



# **Injury Determinations for Humpback Whales and Other Cetaceans Reported to NOAA Response Networks in the Hawaiian Islands During 2013–2016**

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**U.S. DEPARTMENT OF COMMERCE**  
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Pacific Islands Fisheries Science Center

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## Abstract

Reports of cetaceans with human-caused injuries in Hawaiian waters are made each year to the Pacific Islands Region Marine Mammal Response Network (PIR-MMRN, coordinated by the NOAA National Marine Fisheries Service (NMFS) Pacific Islands Regional Office) and the Hawaiian Islands Entanglement Response Network (HIERN, coordinated by the NOAA Hawaiian Islands Humpback Whale National Marine Sanctuary). These injury reports largely involve humpback whales that were entangled in fishing gear or marine debris or were struck by or otherwise made contact with a vessel. Bradford and Lyman (2015) made determinations of injury severity (i.e., serious or non-serious) for cetaceans in Hawaii reported injured by human causes during 2007–2012. Prior to this work, most human-caused injuries reported to PIR-MMRN and HIERN were not accounted for in the mortality and serious injury (M&SI) estimates that are a key component of the Stock Assessment Reports (SARs) for cetaceans in Hawaiian waters. The present paper provides a summary of injury determinations for cetaceans in Hawaii reported injured by human causes during 2013–2016. Injury determinations were made using a nationally standardized process and criteria for distinguishing serious from non-serious injuries (NMFS 2012). From 2013 to 2016, there were 70 reports of cetaceans with human-caused injuries, including 21 humpback whales involved in vessel collisions, 38 humpback whales entangled in presumed or confirmed fishing gear, and 11 other cetaceans hooked or entangled in presumed fishing gear or marine debris. Estimates of M&SI are considered over five-year periods; thus, determinations from 2012 to 2016 are relevant to the 2018 SARs. The 71 humpback whale vessel collisions and entanglements during 2012–2016 led to 37.68 serious injuries and 1 mortality. The resulting average of 7.74 mortalities and serious injuries per year can be considered a minimum estimate of M&SI from Hawaii for use in the 2018 SAR of the central North Pacific stock of humpback whales. For the other cetaceans in 2012–2016, serious injury determinations of relevance to the 2018 SARs were made for a bottlenose dolphin of the Hawaii Island stock, rough-toothed dolphins of the Hawaii stock ( $n = 2$ ), spinner dolphins of the Hawaii Island ( $n = 5$ ) and Oahu/4-Islands<sup>1</sup> ( $n = 2$ ) stocks, and a pantropical spotted dolphin of the Hawaii Island stock. Significantly more effort is needed to report, document, and monitor injured Hawaiian cetaceans other than humpback whales.

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<sup>1</sup> The 4-Islands region comprises the islands of Maui, Molokai, Lanai, and Kahoolawe.

## Introduction

The Marine Mammal Protection Act (MMPA) requires the NOAA National Marine Fisheries Service (NMFS) to prepare Stock Assessment Reports (SARs) for marine mammal stocks occurring in U.S. waters. Along with information on stock abundance and status, the SARs include an estimate of the annual human-caused mortality and serious injury (M&SI) by source. Regulations define serious injury as an injury that will likely result in mortality.<sup>2</sup> In 2012, NMFS clarified its interpretation of this definition as any injury that is more likely than not to result in mortality.<sup>3</sup> The process for distinguishing serious from non-serious injuries pursuant to the MMPA was also revised (NMFS 2012).<sup>4</sup> These revisions were aimed at making the injury determination process more consistent and transparent, as well as providing additional guidance for cases that would have previously been classified as “cannot be determined.” Estimates of human-caused M&SI are compiled and averaged over five-year periods for inclusion in the SARs. However, the process of injury determination, including internal and external peer review, and the MMPA-specified SAR public review leads to a 2-year lag between the M&SI estimation period and the SAR year. The 2018 SARs require estimates of M&SI from 2012 to 2016.

Reports of injured and dead cetaceans in the U.S. Exclusive Economic Zone around the Hawaiian Islands (Hawaiian EEZ) are received each year by the Pacific Islands Region Marine Mammal Response Network (PIR-MMRN), which is coordinated by the NMFS Pacific Islands Regional Office (PIRO), and the Hawaiian Islands Entanglement Response Network (HIERN), which is coordinated by the NOAA Hawaiian Islands Humpback Whale National Marine Sanctuary. These two agencies work closely together and are part of the greater NMFS Marine Mammal Health and Stranding Response Program. Most of the injury reports involve humpback whales (*Megaptera novaeangliae*) that are entangled in fishing gear or marine debris or have been struck by or otherwise made contact with a vessel. Occasionally, however, reports of other species are received. While reported cetaceans have traditionally been assessed for injury and impact by PIR-MMRN or HIERN, and response efforts mobilized as appropriate, determinations of injury severity (i.e., serious or non-serious) were only recently initiated (Bradford and Lyman 2015). Prior to that effort, injury determinations based on reports to PIR-MMRN or HIERN had not previously been accounted for in estimates of M&SI for the affected stocks.

Bradford and Lyman (2015) provided a summary of injury determinations for cetaceans in and around the Hawaiian EEZ reported injured by human causes to the PIR-MMRN and HIERN during 2007–2012. The present paper extends this time series of injury determinations from 2013 to 2016. These determinations are based on injury reports that are opportunistic and not a part of a quantifiable and directed sampling scheme. Thus, the resulting determinations of serious injury (or mortality) cannot be used to estimate undocumented M&SI from the same source. However, these serious injuries and mortalities can serve as minimum estimates of M&SI by source and should be included in the relevant SARs (NMFS 2016).

