



Northeast Fisheries Science Center Reference Document 08-04

**Mortality and Serious Injury Determinations  
for Baleen Whale Stocks  
along the United States Eastern Seaboard  
and Adjacent Canadian Maritimes,  
2002-2006**

by Allison H. Glass, Timothy V.N. Cole, Mendy Garron,  
Richard L. Merrick, and Richard M. Pace III

February 2008

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**U.S. DEPARTMENT OF COMMERCE**  
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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. Serious injury is defined as an injury that is likely to lead to death. 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. This report describes determinations made for reports received during 2002 through 2006 involving right, humpback, fin, sei, blue, minke, and Brydes whales along the eastern seaboard of the United States and adjacent Canadian Maritimes. A total of 469 unique large whale events were reported during the period, including carcasses (both beached and at sea) and live whales sighted at sea. We received 160 entanglement reports and 43 reports of ship strikes. We were able to confirm 145 unique entanglement, 43 ship strike, and 314 mortality events. Twenty-one (14%) of the entanglements and 27 (63%) of the ship strikes were fatal. Serious injury was sustained in 16 (11%) of the entanglement events and in 2 (5%) of the confirmed ship strikes. Twenty-three (16%) of the entanglements and 3 (7%) of the ship strike events did not have adequate documentation to determine if serious injury occurred. Seventy-eight (54%) of the entanglement events and 9 (21%) of the ship strike events were determined to have not caused serious injury or death. Of the confirmed mortalities, 249 (79%) lacked sufficient evidence to determine cause of death. Minke whales had the greatest number of entanglement mortalities (n=9); humpback whales had the highest number of serious injury events resulting from entanglements (n=9); and right whales had the greatest number of ship strike mortalities (n=10) and serious injuries (n=2) from ship strikes. Poor detection probabilities and inadequate documentation have likely reduced these tallies significantly. The true level of human impact to these stocks is unknown.

## INTRODUCTION

As part of the 1994 amendments to the Marine Mammal Protection Act (MMPA), the NOAA National Marine Fisheries Service (NMFS) was mandated to establish monitoring programs to obtain statistically reliable estimates of incidental mortality and serious injury of marine mammals taken during commercial fishing operations. The Agency was also charged with developing Take Reduction Plans (TRPs) to reduce commercial takes of strategic stocks of marine mammals below the Potential Biological Removal (PBR) levels specified in the TRPs within six months after plan implementation. 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.

In April 1997, NMFS convened a Serious Injury Workshop to develop a consistent set of guidelines for determining what constitutes a serious injury (Angliss and DeMaster 1998). Although the workshop produced a set of recommendations, implementation of a national serious injury standard has not yet occurred.

Nonetheless, NOAA Fisheries staff and Scientific Review Group (SRG) members decided to take account of serious injuries in the annual marine mammal stock assessment reports (SAR). Subsequently, the Northeast Fisheries Science Center (NEFSC) implemented the Workshop's large cetacean recommendations and since 1996 has annually determined serious injury and mortality of large whale stocks in Northwest Atlantic Ocean (Cole et al. 2006; Nelson et al. 2007).

The most current five years' average rate of human-caused serious injury and mortality is reported for each species in the annual stock assessment report. This rate can be used as an index of the success of a recovery plan when compared to a population's potential biological removal level (PBR). The PBR is the maximum number of animals, not including natural mortalities, that 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 between 0.1 and 1.0.

This report presents the protocols and determinations for events involving right (*Eubalaena glacialis*), humpback (*Megaptera novaeangliae*), fin (*Balaenoptera physalus*), sei (*Balaenoptera borealis*), blue (*Balaenoptera musculus*), minke (*Balaenoptera acutorostrata*), and Brydes (*Balaenoptera edeni*) whale stocks along the U.S. eastern seaboard for the period 2002–2006.

## METHODS

Marine mammal strandings and human-induced interaction events were recorded and submitted to the NMFS Northeast Regional Office (NERO) and Southeast Regional Office (SERO) by members of the National Stranding Network, large whale disentanglement teams, the U.S. Coast Guard, and civilian sources. The Regional Offices identified and obtained all available information for each event (photos, necropsy reports, etc.) and placed these in a central folder for each event. Case files were also compiled for all individually identified whales with injuries. Several NEFSC and NERO staff members were involved in reviewing event records, confirming each event's

occurrence and the species involved, identifying duplicate records, and consolidating unique information from each source into a single record for each event. Information from additional sightings of a previously documented event was added to the original event record. If an identified whale was involved in a second interaction, a new event record was assigned. The NEFSC staff then 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 (TVC) reviewed all determinations each year to ensure consistency in the application of determination criteria within and across years.

