



**NOAA Technical Memorandum NMFS-NE-214**

**Mortality and Serious Injury  
Determinations for Baleen Whale Stocks  
along the United States and Canadian  
Eastern Seaboards, 2004-2008**

**US DEPARTMENT OF COMMERCE  
National Oceanic and Atmospheric Administration  
National Marine Fisheries Service  
Northeast Fisheries Science Center  
Woods Hole, Massachusetts  
March 2010**

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# **Mortality and Serious Injury Determinations for Baleen Whale Stocks along the United States and Canadian Eastern Seaboards, 2004-2008**

Allison H. Glass<sup>1</sup>  
Timothy V.N. Cole<sup>1</sup>  
Mendy Garron<sup>2</sup>

<sup>1</sup>*NOAA National Marine Fisheries Service, NEFSC 166 Water Street, Woods Hole, MA 02543*

<sup>2</sup>*NOAA National Marine Fisheries Service, NERO, 55 Great Republic Dr., Gloucester, MA 01930*

**US DEPARTMENT OF COMMERCE**  
Carlos M. Gutierrez, Secretary  
**National Oceanic and Atmospheric Administration**  
Vice Admiral Conrad C. Lautenbacher, Jr., USN (ret.), Administrator  
**National Marine Fisheries Service**  
James W. Balsiger, Acting Assistant Administrator for Fisheries  
**Northeast Fisheries Science Center**  
Woods Hole, Massachusetts

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## ABSTRACT

The Northeast Fisheries Science Center (NEFSC) has developed criteria to evaluate reports of human-caused injury and mortality to large whales. The criteria minimize the identification of false positive human-caused mortalities and serious injuries and therefore provide a minimum value of human impact to whale stocks. Serious injury is defined as an injury that is likely to lead to death. This report describes determinations made for reports received from 2004 - 2008 involving North Atlantic right (*Eubalaena glacialis*), humpback (*Megaptera novaeangliae*), fin (*Balaenoptera physalus*), sei (*B. borealis*), blue (*B. musculus*), minke (*B. acutorostrata*), and Bryde's (*B. edeni*) whales observed along the eastern seaboard of the United States and adjacent Canadian Maritimes. A total of 539 unique large whale events were verified during the period, including carcasses (both beached and at-sea) and live whales. We confirmed 188 unique entanglement, 57 ship strike, and 330 mortality events. Twenty-four (13%) of the entanglements and 30 (53%) of the ship strikes were fatal. Serious injury was sustained in 18 (10%) of the entanglement events and in 2 (4%) of the confirmed ship strikes. Thirty-three (18%) of the entanglements and six (11%) of the ship strike events did not have adequate documentation to determine if serious injury occurred. Seventy-nine (42%) of the entanglement events and 15 (26%) of the ship strike events were determined to have not caused serious injury or death. Of the 330 confirmed mortalities, 256 (78%) lacked sufficient evidence to determine cause of death. Minke whales had the greatest number of entanglement mortalities (n=11); humpback whales had the highest number of serious injury events resulting from entanglements (n=11); fin whales had the greatest number of ship strike mortalities (n=10); and right whales had the only serious injuries (n=2) from ship strikes. These mortality and serious injury numbers are minimum counts because of poor detection probabilities and inadequate documentation. Thus, the true level of human impact to these stocks is assumed to be greater than that reported here, however the amount greater is unknown.

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# INTRODUCTION

As part of the 1994 amendments to the Marine Mammal Protection Act (MMPA), the NOAA National Marine Fisheries Service (NMFS) is mandated to establish monitoring programs to estimate incidental mortality and serious injury of marine mammals taken during commercial fishing operations. The agency is also charged with developing Take Reduction Plans (TRPs) such that within six months of the implementation of the TRP, commercial takes of strategic stocks of marine mammals are reduced to levels below the Potential Biological Removal (PBR) level of the stocks. The longer-term goal of all the TRPs is to reduce--within 5 years of implementation--commercial takes of marine mammals to insignificant levels approaching zero mortality and serious injury rates, which has been defined as 10% of PBR (69 FR 43338; July 20, 2004).

The most current five years' average rate of human-caused serious injury and mortality is reported for each species in the annual marine mammal stock assessment reports (SAR). This rate when compared to a population's PBR can be used as an index of the success of a recovery plan. The PBR is defined as the maximum number of animals, not including natural mortalities, which may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population (Wade and Angliss 1997). The PBR is the product of the following factors:

1. The minimum population estimate of the stock;
2. One-half the maximum theoretical or estimated net productivity rate of the stock at a small population size; and
3. A recovery factor of between 0.1 and 1.0.

This report presents the protocols and determinations for events involving North Atlantic right (*Eubalaena glacialis*), humpback (*Megaptera novaeangliae*), fin (*Balaenoptera physalus*), sei (*B. borealis*), blue (*B. musculus*), minke (*B. acutorostrata*), and Bryde's (*B. edeni*) whale stocks along the US and Canadian eastern seaboard for the period 2004 - 2008.

## METHODS

Members of the US and Canadian national stranding networks, large whale disentanglement teams, the US and Canadian Coast Guard, and civilians recorded and submitted marine mammal strandings and human-induced interaction reports to either the NMFS Northeast Regional Office (NERO), Southeast Regional Office (SERO), or the Northeast Fisheries Science Center (NEFSC). The Regional Offices obtained all available information for each report (photos, necropsy reports, etc.), which was then reviewed by NEFSC and NERO staff members. Confirmed reports were designated "events," and the species involved was verified, duplicate records identified, and relevant information from each source consolidated into a single record. Information from additional sightings of a previously documented event was added to the existing record. If an identified whale was involved in a second interaction, a new event record was assigned. Subsequent sighting and demographic information for each event were obtained, where available, from local population monitoring studies. NEFSC staff reviewed each mortality event and assigned a cause of death following the confirmation criteria listed below. Each injury event was similarly examined for indications of cause and identified as a serious injury if it was likely to lead to the whale's death. One staff member reviewed all determinations each year to ensure consistency in the application of

determination criteria within and across years. Criteria indicated by an asterisk (\*) in the lists below were applied to the 2007 and 2008 events only. Application of the revised criteria to events prior to 2007 will be completed in a separate document.

