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**Mortality and Serious Injury Determinations
for Baleen Whale Stocks
along the United States Eastern Seaboard
and Adjacent Canadian Maritimes,
2001-2005**

by Misty Nelson, Mendy Garron, Richard L. Merrick,
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Abstract

The Northeast Fisheries Science Center (NEFSC) has developed protocols for determining large whale serious injuries and human-caused mortalities. This report describes determinations made for events occurring from 2001–2005 involving stocks of right, humpback, fin, sei, blue, minke, and Brydes whales along the eastern seaboard of the United States and adjacent Canadian Maritimes. A total of 417 unique large whale events was reported during the period, including carcasses (both beached and at sea) and live whales sighted at sea. We received 151 entanglement reports and 48 reports of ship strikes. We were able to verify 133 entanglement events, 42 ship strikes, and 292 mortalities. Entanglements were identified as the cause of 26 whale deaths and ship strikes the cause of 27; 223 mortalities (76%) lacked sufficient evidence to determine cause of death. Entanglements were determined to have caused serious injury in 11 events, and 1 serious injury was caused by a vessel strike. Seventy (53%) of the verified entanglement events and 9 (21%) of the ship strike events were determined to have not caused serious injury or death; 21 (16%) entanglement events and 2 (5%) ship strike events lacked sufficient evidence for determination. 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=6). Right whales and fin whales both had 8 mortalities from ship strikes. These human-caused mortality and serious injury rates represent the minimum levels of impact to these stocks.

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 five years of implementation – commercial takes and serious mortality of marine mammals to insignificant levels approaching zero mortality and serious injury rates.

In April 1997, the 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 (SARs). Subsequently, the Northeast Fisheries Science Center (NEFSC) implemented the Workshop's large cetacean recommendations and has annually estimated serious injury and mortality of Northwest Atlantic Ocean large whale stocks for the SARs since 1996 (e.g., Cole et al. 2006).

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 2001–2005.

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 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 observer was inexperienced, but the report was accompanied by photographs or videotape of sufficient quality to positively verify the species or event;
4. a fisherman reported a whale entangled in his/her gear or a shipper reported colliding with a whale;
5. gear was retrieved from a whale.

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

6. the observer was experienced and was fairly certain, but not positive, of the species or event;
7. the observer was inexperienced, but was interviewed and the account was descriptive enough that the species or event was probable but not certain;
8. 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 videotaped, but staff reviewing the images could not identify species or the event's occurrence;
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 on 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 change 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 change in 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 entanglements or collisions with vessels).

RESULTS

A total of 417 events was reported during 2001–2005, involving both live and dead whales (Table 1). There were 151 reports of entanglement and 48 of ship strike. From these, we confirmed 133 entanglement events and 42 ship strike events. We were able to verify 292 mortalities, and determine that 26 mortalities were due to entanglements and 27 mortalities were the result of ship strikes. Entanglement was determined to have caused serious injury in 11 events, and one serious injury was 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 223 mortalities (76%). There were 68 entanglement events which did not result in serious injury (this

includes cases where the animal was disentangled or shed gear), and 28 which lacked sufficient evidence to determine if serious injury had occurred. Ten ship strike events occurred which did not result in serious injury, and four events lacked sufficient evidence to make a determination. Annual human-caused mortality and serious injury rates for 2001–2005 are presented by 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 51 reports involving right whales, 24 were confirmed entanglements and 14 were confirmed ship strikes. There were 22 verified right whale mortalities (Table 1), three due to entanglements, and eight due to ship strikes. Serious injury was documented for four entanglement events and one ship strike involving right whales.

Humpbacks were involved in 162 reported events (Table 1). Of these, 70 of the 79 reported entanglements could be confirmed, as could 12 of the 16 reported ship strikes. Humpbacks were the most commonly observed entangled whale species and the most commonly observed dead whale (91 confirmed mortalities). Entanglements accounted for eight mortalities and six serious injuries. Ship strikes were relatively uncommon, with only 12 confirmed events, seven of which were fatal. 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 47 reported events, eight were of entanglements (all confirmed), three of which were fatal (Table 1). Twelve ship strikes were reported, 10 of which were confirmed, and eight proved fatal. One serious injury resulted from an entanglement.

Only six events were reported for sei whales, all of which were confirmed mortalities. Two of the mortalities were determined to have resulted from ship strikes.