### **Event and Species Confirmation Criteria**

Events and the species involved were considered confirmed if they met one of the following criteria:

1. the event was observed by a trained marine mammal observer who was certain of the species or event;
2. the event was observed by a trained member of the Disentanglement Network and the species or event was verified via interview by NMFS, disentanglement or stranding network staff;
3. the report was accompanied by photographs or videotape of sufficient quality to verify the species or event;
4. a fisherman reported a whale entangled in his/her gear or a shipper reported colliding with a whale; or
5. gear was retrieved from a whale.

Events and the species involved were considered confirmed in the following less certain cases:

1. the observer was a trained marine mammal observer and was fairly certain, but not positive, of the species or event;
2. the observer was inexperienced, but was interviewed by trained staff and the account was descriptive enough that the species or event was probable but not certain; or
3. the report was accompanied by poorer quality photographs or video, and staff reviewing this material assessed the event as probable but not certain.

Events or the species involved were considered unconfirmed if:

1. the observer was inexperienced and no photographs or video were taken, and the observer's account did not provide sufficient detail to identify the species or event occurrence;
2. the observer was experienced, but did not see the whale long enough or in good enough conditions to state the species or event as being probable;
3. the event was photographed or video taped, but staff reviewing the images could not identify species or the event's occurrence; or
4. a carcass was too decomposed to identify species or to show any indication of human interaction.

### **Human-Induced Mortality Determinations**

Events were categorized as entanglement mortalities if both of the following indications were confirmed to be present during gross inspection or necropsy of the carcass:

1. fishing line constricted any body part; and
2. subdermal hemorrhaging or extensive necrosis was present at point of attachment.

Events were categorized as ship strike mortalities if one of the following indications was confirmed to be present on a 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. gear was ingested; or
5. whale was anchored.

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.

Injuries that impaired the whale's locomotion or feeding were not considered serious injuries unless they were likely to be fatal in the foreseeable future. No forecasts were made as to how an entanglement or injury might increase the whale's susceptibility to further injury (e.g., from additional entanglement or collisions with vessels).

## **RESULTS**

A total of 469 events was reported during 2002 - 2006, involving both live and dead whales (Table 1). There were 160 reports of entanglement and 43 of ship strike. From these, we confirmed 145 entanglement events and 43 ship strike events. We were able to verify 314 mortalities, and determine that 21 mortalities were due to entanglements and 27 mortalities were the result of ship strikes. Entanglement was determined to have caused serious injury in 16 events, and 2 serious injury events were determined to have resulted from ship strike. 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. The cause of death could not be established for 249 (79%) of the verified mortalities. There were 78 entanglement events which did not result in serious injury (this includes cases where the animal was disentangled or shed gear), and

23 which lacked sufficient evidence to determine if serious injury had occurred. Nine ship strike events occurred which did not result in serious injury, and three events lacked sufficient evidence to make a determination. Annual human-caused mortality and serious injury rates for 2002 - 2006 are presented for each large whale stock in Table 3. Tables 4 to 9 provide details of each confirmed serious injury or mortality record.

Over the five-year period, right whales had the highest proportion of entanglements and ship strikes relative to the number of reports for a species: of 54 reports involving right whales, 25 were confirmed entanglements and 16 were confirmed ship strikes (Table 1). There were 21 verified right whale mortalities, three due to entanglements, and ten due to ship strikes. Serious injury was documented for four entanglement events and two ship strikes involving right whales (details in Table 4).

Humpbacks were involved in 181 reported events (Table 1). Of these, 77 of the 86 reported entanglements could be confirmed, as could 9 of the 10 reported ship strikes. Humpbacks were the most commonly observed entangled whale species and the most commonly observed dead whale (101 confirmed mortalities). Entanglements accounted for six mortalities and nine serious injuries. Ship strikes were relatively uncommon, with only nine confirmed events, seven of which were fatal.

Details are provided in Table 5. Contrary to previous determination reports, here we assumed all humpback events involved members of the Gulf of Maine stock unless a whale was confirmed to be from another stock. At the time of this writing, there was no available information to indicate an event did not involve a Gulf of Maine animal (see Table 3).

Fin whales had a low proportion of entanglements. Of 51 reported events, eight were entanglements (all confirmed); two of these were fatal and two resulted in serious injury. Nine ship strikes were reported, eight of which were confirmed, and six proved fatal. Details are provided in Table 6.

Only eight events were reported for sei whales. There was one report of entanglement, which was confirmed and resulted in serious injury. The remaining seven events were confirmed mortalities. Two of the mortalities were determined to have resulted from ship strikes (see Table 7).

