

**Mortality and Serious Injury Determinations
for Northwest Atlantic Ocean
Large Whale Stocks
1999-2003**

by

**Timothy V.N. Cole, Dana L. Hartley,
and Richard L. Merrick**

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ABSTRACT

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. A serious injury has been defined as “any injury that will likely result in mortality”. Using guidelines recommended by NMFS’s 1997 Serious Injury Workshop, the Northeast Fisheries Science Center developed protocols for determining large whale serious injuries and human-caused mortalities. We describe the protocols used and report on the determinations made for right, humpback, fin, sei, blue, minke and Brydes whale events that occurred from 1999 through 2003 along the eastern seaboard of the United States. A total of 408 unique large whale events were reported during the period, including both strandings and sightings at sea. These included 173 entanglement reports and 37 reports of ship strikes. We were able to verify 146 entanglement events, 25 ship strikes, and 267 mortalities. Entanglements were identified as the cause of 29 whale deaths and ship strikes the cause of 18. Entanglements were determined to have caused serious injury in 18 events. Minke whales had the greatest number of entanglement mortalities (15). Humpback whales had the highest number of serious injury events resulting from entanglements (12) and the most incidents of ship strike mortalities (6). Right whales and fin whales each had five mortalities from ship strikes. No serious injuries resulting from ship strikes were confirmed for any species. These human-caused mortality and serious injury rates represent the minimum levels of impact to these stocks. Procedures and methods for estimating actual serious injury and mortality rates have yet to be developed.

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 and serious mortality of marine mammals to insignificant levels approaching zero mortality and serious injury rates.

Mortalities are relatively easy to assess, but assessments of serious injuries are more problematic. NOAA has defined an 'injury' under 50 CFR 229.2 as:

“... a wound or other physical harm. Signs of injury to a marine mammal include, but are not limited to, visible blood flow, loss of or damage to an appendage or jaw, inability to use one or more appendages, asymmetry in the shape of the body or body position, noticeable swelling or hemorrhage, laceration, puncture or rupture of eyeball, listless appearance or inability to defend itself, inability to swim or dive upon release from fishing gear, or signs of equilibrium imbalance. Any animal that ingests fishing gear, or any animal that is released with fishing gear entangling, trailing or perforating any part of the body will be considered injured regardless of the absence of any wound or other evidence of an injury.”

A serious injury has been defined as “any injury that will likely result in mortality”.

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). Specifically, the Atlantic SRG (ASRG) at its April 1999 meeting recommended that

“...the draft serious injury guidelines be followed whenever possible and applied in all fisheries. Those serious injury observations should be added to the observed mortalities and extrapolated to the population for status determination.”

The ASRG was specifically concerned about serious injuries to small cetaceans in the Atlantic pelagic longline fishery and large cetaceans in Northwest Atlantic Ocean pot and gillnet gear.

Subsequently, the Northeast (NEFSC) and Southeast Fisheries Science Centers (SEFSC) prepared serious injury determinations for the SARs and presented these to the ASRG in autumn 1999. The SEFSC implemented the Serious Injury Workshop recommendations for small

cetaceans taken in the longline fishery, while the NEFSC implemented the Workshop's large cetacean recommendations for right, humpback, fin, sei, blue, minke and Brydes whales interacting with gillnet and pot gear. At this and subsequent meetings, the ASRG spent considerable time discussing the protocols in general, and the analyses conducted for specific species (especially right whales).

Serious injury determinations continue to be prepared annually by the NEFSC and SEFSC. However, the actual criteria used in these determinations have never been formalized in manuscript form. In this document, we formally describe these protocols and report on the determinations made from 1999 through 2003.

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 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 within and across years.

Event and Species Confirmation Criteria

Events and the species involved were considered confirmed if they meet 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:

1. The observer was experienced and was fairly certain, but not positive, of the species or event;
2. The observer was inexperienced, but was interviewed and the account was descriptive enough that the species or event was probable but not certain;
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;
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 the following indications were confirmed to be present during gross inspection or necropsy of the carcass:

1. Fishing line constricted any body part;
2. Subdermal hemorrhaging or extensive necrosis was present at point of attachment.