Minke whales were involved in 86 reported events. Entanglements accounted for 30 of these reports, but only 25 could be confirmed (Table 1). Eleven 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.

Blue whales and Brydes whales appeared in only one reported event each. The blue whale report was a confirmed entanglement in the St. Lawrence River, Canada, but there was not sufficient information available to confirm if a serious injury occurred. The Brydes whale report was a confirmed entanglement which resulted in the death of the whale.

In 63 of the 417 large whale events reported during 2001–2005, positive species identification was not possible (Table 1). In nine events, the similarity in body shape and size between fin and sei whales prevented positive species identification. In another 15, 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 39 events could not be assigned with any certainty. Entanglement was reported in seven of these cases, four of which were considered confirmed. Fifty-four of the 63 reported events involving unidentified whale species 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 identify 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. 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.

Over the five-year period, 223 of 292 confirmed mortalities (76%) lacked sufficient evidence to determine cause of death. 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 28 of 133 confirmed entanglement events (21%) and four of 42 ship strike events (10%).

However, our greatest concern remains the number of animals we never saw. 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.

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We are especially grateful to the East Coast stranding and disentanglement 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 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.

REFERENCES

- Angliss RP, DeMaster DP. 1998. Differentiating serious and non-serious injury of marine mammals taken incidental to commercial fishing operations: Report of the Serious Injury Workshop, 1-2 April 1997, Silver Spring MD. U.S. Dep Commer, NOAA Tech Memo NMFS-OPR-13; 48 p.
- Cole TVN, Hartley DL, Garron M. 2006. Mortality and serious injury determinations for baleen whale stocks along the eastern seaboard of the United States, 2000–2004. U.S. Dep Commer, Northeast Fish Sci Cent Ref Doc. 06-04; 18 p. Available at: www.nefsc.noaa.gov/publications.
- Knowlton AR, Korsmeyer FT, Kerwin JE, Wu H, Hynes B. 1995. The hydrodynamic effects of large vessels on right whales. Final report to NOAA Fisheries for Contract No. 40EANFF400534; 81 p.
- Kraus SD. 1990. Rates and potential causes of mortality in North Atlantic right whales (*Eubalaena glacialis*). *Mar Mamm Sci*. 6(4):278-291.
- Lambertsen RH, Rasmussen KJ, Lancaster WC, Hintz RJ. 2005. Functional morphology of the mouth of the bowhead whale and its implications for conservation. *J Mammal*. 86(2):342-352.
- Moore MJ, Knowlton AR, Kraus SD, McLellan WA, Bonde RK. 2004. Morphometry, gross morphology and available histopathology in North Atlantic right whale (*Eubalaena glacialis*) mortalities (1970–2002). *J Cetacean Res Manage*. 6(3):199-214.
- Robbins J, Mattila DK. 2000. Monitoring entanglement scars on the caudal peduncle of Gulf of Maine humpback whales: 1997-1999. Center for Coastal Studies, Report to the National Marine Fisheries Service. Order number 40ENNF900253; 24 p.
- Robbins J, Mattila DK. 2004. Estimating humpback whale (*Megaptera novaeangliae*) entanglement rates on the basis of scar evidence. Center for Coastal Studies, Report to the National Marine Fisheries Service. Order number 43ENNF030121; 22 p.

Table 1. Summary of all reported baleen and unidentified whale events along the Northern Gulf of Mexico coast, U.S. East Coast and adjacent Canadian Maritimes, 2001–2005.