### *Confirmation Criteria for Species and Event (listed in order of certainty)*

Species/event was considered confirmed if it met one of the following criteria:

1. Photographs or video allowed identification;
2. Marine mammal expert reported as certain;
3. Report by trained observer or member of the disentanglement network verified via interview by NMFS, disentanglement or stranding network staff; or
4. A fisherman reported a whale entangled in gear or a shipper reported colliding with a whale.

Species/event was considered confirmed in the following less certain cases:

1. Photographs or video allowed probable identification;
2. Marine mammal expert reported as possible;
3. Inexperienced observer's report allowed probable identification; or
4. Inexperienced observer's report verified via interview by NMFS, disentanglement or stranding network staff.

Species/event was considered unconfirmed if:

1. Photographs or video were of insufficient quality to verify;
2. Inexperienced observer report lacked photographs or video and/or detail to confirm;
3. Incomplete examination for identification; or
4. Carcass too decomposed to identify.

### *Human-induced Mortality Determinations*

Events were categorized as entanglement mortalities if one of the following indications were confirmed to be present on a whale carcass:

1. Fishing line constricted any body part, and subdermal hemorrhaging or extensive necrosis was present at point of attachment;
2. Extensive entanglement evident\*;
3. Entanglement prevented feeding\*; or
4. A code 2 (fresh dead) whale was pulled up during fishing operations\*.

Events were categorized as ship strike mortalities if one of the following indications was confirmed to be present on a whale carcass:

1. Large linear lacerations (anywhere on body, as opposed to just dorsally as in Kraus (1990));
2. Large areas of subdermal hemorrhaging, hematoma, or edema;



3. Extensive skeletal fracturing; or
4. A code 2 (fresh dead) carcass was brought in on the bow of a ship.

### *Serious Injury Determinations*

Events were categorized as entanglement serious injuries if one of the following indications was confirmed on a living whale:

1. Fishing line constricted any body part or was likely to become constricting as the whale grew;
2. It was uncertain if the line was constricting, but appendages near the entanglement's point of attachment were discolored and likely compromised;
3. The whale showed a marked decline in appearance following entanglement, including skin discoloration, lesions near the nares, fat loss, or increased cyamid loads;
4. Entanglement prevented feeding\*;
5. Whale was anchored; or
6. Entanglement was extensive\*.

A whale was typically not considered seriously injured if all constricting lines were removed or shed.

Events were categorized as ship-strike serious injuries if, following the appearance of a linear laceration or large gouge, a living whale exhibited a marked decline in appearance, including skin discoloration, lesions near the nares, fat loss, or increased cyamid loads.

No forecasts were made as to how an entanglement or injury might increase the whale's susceptibility to further injury (e.g., from additional entanglements or collisions with vessels).

Large whale events from Newfoundland and Labrador were included for the first time in this year's analysis. Since humpbacks from these regions are known to be from a feeding stocks that are distinct from the Gulf of Maine stock (Palsbøll et al. 2001), humpback events from these regions were not included in tallies. Similarly, because of the presence of other species not found in US waters, only events identified to species and involving transboundary stocks were included in tallies.

## **RESULTS**

A total of 539 unique events occurred during 2004 - 2008, involving both live and dead whales (Table 1). Of these, 188 entanglement events and 57 ship strike events were confirmed. A total of 330 mortalities were documented, of which 24 were verified to be due to entanglement and 30 were due to ship strike. The cause of death could not be identified for 256 (78%) of the mortalities. Serious injury was caused by entanglement in 18 events and by ship strike in 2 events. There were 79 entanglement events which did not result in serious injuries (this includes cases where the animal was freed by a disentanglement team or shed gear on its own), and 33 entanglement events for which the available information was not sufficient to determine if a serious injury had occurred. Fifteen ship strike events occurred which did not result in serious injury, and 6 ship strikes which lacked sufficient evidence to make a determination. Table 2 presents a summary of mortalities attributed to causes other than entanglement or ship strike, confirmed entanglement and ship strike events not resulting in serious injury or mortality, and confirmed events for which insufficient information was available for determination. Annual human-caused mortality and

serious injury rates for 2004 - 2008 are presented for each large whale stock in Table 3. Tables 4 - 8 provide details of each confirmed serious injury or mortality event.

Over the 5 year period, North Atlantic right whales had the highest proportion of entanglements and ship strikes relative to the number of events for a species; of 64 events involving right whales, 24 were confirmed entanglements, and 17 were confirmed ship strikes (Table 1). Of the 21 verified right whale mortalities, 3 were due to entanglements, 8 due to ship strikes, 5 due to natural causes, and 5 were undetermined. Serious injury was documented for one entanglement event and two ship strikes (details in Table 4).

Humpbacks were involved in 204 events, were the most commonly observed entangled whale species, and the most commonly observed dead whale (107 confirmed mortalities; Table 1). Of the 81 confirmed entanglements, 5 resulted in mortality, and 11 in serious injury. Ship strikes were relatively uncommon with only 14 verified events, 8 of which were fatal (Table 5). We assumed all humpback events occurring in or near US and southeast Canadian waters involved the Gulf of Maine stock unless a whale was confirmed to be from another stock. Humpback events from Labrador and Newfoundland were assumed to not involve the Gulf of Maine stock.

Of 55 fin whale events, 14 were confirmed entanglements; 3 of these were fatal, the highest percentage for any of the whale species (21%), and 3 resulted in serious injury. Thirteen ship strike events were documented, and 10 proved fatal (Table 6).