Events were categorized as ship strike mortalities if any of the following indications were 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 any of the following indications were 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;
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 408 events was reported during 1999-2003, involving both live and dead whales (Table 1). There were 173 reports of entanglement and 37 of ship strike. From these, we confirmed 146 entanglement events and 25 ship strike events. We were able to verify 267 mortalities, and determine that 29 mortalities were due to entanglements and 18 mortalities were the result of ship strikes. The cause of death could not be established for the remaining mortalities. Entanglement was determined to have caused serious injury in 18 events. There were no records of serious injuries resulting from ship strikes. Annual human-caused mortality and serious injury rates for 1999-2003 are presented by stock in Table 2. Tables 3 to 8 provide the details of each confirmed serious injury or mortality record.

Right whales had the highest proportion of entanglements and ship strikes relative to the number of reports for a species--of 50 reports involving right whales, 31 were confirmed entanglements and 8 were confirmed ship strikes. Over the five-year period, there were 18 verified right whale mortalities (Table 1). Three of these mortalities were due to entanglements, and five were due to ship strikes. Serious injury was documented for five entanglement events involving right whales.

Humpbacks were involved in 169 reported events (Table 1). Of these, 74 of the 82 reported entanglements could be confirmed, as could 10 of the 14 reported ship strikes. Humpbacks were the most commonly observed entangled whale species and the most commonly observed dead whale (92 confirmed mortalities). Entanglements accounted for eight mortalities and 12 serious injuries. Ship strikes were relatively uncommon, with only 10 confirmed events, six of which were fatal. Whales identified as members of the Gulf of Maine stock accounted for five of the entanglement mortalities, nine of the entanglement serious injuries and three of the ship strike mortalities (Table 2).

Fin whales had a low proportion of entanglements; of 40 reported events, only 7 were of entanglements (all confirmed), two of which were fatal (Table 1). Ten ship strikes were reported, five of which were confirmed and proved fatal. No serious injury events involving fin whales were reported.

Only four 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 reported in 82 events. Entanglements accounted for 35 of these events, but only 27 could be confirmed (Table 1). Fifteen of the confirmed entanglement events were fatal, the highest percentage for any of the whale species. One additional entanglement event was determined to have caused serious injury. There were only two ship strike reports, but neither of these could be confirmed.

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 was sustained. The Brydes whale report was a confirmed entanglement in the Gulf of Mexico, which resulted in the death of the whale.

In 61 of the 408 large whale events reported during 1999-2003, positive species identification was not possible (Table 1). In five stranding events, the similarity in body shape and size between fin and sei whales prevented positive species identification. In another 14 strandings, the whales could only be identified as balaenopteriids based on the presence of ventral pleats. In 42 other events, the taxonomic identity of the whales could not be assigned with certainty. Entanglement was reported in 12 of these cases, five of which were considered confirmed. Twenty eight of the 42 reported events involving unidentified whales were confirmed mortalities.

DISCUSSION

Sufficient experience with serious injury determinations has been gained since 1999 to now comment on the efficacy of the recommendations from the 1997 Workshop for assessing large whale serious injuries.

First and foremost, determinations of human-caused mortality and serious injury must be made on a case-by-case basis. The guidelines provided in the Workshop report tend to be overly general, so it is important that individual users clearly define *a priori* how the guidelines are to be used and then apply them in a consistent fashion. The process might best be conducted using the same personnel to ensure consistency. All available data should be carefully examined before determinations are made. Frequently determinations are made in a rush in response to decision makers' requests, when in fact a measured approach will likely provide a more accurate evaluation. The serious injury determinations for Northwest Atlantic baleen whales are performed annually, immediately prior to completion of the draft Stock Assessment Report for the next year (*i.e.*, determinations for animals observed in 2003 were made in late summer 2004 for the 2005 SAR).

Secondly, for dead animals, it is essential that the carcass be recovered and necropsied by a competent biologist with an attending veterinarian or pathologist present. Differentiating causal

injuries from pre-existing ones or post-mortem damage is problematic, but can be accomplished through examination of necropsy data. Necropsies frequently identify subdermal hemorrhaging or hematomas, indicating that blood was still circulating at the time of injury. McLellan *et al.* (2004) have provided an excellent right whale necropsy protocol that should be followed.