Minke whales were involved in 98 reported events. Entanglements accounted for 31 of these reports, but only 27 could be confirmed (Table 1). Nine of the confirmed entanglement events were fatal, the highest percentage for any of the whale species. There were only two confirmed ship strike events, both of which resulted in mortality (Table 8).

Blue and Brydes whales had the lowest number of reporting events for all species. Blue whales appeared in only one reported event which was a confirmed entanglement in the St. Lawrence River, Canada. There was not sufficient information available to confirm if a serious injury occurred. Of the two reported events for Brydes whales, one was a confirmed entanglement which resulted in the death of the whale (See Table 9).

In 74 of the 469 large whale events reported during 2002 - 2006, positive species identification was not possible (Table 1). In nine events, the similarity in body shape and size between fin and sei whales prevented us from distinguishing which of these two species were involved. In another 15 events, the whales could only be identified as balaenopterids based on the presence of ventral pleats.

The taxonomic identity of the whales involved in the remaining 50 events could not be assigned with any certainty. Entanglement was reported in seven of these cases, five of which were considered confirmed. Sixty of the 74 reported events involving unidentified whales were confirmed mortalities.

## DISCUSSION

Differentiating causal injuries from pre-existing ones or post-mortem damage is problematic, but can be accomplished through examination of necropsy data. In our determinations, fishing line constrictions were considered circumstantial evidence of pre-mortem 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 pre-mortem 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).

Events involving constricting entanglements with evidence of the whale's deteriorating health were considered confirmed serious injuries. A whale's physiological response to tissue damage includes increased secretion of glucocorticoids, which suppresses lymphocytes, and if sustained (due to chronic destruction of tissue by gear) 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. Removal of constricting gear 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.

We recently were made aware of an additional concern for entanglements involving the mouth. Large whales likely require a hydrostatic oral seal to create negative pressure inside the mouth, keeping the mouth closed by suction. If an entanglement fouls the baleen and trails out of the mouth, or results in tissue damage that deforms the lips, this seal could be rendered ineffective, resulting in a substantial energetic drain as the whale is forced to hold the mouth closed muscularly. Unless the gear is removed, or the injury heals enough to allow formation of the oral seal, such entanglements are likely to be lethal (Lambertsen *et al.* 2005).

Over the five-year period, 249 of 314 confirmed mortalities (79%) 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 generate false negatives if they are not towed ashore and necropsied. Likewise, insufficient documentation precluded determination in 23 of 145 confirmed entanglement events (16%) and 3 of 43 ship strike events (7%).

However, our greatest concern remains 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 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 U.S. eastern seaboard.

## ACKNOWLEDGMENTS

We are especially grateful to the East Coast stranding and entanglement networks, whose members searched for and examined whales both live and dead. It is a difficult and smelly 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 and New England Aquarium, NOAA aerial survey teams, Wildlife Trust, the States of Florida/Georgia and many others for providing the sightings that have allowed this work to be conducted. Liz Pomfret-Wiley, Amy Whittingham Chase, Brenda Rone and Misty Niemeyer verified records. 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, 2002-2006