Mortalities accounted for 10 of the 12 sei whale events. Two of these mortalities were attributed to ship strikes. In one additional ship strike event, it could not be determined whether the strike occurred pre or postmortem. There were 3 confirmed entanglement events, 1 of which resulted in mortality and 2 in serious injury (Table 7).

Minke whales were involved in 128 events, of which 55 were confirmed entanglements. Eleven of the entanglement events were fatal, while 1 resulted in serious injury. There were only 2 verified ship strike events, both of which resulted in mortality (Table 8).

Bryde's whales had the lowest number of events--1. The sole mortality was attributed to natural causes.

There were no events involving blue whales.

In 75 of the 539 large whale events during 2004 - 2008, positive species identification was not possible. In 9 of the 75 events, the similarity in body shape and size between fin and sei whales prevented us from distinguishing which of these 2 species were involved. In another 14 events, the whales could only be identified as balaenopteridae based on the presence of ventral pleats. The taxonomic identity of the whales involved in the remaining 52 events could not be assigned with any certainty. Entanglement was confirmed in 11 of these 75 events. Fifty-one of the 75 events involving unidentified whales were confirmed mortalities (see Table 1).

## **DISCUSSION**

The criteria employed in this report evolved from recommendations of serious injury workshops (Andersen et al. 2008; Angliss and DeMaster 1998) and our experience examining large whale reports collected since 1990. The criteria attempt to encompass all event scenarios and minimize the identification of false positive human-caused mortalities and serious injuries. The resulting values provide a minimum value of human impact to whale stocks.

Differentiating causal injuries from preexisting ones or postmortem damage is problematic but can be accomplished through examination of necropsy data or parsimonious evaluation of available evidence. In our determinations, fishing line constrictions were considered circumstantial evidence of premortem entanglement, as these constrictions were likely the result of force applied by

an active animal. Vessel collisions frequently lack external evidence and may not be detected unless a necropsy is conducted; necropsies frequently identified subdermal hemorrhaging or hematomas, indicating that blood was still circulating at the time of injury. Large lacerations were considered an indication of a premortem vessel collision since only whales at depth would be exposed to the propellers of a ship; floating carcasses would be pushed aside by the ship's bow wave (Knowlton et al. 1995).

Assessments of serious injury was guided by regulation 50 *CFR* 229.2, which defines serious injury as "any injury that will likely result in mortality." Evidence of the whale's deteriorating health was used as confirmation of serious injury. A whale's physiological response to tissue damage includes increased secretion of glucocorticoids, which suppresses lymphocytes, and if sustained (because of chronic destruction of tissue by gear or hydrodynamic forces) compromises the ability of an animal to fight other infections. External indications of poor health, including skin discoloration, lesions near the nares, fat loss, or increased cyamid loads, are part of a cascade of immunological disorders. Cases of constricting entanglements invariably follow this sequence. Removal of constricting gear typically reversed the decline in appearance, and disentanglement was generally considered to prevent serious injury. Whales only loosely entangled in line typically did not have external indications of poor health; some whales carried loose wraps for years.

Over the 5 year period, 256 of 330 confirmed mortalities (78%) lacked sufficient evidence to determine cause of death (Table 2). Carcasses floating at sea often cannot be examined sufficiently for either internal or external indications, and they generate false negatives if they are not towed ashore and necropsied. Likewise, insufficient documentation precluded determination in 33 of 188 confirmed entanglement events (18%) and 6 of 57 ship strike events (11%).

Perhaps of greater concern is the number of animals never observed. Humpback whale scar evidence suggests that only 3-10% of entanglements are witnessed and reported (Robbins and Mattila 2000, 2004). Thus, whales may succumb to entanglement before the event can be detected. Negatively buoyant species are less likely to be detected after death, and positively buoyant species, such as North Atlantic right whales, may become negatively buoyant if an injury precludes effective feeding for an extended period (Moore et al. 2004). The numbers in this report therefore represent the minimum values for human-caused serious injury and mortality to large whale stocks along the US eastern seaboard.

## **ACKNOWLEDGMENTS**

We are especially grateful to the US and Canadian East Coast stranding and entanglement networks, whose members searched for and examined whales both live and dead. It is a difficult and dirty job that deserves special recognition. The United States Coast Guard was instrumental in conveying sightings reported by mariners, investigating carcasses at sea, and assisting in disentanglement efforts. We are also grateful to the staff of the Provincetown Center for Coastal Studies (PCCS), New England Aquarium, Whale Center of New England (WCNE), NOAA aerial survey teams, Wildlife Trust, the states of Florida and Georgia, Northeast Fisheries Observer Program, Marine Animal Response Society, Whale Release and Stranding, and many others for providing the sightings that have allowed this work to be conducted. Betty Lentell, Misty Nelson, Liz Pomfret-Wiley, Amy Whittingham Chase, Brenda Rone, and Misty Niemeyer assisted in verifying records. PCCS and WCNE provided sighting histories and demographic information. Members of the Atlantic Scientific Review Group have provided numerous useful comments on the protocols described here. We also thank the anonymous reviewers of earlier drafts of this report.

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**Table 1. Summary of all reported baleen and unidentified whale events along the Gulf of Mexico Coast, US East Coast and adjacent Canadian Maritimes, 2004 -2008.**