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<sup>2</sup> 50 CFR 229.2

<sup>3</sup> NMFS Policy Directive PD 02-238

<sup>4</sup> 77 Federal Register 3233 (23 January 2012)

Most cetacean species that occur in the Hawaiian EEZ are recognized as Hawaii stocks, with differentiation as pelagic and island-associated stocks for some species. Hawaiian stocks of cetaceans are assessed and managed by the NMFS Pacific Islands Fisheries Science Center (PIFSC) and PIRO, respectively. However, humpback whales that overwinter in the Hawaiian EEZ are part of the central North Pacific (CNP) stock, which falls under the purview of the NMFS Alaska Fisheries Science Center (AFSC) for assessment and the NMFS Alaska Regional Office and PIRO for management. Therefore, in terms of SAR preparation, the determinations contained herein are directed at AFSC for humpback whales and at PIFSC for all other cetaceans.

## Methods

The PIR-MMRN maintains an electronic database of over 1,300 records with summary information (e.g., date, species, location, condition) for each stranded or injured marine mammal reported from 1848 to the present. Generally, these records are associated with case-specific documentation, such as a Level A Form, a necropsy report, or photographs. The PIR-MMRN database was accessed and cetacean records in and around the Hawaiian EEZ from 2013 to 2016 ( $n = 139$ ) were extracted. These records were reviewed to identify reports of cetaceans injured by human causes so that injury determinations could be made and incorporated into M&SI estimates for the affected stocks.

The identified PIR-MMRN reports were supplemented with 59 confirmed injury reports (i.e., containing sufficient descriptive information from a reliable source) maintained in the HIERN database, which dates back to 2002 and contains over 850 records also associated with case-specific documentation. The HIERN database records occasionally overlapped with those of the PIR-MMRN, but were more complete because the HIERN was the primary data source. Further supplementing the reports compiled from the two databases were two reports of injured rough-toothed dolphins (*Steno bredanensis*): 1) a “Cetacean of Concern” document prepared by PIR-MMRN in 2014, and 2) a report from a research team led by R. Baird (Cascadia Research Collective), both of which should have been incorporated in the PIR-MMRN database. The merged set of 2013–2016 injury reports was evaluated and the injury severity of each injured cetacean was determined using the revised guidelines and criteria presented in NMFS (2012). When follow-up (observation or response) of injured individuals occurred, which was often the case for entangled humpback whales, an injury determination was made both before and after follow-up and any mitigation efforts, so that the appropriate number of mortalities and serious injuries can be considered when classifying commercial fisheries on the MMPA-mandated List of Fisheries (LOF), and when comparing M&SI estimates with the Potential Biological Removal (PBR) value reported in the SARs. That is, initial injury determinations prior to follow-up and mitigation are used in LOF classifications, and determinations after these efforts are relevant to the PBR comparisons (NMFS 2012).

Injury determinations were made collaboratively by the authors, with EGL taking the lead on the reports of humpback whales and ALB on the reports of other cetaceans. Additional interpretation or consideration was required in the application of some of the injury categories for injured large whales (see Appendix A for details of how these categories were applied). As directed by NMFS (2012), the preliminary injury determinations were then sent for independent review to members of the NMFS Determination Staff Working Group with applicable expertise (Forney 2010;



Henry et al. 2017). The humpback injury determinations were reviewed by A. Henry (NMFS Northeast Fisheries Science Center), and the other cetacean injury determinations were reviewed by K. Forney (NMFS Southwest Fisheries Science Center). Differences between the preliminary and reviewer determinations were discussed and reconciled by ALB and EGL, with input from the reviewers as needed.

Follow-up and mitigation efforts of entangled cetaceans, particularly disentanglement activities by the HIERN, often involved the photo-documentation and occasionally the collection of entangling gear. The HIERN made substantial efforts, in collaboration with PIRO and other partner agencies, to identify the gear type and associated fishery (if applicable) for the humpback entanglement cases. However, unlike other regions where there are dedicated gear specialists, staff resources in the Pacific Islands were challenged to systematically review the gear in all cases. A summary of the information available for a systematic gear review for all the cetacean entanglements is included along with the injury determinations. For the humpback entanglements, the details and available results of gear reviews conducted to date are included along with assessment of the possibility of further classification from additional review efforts.

## Results and Discussion

In total, 70 reports of cetaceans with human-caused injuries from 2013–2016 were identified. The reports consist of 21 humpback whales involved in vessel collisions (Table 1), 38 humpback whales entangled in presumed or confirmed fishing gear (Table 2), and 11 other cetaceans hooked or entangled in presumed fishing gear or marine debris (Table 3). The other cetaceans include a bottlenose dolphin (*Tursiops truncatus*), two rough-toothed dolphins, six spinner dolphins (*Stenella longirostris*), a pantropical spotted dolphin (*Stenella attenuata*), and a dolphin unidentified to species.

As in Bradford and Lyman (2015), the review process highlighted the challenging nature of some of the humpback whale injury events and revealed regional differences in the ways some injury categories are applied to large whales (Appendix A). For the 59 humpback whale vessel collisions and entanglements, the injury determinations of the reviewer differed from the preliminary determinations in six (10.2%) cases ( $n = 2$  vessel collisions and  $n = 4$  entanglements; Table 4). Follow-up discussions led to changes in three of the preliminary entanglement injury determinations (Table 4). Further discussion among all members of the NMFS Determination Staff Working Group could reduce the variability in large whale injury determinations between member subsets. However, considerable regional differences in entangling gear type, whale seasonal ecology (e.g., stage in migratory cycle), and opportunities for follow-up and mitigation will remain that will likely continue to influence the injury determination process at a regional scale. The reviewer of the other cetacean injury determinations was in agreement with all of the preliminary determinations, with the exception of the spinner dolphin reported entangled on 03/11/13 (Table 3). Following input from the reviewer, both the initial and follow-up determinations for that report were changed from “non-serious” (according to category S5b) to “serious” (according to category S5a).