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. 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.

Events involving constricting entanglements with evidence of the whale's deteriorating health were considered confirmed serious injuries. Removal of constricting gear was generally considered to prevent serious injury. 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. Therefore, the removal of gear frees a whale's immune system resources to combat resident disease or infection that might otherwise lead to the whale's death. Loosely wrapped gear did not appear to elicit as much stress (some whales carried loose wraps for years), and were not considered serious injuries even if they impaired the locomotion or feeding of an animal. We also made no attempt to predict how an entanglement or injury might increase a whale's susceptibility to further injury; however, further research on the fate of individual entangled/injured/impaired animals might provide information to improve such predictions. Fishing gear interactions may also generate non-lethal effects, such as impacts to reproduction that may negatively affect population recovery (Robbins and Mattila 2001a; Robbins *et al.* 2004); however, such impacts require further investigation.

However, our greatest concern in our serious injury work was the number of animals we never saw! Scar-based studies suggest that interactions between whales and fishing gear are common, and that many whales survive those encounters. Hamilton *et al.* (1998) examined photographs of 357 individual right whales and found that 62% ($n = 220$) had scars from entanglement, and 124 had been entangled more than once. Approximately half (48-65%) of Gulf of Maine humpback whales have been entangled at least once in their life time, while 8-25% sustain new injuries each year (Mattila and Robbins 1998; Robbins and Mattila 1999, 2000, 2001a, 2001b, 2003, 2004). But scar studies generally only provide information on non-lethal encounter rates. Any interaction between a whale and fishing gear has the potential to be fatal if a constricting entanglement occurs. There is currently no reliable method for estimating the number of large whales that die each year from entanglements, although recovered carcasses provide minimum values. 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. Right whales may also become negatively buoyant if an injury precludes effective feeding for an extended period (Moore *et al.* 2004).

Vessel collisions frequently lack external evidence, and may not be detected unless a necropsy is conducted. Knowlton and Kraus (2001) reported on 45 right whale mortalities from 1970-1999.

Of these, 16 (36%) were attributed to ship strikes, 13 (29%) to natural causes, 13 were from unknown causes, and 3 (7%) were the result of entanglements. Of 15 right whales identified as ship strike mortalities, four (27%) showed no outward appearance of a strike (Hamilton et al. 1998). Wiley et al. (1995) reported a similar lack of external evidence of vessel collisions; of 20 large whale carcasses examined from the Carolina, Virginia and New Jersey coasts, 6 (30%) had major injuries potentially attributable to ship strikes and two of these showed no external signs of trauma. 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. Of the 30 right whales necropsied during 1970 through 2002, 13 (43%) were confirmed as ship strike mortalities, four (13%) were confirmed to be the result of entanglement, and one was due to natural causes (Moore *et al.* 2004). The causes of death were not identified for the remaining cases, however, one was possibly the result of a ship strike. An additional 24 mortalities were reported during the period, but no internal examination was conducted (Moore *et al.* 2004).

The Marine Mammal Commission has indicated that serious injury and mortality estimates based only on confirmed reports are not precautionary because these estimates are negatively biased. That is, not all injured or dead animals are accounted for. Given the low sighting probability and apparently high rate of interaction of whales with fishing gear and ships, we concur that any estimate based on observed dead or seriously injured animals is a very conservative lower bound. Thus, if the observed mortality and serious injury estimate developed from stranding/floater/ entanglement data is near but below a threshold value (*e.g.*, PBR for a marine mammal stock), it is reasonable to assume that the true mortality/serious injury value exceeds the threshold.

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Table 1. Summary of all reported baleen and unidentified whale events along the Gulf of Mexico coast, U.S. East coast and adjacent Canadian Maritimes, 1999 -2003.