Species	Western North Atlantic right whale ( <i>Eubalaena glacialis</i> )	Gulf of Maine humpback whale ( <i>Megaptera novaeangliae</i> )	Western North Atlantic fin whale ( <i>Balaenoptera physalus</i> )	Nova Scotian sei whale ( <i>B. borealis</i> )	Western North Atlantic blue whale ( <i>B. musculus</i> )	Canadian East Coast minke whale ( <i>B. acutorostrata</i> )	Western North Atlantic Bryde's whale ( <i>B. edeni</i> )	Unidentified fin/sei whale	Unidentified balaenopterid <sup>b</sup>	Unidentified whale spp.	TOTALS
Total events <sup>a</sup> (2004, 2005, 2006, 2008, 2008)	<b>64</b> (12, 15, 14, 9, 14)	<b>204</b> (23, 31, 50, 39, 61)	<b>55</b> (11, 11, 14, 13, 6)	<b>12</b> (2, 0, 5, 1, 4)	<b>0</b>	<b>128</b> (27, 23, 25, 29, 24)	<b>1</b> (0, 0, 1, 0, 0)	<b>9</b> (2, 4, 2, 1, 1)	<b>14</b> (6, 4, 1, 3, 0)	<b>52</b> (5, 10, 18, 9, 10)	<b>539</b>
Confirmed entanglement events	<b>24</b> (4, 2, 5, 3, 10)	<b>81</b> (10, 13, 19, 15, 24)	<b>14</b> (4, 0, 2, 6, 2)	<b>3</b> (0, 0, 1, 0, 2)	<b>0</b>	<b>55</b> (11, 7, 8, 12, 17)	<b>0</b>	<b>2</b> (0, 1, 1, 0, 0)	<b>1</b> (1, 0, 0, 0, 0)	<b>8</b> (2, 2, 3, 1, 0)	<b>188</b>
Confirmed ship strike events	<b>17</b> (2, 7, 6, 1, 1)	<b>14</b> (1, 1, 3, 4, 5)	<b>13</b> (2, 7, 0, 3, 1)	<b>3</b> (1, 0, 1, 1, 0)	<b>0</b>	<b>2</b> (1, 1, 0, 0, 0)	<b>0</b>	<b>0</b>	<b>0</b>	<b>8</b> (0, 2, 3, 2, 1)	<b>57</b>
Total confirmed mortalities	<b>21</b> (5, 4, 6, 3, 3)	<b>107</b> (11, 13, 33, 22, 28)	<b>37</b> (8, 9, 7, 8, 5)	<b>10</b> (2, 0, 4, 1, 3)	<b>0</b>	<b>103</b> (27, 19, 18, 20, 19)	<b>1</b> (0, 0, 1, 0, 0)	<b>6</b> (2, 2, 1, 1, 0)	<b>12</b> (5, 4, 1, 2, 0)	<b>33</b> (3, 5, 12, 6, 7)	<b>330</b>
Confirmed entanglement mortalities	<b>3</b> (1, 0, 1, 1, 0)	<b>5</b> (1, 0, 1, 1, 2)	<b>3</b> (1, 0, 0, 2, 0)	<b>1</b> (0, 0, 0, 0, 1)	<b>0</b>	<b>11</b> (4, 1, 1, 1, 4)	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b> (0, 0, 0, 1, 0)	<b>24</b>
Confirmed ship strike mortalities	<b>8</b> (2, 2, 4, 0, 0)	<b>8</b> (1, 0, 3, 3, 1)	<b>10</b> (2, 5, 0, 2, 1)	<b>2</b> (0, 0, 1, 1, 0)	<b>0</b>	<b>2</b> (1, 1, 0, 0, 0)	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>30</b>
Confirmed entanglement serious injuries	<b>1</b> (0, 0, 0, 0, 1)	<b>11</b> (1, 0, 3, 2, 5)	<b>3</b> (1, 0, 1, 1, 0)	<b>2</b> (0, 0, 1, 0, 1)	<b>0</b>	<b>1</b> (0, 0, 0, 1, 0)	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>18</b>
Confirmed ship strike serious injuries	<b>2</b> (0, 1, 1, 0, 0)	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b>

<sup>a</sup> Excludes resights of previously entangled individuals unless a new entanglement was documented.

<sup>b</sup> Described as having throat grooves (rorqual pleats).

**Table 2. Summary of large whale events not resulting in serious injury or mortality and of events lacking sufficient evidence for determination, 2004 -2008.**

Species	Western North Atlantic right whale ( <i>Eubalaena glacialis</i> )	Gulf of Maine humpback whale ( <i>Megaptera novaeangliae</i> )	Western North Atlantic fin whale ( <i>Balaenoptera physalus</i> )	Nova Scotian sei whale ( <i>B. borealis</i> )	Western North Atlantic blue whale ( <i>B. musculus</i> )	Canadian East Coast minke whale ( <i>B. acutorostrata</i> )	Western North Atlantic Bryde's whale ( <i>B. edeni</i> )	Unidentified fin/sei whale	Unidentified balaenopterid	Unidentified whale spp.	TOTALS
Confirmed mortalities, NOT ship strike or entanglement	<b>5</b> 23%	<b>3</b> 3%	<b>4</b> 11%	<b>1</b> 10%	<b>0</b>	<b>6</b> 6%	<b>1</b> 100%	<b>0</b>	<b>0</b>	<b>0</b>	<b>20</b> 6%
Confirmed mortalities, IITD*	<b>5</b> 23%	<b>91</b> 85%	<b>20</b> 54%	<b>6</b> 60%	<b>0</b>	<b>84</b> 82%	<b>0</b>	<b>6</b> 100%	<b>12</b> 100%	<b>32</b> 97%	<b>256</b> 78%
Confirmed entanglement events, NOT serious injury/mortality* *	<b>18</b> 75%	<b>43</b> 53%	<b>4</b> 29%	<b>0</b>	<b>0</b>	<b>13</b> 24%	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b> 13%	<b>79</b> 42%
Confirmed entanglement events, IITD*	<b>2</b> 8%	<b>13</b> 16%	<b>3</b> 21%	<b>0</b>	<b>0</b>	<b>10</b> 18%	<b>0</b>	<b>2</b> 100%	<b>1</b> 100%	<b>2</b> 25%	<b>33</b> 18%
Confirmed ship strike events, NOT serious injury/mortality	<b>5</b> 29%	<b>6</b> 43%	<b>2</b> 15%	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>2</b> 25%	<b>15</b> 26%
Confirmed ship strike events, IITD*	<b>1</b> 6%	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>5</b> 63%	<b>6</b> 11%

\* IITD = insufficient information to determine cause of death or if the injury likely to lead to mortality.