Species	Western North Atlantic right whale	Northwest Atlantic humpback whale ^b	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 ^d	Unidentified whale spp.	TOTALS
Total reports ^a (2001, 2002, 2003, 2004, 2005)	51 (10, 12, 8, 8, 13)	162 (30, 35, 50, 20, 27)	47 (10, 5, 13, 10, 9)	6 (2, 1, 1, 2, 0)	1 (0, 1, 0, 0, 0)	86 (10, 14, 25, 22, 15)	1 (0, 0, 1, 0, 0)	9 (1, 0, 3, 2, 3)	15 (1, 2, 7, 2, 3)	39 (5, 4, 19, 3, 8)	417
Total entanglement reports ^a	25 (4, 8, 6, 3, 4)	79 (12 ^c , 21 ^c , 21, 11, 14)	8 (2, 1, 1, 4, 0)	0	1 (0, 1, 0, 0, 0)	30 (5, 5, 11, 8, 1)	1 (0, 0, 1, 0, 0)	1 (0, 0, 0, 0, 1)	1 (0, 0, 0, 1, 0)	5 (1, 0, 0, 1, 3)	151
Total ship strike reports	15 (2, 3, 2, 3, 5)	16 (6 ^c , 4 ^c , 3, 1, 2)	12 (3, 0, 4, 3, 2)	3 (1, 0, 1, 1, 0)	0	1 (0, 0, 0, 1, 0)	0	0	0	1 (0, 0, 0, 0, 1)	48
Confirmed entanglement events	24 (4, 8, 6, 4, 2)	70 (10 ^c , 18 ^c , 19, 10, 13)	8 (2, 1, 1, 4, 0)	0	1 (0, 1, 0, 0, 0)	25 (4, 4, 9, 6, 2)	1 (0, 0, 1, 0, 0)	1 (0, 0, 0, 0, 1)	1 (0, 0, 0, 1, 0)	2 (0, 0, 0, 1, 1)	133
Confirmed ship strike events	14 (2, 1, 2, 2, 7)	12 (5 ^c , 3 ^c , 2, 1, 1)	10 (2, 0, 0, 2, 6)	3 (1, 0, 1, 1, 0)	0	2 (0, 0, 0, 1, 1)	0	0	0	1 (0, 0, 0, 0, 1)	42
Total confirmed mortalities	22 (7, 5, 1, 5, 4)	91 (22, 18, 29, 11, 11)	40 (9, 5, 11, 7, 8)	6 (2, 1, 1, 2, 0)	0	78 (8, 12, 23, 20, 15)	1 (0, 0, 1, 0, 0)	8 (1, 0, 3, 2, 2)	14 (1, 2, 7, 1, 3)	32 (4, 4, 18, 2, 4)	292
Confirmed entanglement mortalities	3 (1, 1, 0, 1, 0)	8 (3, 3, 1, 1, 0)	3 (1, 1, 0, 1, 0)	0	0	11 (2, 2, 5, 2, 0)	1 (0, 0, 1, 0, 0)	0	0	0	26
Confirmed ship strike mortalities	8 (2, 1, 1, 2, 2)	7 (3, 2, 1, 1, 0)	8 (2, 0, 0, 2, 4)	2 (1, 0, 1, 0, 0)	0	2 (0, 0, 0, 1, 1)	0	0	0	0	27
Confirmed entanglement serious injuries	4 (1, 2, 1, 0, 0)	6 (0, 1, 4, 1, 0)	1 (0, 0, 0, 1, 0)	0	0	0	0	0	0	0	11
Confirmed ship strike serious injuries	1 (0, 0, 0, 0, 1)	0	0	0	0	0	0	0	0	0	1

^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 One humpback report included as both a confirmed entanglement and confirmed ship strike event.

^d 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, 2001–2005.

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 ¹ or EN ²	1 5%	4 4%	3 8%	2 33%	0	6 8%	0	0	0	0	16 5%
Confirmed mortalities, IIFD ³	10 45%	72 79%	26 65%	2 33%	0	59 76%	0	8 100%	14 100%	32 100%	223 76%
Confirmed entanglement events, NOT SI/MT ^{4,5}	15 63%	45 64%	3 38%	0	0	5 20%	0	0	0	0	68 51%
Confirmed entanglement events, IIFD*	2 8%	11 16%	1 13%	0	1 100%	9 36%	0	1 100%	1 100%	2 100%	28 21%
Confirmed ship strike events, NOT SI/MT	4 29%	5 42%	1 10%	0	0	0	0	0	0	0	10 24%
Confirmed ship strike events, IIFD*	1 7%	0	1 10%	1 33%	0	0	0	0	0	1 100%	4 10%