Species	Western North Atlantic right whale	Northwest Atlantic humpback whale <sup>b</sup>	Western North Atlantic fin whale	Nova Scotian sei whale	Western North Atlantic blue whale	Canadian East Coast minke whale	Western North Atlantic Brydes whale	Unidentified fin/sei whale	Unidentified balaenopterid <sup>c</sup>	Unidentified whale spp.	TOTALS
Total reports <sup>a</sup> (2002, 2003, 2004, 2005, 2006)	<b>54</b> (12, 8, 8, 13, 13)	<b>181</b> (35, 50, 20, 27, 49)	<b>51</b> (5, 13, 10, 9, 14)	<b>8</b> (1, 1, 2, 0, 4)	<b>1</b> (1, 0, 0, 0, 0)	<b>98</b> (14, 25, 22, 15, 22)	<b>2</b> (0, 1, 0, 0, 1)	<b>9</b> (0, 3, 2, 3, 1)	<b>15</b> (2, 7, 2, 3, 1)	<b>50</b> (4, 19, 3, 8, 16)	<b>469</b>
Total entanglement reports <sup>a</sup>	<b>25</b> (8, 6, 3, 4, 4)	<b>86</b> (21, 21, 11, 14, 19)	<b>8</b> (1, 1, 4, 0, 2)	<b>1</b> (0, 0, 0, 0, 1)	<b>1</b> (1, 0, 0, 0, 0)	<b>31</b> (5, 11, 8, 1, 6)	<b>1</b> (0, 1, 0, 0, 0)	<b>1</b> (0, 0, 0, 1, 0)	<b>1</b> (0, 0, 1, 0, 0)	<b>5</b> (0, 0, 1, 3, 1)	<b>160</b>
Total ship strike reports	<b>16</b> (3, 2, 3, 5, 3)	<b>10</b> (4, 3, 1, 2, 0)	<b>9</b> (0, 4, 3, 2, 0)	<b>3</b> (0, 1, 1, 0, 1)	<b>0</b>	<b>1</b> (0, 0, 1, 0, 0)	<b>0</b>	<b>0</b>	<b>0</b>	<b>4</b> (0, 0, 0, 1, 3)	<b>43</b>
Confirmed entanglement events	<b>25</b> (8, 6, 4, 2, 5)	<b>77</b> (18, 19, 10, 13, 17)	<b>8</b> (1, 1, 4, 0, 2)	<b>1</b> (0, 0, 0, 0, 1)	<b>1</b> (1, 0, 0, 0, 0)	<b>27</b> (4, 9, 6, 2, 6)	<b>1</b> (0, 1, 0, 0, 0)	<b>1</b> (0, 0, 0, 1, 0)	<b>1</b> (0, 0, 1, 0, 0)	<b>3</b> (0, 0, 1, 1, 1)	<b>145</b>
Confirmed ship strike events	<b>17</b> (1, 2, 2, 7, 5)	<b>9</b> (3, 2, 1, 1, 2)	<b>8</b> (0, 0, 2, 6, 0)	<b>3</b> (0, 1, 1, 0, 1)	<b>0</b>	<b>2</b> (0, 0, 1, 1, 0)	<b>0</b>	<b>0</b>	<b>0</b>	<b>4</b> (0, 0, 0, 1, 3)	<b>43</b>
Total confirmed mortalities	<b>21</b> (5, 1, 5, 4, 6)	<b>101</b> (18, 29, 11, 11, 32)	<b>38</b> (5, 11, 7, 8, 7)	<b>7</b> (1, 1, 2, 0, 3)	<b>0</b>	<b>85</b> (12, 23, 20, 15, 15)	<b>2</b> (0, 1, 0, 0, 1)	<b>8</b> (0, 3, 2, 2, 1)	<b>14</b> (2, 7, 1, 3, 1)	<b>38</b> (4, 18, 2, 4, 10)	<b>314</b>
Confirmed entanglement mortalities	<b>3</b> (1, 0, 1, 0, 1)	<b>6</b> (3, 1, 1, 0, 1)	<b>2</b> (1, 0, 1, 0, 0)	<b>0</b>	<b>0</b>	<b>9</b> (2, 5, 2, 0, 0)	<b>1</b> (0, 1, 0, 0, 0)	<b>0</b>	<b>0</b>	<b>0</b>	<b>21</b>
Confirmed ship strike mortalities	<b>10</b> (1, 1, 2, 2, 4)	<b>7</b> (2, 1, 1, 0, 3)	<b>6</b> (0, 0, 2, 4, 0)	<b>2</b> (0, 1, 0, 0, 1)	<b>0</b>	<b>2</b> (0, 0, 1, 1, 0)	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>27</b>
Confirmed entanglement serious injuries	<b>4</b> (2, 1, 0, 0, 1)	<b>9</b> (1, 4, 1, 0, 3)	<b>2</b> (0, 0, 1, 0, 1)	<b>1</b> (0, 0, 0, 0, 1)	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>16</b>
Confirmed ship strike serious injuries	<b>2</b> (0, 0, 0, 1, 1)	<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>

a. Excludes resightings of previously entangled individuals unless a new entanglement was documented.

b. Includes all humpback reports, whether confirmed as members of the Gulf of Maine feeding stock or not.

c. Described as having throat grooves (rorqual pleats).

Table 2. Summary of large whale events not resulting in serious injury or mortality, and events lacking sufficient evidence for determination, 2002 -2006