\*\* Includes cases where animal was disentangled or shed gear.

**Table 3. Summary of the confirmed human-caused mortality and serious injury (SI) events involving baleen whale stocks along the Gulf of Mexico Coast, US East Coast, and adjacent Canadian Maritimes, 2004 - 2008, with number of events attributed to entanglements or vessel collisions by year.**

Stock	Mean annual mortality and SI rate (PBR <sup>1</sup> for reference)	Entanglements			Vessel Collisions		
		Annual rate (US waters / Canadian waters)	Confirmed mortalities (2004, 2005, 2006, 2007, 2008)	Confirmed SIs (2004, 2005, 2006, 2007, 2008)	Annual rate (US waters / Canadian waters)	Confirmed mortalities (2004, 2005, 2006, 2007, 2008)	Confirmed SIs (2004, 2005, 2006, 2007, 2008)
Western North Atlantic right whale ( <i>Eubalaena glacialis</i> )	<b>2.8</b> (0.7)	<b>0.8</b> (0.6 / 0.2)	(1, 0, 1, 1, 0)	(0, 0, 0, 0, 1)	<b>2.0</b> (1.6 / 0.4)	(2, 2, 4, 0, 0)	(0, 1, 1, 0, 0)
Gulf of Maine humpback whale ( <i>Megaptera novaeangliae</i> )	<b>4.6</b> (1.1)	<b>3.0</b> (2.6 / 0.4)	(1, 0, 1, 1, 2)	(1, 0, 3, 2, 4)	<b>1.6</b> (1.6 / 0)	(1, 0, 3, 3, 1)	<b>0</b>
Western North Atlantic fin whale ( <i>Balaenoptera physalus</i> )	<b>3.2</b> (3.4)	<b>1.2</b> (1.0 / 0.2)	(1, 0, 0, 2, 0)	(1, 0, 1, 1, 0)	<b>2.0</b> (1.4 / 0.6)	(2, 5, 0, 2, 1)	<b>0</b>
Nova Scotian sei whale ( <i>B. borealis</i> )	<b>1.0</b> (0.4)	<b>0.6</b> (0.4 / 0.2)	(0, 0, 0, 0, 1)	(0, 0, 1, 0, 1)	<b>0.4</b> (0.4 / 0)	(0, 0, 1, 1, 0)	<b>0</b>
Western North Atlantic blue whale <sup>2</sup> ( <i>B. musculus</i> )	<b>0</b> (-)	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>
Canadian East Coast minke whale ( <i>B. acutorostrata</i> )	<b>2.8</b> (19)	<b>2.4</b> (1.2 / 1.2)	(4, 1, 1, 1, 4)	(0, 0, 0, 1, 0)	<b>0.4</b> (0.4 / 0)	(1, 1, 0, 0, 0)	<b>0</b>
Western North Atlantic Bryde's whale ( <i>B. edeni</i> )	<b>0</b> (0.1)	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>

<sup>1</sup> Potential Biological Removal (PBR)

<sup>2</sup> Stock abundance estimates outdated; no PBR established for this stock.

**Table 4. Confirmed human-caused mortality and serious injury records of Western North Atlantic right whales (*Eubalaena glacialis*), 2004 - 2008.**

Date <sup>a</sup>	Report Type	Age, Sex, ID, Length	Location <sup>a</sup>	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship Strike	Entanglement/ Fishery interaction	
2/7/2004	mortality	Adult Female #1004 16.0m	Virginia Beach, VA	P		Severe subdermal bruising; complete fracture of rostrum and laceration of oral rete
9/6/2004	mortality	Adult Female #2301 15m (est)	Roseway Basin, NS		P	Extensive constricting line on head and left flipper; found dead March 3, 2005 on Ship Shoal Island, VA; gear recovered consists of 10 fathoms of 3/8" & 7/16" rope
11/24/2004	mortality	Adult Female #1909 14.9m	Ocean Sands, Corolla, NC	P		Left fluke lobe severed and large bore blood vessels exposed
1/12/2005	mortality	Adult Female #2143 13.1m	Cumberland Island, GA	P		Healed propeller wounds from strike as a calf reopened as a result of pregnancy
3/10/2005	serious injury	Adult <sup>b</sup> Female <sup>b</sup> #2425	Cumberland Island, GA	P		43 ft power yacht partially severed left fluke; resighted 9/4/05 in extremely poor condition
4/28/2005	mortality	Adult Female #2617 14.7m	Monomoy Island, MA	P		Significant bruising and multiple vertebral fractures
1/10/2006	mortality	Calf Male 5.4m w/out fluke	Jacksonville, FL	P		Propeller lacerations associated with hemorrhaging and edema; flukes completely severed
1/22/2006	mortality	Calf Female <sup>b</sup> 5.6m	off Ponte Vedra Beach, FL		P	Significant premortem lesions from entanglement in apparent monofilament netting; no gear present
3/11/2006	serious injury	Yearling Male #3522	Off Cumberland Island, GA	P		11 propeller lacerations across dorsal surface



**Table 4 (continued). Confirmed human-caused mortality and serious injury records of Western North Atlantic right whales (*Eubalaena glacialis*), 2004 - 2008.**

Date <sup>a</sup>	Report Type	Age, Sex, ID, Length	Location <sup>a</sup>	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship Strike	Entanglement/  Fishery interaction	
7/24/2006	mortality	age unknown Female 9.6m	Campobello Island, NB	P		Propeller lacerations through blubber, into muscle and ribs
8/24/2006	mortality	Adult Female 14.7m	Roseway Basin, NS	P		16 fractured vertebrae; dorsal blubber bruise from head to genital region
12/30/2006	mortality	Yearling Male #3508 12.6m	off Brunswick, GA	P		20 propeller lacerations along right side of head and back with associated hemorrhaging
3/31/2007	mortality	Calf Male 7.7m	Outer Banks, NC		P	Edema associated with flipper and dorsal & ventral thoracic musculature; epidermal abrasion indicated entangling body and flipper wraps; no gear recovered
2/3/2008	serious injury	Adult Male #1980	Cape Hatteras, NC		P	Embedded wrap in rostrum; decline in health; no gear recovered
<p>a. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was first reported beached, entangled, or injured.</p> <p>b. Additional information which was not included in previous reports.</p>						