Species	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 ^e	Unidentified whale spp.	TOTALS
Total reports ^a (1999, 2000, 2001, 2002, 2003)	50 (9, 12, 10, 12, 7)	169 (17, 34, 30, 35, 53)	40 (8, 4, 9, 5, 14)	4 (0, 0, 2, 1, 1)	1 (0, 0, 0, 1, 0)	82 (20, 14, 10, 14, 24)	1 (0, 0, 0, 0, 1)	5 (0, 0, 2, 0, 3)	14 (3, 0, 2, 2, 7)	42 (10, 5, 7, 4, 16)	408
Total entanglement reports ^a	35 (8, 10, 4, 8, 5)	82 (10, 17, 13 ^c , 21, 21)	7 (2, 0, 2, 1, 2)	0	1 (0, 0, 0, 1, 0)	35 (8, 6, 5 ^d , 5, 11)	1 (0, 0, 0, 0, 1)	0	0	12 (3, 2, 4, 1, 2)	173
Total ship strike reports	9 (1, 2, 2, 2, 2)	14 (0, 2, 6 ^c , 3, 3)	10 (2, 1, 3, 0, 4)	2 (0, 0, 1, 0, 1)	0	2 (1, 0, 1 ^d , 0, 0)	0	0	0	0	37
Confirmed entanglement events	31 (6, 9, 4, 8, 4)	74 (10, 15, 11 ^c , 18, 20)	7 (2, 0, 2, 1, 2)	0	1 (0, 0, 0, 1, 0)	27 (6, 5, 4, 3, 9)	1 (0, 0, 0, 0, 1)	0	0	5 (1, 0, 2, 1, 1)	146
Confirmed ship strike events	8 (1, 2, 2, 1, 2)	10 (0, 1, 5 ^c , 2, 2)	5 (2, 1, 2, 0, 0)	2 (0, 0, 1, 0, 1)	0	0	0	0	0	0	25
Total confirmed mortalities	18 (3, 1, 8, 5, 1)	92 (7, 14, 22, 18, 31)	34 (5, 4, 8, 5, 12)	4 (0, 0, 2, 1, 1)	0	71 (19, 10, 8, 12, 22)	1 (0, 0, 0, 0, 1)	5 (0, 0, 2, 0, 3)	14 (3, 0, 2, 2, 7)	28 (4, 3, 3, 3, 15)	267
Confirmed entanglement mortalities	3 (1, 0, 1, 1, 0)	8 (1, 0, 3, 3, 1)	2 (0, 0, 1, 1, 0)	0	0	15 (5, 1, 2, 2, 5)	1 (0, 0, 0, 0, 1)	0	0	0	29
Confirmed ship strike mortalities	5 (1, 0, 2, 1, 1)	6 (0, 0, 3, 2, 1)	5 (2, 1, 2, 0, 0)	2 (0, 0, 1, 0, 1)	0	0	0	0	0	0	18
Confirmed entanglement serious injuries	5 (0, 1, 1, 2, 1)	12 (2, 5, 0, 1, 4)	0	0	0	1 (0, 1, 0, 0, 0)	0	0	0	0	18
Confirmed ship strike serious injuries	0	0	0	0	0	0	0	0	0	0	0

^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 One minke report included as both an unconfirmed entanglement and unconfirmed ship strike report.

^e Described as having throat grooves (rorqual pleats).

Table 2. Summary of the confirmed human-caused mortality and serious injury ('SI') events involving baleen whales along the Gulf of Mexico coast, U.S. East coast and adjacent Canadian Maritimes, 1999 - 2003, 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 (1999, 2000, 2001, 2002, 2003)	Confirmed SI's (1999, 2000, 2001, 2002, 2003)	Annual rate (US waters / Canadian waters)	Confirmed mortalities (1999, 2000, 2001, 2002, 2003)	Confirmed SI's
North Atlantic right whale	2.6 (0)	1.6 (1.0 / 0.6 / 0)	3 (1, 0, 1, 1, 0)	5 (0, 1, 1, 2, 1)	1.0 (0.8 / 0.2)	5 (1, 0, 2, 1, 1)	0
Gulf of Maine humpback whale ¹	3.8 ² (1.3)	2.8 (2.0 / 0.6 / 0)	5 (1, 0, 1, 2, 1)	9 (2, 3, 0, 1, 3)	0.6 (0.6 / 0)	3 (0, 0, 2, 1, 0)	0
Western North Atlantic fin whale ³	1.4 (4.7)	0.4 (0.2 / 0 / 0.2)	2 (0, 0, 1, 1, 0)	0	1.0 (1.0 / 0)	5 (2, 1, 2, 0, 0)	0
Nova Scotian sei whale ⁴	0.4 (-)	0	0	0	0.4 (0.4 / 0)	2 (0, 0, 1, 0, 1)	0
Western North Atlantic blue whale ⁵	0 (-)	0	0	0	0	0	0
Canadian East Coast minke whale	3.2 (3.1)	3.2 (3.2 / 0 / 0)	15 (5, 1, 2, 2, 5)	1 (0, 1, 0, 0, 0)	0	0	0
Western North Atlantic Brydes whale	0.2 (0.3)	0.2 (0.2 / 0 / 0)	1 (0, 0, 0, 0, 1)	0	0	0	0