As reported in Bradford and Lyman (2015), there were 3 humpback whales involved in vessel collisions and 9 humpback whales entangled in presumed or confirmed fishing gear in 2012. For the 2012–2016 period relevant to the 2018 SAR, the humpback whale vessel collisions ( $n = 24$ )

led to 7.68 serious injuries (note that some large whale injury categories involve prorating injuries as proportionally serious; NMFS 2012) for comparison to PBR (Table 1; Bradford and Lyman 2015). The 2012–2016 humpback whale entanglements ( $n = 47$ ) led to 35 serious injuries and one mortality for consideration with the LOF and 30 serious injuries and one mortality for comparison to PBR (Table 2; Bradford and Lyman 2015). Overall, there were 37.68 serious injuries and one mortality in Hawaii relevant to the PBR comparison of CNP humpback whales in the 2018 SAR. Thus, the average of 7.74 mortalities and serious injuries per year can be considered a minimum estimate of M&SI resulting from vessel collisions and entanglements reported in Hawaiian waters.

Further reported in Bradford and Lyman (2015), there was a spinner dolphin entangled in marine debris in 2012. For the other cetaceans reported injured in 2012–2016 ( $n = 12$ ), there were 8 serious injuries and 1 mortality for consideration with the LOF and 10 serious injuries and 1 mortality for comparison with PBR values (Table 3; Bradford and Lyman 2015). The serious injuries and mortalities of relevance to the SARs were from a bottlenose dolphin of the Hawaii Island stock, rough-toothed dolphins of the Hawaii stock ( $n=2$ ), spinner dolphins of the Hawaii Island ( $n = 5$ ) and Oahu/4-Islands ( $n = 2$ ) stocks, and a pantropical spotted dolphin of the Hawaii Island stock. An additional serious injury could have been used for LOF consideration and PBR comparison, but this determination was associated with an unidentified dolphin (Table 3).

The HIERN makes an effort to cross-match the injured humpback whales that were adequately photo-identified with other photo-identified whales in its database and with other CNP humpback whale photo-identification catalogs. However, there are not dedicated personnel to systematically pursue identification of injured individuals to the greatest extent possible, and the CNP stock of humpback whales numbers in the thousands of individuals (Muto et al. 2016). Additionally, many reports are made without images suitable for photo-identification. Based on identification efforts to date, there are no individuals of any cetacean species known to have been injured more than once between 2012 and 2016. Thus, for the purposes of establishing minimum estimates of M&SI, all injured cetaceans summarized here are considered to represent separate individuals. There may be cases where a given individual is associated with more than one injury report, which would lead to a positive bias in the resulting minimum M&SI estimates. However, any positive bias is unlikely to exceed the level of undocumented M&SI from vessel collisions and fishing gear entanglement, indicating that the values reported here are appropriate minimum estimates of M&SI.

Of the 38 humpback whale entanglements from 2013 to 2016, gear type was identified for 6 (15.8%), involving Alaska pot gear ( $n = 3$ ), longline<sup>5</sup> ( $n = 2$ ), and Hawaii pot gear ( $n = 1$ ) (Table 2). Four (66.7%) of the six entanglements with known gear types were further linked to specific commercial fisheries, including Alaska shrimp, Alaska king or tanner crab or finfish, Alaska king crab, and Hawaii crab. Although a substantial effort was made to review the photographed and collected gear, staff resources did not allow a complete review in all cases. The best assessment of available gear and photographs suggests additional effort in identifying gear type or fishery is warranted for 4 of the 32 humpback whale cases where both gear type and fishery

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<sup>5</sup> Observed humpback whale interactions with the Hawaii longline fisheries between 2013 and 2016 ( $n = 2$ ) are summarized in Bradford (2018) and Bradford and Forney (2017).

are unknown, and for both of the cases where gear type is known but the fishery is not (Table 2). Gear type and fishery is currently unknown for all ten presumed fishery-related injuries of other cetaceans from 2013 to 2016, but additional review to identify these characteristics is recommended for five of the cases (Table 3).

Part of the process of reviewing the PIR-MMRN database for reports of cetaceans injured by human causes involved following up on stranding records where there was noted or suggested evidence of human-caused injury, which often required obtaining information from necropsy reports prepared by the marine mammal stranding program led by K. West (presently at University of Hawaii at Manoa, formerly of Hawaii Pacific University). If the injury was determined to be the cause of death, the associated record was added to the subset of injury reports of relevance to the human-caused M&SI estimates and summarized herein. If the injury could not be confirmed or was determined not to be the cause of death, the associated record was excluded from the subset of injury reports compiled for the present paper. Yet, the excluded reports merit mention, as they contain qualitative information on potential injury sources and susceptible species, which is important given how little is known about anthropogenic injuries for Hawaiian cetaceans other than humpback whales (Bradford and Lyman 2015).

From 2013 to 2016, there was one PIR-MMRN stranding record where a human-caused injury was determined to be the cause of death (i.e., the entangled spinner dolphin reported on 03/10/14; Table 3). Additionally, there were two stranding records during this period where a human-caused injury could not be confirmed and four where the injury was determined not to be the cause of death. The two unconfirmed cases involved two short-finned pilot whales (*Globicephala macrorhynchus*) of the Hawaii stock that were found stranded during naval sonar training exercises in 2014; one on 07/25/14, and the other on 08/01/14 (K. West, personal communication). The four cases where a human-caused injury was documented but determined not to be the cause of death involve two false killer whales (*Pseudorca crassidens*) of the main Hawaiian Islands insular stock, a short-finned pilot whale of the Hawaii stock, and a pantropical spotted dolphin of the Oahu stock. The two false killer whales were found stranded with fishing hooks in their stomachs; one on 10/04/13 with five hooks, and the other on 09/28/16 with one hook (K. West, personal communication). None of the hooks were consistent with those currently used in the Hawaii-based commercial longline fisheries. The short-finned pilot whale was found stranded on 07/06/14 with a large amount of marine debris, including fishing nets, in its stomach (K. West, personal communication). Finally, the pantropical spotted dolphin was found stranded on 10/21/14 with scarring on its gum line suggestive of a previous fishery interaction.