**Table 5. Confirmed human-caused mortality and serious injury records of Gulf of Maine humpback whales (*Megaptera novaeangliae*), 2004 - 2008.**

Date <sup>a</sup>	Report Type	Age, Sex, ID, Length	Location <sup>a</sup>	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entanglement/ Fishery interaction	
7/11/2004	serious injury	Juvenile sex unknown "Lucky"	Brier Island, NS		P	Entanglement on a young whale; no gear recovered
10/3/2004	mortality	age unknown Male 15m (est)	Georges Bank		P	Fresh carcass with entangling line and high flyer; no gear recovered
12/19/2004	mortality	Calf Female 8.0m	Bethany Beach, DE	P		Hematoma and skeletal fracturing
1/9/2006	mortality	Adult Female #8667 14.0m	off Charleston, SC	P		Extensive muscle hemorrhaging; rib fractures; dislocated flipper on left side of animal
3/17/2006	mortality	Juvenile Female 10.0m	Virginia Beach, VA	P		Crushed cranium and fractured mandible; hemorrhaging associated with fractures; ventral lacerations consistent with propeller wounds
3/25/2006	serious injury	Juvenile sex unknown 8m (est)	Flagler Beach, FL		P	Heavy cyamid load; emaciated; spinal deformity that may or may not have been caused by the entanglement; gear recovered included line and buoys and was identified as lobster pot gear
8/6/2006	serious injury	age & sex unknown	Georges Bank		P	Multiple constricting wraps around head; line cutting into upper lip; wraps around both flippers; no gear recovered

**Table 5 (continued). Confirmed human-caused mortality and serious injury records of Gulf of Maine humpback whales (*Megaptera novaeangliae*), 2004 - 2008.**

Date <sup>a</sup>	Report Type	Age, Sex, ID, Length	Location <sup>a</sup>	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entanglement/  Fishery interaction	
8/23/2006	serious injury	age & sex unknown 12m (est)	Great South Channel		P	Flukes necrotic and nearly severed as a result of entanglement; pale skin and emaciated; gear recovered included heavy line and wire trap
09/06/06 <sup>b</sup>	mortality	age & sex unknown	East of Cape Cod, MA		P	Whale entangled through mouth, continuing back to multiple wraps around peduncle; no gear recovered
10/15/2006	mortality	Juvenile Female 10.1m	off Fenwick Island, DE	P	S	Large laceration, penetrating through the bone, across rostrum with accompanying fractures; no gear, but marks around right flipper consistent with entanglement; subdermal hemorrhaging and bone trauma at entanglement point
1/27/2007	serious injury	age & sex unknown	off Beach Haven, NJ		P	Body wrap likely to become constricting; random cyamid patches; thin body condition; probable flipper wraps; no gear recovered
5/10/2007	mortality	Adult Female 12.5m	off Wachapreague, VA	P		Cranium shattered, hemorrhaging on left lateral side midway between flippers & fluke
5/13/2007	mortality	Juvenile Male 9.3m	Rockport, MA	P		Areas of hemorrhaging indicate major blunt trauma to chest, neck, & head
6/23/2007	serious injury	age unknown Male "Egg Toss"	Wildcat Knoll		P	Body wrap of gear imbedded; no gear recovered

**Table 5 (continued). Confirmed human-caused mortality and serious injury records of Gulf of Maine humpback whales (*Megaptera novaeangliae*), 2004 - 2008.**

Date <sup>a</sup>	Report Type	Age, Sex, ID, Length	Location <sup>a</sup>	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entanglement/ Fishery interaction	
6/24/2007	mortality	Juvenile Female "Tofu" 9.9m	Stellwagen Bank	P		Subdermal hemorrhaging involving blubber, fascia, & muscle extending from/around the insertion of the right flipper ventrally to the axilla
12/21/2007	mortality	age unknown Male 9.4m	Ocean Sands, Corolla, NC		P	Documented wrapped in gear, gear removed without permission prior to necropsy; external lesions at flukes, flippers, mouth, dorsal fin, dorsal keel, & ventral pleats consistent with gillnet entanglement; emaciated; no gear recovered
1/6/2008	serious injury	age & sex unknown 10m (est)	off Cape Lookout, NC		P	Constricting line cutting into right flipper in several places; heavy cyamid load; emaciated; no gear recovered
5/30/2008	mortality	age & sex unknown	Georges Bank		P	Constricting body wraps, one wrap under lower jaw; open wound on right flipper; no gear recovered
6/9/2008	mortality	age & sex unknown	Georges Bank		P	Constricting body wrap; gear analysis pending
7/8/2008	serious injury	Adult Female "Estuary"	off Nauset, MA		P	Cuts were made, but no gear was removed; emaciated; moderate cyamid coverage; deep wounds in fluke blades from gear; hunched over position maintained after cuts were made to the gear; gear analysis pending
8/13/2008	serious injury	age & sex unknown 10m (est)	off NJ		P	Partial disentanglement; emaciated; lethargic; heavy cyamid load; gear analysis pending
8/21/2008	serious injury	age & sex unknown	off Chatham, MA		P	Evidence of decline in health; no gear recovered
11/4/2008	mortality	Juvenile Male 10.1m	Assateague Island, MD	P		Cranial fractures with associated hemorrhaging

- a. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was first reported beached, entangled, or injured.
- b. Record was added after review of carcasses sighted on 08/20/06 and 09/06/06. Previous reports stated these were the same animal. Recent review could not confirm the resight, therefore they are now being treated as two separate events. There was inconclusive evidence with regard to the carcass on 08/20/06 to determine mortality caused by entanglement.