Species	Western North Atlantic right whale	Northwest Atlantic humpback whale	Western North Atlantic fin whale	Nova Scotian sei whale	Western North Atlantic blue whale	Canadian East Coast minke whale	Western North Atlantic Brydes whale	Unidentified fin/sei whale	Unidentified balaenopterid	Unidentified whale spp.	TOTALS
Confirmed mortalities, NOT SS or EN	<b>1</b> 5%	<b>4</b> 4%	<b>3</b> 8%	<b>2</b> 29%	<b>0</b>	<b>6</b> 7%	<b>1</b> 50%	<b>0</b>	<b>0</b>	<b>0</b>	<b>17</b> 5%
Confirmed mortalities, IIFD*	<b>7</b> 33%	<b>84</b> 83%	<b>27</b> 71%	<b>3</b> 43%	<b>0</b>	<b>68</b> 80%	<b>0</b>	<b>8</b> 100%	<b>14</b> 100%	<b>38</b> 100%	<b>249</b> 79%
Confirmed entanglement events, NOT SI/MT**	<b>15</b> 60%	<b>49</b> 64%	<b>3</b> 38%	<b>0</b>	<b>0</b>	<b>11</b> 41%	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>78</b> 54%
Confirmed entanglement events, IIFD*	<b>3</b> 12%	<b>11</b> 14%	<b>2</b> 25%	<b>0</b>	<b>1</b> 100%	<b>1</b> 4%	<b>0</b>	<b>1</b> 100%	<b>1</b> 100%	<b>3</b> 100%	<b>23</b> 16%
Confirmed ship strike events, NOT SI/MT	<b>4</b> 25%	<b>3</b> 33%	<b>1</b> 13%	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1</b> 25%	<b>9</b> 21%
Confirmed ship strike events, IIFD*	<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>2</b> 50%	<b>3</b> 7%

\* IIFD = insufficient information for determination.

\*\* 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, 2002-2006, with number of events attributed to entanglements or vessel collisions by year

Stock	Mean annual mortality and SI rate (and PBR)	Entanglements			Vessel Collisions		
		Annual rate (US waters / Canadian waters)	Confirmed mortalities (2002, 2003, 2004, 2005, 2006)	Confirmed SI's (2002, 2003, 2004, 2005, 2006)	Annual rate (US waters / Canadian waters)	Confirmed mortalities (2002, 2003, 2004, 2005, 2006)	Confirmed SI's (2002, 2003, 2004, 2005, 2006)
Western North Atlantic right whale	<b>3.8</b> (0)	<b>1.4</b> (0.6 / 0.8)	<b>3</b> (1, 0, 1, 0, 1)	<b>4</b> (2, 1, 0, 0, 1)	<b>2.4</b> (1.8 / 0.6)	<b>10</b> (1, 1, 2, 2, 4)	<b>2</b> (0, 0, 0, 1, 1)
Gulf of Maine humpback whale <sup>1</sup>	<b>4.4</b> (1.1)	<b>3.0</b> (2.6 / 0.4)	<b>6</b> (3, 1, 1, 0, 1)	<b>9</b> (1, 4, 1, 0, 3)	<b>1.4</b> (1.4 / 0)	<b>7</b> (2, 1, 1, 0, 3)	<b>0</b>
Western North Atlantic fin whale	<b>2.0</b> (4.0)	<b>0.8</b> (0.8 / 0)	<b>2</b> (1, 0, 1, 0, 0)	<b>2</b> (0, 0, 1, 0, 1)	<b>1.2</b> (0.8 / 0.4)	<b>6</b> (0, 0, 2, 4, 0)	<b>0</b>
Nova Scotian sei whale	<b>0.6</b> (0.3)	<b>0.2</b> (0.2 / 0)	<b>0</b>	<b>1</b> (0, 0, 0, 0, 1)	<b>0.4</b> (0.4 / 0)	<b>2</b> (0, 1, 0, 0, 1)	<b>0</b>
Western North Atlantic blue whale <sup>2</sup>	<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	<b>2.2</b> (9.2)	<b>1.8</b> (1.8 / 0)	<b>9</b> (2, 5, 2, 0, 0)	<b>0</b>	<b>0.4</b> (0.4 / 0)	<b>2</b> (0, 0, 1, 1, 0)	<b>0</b>
Western North Atlantic Brydes whale	<b>0.2</b> (0.3)	<b>0.2</b> (0.2 / 0)	<b>1</b> (0, 1, 0, 0, 0)	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>