Cetaceans in Hawaiian waters, particularly humpback whales, are subject to human-caused injuries from a variety of sources, which should continue to be accounted for in the SARs. For cetaceans other than humpback whales, significantly more effort and resources are needed to report, document, and monitor individuals with anthropogenic injuries. The PIR-MMRN and HIERN have been expanding their efforts in this regard primarily by communicating to various partners and stakeholders the value of reporting injured cetaceans. Continued progress in soliciting and documenting such injuries will inform and improve assessments of the affected cetacean stocks.

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Table 1. Injury determinations for humpback whales reported to be involved in vessel collisions in Hawaiian waters during 2013–2016, using the most recent established criteria for distinguishing serious from non-serious injury of large whales (Table 1 in NMFS 2012). Table continues on following page.

Report date	Age class	Vessel length (ft)	Vessel speed (kn)	Event summary	Observed injury	Injury categories	Injury determination	Value for PBR
01/26/13	Subadult	54	10	Tour vessel struck whale. Whale observed for unspecified period of time and did not show signs of injury.	None observed	L6c	Non-serious	0
01/29/13	Non-calf	22-24	<10	Whale made contact with a single-person canoe with fluke damaging the canoe and capsizing the occupant.	None observed	L6c	Non-serious	0
01/29/13	Calf	50	6-8	Whale surfaced under tour vessel and was struck by propeller. Whale surfaced with mother after contact and observed for two surfacings; injury observed and blood seen in water.	Lacerations (6-8 in long, severity unknown) on dorsal surface; blood in water	L6c, L11	Prorate 0.52 Serious	0.52
01/30/13	Calf	15	9	Private motor vessel struck whale. Whale observed for unspecified period of time and did not show signs of injury.	None observed	L6c	Non-serious	0
02/03/13	Subadult	~46	0	Whale breached and made contact with bow of multi-person outrigger canoe.	None observed	L6c	Non-serious	0
02/16/13	Adult	60	8-9	Whale (mother with associated calf) surfaced under tour vessel and was struck. Whales surfaced after contact; blood seen in water behind dorsal fin of mother.	Blood in water	L6c, L11	Prorate 0.52 Serious	0.52
02/16/13	Calf	60	8-9	Mother of this associated calf surfaced under tour vessel and was struck. Whales surfaced after contact; blood seen in water behind dorsal fin of mother.	None observed	L8	Prorate 0.52 Serious	0.52
02/17/13	Calf	33	11-13	Dive vessel struck whale. Whale observed for two surfacings; injury observed and blood seen in water.	4 lacerations (severity unknown) behind dorsal fin; blood in water	L6b (calf), L11	Serious	1
03/01/13	Calf	?	?	Whale discovered with injuries consistent with vessel strike (date and location of strike unknown).	>14 lacerations (deep, with some open) along left flank	L5a, L12 (calf)	Serious	1
03/26/13	Unknown	32	7	Whale surfaced under sailing vessel and was struck by hull. Whale observed for unspecified period of time and did not show signs of injury. Vessel sustained damage to the keel.	None observed	L6c	Non-serious	0
01/19/14	Adult	65	7	Tour vessel presumably struck whale that surfaced after a bump, but unknown if mother or calf (or both) were struck. Precautionarily, presumed both whales struck for injury determination. Whales observed for 40 min and did not show signs of injury.	None observed	L6c	Non-serious	0
01/19/14	Calf	65	7	Tour vessel presumably struck whale that surfaced after a bump, but unknown if mother or calf (or both) were struck. Precautionarily, presumed both whales struck for injury determination. Whales observed for 40 min and did not show signs of injury.	None observed	L6c	Non-serious	0
02/28/14	Adult	65	17	Ferry vessel presumably struck one of whales that surfaced after a bump. Whales observed for one surfacing and did not show sign of injury.	None observed	L6a	Serious	1
04/01/14	Unknown	26	7	Whale surfaced under private fishing vessel and was struck. Vessel sustained damage to the hull.	None observed	L6c	Non-serious	0

Report date	Age class	Vessel length (ft)	Vessel speed (kn)	Event summary	Observed injury	Injury categories	Injury determination	Value for PBR
01/12/15	Adult	28	0	Whale swam toward and made contact with tour vessel.	None observed	L6c	Non-serious	0
02/12/15	Adult	64	10	Whale surfaced under bow of tour vessel and was struck. One passenger sustained minor injuries. Whale observed for unspecified period of time and did not show signs of injury. Vessel sustained damage to the bow.	None observed	L6c	Non-serious	0
03/25/15	Adult	42	8.5	Charter fishing vessel struck whale. Vessel put in neutral, but whale was still struck with hull and propeller. Whale observed for unspecified period of time; injury observed.	Lacerations (3-4 in long, superficial) midway along dorsal peduncle	L5b, L6c	Non-serious	0
04/11/15	Adult	55	11	Whale surfaced under starboard hull of unspecified vessel and was struck, but unknown if mother or calf (or both) were struck. Precautionarily, presumed both whales struck for injury determination. Whales observed unspecified period of time and did not show signs of injury.	None observed	L6b	Prorate 0.20 Serious	0.2
04/11/15	Calf	55	11	Whale surfaced under starboard hull of unspecified vessel and was struck, but unknown if mother or calf (or both) were struck. Precautionarily, presumed both whales struck for injury determination. Whales observed unspecified period of time and did not show signs of injury.	None observed	L6b (calf)	Serious	1
01/25/16	Adult	30	15	Rigid hull inflatable struck whale. Whale observed for unspecified period of time and did not show signs of injury.	None observed	L6b	Prorate 0.20 Serious	0.2
02/01/16	Subadult	55	5-7	Unspecified vessel slowed when whale observed off the bow, but whale was struck.	None observed	L6c	Non-serious	0