¹ SS = ship strike

² EN = entanglement

³ IIFD = insufficient information for determination

⁴ MT = mortality

⁵ 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, U.S. East Coast and adjacent Canadian Maritimes, 2001–2005, 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 / other waters)	Confirmed mortalities (2001, 2002, 2003, 2004, 2005)	Confirmed SI's (2001, 2002, 2003, 2004, 2005)	Annual rate (US waters / Canadian waters)	Confirmed mortalities (2001, 2002, 2003, 2004, 2005)	Confirmed SI's (2001, 2002, 2003, 2004, 2005)
Western North Atlantic right whale	3.2 (0)	1.4 (0.4 / 1.0 / 0)	3 (1, 1, 0, 1, 0)	4 (1, 2, 1, 0, 0)	1.8 (1.6 / 0.2)	8 (2, 1, 1, 2, 2)	1 (0, 0, 0, 0, 1)
Gulf of Maine hump-back whale ¹	4.2 (1.1)	2.8 (2.4 / 0.4 / 0)	8 (3, 3, 1, 1, 0)	6 (0, 1, 4, 1, 0)	1.4 (1.4 / 0)	7 (3, 2, 1, 1, 0)	0
Western North Atlantic fin whale ²	2.4 (4.0)	0.8 (0.6 / 0 / 0.2)	3 (1, 1, 0, 1, 0)	1 (0, 0, 0, 1, 0)	1.6 (1.2 / 0.4)	8 (2, 0, 0, 2, 4)	0
Nova Scotian sei whale	0.4 (0.3)	0	0	0	0.4 (0.4 / 0)	2 (1, 0, 1, 0, 0)	0
Western North Atlantic blue whale ³	0 (–)	0	0	0	0	0	0
Canadian East Coast minke whale	2.6 (9.2)	2.2 (2.2 / 0 / 0)	11 (2, 2, 5, 2, 0)	0	0.4 (0.4 / 0)	2 (0, 0, 0, 1, 1)	0
Western North Atlantic Brydes whale	0.2 (0.3)	0.2 (0.2 / 0 / 0)	1 (0, 0, 1, 0, 0)	0	0	0	0

¹ Excludes events involving confirmed members of a stock other than the Gulf of Maine feeding stock (no events could be excluded based on the information available at the time of writing).

² Includes an entanglement mortality found off Bermuda in 2001.

³ Stock abundance estimates outdated; no Potential Biological Removal established for this stock.

Table 4. Confirmed human-caused mortality and serious injury records of Northern right whales, Western Atlantic stock, 2001–2005.

Date	Report Type	Sex, age, ID	Location	Assigned Cause: P=primary, S=secondary		Notes / Observations
				Ship strike	Entang./ Fsh inter	
3/17/01	mortality	Male Calf	Assateague, VA	P		Large fresh propeller gashes on dorsal caudal and acute muscular hemorrhage
6/8/01	serious injury	Male Adult #1102	58mi east of Cape Cod, MA		P	Entangling gear deeply embedded; numerous signs of poor health including emaciation, skin discoloration, and abnormal cyanid distribution
6/18/01	mortality	Female Calf	Long Island, NY	P		Dorsal propeller wounds, sub-dermal hemorrhage
11/3/01	mortality	Male Adult #1238	Magdellen Islands, Canada		P	Thoroughly wrapped up in Danish Seine gear, whale seen alive and well five months earlier
7/6/02	mortality	Female #3107	Off Briar Island, NS Canada		P	Carcass ashore on Nantucket, MA, on October 12, 2002; caudal peduncle severely lacerated where entangled; gear consistent with inshore lobster fishery
8/22/02	serious injury	Female Adult #1815	Scotian Shelf, Canada		P	Line tightly wrapped around head and tail stock; no gear recovered
8/22/02	mortality	Female 1 year old	off Ocean City, MD	P		Large laceration on dorsal surface
8/30/02	serious injury	Sex & age 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	Female Adult #2240	Jacksonville, FL		P	Line in mouth no longer visible; body condition poor; no gear recovered
10/02/03	mortality	Female Adult #2150	Digby, NS	P		Large fracture in skull, sub-dermal hemorrhage
2/7/04	mortality	Female Adult #1004	Virginia Beach, VA	P		Severe subdermal bruising, complete fracture of rostrum and laceration of oral rete
9/6/04	mortality	Female Adult #2301	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	Female Adult #1909	Ocean Sands, NC	P		Left fluke lobe severed and large bore blood vessels exposed.