**Table 6. Confirmed human-caused mortality and serious injury records of Western North Atlantic fin whales (*Balaenoptera physalus*), 2004 - 2008.**

Date <sup>a</sup>	Report Type	Age, Sex, Length	Location <sup>a</sup>	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entanglement/ Fishery interaction	
2/12/2004	serious injury	age & sex unknown	Pea Island, NC		P	Emaciated; no gear recovered
2/25/2004	mortality	Adult Female 16.3m	Port Elizabeth, NJ	P		Displaced vertebrae; ruptured aorta
6/30/2004	mortality	age & sex unknown 12m (est)	Georges Bank		P	Freshly dead; heavy line constricting midsection; no gear recovered
9/26/2004	mortality	age & sex unknown 15m (est)	Saint John, NB	P		Fresh carcass on bow of ship
3/26/2005	mortality	Adult <sup>b</sup> Female 16.3m	off Virginia Beach, VA	P		Extensive hemorrhaging and vertebral fractures
4/3/2005	mortality	Adult <sup>b</sup> Female 18.8m	Southampton, NY	P		Subdermal hemorrhaging
8/23/2005	mortality	Juvenile <sup>b</sup> Male 13.7m	Port Elizabeth, NJ	P		Fresh carcass on bow of ship; extensive hemorrhaging on right side of body
9/11/2005	mortality	Juvenile <sup>b</sup> Male 11.0m	Bonne-Esperance, QC	P		Bottom jaw completely severed/broken
09/13/05 <sup>c</sup>	mortality	age & sex unknown	Blanc Sablon, NL	P		Lower jaw broken associated with massive areas of bruising

**Table 6 (continued). Confirmed human-caused mortality and serious injury records of Western North Atlantic fin whales (*Balaenoptera physalus*), 2004 - 2008.**

Date <sup>a</sup>	Report Type	Age, Sex, Length	Location <sup>a</sup>	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entanglement/ Fishery interaction	
9/17/2006	serious injury	age & sex unknown 18m (est)	off Mt. Desert Rock, ME		P	Pale skin overall; cyamid load at point of attachment; emaciated; no gear recovered
3/25/2007	mortality	age unknown Female 18.0m	Norfolk, VA	P		Extensive fracturing of ribs, skull, and vertebrae w/ associated hemorrhage & edema
5/24/2007	mortality	age unknown Male	Newark Bay, NJ	P		Hemorrhage (epaxial muscle, diaphragm, pleural lining) and multiple fractures of the ribs, vertebrae, & sternum and the trailing tissue of the animal was marked by propeller cuts
6/25/2007	serious injury	age & sex unknown	Great South Channel		P	Wrap on tail assoc w/ cyamid load; flippers & mouth involved; extremely emaciated; lethargic; no gear recovered
8/11/2007	mortality	age & sex unknown	Cabot Strait, NS		P	Constricting wrap around body, between the head and flippers; no gear recovered
9/26/2007	mortality	Juvenile Male 13m (est)	off Martha's Vineyard, MA		P	Freshly dead, scavenged carcass with gear present; evidence of multiple body wraps with associated hemorrhaging; no gear recovered
7/2/2008	mortality	age unknown Male 14.8m	Barnegat Inlet, NJ	P		Vertebral fractures with associated hemorrhaging; hemorrhaging around ball joint of right flipper

- a. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was first reported beached, entangled, or injured.
- b. The gender and length were misreported in the 2006 Stock Assessment Report. This table shows the correct values.
- c. Additional record which was not included in previous reports.

**Table 7. Confirmed human-caused mortality and serious injury records of Nova Scotian sei whales (*Balaenoptera borealis*), 2004 - 2008.**

Date <sup>a</sup>	Report Type	Age, Sex, Length	Location <sup>a</sup>	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entanglement/ Fishery interaction	
04/17/06	mortality	Juvenile Male 10.9m	Baltimore, MD	P		Brought in on bow of ship, freshly dead; massive hemorrhaging on right side; large blood clot behind head; several broken ribs
09/16/06	serious injury	age & sex unknown	Jeffreys Ledge		P	Constricting wrap cutting into skin; no gear recovered
05/30/07	mortality	Adult Female 14.4m	off Deer Island, MA	P		Broken left flipper, 8 vertebral processes, and 4 ribs; right flipper sheared off; lower jaw dislocated; hemorrhaging and/or edema associated with lower jaw and left flipper region
04/09/08	serious injury	age & sex unknown	Great South Channel		P	Constricting wrap on fluke; skin sloughing; no gear recovered
06/29/08	mortality	age & sex unknown 15m (est)	Slack's Cove, NB		P	Extensive entanglement evident; no gear present
<p>a. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was first reported beached, entangled, or injured.</p>						

**Table 8. Confirmed human-caused mortality and serious injury records of Canadian East Coast minke whales (*Balaenoptera acutorostrata*), 2004 - 2008.**

Date <sup>a</sup>	Report Type	Age, Sex, Length	Location <sup>a</sup>	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entanglement/ Fishery interaction	
5/6/2004	mortality	Adult <sup>c</sup> Female 7.7m	Martha's Vineyard, MA		P	Unknown fishery; constricting line marks on peduncle; indications of drowning from internal exam; no gear present
6/1/2004	mortality	Juvenile <sup>c</sup> Female 6.5m	Chatham, MA	P		Large area of subdermal hemorrhaging
7/19/2004	mortality	Adult <sup>c</sup> Female 7.9m	Eastham, MA		P	Unknown fishery; extensive entanglement markings; no gear recovered
08/04 <sup>b</sup>	mortality	age & sex unknown 4m (est)	Georges Bank		P	Bottom Otter Trawl; fresh dead, rigid, had to cut out of net, rope in mouth
08/09/04 <sup>b</sup>	mortality	age & sex unknown	Cape Broyle Head, NL		P	Partial disentanglement; fishermen witnessed death of animal in remaining gear; blackback flounder nets
5/23/2005	mortality	Juvenile Male 5.9m	Port Elizabeth, NJ	P		Ribs shattered; liver ruptured; evidence of internal hemorrhaging
08/24/05 <sup>b</sup>	mortality	age & sex unknown	Bridgeport, New World Island, NL		P	Constricting gear through mouth with flipper and tail wraps; toad crab pots
09/22/06 <sup>b</sup>	mortality	age & sex unknown	Woods Cove, Great Northern Peninsula, NL		P	Anchored by tail in doorways of the gear; mackerel trap
7/16/2007	serious injury	age & sex unknown 10m (est)	Trescott, ME		P	Wrapped in gear and anchored; no gear recovered