1. Excludes events involving confirmed members of a stock other than the Gulf of Maine feeding stock.

2. 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, 2002-2006

Date <sup>a</sup>	Report Type <sup>b</sup>	Age, Sex, ID, Length	Location <sup>a</sup>	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entang./ Fsh inter	
7/6/02	mortality	Yearling Female #3107 11m	Observed alive off Briar Island, NS		P	Carcass ashore on Nantucket, MA; caudal peduncle severely lacerated where entangled; gear consistent with inshore lobster fishery
8/22/02	serious injury	Adult Female #1815	Scotian Shelf, Canada		P	Line tightly wrapped around head and tail stock; no gear recovered
8/22/02	mortality	Yearling Female 12.6m	off Ocean City, MD	P		Large laceration on dorsal surface
8/30/02	serious injury	age & sex unknown #3210	Bay of Fundy, NS		P	Line tightly wrapped around rostrum; resighted in 2004 in poor condition; no gear recovered
1/14/03	serious injury	Adult Female #2240	Jacksonville, FL		P	Body condition poor; no gear recovered
10/02/03	mortality	Adult Female #2150 15m (est)	Digby, NS	P		Large fracture in skull; subdermal hemorrhage
2/7/04	mortality	Adult Female #1004 16m	Virginia Beach, VA	P		Severe subdermal bruising; complete fracture of rostrum and laceration of oral rete
9/6/04	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
11/24/04	mortality	Adult Female #1909 14.9m	Ocean Sands, NC	P		Left fluke lobe severed and large bore blood vessels exposed
1/12/05	mortality	Adult Female #2143 13m	Cumberland Island, GA	P		Healed propeller wounds from strike as a calf re-opened as a result of pregnancy
3/10/05	serious injury	age & sex unknown #2425	Cumberland Island, GA	P		43 ft power yacht partially severed left fluke; resighted 9/4/05 in extremely poor condition

Table 4 continued.

Date <sup>a</sup>	Report Type <sup>b</sup>	Age, Sex, ID, Length	Location <sup>a</sup>	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entang./ Fsh inter	
4/28/05	mortality	Adult Female #2617 14.7m	Monomoy Island, MA	P		Significant bruising and multiple vertebral fractures
1/10/06	mortality	Calf Male 5.4m w/out fluke	Jacksonville, FL	P		Propeller lacerations associated with hemorrhaging and edema; flukes completely severed
1/16/06	serious injury	Calf 5m (est)	Corpus Christi Bay, TX		P	Wrapping laceration with heavy cyamid load on dorsal surface of calf; vertebral processes noticeable indicating fat loss
1/22/06	mortality	Calf 5.6m	off Ponte Vedra Beach, FL		P	Significant pre-mortem lesions from entanglement in apparent monofilament netting
3/11/06	serious injury	Yearling Male #3522	Off Cumberland Island, GA	P		11 propeller lacerations across dorsal surface
7/24/06	mortality	age unknown Female 9.6m	Campobello Island, NB	P		Propeller lacerations through blubber, into muscle and ribs
8/24/06	mortality	Adult Female 14.7m	Roseway Basin, NS	P		16 fractured vertebrae; dorsal blubber bruise from head to genital region
12/30/06	mortality	Yearling Male #3508 12.6m	off Brunswick, GA	P		20 propeller lacerations along right side of head and back with associated hemorrhaging
<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. National guidelines for determining what constitutes a serious injury have not been finalized. Interim criteria as established by NERO/NMFS (Nelson et al. 2007) have been used here. Some assignments may change as new information becomes available and/or when national standards are established.</p>						

Table 5. Confirmed human-caused mortality and serious injury records of Northwest Atlantic humpback whales, 2002-2006. All records were assumed to involve members of the Gulf of Maine humpback whale stock unless a whale was confirmed to be a member of another stock. This is in contrast to prior reports.

Date <sup>a</sup>	Report Type <sup>b</sup>	Age, Sex, ID, Length	Location <sup>a</sup>	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entang./ Fsh.inter	
2/08/02	mortality	Juvenile Female 8.4m	off Cape Henry, VA	P		3 large lacerations; hemorrhaging; broken bones
3/24/02	mortality	Juvenile Male 8.0m	off Virginia Beach, VA		P	Deep cuts on caudal peduncle and tail indicative of embedded line; no gear recovered
6/03/02	mortality	age & sex unknown 9.9m	off Cape Elizabeth, ME		P	Deep cuts on caudal peduncle indicative of embedded line; state water lobster fishery
6/17/02	serious injury	age & sex unknown 10.2m (est)	Cape Cod, MA		P	Fluke severely damaged by line; whale emaciated
8/01/02	mortality	Yearling Male 9.3m	Long Island, NY	P		Large hematoma posterior to blow holes
10/01/02	mortality	Calf Female 7.5m	Plymouth, MA		P	Found wrapped in line; extensive bruising; no gear recovered
6/06/03	mortality	Juvenile Female 8.3m	Chesapeake Bay mouth, VA	P		Major trauma to right side of head; hematoma
7/09/03	serious injury	Calf of Shockwave sex unknown	Bay of Fundy, NS		P	Constricting entanglement on a young whale; no gear recovered
7/12/03	serious injury	age & sex unknown	Oregon Inlet, NC		P	Entangled in substantial amount of gear; no gear recovered
8/15/03	mortality	Calf sex unknown 7.3m (est)	Petit Manan Island, ME		P	Floating offshore wrapped in line

Table 5 continued.