Table 2. Injury determinations for humpback whales reported to be entangled in presumed or confirmed fishing gear in Hawaiian waters during 2013–2016, using the most recent established criteria for distinguishing serious from non-serious injury of large whales (Table 1 in NMFS 2012). The “initial” injury determination is associated with the condition of the whale prior to any follow-up and mitigation efforts and may be used for List of Fisheries (LOF) fisheries classifications. The condition of the whale following a change in entanglement status, whether by mitigation or self-release, is reflected in the “follow-up” injury determination, which is used for Potential Biological Removal (PBR) comparison. Note that in cases where there were no follow-up or mitigation efforts, the initial and follow-up determinations are the same. An injury determination of serious followed by an asterisk indicates that the basis of the determination was the significant health decline caused by the injury (NMFS 2012). Table continues on following four pages.

Report date	Age class	Event summary	Initial injury categories	Initial injury determination	Value for LOF	Response outcome	Follow-up injury categories	Follow-up injury determination	Value for PBR	Gear type	Fishery	Fishery review details
02/28/13	Calf	Line wrapped tightly around body forward of pectoral flippers.	L2	Serious	1	Response mounted, but whale not tagged or disentangled. Subsequent observation indicates whale is either still entangled or has indentation wound where previously entangled.	L10	Prorate 0.75 Serious	0.75	Unknown	Unknown	Photographed gear reviewed by a level 5 responder. Little identifying information on gear to identify gear type or fishery. Limited possibility of further classification from additional review effort.
03/07/13	Adult	Line wrapped tightly around body from forward of left pectoral flipper and back along right side.	L2	Serious	1	Response mounted, but whale not re-located.	L2	Serious	1	Unknown	Unknown	Photographed gear reviewed by a level 5 responder. Little identifying information on gear to identify gear type or fishery. Limited possibility of further classification from additional review effort.
03/08/13	Subadult	Line wrapped tightly around peduncle and left fluke blade at least two times before trailing 30ft behind whale, with a buoy immediately behind the left fluke blade and another 5ft behind. Whale had superficial wounds from line.	L2, L5b	Serious	1	Fully disentangled. Superficial wounds remained.	L5b	Non-serious	0	Hawaii pot gear	Crab, but unknown	Recovered gear reviewed by a level 5 responder. Little identifying information on gear to identify exact crab fishery. Known gear configuration may be enough to determine fishery with additional review effort.
03/13/13	Adult	A large buoy trailed along left side of whale between the dorsal fin and fluke from unknown location on body. Lack of constricting gear not confirmed.	L10	Prorate 0.75 Serious	0.75	Response mounted, but whale not re-located.	L10	Prorate 0.75 Serious	0.75	Unknown	Unknown	No gear recovered and gear not documented enough for a review of gear type and fishery.
04/10/13	Calf	Weighted line through mouth of whale, cutting into back of mouth. Whale had wounds of unknown severity from line, was stationary, and surrounded by sharks.	L2	Serious	1	Response mounted, but whale not re-located.	L2	Serious	1	Unknown	Unknown	No gear recovered and gear not documented enough for a review of gear type and fishery.
11/11/13	Subadult	Line wrapped tightly multiple times around body forward of dorsal fin, at least two times around peduncle, and once over fluke blade before trailing behind whale. Whale was moderately emaciated with light skin.	L2	Serious	1	Response mounted, but whale not tagged or disentangled.	L2	Serious	1	Unknown	Unknown	Photographed gear reviewed by a level 5 responder. Little identifying information on gear to identify gear type or fishery. Limited possibility of further classification from additional review effort.



Report date	Age class	Event summary	Initial injury categories	Initial injury determination	Value for LOF	Response outcome	Follow-up injury categories	Follow-up injury determination	Value for PBR	Gear type	Fishery	Fishery review details
11/29/13	Subadult	Over several hundred yards of line trailed behind whale from unknown location on body. Lack of constricting gear not confirmed.	L10	Prorate 0.75 Serious	0.75	No response	L10	Prorate 0.75 Serious	0.75	Unknown	Unknown	No gear recovered and gear not documented enough for a review of gear type and fishery.
12/15/13	Calf	Line wrapped tightly at least once around body forward of pectoral flippers. Whale had superficial wounds from line.	L2, L5b	Serious	1	Fully disentangled. Superficial wounds remained.	L5b	Non-serious	0	Unknown	Unknown	Photographed gear reviewed by a level 5 responder. Little identifying information on gear to identify gear type or fishery. Limited possibility of further classification from additional review effort.
12/16/13	Subadult	Line wrapped tightly multiple times around peduncle and fluke blades before trailing 60ft behind whale, with twists and several gangion clips and hooks in line. Whale had superficial wounds from line. Whale was moderately emaciated with light skin.	L2, L5b	Serious	1	Response mounted, but whale not tagged or disentangled.	L2, L5b	Serious	1	Longline	Unknown	Photographed gear reviewed by a level 5 responder. Little identifying information on gear to identify fishery. Known gear configuration may be enough to determine fishery with additional review effort.
01/10/14	Adult	Line wrapped tightly around right pectoral flipper before trailing 15ft, with a pair of buoys immediately behind pectoral flipper and another pair toward end of line. Whale had superficial wounds from line. Whale was slightly emaciated with cyamid carpet and rough skin.	L2, L5b	Serious	1	Response mounted, but whale not tagged or disentangled.	L2, L5b	Serious	1	Unknown	Unknown	Photographed gear reviewed by a level 5 responder. Images may contain enough information to determine gear type and fishery with additional review effort.
02/10/14	Adult	Scarring indicates line wrapped tightly around forward part of body and right pectoral flipper, but fat loss loosened wrap. Line trailed 30ft behind whale, with a buoy at end. Whale had superficial wounds from line. Whale was extremely emaciated with cyamid carpet and light and rough skin and was considered to be in significant health decline.	L2, L5b	Serious*	1	Fully disentangled. Superficial wounds remained, and whale still showed signs of significant health decline.	L5b	Serious*	1	Alaska pot gear	Shrimp	Recovered gear reviewed by a level 5 responder and traced back to fisher.
02/11/14	Non-calf	Line wrapped around body before trailing 15ft behind whale, with a buoy at end. Lack of constricting gear not confirmed.	L10	Prorate 0.75 Serious	0.75	Response mounted, but whale not re-located.	L10	Prorate 0.75 Serious	0.75	Unknown	Unknown	No gear recovered and gear not documented enough for a review of gear type and fishery.
02/11/14	Non-calf	Line wrapped around body forward of pectoral flippers and multiple times around peduncle. Lack of constricting gear not confirmed.	L10	Prorate 0.75 Serious	0.75	No response	L10	Prorate 0.75 Serious	0.75	Unknown	Unknown	No gear recovered and gear not documented enough for a review of gear type and fishery.
02/20/14	Adult	Over 130ft of line trailed behind whale from unknown location on body, with a buoy 50 ft behind. Lack of constricting gear not confirmed.	L10	Prorate 0.75 Serious	0.75	No response	L10	Prorate 0.75 Serious	0.75	Unknown	Unknown	No gear recovered and gear not documented enough for a review of gear type and fishery.