¹ Includes only events involving confirmed members of the Gulf of Maine feeding stock.

² Includes a mother and calf taken by the Bequian hunt in 1999 (an addition of 0.4 per year for the period).

³ Includes an entanglement mortality found off Bermuda in 2001.

^{4, 5} Stock abundance estimates outdated; no PBR established for these stocks.

Table 3. Confirmed human-caused mortality and serious injury records of North Atlantic right whales, 1999 - 2003.

Date	Report Type	Sex, age, ID	Location	Assigned Cause: P=primary, S=secondary		Notes
				Ship strike	Entang./ Fsh inter	
4/20/99	mortality	27+ yr. old female #1014	Cape Cod, MA	P		Fractures to mandible and vertebral column, abrasion and edema around right flipper
5/10/99	mortality	Adult female #2030	80mi east of Cape Cod, MA		P	Constricting sink gillnet gear created deep, extensive lacerations
3/01/00	serious injury	Adult male #1130	6mi east of Manomet, MA		P	Line apparently constricting left flipper; flipper discolored; abnormal cyamid distribution; bullet buoy trailing, line weighted down between whale and buoy
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	Adult male #1102	58mi east of Cape Cod, MA		P	Entangling gear deeply embedded; whale showing numerous signs of poor health including emaciation, skin discoloration, and abnormal cyamid distribution
6/18/01	mortality	female calf	Long Island, NY	P		Dorsal propeller wounds, sub-dermal hemorrhage
11/3/01	mortality	Adult male #1238 14 m	Magdellen Islands, Canada		P	Thoroughly wrapped up in gear, whale seen alive and well five months earlier
7/6/02	mortality	11.0m (est) female #3107	off Briar Island, NS Canada		P	carcass ashore on Nantucket, MA; caudal peduncle severely lacerated where entangled
8/22/02	serious injury	Adult female #1815	Scotian Shelf, Canada		P	line tightly wrapped around head and tail stock
8/22/02	mortality	12.6m female 1y.o.	off Ocean City, MD	P		large laceration on dorsal surface
8/30/02	serious injury	#3210 age & sex unknown	Bay of Fundy, NS		P	line tightly wrapped around rostrum, resighted in 2004 in poor condition
1/14/03	serious injury	Adult female #2240	Jacksonville, FL		P	body condition poor, gear possibly ingested
10/02/03	mortality	Adult female #2150	Digby, NS	P		Large fracture in skull, sub-dermal hemorrhage

Table 4. Confirmed human-caused mortality and serious injury records of North Atlantic humpback whales, 1999 - 2003. Records from the Gulf of Maine humpback whale stock are indicated by an asterisk (*) following the date. Stock identification of the remaining records awaits genetic analysis results. These may identify additional Gulf of Maine whales.