Date <sup>a</sup>	Report Type <sup>b</sup>	Age, Sex, ID, Length	Location <sup>a</sup>	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entang./ Fsh.inter	
8/16/03	serious injury	age & sex unknown	Cape Cod, MA		P	Poor body condition; line deeply embedded; gear recovered included sink gillnet, vessel anchoring system, surface buoy system and endline
8/18/03	serious injury	age & sex unknown	Cape Cod, MA		P	Extensive entanglement; no gear recovered
7/11/04	serious injury	Juvenile sex unknown "Lucky"	Briar Island, NS		P	Entanglement on a young whale
10/03/04	mortality	age unknown Male 15m (est)	Georges Bank		P	Fresh carcass with entangling line and high flyer; no gear recovered
12/19/04	mortality	Calf Female 8.0m	Bethany Beach, DE	P		Hematoma and skeletal fracturing
1/9/06	mortality	Adult Female #8667 14.0m	off Charleston, SC	P		Extensive muscle hemorrhaging; rib fractures; dislocated flipper on left side of animal
3/17/06	mortality	Juvenile Female 10.0m	Virginia Beach, VA	P		Crushed cranium and fractured mandible; hemorrhaging associated with fractures; ventral lacerations consistent with propeller wounds
3/25/06	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
8/06/06	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
8/20/06	mortality	age & sex unknown	East of Cape Cod, MA		P	Whale entangled through mouth continuing back to multiple wraps around peduncle. Resighted 9/6/06

Table 5 continued.

Date <sup>a</sup>	Report Type <sup>b</sup>	Age, Sex, ID, Length	Location <sup>a</sup>	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entang./ Fsh.inter	
8/23/06	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
10/15/06	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
<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. National guidelines for determining what constitutes a serious injury have not been finalized. Interim criteria as established by NERO/NMFS (Nelson et al. 2007) have been used here. Some assignments may change as new information becomes available and/or when national standards are established.</p>						

Table 6. Confirmed human-caused mortality and serious injury records of Western North Atlantic fin whales, 2002-2006

Date <sup>a</sup>	Report Type <sup>b</sup>	Age, Sex, Length	Location <sup>a</sup>	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entang./ Fsh.inter	
7/28/02	mortality	age & sex unknown	Georges Bank		P	Heavy line seen on tail stock; appeared embedded; no gear recovered
2/12/04	serious injury	age & sex unknown	Pea Island, NC		P	Entangled whale noticeably emaciated; no gear recovered
2/25/04	mortality	Adult Female 16.3m	Port Elizabeth, NJ	P		Displaced vertebrae; ruptured aorta
6/30/04	mortality	age & sex unknown 12m (est)	Georges Bank		P	Freshly dead; heavy line constricting mid-section; no gear recovered
9/26/04	mortality	age & sex unknown 15m (est)	St. Johns, NB	P		Fresh carcass on bow of ship
3/26/05	mortality	Adult <sup>c</sup> Female 16.3m	off Virginia Beach, VA	P		Extensive hemorrhaging and vertebral fractures
4/3/05	mortality	Adult <sup>c</sup> Female 18.8m	Southampton, NY	P		Subdermal hemorrhaging
8/23/05	mortality	Juvenile <sup>c</sup> Male 13.7m	Port Elizabeth, NJ	P		Brought in on bow of ship
9/11/05	mortality	Juvenile <sup>c</sup> Male 11m	Bonne Esperance, QC	P		Bottom jaw completely severed/broken
9/17/06	serious injury	age & sex unknown 18m (est)	off Mt. Desert Rock, ME		P	Pale skin overall; cyamid load at point of attachment; emaciated

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. National guidelines for determining what constitutes a serious injury have not been finalized. Interim criteria as established by NERO/NMFS (Nelson et al. 2007) have been used here. Some assignments may change as new information becomes available and/or when national standards are established.

c. The gender and length were misreported in the 2005 Stock Assessment Report. This table shows the correct values.