Report date	Age class	Event summary	Initial injury categories	Initial injury determination	Value for LOF	Response outcome	Follow-up injury categories	Follow-up injury determination	Value for PBR	Gear type	Fishery	Fishery review details
03/11/14	Non-calf	Line wrapped tightly around body forward of dorsal fin and likely around peduncle before trailing 50-60ft behind whale, with two buoys 5-10ft behind. Whale was moderately emaciated with light and rough skin.	L2	Serious	1	Partially disentangled; buoys recovered from whale, but lack of constricting gear not confirmed.	L10	Prorate 0.75 Serious	0.75	Alaska pot gear	King or tanner crab or finfish	Recovered gear reviewed by a level 5 responder and traced back to fisher, who fishes crab part of the year and finfish the other and did not know when gear was lost.
03/14/14	Unknown	Line or netting wrapped around peduncle. Lack of constricting gear not confirmed.	L10	Prorate 0.75 Serious	0.75	No response	L10	Prorate 0.75 Serious	0.75	Unknown	Unknown	No gear recovered and gear not documented enough for a review of gear type and fishery.
03/28/14	Adult	Line wrapped around body forward of dorsal fin. Lack of constricting gear not confirmed.	L10	Prorate 0.75 Serious	0.75	No response	L10	Prorate 0.75 Serious	0.75	Unknown	Unknown	No gear recovered and gear not documented enough for a review of gear type and fishery.
03/31/14	Subadult	Line wrapped tightly around peduncle before trailing over 300ft behind whale. Whale had significant wounds from line.	L2, L5a	Serious	1	No response	L2, L5a	Serious	1	Unknown	Unknown	Photographed gear reviewed by a level 5 responder. Little identifying information on gear to identify gear type or fishery. Limited possibility of further classification from additional review effort.
04/06/14	Subadult	Line went through mouth forming a loose bridle. Line trailed 40ft along left side of whale and 80ft along right side, with a buoy at the end of the longer line.	L3	Non-serious	0	Fully disentangled.	n/a	Non-serious	0	Unknown	Unknown	Recovered gear reviewed by a level 5 responder. Identifying features on buoy may be enough to determine gear type and fishery with additional review effort.
04/14/14	Subadult	A buoy trailed along right side of whale from unknown location on body. Lack of constricting gear not confirmed.	L10	Prorate 0.75 Serious	0.75	No response	L10	Prorate 0.75 Serious	0.75	Unknown	Unknown	No gear recovered and gear not documented enough for a review of gear type and fishery.
12/10/14	Subadult	Line wrapped tightly multiple times around peduncle before trailing 30ft behind whale in a bundle of gear. Whale had significant wounds from line and shark bites. Whale was moderately emaciated with cyamid carpet and light and rough skin and was considered to be in significant health decline.	L2, L5a	Serious*	1	Partially disentangled; constricting wraps removed. Significant wounds remained, and whale still showed signs of significant health decline.	L3, L5a	Serious*	1	Longline	Unknown	Photographed gear reviewed by a level 5 responder and gear expert. Little identifying information on gear to identify fishery. Known gear configuration may be enough to determine fishery with additional review effort.
01/13/15	Yearling	Line wrapped tightly at least five times around peduncle and fluke notch before trailing 5ft behind whale, with a bundle of gear immediately behind fluke. Whale had significant wounds from line. Whale was moderately emaciated with light and rough skin.	L2, L5a	Serious	1	Response mounted, but whale not tagged or disentangled, although a single cut was made.	L2, L5a	Serious	1	Unknown	Unknown	Photographed gear reviewed by a level 5 responder. Images may contain enough information to determine gear type and fishery with additional review effort.
01/25/15	Adult	Line went through mouth or around pectoral flippers forming a bridle twisted together between dorsal fin and peduncle. Line trailed 30-50ft behind whale, with two buoys at end. Lack of constricting gear not confirmed.	L10	Prorate 0.75 Serious	0.75	No response	L10	Prorate 0.75 Serious	0.75	Unknown	Unknown	Photographed gear reviewed by a level 5 responder. Little identifying information on gear to identify gear type or fishery. Limited possibility of further classification from additional review effort.