Date	Report Type	Sex, age, ID	Location	Assigned Cause: P=primary, S=secondary		Notes / Observations
				Ship strike	Entang./ Fsh inter	
1/12/05	mortality	Female Adult #2143	Cumberland Island, GA	P		Healed propeller wounds from strike as a calf re-opened as a result of pregnancy
3/10/05	serious injury	Sex & age unknown #2425	Cumberland Island, GA	P		45' power yacht partially severed left fluke; resighted 9/4/05 in extremely poor condition
4/28/05	mortality	Female Adult #2617	Monomoy Island, MA	P		Significant bruising and multiple vertebral fractures

Table 5. Confirmed human-caused mortality and serious injury records of Gulf of Maine humpback whales, 2001–2005. 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	Report Type	Sex, age, length	Location	Assigned Cause: P=primary, S=secondary		Notes / Observations
				Ship strike	Entang./ Fsh inter	
1/25/01	mortality	Sex & age unknown 6.9m (est)	Avon, NC	P		Extensive hemorrhaging along left thoracic; clean cut through vertebrae
4/7/01	mortality	Male Juvenile 7.6m	Emerald Isle, NC		P	Entanglement around peduncle caused extensive edema and hemorrhaging; no gear recovered
4/8/01	mortality	Male Juvenile 7.9m	Myrtle Beach, SC	S	P	Pre-mortem evidence of chronic line entanglement; severe prop wounds; no gear recovered
4/9/01	mortality	Female Juvenile “Inland” 8.8m	offshore of Sandbridge, Virginia Beach		P	Found anchored in croaker sink gillnet gear; line wraps around rostrum had immobilized the whale
7/29/01	mortality	Female Juvenile 8.5m	floating south of Verrazano Bridge, NY	P		Large laceration on left side of head, extensive fracturing of skull
10/1/01	mortality	Female 3 yr old “Pitfall” 11.4m	Duxbury Beach, MA	P		Massive fracturing to skull, focal bruising indicative of pre-mortem ship strike
2/8/02	mortality	Female Juvenile 8.4m	off Cape Henry, VA	P		Three large lacerations, hemorrhaging and broken bones
3/24/02	mortality	Male Juvenile 8.0m	off Virginia Beach, VA		P	Deep cuts on caudal peduncle and tail indicative of embedded line; no gear recovered
6/3/02	mortality	Sex & age unknown 9.9m	off Cape Elizabeth, ME		P	Deep cuts on caudal peduncle indicative of embedded line; state waters lobster fishery
6/17/02	serious injury	Sex & age unknown 10.2m (est)	Cape Cod Bay, MA		P	Fluke severely damaged by line, whale emaciated
8/1/02	mortality	Male 9.3m	Long Island, NY	P		Large hematoma posterior to blow holes
10/1/02	mortality	Female Calf 7.5m	Plymouth, MA		P	Extensive line chaffing and bruising on carcass; no gear recovered

Date	Report Type	Sex, age, length	Location	Assigned Cause: P=primary, S=secondary		Notes / Observations
				Ship strike	Entang./ Fsh inter	
6/6/03	mortality	Female 8.3m	Chesapeake Bay mouth, VA	P		Major trauma to right side of head, hematoma present
7/9/03	serious injury	Calf of Shockwave	Bay of Fundy, Canada		P	Constricting entanglement on a young whale; no gear recovered
7/12/03	serious injury	unknown	Oregon Inlet, NC		P	Entangled in substantial amount of gear; no gear recovered
8/15/03	mortality	Calf 7.3m (est)	Petit Manan Island, ME		P	Floating offshore wrapped in line
8/16/03	serious injury	unknown	off Cape Cod, MA		P	Poor body condition; line deeply embedded; gear recovered included sink gillnet, vessel anchoring system and surface buoy system and endline
8/18/03	serious injury	unknown	off Cape Cod, MA		P	Extensive entanglement; no gear recovered
7/11/04	serious injury	Subadult "Lucky"	Briar Island, NS		P	Entanglement likely to become constricting as whale grows
10/3/04	mortality	Sex & age unknown 15m (est)	Georges Bank		P	Fresh carcass with entangling line and high flyer; no gear recovered
12/19/04	mortality	Calf 8.0m	Bethany Beach, DE	P		Hematoma and skeletal fracturing

Table 6. Confirmed human-caused mortality and serious injury records of Western North Atlantic fin whales, 2001–2005.