Date	Report Type	Sex, age, ID length	Location	Assigned Cause: P=primary, S=secondary		Notes
				Ship strike	Entang./ Fsh.inter	
1/12/99*	mortality	9.7m male	Martha's Vineyard, MA		P	Fresh and extensive rope marks on carcass with associated hemorrhaging
3/6/99*	mortality	13.8m female and calf	Bequia, St. Vincent and the Grenadines			Two whales taken by the Bequian harpoon fishery
8/2/99*	serious injury	9.4m estimated	Bay of Fundy, Canada		P	Single wrap of ½ inch poly line pinning flippers
9/23/99*	serious injury	unknown	off Chatham, MA		P	Line out of mouth and several wraps around body; possibly anchored
1/8/00	serious injury	9.9m estimated	30mi east Cape Lookout, NC		P	whale swam off with 600' of sea trout sink gillnet, a chain anchor and a high flyer in tow
8/4/00*	serious injury	10.7m estimated	Bay of Fundy, Canada		P	gillnet wrapped on head with weighted trailing line giving tension
9/6/00*	serious injury	<1 yr old, calf of "Giraffe"	Stellwagen Bank, MA		P	single line wrapped across back; constriction will increase as whale grows
10/14/00	serious injury	9.9m estimated	off Ocean City Inlet, MD		P	Heavily entangled in line and netting; constrictive--fresh wounds noted
10/20/00*	serious injury	10 yr old male "Tribble"	Stellwagen Bank, MA		P	Entangled in green poly line on multiple body parts; appears constrictive
1/25/01	mortality	6.9m estimated	Avon, NC	P		extensive hemorrhaging along left thoracic, clean cut through center of vertebrae; ship strike
4/8/01	mortality	7.9m juvenile male	Myrtle Beach, SC	S	P	pre-mortem evidence of chronic line entanglement; severe prop wounds
4/8/01	mortality	7.6m juvenile male	Emerald Isle, NC		P	entanglement around peduncle caused extensive edema, hemorrhaging
4/9/01*	mortality	8.8m juvenile female "Inland"	offshore of Sandbridge, Virginia Beach		P	found anchored in gillnet gear; line wraps around rostrum had immobilized the whale

Date	Report Type	Sex, age, ID length	Location	Assigned Cause: P=primary, S=secondary		Notes
				Ship strike	Entang./ Fsh.inter	
7/29/01*	mortality	8.5m juvenile female	floating south of Verrazano Bridge, NY	P		large laceration on left side of head, extensive fracturing of skull
10/1/01*	mortality	11.4m 3 yr old female "Pitfall"	Duxbury Beach, MA	P		massive fracturing to skull, focal bruising indicative of pre-mortem ship strike
2/8/02	mortality	8.4m juvenile female	off Cape Henry, VA	P		three large lacerations, hemorrhaging, broken bones
3/24/02	mortality	8.0m juvenile male	off Virginia Beach, VA		P	deep cuts on caudal peduncle and tail indicative of embedded line
6/3/02*	mortality	9.9m	off Cape Elizabeth, ME		P	deep cuts on caudal peduncle indicative of embedded line
6/17/02*	serious injury	10.2m estimated	Cape Cod Bay, MA		P	fluke severely damaged by line, whale emaciated
8/1/02*	mortality	9.3m male	Long Island, NY	P		large hematoma posterior to blow holes
10/1/02*	mortality	7.5m female calf	Plymouth, MA		P	Found wrapped in lobster warp, extensive bruising
6/6/03	mortality	8.3m female	Chesapeake Bay mouth, VA	P		Major trauma to right side of head, hematoma
7/9/03*	serious injury	calf of Shockwave	Bay of Fundy, Canada		P	Constricting entanglement on a young whale
7/12/03	serious injury	unknown	Oregon Inlet, NC		P	Entangled in substantial amount of gear
8/15/03*	mortality	7.3m (est) calf	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
8/18/03*	serious injury	unknown	off Cape Cod, MA		P	Extensive entanglement

Table 5. Confirmed human-caused mortality and serious injury records of North Atlantic fin whales, 1999 - 2003.

