methodology (transects closer together) are concentrated around port entrances and include those areas where close encounters between ships and whales have been observed, managers could be relatively confident that they are achieving their management goals for these aerial surveys in the most efficient manner possible.

Passive acoustics: Recent ongoing research on the detection of right whale vocalizations using passive acoustics has demonstrated that this technique has potential for detection of vocalizing right whales in certain offshore areas, at ranges of 10 miles or so. Research into further automation of the detection process and the implementation of a fully automatic, real-time detection system suitable for deployment offshore is underway but with limited. This is potentially an important additional technique for real-time detection of right whales and if implemented on a wide scale, will require investment in

technological developments. This has been partially funded by the Northeast Consortium and the International Fund for Animal Welfare.

Predictive modeling. Continued research into the biological and oceanographic predictors of right whale distribution on suitable scales is needed. These predictors include variables such as sea surface temperature, biological-ocean productivity, and copepod (prey) distribution. This could include for example, the development of quantitative methods to identify and assess samples collected by a small fleet of vessels under contract (e.g. whale watch vessels, charter boats, ferries, ships on dedicated runs, fishing vessels) to identify densities of calanoid copepods, followed up by aerial surveys. Reviews of historical data should be useful in this context.

Satellite tagging. Tagging and long term tracking of right whales could also be used to understand the occurrence of right whales in high-risk areas. However, some analysis needs to be done before considering whether satellite tagging or aerial surveillance will be more effective for this. Existing data from satellite tagging of a few individuals indicates highly variable behaviors. Satellite tagging provides a potentially long time series of data on movement patterns for a single individual but tagged individuals might not go to the areas where risk assessments are being considered or be truly representative of the whales in that area. In contrast, aerial surveillance can be targeted at essential areas and results are less sensitive to individual variation, but observations are limited to a short time period. However, concerns have been raised by several conservation groups and research institutions regarding the threat that these implantable tags pose to the health of the subjects. Before a program of satellite tagging of right whales, the long-term safety of tags should be demonstrated on non-endangered species before issuing further permits for their use on endangered North Atlantic right whales. As well, that the relative merits of satellite tagging over research techniques be evaluated in light of the need to close information gaps for the explicit purpose of reducing ship strikes.

Active sonar detection; evaluation of concept. Several researchers have advertised an unproven technology that *could* detect right whales ahead of ship using active sonar. Port authorities and the shipping industry have embraced the concept as a technologic solution instead of or in addition to other management options. In contrast, acoustic experts have examined the use of active sonar and have dismissed the approach as unworkable. The use of bow-mounted active sonar to detect whales underwater ahead of vessels might enable vessels to detect and avoid whales. However, active sonar detection systems have actually only been tested and proven at short ranges of up to about 50 m, for scientific purposes. Further trials are planned in the hope that future technological developments could improve this range, such that it might improve the ability of some types of vessel to avoid whales. These systems are currently not able to differentiate between species of whale. Concerns have also been raised about the environmental impacts of increasing noise levels in the ocean, particularly disturbance to dolphin and porpoise species that are known to have sensitive hearing in the same sound frequencies. Prior to further discussion on the potential use of this technology in ship strike mitigation, the practical, commercial application of active sonar in the context of ship/whale strike mitigation needs to be realistically presented, including, for example,

realistic time frames for the required technological development and careful consideration of possible environmental impacts. Detection by itself does not mean avoidance. Even if the technology were proven an effective detector for more than a few hundred yards, such a system must demonstrate its effectiveness in assisting the mariner in avoiding as ship strikes.

Right whale behavior in relation to ships. Little is known about how right whales react to approaching vessels, and what characteristics of a vessel sounds enable a whale to hear an approaching vessel and realize that there is a threat of a collision. Models and simulations of right whale motion relative to vessels should be developed, to include components of behavior, ship speed, hydrodynamics of different vessels. The collection of data on near-misses and close approaches between whales and ships is important to determine whale behavior near vessels. The behavior of the ship should also be examined as there is some indication that changes in vessel speed or course may signal to the whale that avoidance actions are necessary.

Mortality. Understanding the size of vessels on the basis of the analysis of propeller cuts (e.g., depth, spacing) may help target vessel operating restrictions.

Appendix V
Comments received on Discussion Drafts and Final Draft