Table 7. Confirmed human-caused mortality and serious injury records of Nova Scotian sei whales, 2002-2006

Date <sup>a</sup>	Report Type <sup>b</sup>	Age, Sex, Length	Location <sup>a</sup>	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entang./ Fsh inter	
2/19/03	mortality	age unknown Male 11.0m	Norfolk, VA	P		Large gash into muscle, hematoma and abrasions
4/17/06	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
9/16/06	Mortality	age & sex unknown	Jeffreys Ledge		P	Constricting wrap cutting into skin; 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. National guidelines for determining what constitutes a serious injury have not been finalized. Interim criteria as established by NERO/NMFS (Nelson et al. 2007) have been used here. Some assignments may change as new information becomes available and/or when national standards are established.</p>						

Table 8. Confirmed human-caused mortality and serious injury records of Canadian East Coast minke whales, 2002-2006

Date <sup>a</sup>	Report Type <sup>b</sup>	Age, Sex, Length	Location <sup>a</sup>	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entang./ Fsh inter	
7/17/02	mortality	Female, 4.6m (est)	Bar Harbor, ME (44°18.22'N 68°07.43'W)		P	Unknown fishery; carcass had a rope scar on the peduncle with associated hemorrhaging; additional bruising around the epiglottis and larynx; no gear recovered
10/15/02	mortality	Female, 5.1m	Gloucester, MA (42°36'N 70°39'W)		P	Whale was entangled through the mouth and around the pectoral flippers; gear from state water lobster fishery was still on the whale
5/24/03	mortality	Male, 7.6m	Gloucester, MA (42°40.8'N 70°39.6'W)		P	Unknown fishery; line marks on head and dorsal fin; no line present; cut across back anterior to dorsal fin; no gear recovered
5/31/03	mortality	Female 3.6m (est)	Martha's Vineyard, MA (41°21.0'N 70°47.5'W)		P	Unknown fishery; whale stranded live wrapped in about 15 feet of 5.5 inch mesh netting, probably trawl gear
6/28/03	mortality	Male, 9.1m	Chatham, MA (41°40'N 69°55'W)		P	Lobster fishery; wrapped in lobster gear
8/9/03	mortality	Sub-adult Female, 3.5m (est)	Harwich, MA (41°37.3'N 70°03.0'W)		P	Unknown fishery; hemorrhaging in areas with net marks on whale; no gear recovered
9/13/03	mortality	Sub-adult Female, 6m (est)	Casco Bay, ME (43°42'N 69°58'W)		P	Unknown fishery; freshly dead; external chaffing marks and belly slit open; no gear recovered
5/6/04	mortality	Female, 7.7m	Martha's Vinyard, MA (41°21'N 70°40'W)		P	Unknown fishery; constricting line marks on peduncle; indications of drowning from internal exam
6/1/04	mortality	Female, 6.5m	Chatham, MA (41° 41'N 69°56'W)	P		Large area of subdermal hemorrhaging

Table 8 continued.

Date <sup>a</sup>	Report Type <sup>b</sup>	Age, Sex, Length	Location <sup>a</sup>	Assigned Cause: P=primary, S=secondary		Notes/Observations
				Ship strike	Entang./ Fsh inter	
7/19/04	mortality	Female, 7.9m	Eastham, MA (41°54'N 69°58'W)		P	Unknown fishery; extensive entanglement markings; no gear recovered
5/23/05	mortality	Sub-adult Male, 5.9m	Port Elizabeth, NJ (40° 41'N 74° 09'W)	P		Ribs shattered; liver ruptured; evidence of internal hemorrhaging
<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. National guidelines for determining what constitutes a serious injury have not been finalized. Interim criteria as established by NERO/NMFS (Nelson et al. 2007) have been used here. Some assignments may change as new information becomes available and/or when national standards are established.</p>						

Table 9. Confirmed human-caused mortality and serious injury records of Western North Atlantic Brydes whales, 2002-2006

Date	Report Type	Sex, age, length	Location	Assigned Cause: P=primary, S=secondary		Notes / Observations
				Ship strike	Entang./ Fsh inter	
3/13/03	mortality	Male 11.0m	New Hanover, NC 33° 55'N 78°13'W		P	Deeply embedded line; whale extremely emaciated NC03-052

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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:

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*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 and most issues receive copy editing.

*Resource Survey Report* (formerly *Fishermen's Report*) -- This information report is a regularly-issued, 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. This report undergoes internal review, but receives no technical or copy editing.

**TO OBTAIN A COPY** of a *NOAA Technical Memorandum NMFS-NE* or a *Northeast Fisheries Science Center Reference Document*, either contact the NEFSC Editorial Office (166 Water St., Woods Hole, MA 02543-1026; 508-495-2350) or consult the NEFSC webpage on "Reports and Publications" (<http://www.nefsc.noaa.gov/nefsc/publications/>). To access *Resource Survey Report*, consult the Ecosystem Surveys Branch webpage (<http://www.nefsc.noaa.gov/femad/ecosurvey/mainpage/>).

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