Report date	Age class	Event summary	Initial injury categories	Initial injury determination	Value for LOF	Response outcome	Follow-up injury categories	Follow-up injury determination	Value for PBR	Gear type	Fishery	Fishery review details
02/01/15	Adult	Line wrapped around unknown location on body. Lack of constricting gear not confirmed.	L10	Prorate 0.75 Serious	0.75	Response mounted, but whale not re-located.	L10	Prorate 0.75 Serious	0.75	Unknown	Unknown	No gear recovered and gear not documented enough for a review of gear type and fishery.
02/13/15	Adult	Line wrapped tightly at least five times around peduncle before trailing 100-150ft behind whale, with a buoy behind fluke. Whale had moderate wounds from line. Whale was moderately emaciated with cyanid carpets and light and rough skin.	L2, L5b	Serious	1	Fully disentangled. Moderate wounds remained, including one with 6in piece of line.	L5b	Non-serious	0	Alaska pot gear	King crab	Recovered gear reviewed by a level 5 responder and traced back to fisher.
02/15/15	Unknown	A trap trailed behind whale from unknown location on body. Lack of constricting gear not confirmed.	L10	Prorate 0.75 Serious	0.75	No response	L10	Prorate 0.75 Serious	0.75	Unknown	Unknown	No gear recovered and gear not documented enough for a review of gear type and fishery.
02/18/15	Adult	A polyball trailed behind whale from unknown location on body. Lack of constricting gear not confirmed.	L10	Prorate 0.75 Serious	0.75	Response mounted, but whale not re-located.	L10	Prorate 0.75 Serious	0.75	Unknown	Unknown	No gear recovered and gear not documented enough for a review of gear type and fishery.
03/12/15	Adult	An object trailed behind whale (mother with associated calf) from unknown location on body. Lack of constricting gear not confirmed.	L10	Prorate 0.75 Serious	0.75	Response mounted, but whale not re-located.	L10	Prorate 0.75 Serious	0.75	Unknown	Unknown	No gear recovered and gear not documented enough for a review of gear type and fishery.
03/12/15	Calf	An object trailed behind mother of this associated calf from unknown location on body. Lack of constricting gear not confirmed.	L8	Prorate 0.75 Serious	0.75	Response mounted, but whale not re-located.	L8	Prorate 0.75 Serious	0.75	Unknown	Unknown	No gear recovered and gear not documented enough for a review of gear type and fishery.
03/16/15	Adult	Line or netting wrapped around body before trailing 10-15ft behind whale, with a buoy at end. Lack of constricting gear not confirmed.	L10	Prorate 0.75 Serious	0.75	No response	L10	Prorate 0.75 Serious	0.75	Unknown	Unknown	No gear recovered and gear not documented enough for a review of gear type and fishery.
03/23/15	Adult	Large amount of netting trailed behind whale from unknown location on body. Lack of constricting gear not confirmed.	L10	Prorate 0.75 Serious	0.75	No response	L10	Prorate 0.75 Serious	0.75	Unknown	Unknown	No gear recovered and gear not documented enough for a review of gear type and fishery.
03/23/15	Calf	Large lure hooked on right pectoral flipper near insertion to body.	L4	Non-serious	0	No response	L4	Non-serious	0	Unknown	Unknown	No gear recovered and gear not documented enough for a review of gear type and fishery.
12/29/15	Adult	Line wrapped around rostrum. Lack of constricting gear not confirmed.	L10	Prorate 0.75 Serious	0.75	No response	L10	Prorate 0.75 Serious	0.75	Unknown	Unknown	No gear recovered and gear not documented enough for a review of gear type and fishery.

Report date	Age class	Event summary	Initial injury categories	Initial injury determination	Value for LOF	Response outcome	Follow-up injury categories	Follow-up injury determination	Value for PBR	Gear type	Fishery	Fishery review details
01/23/16	Adult	Line went through mouth forming a loose bridle over the pectoral flippers and under fluke. Line trailed behind whale twisting to form a bundle 50ft behind whale, with line trailing 50ft behind bundle. At least one metal pole in trailing gear. Whale had superficial wounds from line. Whale was moderately emaciated with cyanid carpet and rough skin and was considered to be in significant health decline.	L3, L5b	Serious*	1	Response mounted, but whale not tagged or disentangled.	L3, L5b	Serious*	1	Unknown	Unknown	Photographed gear reviewed by a level 5 responder. Images suggest pot gear, but not confirmed. Limited possibility of further classification from additional review effort.
01/27/16	Yearling	Line wrapped over pectoral flippers and under belly of whale before trailing 20ft behind whale, with an anchor-like object at end. Lack of constricting gear not confirmed.	L10	Prorate 0.75 Serious	0.75	No response	L10	Prorate 0.75 Serious	0.75	Unknown	Unknown	No gear recovered and gear not documented enough for a review of gear type and fishery.
02/03/16	Subadult	Netting and buoy loosely wrapped around head.	L3	Non-serious	0	No response because whale self-released from gear	n/a	Non-serious	0	Unknown	Unknown	Recovered gear reviewed by level 5 responder. Gear likely marine debris and not from an active set. Type of netting may be enough to determine gear type and fishery with additional review effort.
02/06/16	Adult	Line trailed behind whale from right fluke blade. Lack of constricting gear not confirmed.	L10	Prorate 0.75 Serious	0.75	No response	L10	Prorate 0.75 Serious	0.75	Unknown	Unknown	No gear recovered and gear not documented enough for a review of gear type and fishery.
02/29/16	Adult	Line loosely wrapped around left pectoral flipper before trailing 10-15ft, with buoy 10ft behind.	L3	Non-serious	0	Response mounted, but whale not re-located.	L3	Non-serious	0	Unknown	Unknown	Photographed gear reviewed by a level 5 responder. Little identifying information on gear to identify gear type or fishery. Limited possibility of further classification from additional review effort.