Date	Report Type	Sex, age, ID length	Location	Assigned Cause: P=primary, S=secondary		Notes
				Ship strike	Entang./ Fsh.inter	
2/10/99	mortality	15.5m male	Virginia Beach, VA	P		large external wound, extensive fractures to vertebral column, hemorrhaging
11/5/99	mortality	16.2m male	Elizabeth, NJ	P		large wound anterior of the blowhole, severed left flipper, shattered bones
12/11/00	mortality	10.9m female	New York harbor	P		hemorrhage and fractured bones on right side
1/2/01	mortality	18.1m female	New York harbor	P		dorsal abrasion marks, hematoma
2/1/01	mortality	14.5m female	Port Elizabeth, NJ	P		Very fresh carcass hung on ship's bow
9/19/01	mortality	10.7m unknown	off Bermuda		P	Extensive fresh entanglement marks
7/28/02	mortality	unknown	Georges Bank		P	Heavy line seen on tail stock, appeared embedded

Table 6. Confirmed human-caused mortality and serious injury records of Nova Scotian sei whales, 1999 - 2003.

Date	Report Type	Sex, age, ID	Location	Assigned Cause: P=primary, S=secondary		Notes
				Ship strike	Entang./ Fsh inter	
5/2/01	mortality	13.0 m female	New York Harbor	P		On ship's bow; hemorrhaging
2/19/03	mortality	11.0m male	Norfolk, VA 36 58'N 76 21'W	P		Large gash into muscle, hemotoma and abrasions

Table 7. Confirmed human-caused mortality and serious injury records of Canadian East Coast minke whales, 1999 - 2003.

Date	Report Type	Sex, age, ID	Location	Assigned Cause: P=primary, S=secondary		Notes
				Ship strike	Entang./ Fsh.inter	
5/22/99	mortality	4.6m female	Cape Lookout Bight, NC 34° 41'N 76° 54'W		P	Unknown fishery. Fresh open wounds around fluke and line marks from pectoral fins through mouth.
6/16/99	mortality	6.9m female	Orleans, MA 41° 48'N 65° 56'W		P	Unknown fishery. Extensive rope markings with hemorrhaging.
7/3/99	mortality	4.3m female	Sakonnet River, RI 41° 48'N 71° 12'W		P	Trawl fishery. 4.5 inch stretched mesh driven into rostrum.
8/2/99	mortality	4.1m female	Point Judith Light, RI 41° 23'N 71° 28'W		P	Trawl fishery. 6 inch stretched mesh tightly wrapped around rostrum.
10/2/99	mortality	7.2m female	Provincetown, MA (42° 03'N 70° 21'W)		P	Unknown fishery. Rope marks on left gape of mouth, left pectoral fin, caudal peduncle, and dorsal and ventral surfaces of fluke blades.
8/11/00	serious injury	unk sex and size	Port Clyde, ME 43° 55'N 69° 11'W		P	Unknown fishery. Dark line with several bullet buoys. Unusual minke behavior - whale probably anchored.
10/3/00	mortality	unk sex and size	Rockland, ME 44° 05'N 69° 01'W		P	Unknown fishery. Very fresh carcass with fresh entanglement wounds on tail stock.
8/17/01	mortality	3.9m male,	Middletown, RI 41° 28'N 71° 15'W		P	Unknown fishery. Severe rope entanglement around mouth and rostrum caused malnutrition and infection.
12/13/01	mortality	7m (est) unk sex,	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.
7/17/02	mortality	4.6m (est) female	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

Date	Report Type	Sex, age, ID	Location	Assigned Cause: P=primary, S=secondary		Notes
				Ship strike	Entang./ Fsh.inter	
10/15/02	mortality	5.1m female	Gloucester, MA 42° 36'N 70° 39'W		P	Unknown fishery. Whale was entangled through the mouth and around the pectoral flippers. Gear was still on the whale.
5/24/03	mortality	7.6m male	Glouster, 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.
5/31/03	mortality	3.6m (est) female	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.
6/28/03	Mortality	5.1m male	Chatham, MA 41° 40'N 69° 55'W		P	Whale was wrapped in lobster gear.
8/9/03	mortality	3.5m (est) unk sex	Harwich, MA 41° 37'N 70° 03'W		P	Unknown fishery. Hemorrhaging in areas with net marks on whale.
9/13/03	Mortality	6m (est) female	Casco Bay, ME 43° 42'N 69° 58'W		P	Unknown fishery. Fresh line chaffing marks, belly slit open.

Table 8. Confirmed human-caused mortality and serious injury records of western North Atlantic Brydes whales, 1999 - 2003.

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

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