**Table 8 (continued). Confirmed human-caused mortality and serious injury records of Canadian East Coast minke whales (*Balaenoptera acutorostrata*), 2004 - 2008.**

Date <sup>a</sup>	Report Type	Age, Sex, Length	Location <sup>a</sup>	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entanglement/ Fishery interaction	
8/5/2007	mortality	Juvenile Female 4.3m	Cape Cod Bay, MA		P	Chronic entanglement with severe emaciation and dehydration and loss of protein; line lacerated blubber layer across back and at flipper insertions; severe hemorrhage and necrosis of blubber at gear entanglement points; gear consists of 11/16" diameter floating rope
6/14/2008	mortality	Juvenile Female 4.7m	Orleans, MA		P	Braided line impressions wrapped the body in 3 places and left a deep, hemorrhaged laceration across the rostrum and blowholes; hemorrhaged abrasions present on roof of mouth; wet, blood-filled lungs indicate drowning; no gear present
7/23/2008	mortality	age & sex unknown 7m (est)	Kelligrews, NL		P	Constricting wraps of gear on caudal peduncle; 5/8" polypropylene rope
7/26/2008	mortality	age & sex unknown	Conception Bay, NL		P	Constricting wraps of gear through mouth and around tail; blackback flounder nets
8/25/2008	mortality	age & sex unknown 8m (est)	off Richibucto Cape, NB		P	Evidence of constricting body wraps; gear not recovered

- a. The date sighted and location provided in the table are not necessarily when or where the serious injury or mortality occurred; rather, this information indicates when and where the whale was first reported beached, entangled, or injured.
- b. Additional record which was not included in previous reports.
- c. Additional information which was not included in previous reports.

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**Organization:** Manuscripts must have an abstract, table of contents, and -- if applicable -- lists of tables, figures, and acronyms. As much as possible, use traditional scientific manuscript organization for sections: "Introduction," "Study Area," "Methods & Materials," "Results," "Discussion" and/or "Conclusions," "Acknowledgments," and "References Cited."

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For spelling of scientific and common names of fishes, mollusks, and decapod crustaceans from the United States and Canada, use *Special Publications* No. 29 (fishes), 26 (mollusks), and 17 (decapod crustaceans) of the American Fisheries Society (Bethesda MD). For spelling of scientific and common names of marine mammals, use *Special Publication* No. 4 of the Society for Marine Mammalogy (Lawrence KS). For spelling in general, use the most recent edition of *Webster's Third New International Dictionary of the English Language Unabridged* (Springfield MA: G. & C. Merriam).

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Tables should be prepared with a table formatting function. Each figure should be supplied in digital format (preferably GIF or JPG), unless there is no digital file of a given figure. Except under extraordinary circumstances, color will not be used in illustrations.

### Manuscript Submission

Authors must submit separate digital files of the manuscript text, tables, and figures. The manuscript must have cleared NEFSC's online internal review system. Non-NEFSC authors who are not federal employees will be required to sign a "Release of Copyright" form.

Send all materials and address all correspondence to: Jarita A. Davis (Editor), Editorial Office, NMFS Northeast Fisheries Science Center, 166 Water Street, Woods Hole, MA 02543-1026.

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## **Publications and Reports of the Northeast Fisheries Science Center**

The mission of NOAA's National Marine Fisheries Service (NMFS) is "stewardship of living marine resources for the benefit of the nation through their science-based conservation and management and promotion of the health of their environment." As the research arm of the NMFS's Northeast Region, the Northeast Fisheries Science Center (NEFSC) supports the NMFS mission by "conducting ecosystem-based research and assessments of living marine resources, with a focus on the Northeast Shelf, to promote the recovery and long-term sustainability of these resources and to generate social and economic opportunities and benefits from their use." Results of NEFSC research are largely reported in primary scientific media (*e.g.*, anonymously-peer-reviewed scientific journals). However, to assist itself in providing data, information, and advice to its constituents, the NEFSC occasionally releases its results in its own media. Currently, there are three such media:

*NOAA Technical Memorandum NMFS-NE* -- This series is issued irregularly. The series typically includes: data reports of long-term field or lab studies of important species or habitats; synthesis reports for important species or habitats; annual reports of overall assessment or monitoring programs; manuals describing program-wide surveying or experimental techniques; literature surveys of important species or habitat topics; proceedings and collected papers of scientific meetings; and indexed and/or annotated bibliographies. All issues receive internal scientific review and most issues receive technical and copy editing.

*Northeast Fisheries Science Center Reference Document* -- This series is issued irregularly. The series typically includes: data reports on field and lab studies; progress reports on experiments, monitoring, and assessments; background papers for, collected abstracts of, and/or summary reports of scientific meetings; and simple bibliographies. Issues receive internal scientific review, but no technical or copy editing.

*Resource Survey Report* (formerly *Fishermen's Report*) -- This information report is a quick-turnaround report on the distribution and relative abundance of selected living marine resources as derived from each of the NEFSC's periodic research vessel surveys of the Northeast's continental shelf. There is no scientific review, nor any technical or copy editing, of this report.

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