Date	Report Type	Sex, age, length	Location	Assigned Cause: P=primary, S=secondary		Notes / Observations
				Ship strike	Entang./ Fsh inter	
1/2/01	mortality	Female 18.1m	New York harbor	P		Dorsal abrasion marks, hematoma
2/1/01	mortality	Female 14.5m	Port Elizabeth, NJ	P		Fresh carcass hung on ship's bow
9/19/01	mortality	Sex & age unknown 10.7m	off Bermuda		P	Extensive fresh entanglement marks; no gear recovered
7/28/02	mortality	unknown	Georges Bank		P	Heavy line seen on tail stock, appeared embedded; no gear recovered
2/12/04	serious injury	unknown	Pea Island, NC		P	Entangled whale noticeably emaciated; no gear recovered
2/25/04	mortality	Female 16.3m	Port Elizabeth, NJ	P		Displaced vertebrae, ruptured aorta
6/30/04	mortality	Sex & age unknown 12m (est)	Georges Bank		P	Fresh dead; heavy line constricting mid-section; no gear recovered
9/26/04	mortality	Sex & age unknown 15m (est)	St. Johns, NB	P		Fresh carcass caught on bow of ship
3/26/05	mortality	Male 11m	off Virginia Beach, VA	P		Extensive hemorrhaging and vertebral fractures
4/3/05	mortality	Male 13.7m	Southampton, NY	P		Subdermal hemorrhaging
8/23/05	mortality	Female 18.8m	Port Elizabeth, NJ	P		Brought in on bow of ship
9/11/05	mortality	Female 16.3m	Bonne Esperance, QC	P		Bottom jaw completely severed/broken

Table 7. Confirmed human-caused mortality and serious injury records of Nova Scotian sei whales, 2001–2005.

Date	Report Type	Sex, age, length	Location	Assigned Cause: P=primary, S=secondary		Notes / Observations
				Ship strike	Entang./ Fsh inter	
5/2/01	mortality	Female 13.0 m	New York Harbor	P		Fresh carcass hung on ship's bow; hemorrhaging
2/19/03	mortality	Male 11.0m	Norfolk, VA 36 58'N 76 21'W	P		Large gash into muscle, hematoma and abrasions

Table 8. Confirmed human-caused mortality and serious injury records of Canadian East Coast minke whales, 2001–2005.

Date	Report Type	Sex, age, length	Location	Assigned Cause: P=primary, S=secondary		Notes / Observations
				Ship strike	Entang./ Fsh.inter	
8/17/01	mortality	Male 3.9m	Middletown, RI 41° 28'N 71° 15'W		P	Unknown fishery. Severe rope entanglement around mouth and rostrum caused malnutrition and infection. No gear recovered.
12/13/01	mortality	Sex & age unknown 7m (est)	Massachusetts Bay, MA 42° 21'N 70° 43'W		P	Unknown fishery. Pictures show evidence of fairly fresh entanglement marks on tail stock and across flukes. No gear recovered.
7/17/02	mortality	Female 4.6m (est)	Bar Harbor, ME 44° 18'N 68° 07'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° 41'N 70° 39'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'N 70° 47'W		P	Unknown fishery. Whale stranded live wrapped in about 15 feet of 2-3 inch mesh netting; probably trawl gear.
6/28/03	mortality	Male 5.1m	Chatham, MA 41° 40'N 69° 55'W		P	Lobster fishery. Whale wrapped in line.
8/9/03	mortality	Sex & age unknown 3.5m (est)	Harwich, MA 41° 37'N 70° 03'W		P	Unknown fishery. Hemorrhaging in areas with net marks on whale. No gear recovered.
9/13/03	mortality	Female 6m (est)	Casco Bay, ME 43° 42'N 69° 58'W		P	Unknown fishery. Fresh dead. External chaffing marks and belly slit open. No gear recovered.
5/6/04	mortality	Female 7.7m	Marthas Vineyard, MA 41° 21'N 70° 40'W		P	Unknown fishery. Constricting line marks on tail stock. Indications of drowning from internal exam. No gear recovered.

Date	Report Type	Sex, age, length	Location	Assigned Cause: P=primary, S=secondary		Notes / Observations
				Ship strike	Entang./ Fsh. inter	
6/1/04	mortality	Female 6.5m	Chatham, MA 41° 40'N 69° 56'W	P		Ship strike. Large area of subdermal hemorrhaging.
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	Male 5.9m	Port Elizabeth, NJ 40° 41'N 74° 09'W	P		Ribs shattered, liver ruptured, evidence of internal hemorrhaging

Table 9. Confirmed human-caused mortality and serious injury records of Northern Gulf of Mexico Brydes whales, 2001–2005.

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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