Table 3. Injury determinations for cetaceans other than humpback whales reported to be injured in Hawaiian waters during 2013–2016, using the most recent established criteria for distinguishing serious from non-serious injury of cetaceans (Tables 1-2 in NMFS 2012). The “initial” injury determination is associated with the condition of the whale or dolphin prior to any follow-up and mitigation efforts. For presumed fishery-related injuries, the initial determination is used for List of Fisheries (LOF) classification. The final known condition of the individual, regardless of injury type, follow-up, or mitigation, is reflected in the “follow-up” injury determination, which is used for Potential Biological Removal (PBR) comparison. If the follow-up injury determination cannot be determined (CBD), then the initial determination is used for PBR comparison. Table continues on following page.

Report date	Species	Stock	Age class	Event summary	Initial injury categories	Initial injury determination	Value for LOF	Response outcome	Follow-up injury categories	Follow-up injury determination	Value for PBR	Gear type and fishery summary
01/11/13	Bottlenose dolphin	Hawaii Island	Adult	Dolphin approached divers during manta ray night dive with line tightly wrapped around pectoral flipper. The wrap and associated hooks were restricting movement of the fin. Line originated from mouth, indicating ingestion of one or more hooks. Dolphin previously documented interacting with divers on 07/02/12.	S2, S8a	Serious	1	Diver removed line and hooks from pectoral fin and cut line close to the mouth, leaving ingested hook(s).	S2	Serious	1	Gear not recovered or photographed. Based on diver's description, two PIRMMRN officials suggested gear was from a Damashi rig.
03/11/13	Spinner dolphin	Oahu/4-Islands	Adult	Dolphin observed with a plastic bag through its mouth and wrapping behind its head just behind the blowhole.	S8a	Serious	n/a	No response	S8a	Serious	1	n/a
04/25/13	Spinner dolphin	Hawaii Island	Unknown	Dolphin observed with line tightly wrapped multiple times around base of fluke and right fluke blade forming a bridle that trailed several feet behind dolphin and was associated with a float, glow stick, and hook.	S6, S8a	Serious	1	Swimmer removed trailing gear and one wrap from fluke, but multiple wraps remained. Lack of constricting gear not confirmed.	S8a or S8b	CBD	1	Gear recovered and photographed. PIRMMRN official suggested the float was part of a whipping rig, with the attached glow stick indicating the gear was being used at night, possibly targeting menpachi or aholehole. Additional review effort warranted.
11/14/13	Unidentified dolphin	n/a	Unknown	Dolphin observed with buoy near dorsal fin, trailing from unknown location on body. Unknown if hook involved. Line trailed 50ft behind dolphin associated with a floating object.	S6	Serious	1	No response	S6	Serious	1	Gear not recovered or photographed.
01/16/14	Spinner dolphin	Oahu/4-Islands	Adult	Dolphin observed with thick line or netting entangling rostrum (presumably impacting ability to feed) and extending to right pectoral flipper.	S8a	Serious	1	No response	S8a	Serious	1	Gear photographed, but is presently unidentified. Additional review effort warranted.
01/24/14	Rough-toothed dolphin	Hawaii	Unknown	Dolphin observed with heavy line trailing 25-30ft behind with 2 plastic jugs attached at end. Line assumed to be attached by hook, but location of hook not observed.	S6	Serious	1	Mariner cut jugs, leaving trailing line.	S6	Serious	1	Gear not recovered or photographed.
03/10/14	Spinner dolphin	Hawaii Island	Subadult	Dolphin found dead with netting around rostrum and peduncle. Necropsy results suggested dolphin drowned as a result of the entanglement.	n/a	Dead	1	n/a	n/a	Dead	1	Gear recovered, but is presently unidentified. Gear likely marine debris and not from an active set. Additional review effort warranted.
11/02/14	Spotted dolphin	Hawaii Island	Adult	Dolphin observed hooked in the mouth (left upper jaw) with line trailing 8-10ft, cutting into left pectoral flipper.	S5a, S6	Serious	1	No response	S5a, S6	Serious	1	Gear photographed, but is presently unidentified. Additional review effort warranted.
11/21/14	Spinner dolphin	Hawaii Island	Unknown	Dolphin observed with line wrapped multiple times around rostrum (presumably impacting ability to feed).	S8a	Serious	1	No response	S8a	Serious	1	Gear not recovered or photographed.

Report date	Species	Stock	Age class	Event summary	Initial injury categories	Initial injury determination	Value for LOF	Response outcome	Follow-up injury categories	Follow-up injury determination	Value for PBR	Gear type and fishery summary
02/11/15	Rough-toothed dolphin	Hawaii	Unknown	Dolphin observed with line tightly wrapped around and cutting into left pectoral flipper, with at least 3-4ft of line trailing behind.	S8a	Serious	1	No response	S8a	Serious	1	Gear photographed, but is presently unidentified. Additional review effort warranted.
06/18/16	Spinner dolphin	Hawaii Island	Adult	Dolphin observed with line wrapped tightly around and cutting into base of flukes, with 40-50ft of line trailing behind.	S8a	Serious	1	Diver reduced amount of trailing line to 6ft, although got entangled in the process and had to be cut free.	S8a	Serious	1	Gear recovered by dive operator, but not obtained by HIERN.

Table 4. Summary of humpback whale vessel collisions and entanglements in Hawaiian waters during 2013–2016 that resulted in different preliminary and reviewer injury determinations. The final injury determinations resulting from follow-up discussions are shown along with a rationale for the determination. The injury determination “categories” are based on the most recent established criteria for distinguishing serious from non-serious injury of large whales (Table 1 in NMFS 2012). The injury determination “values” refer to the number of serious injuries relevant to either List of Fisheries classification or Potential Biological Removal comparison. For entanglements, “|” is used to separate the initial and follow-up injury determination categories and values.

Report date	Injury type	Preliminary injury determination		Reviewer injury determination		Final injury determination		Final determination rationale
		Categories	Value	Categories	Value	Categories	Value	
02/28/13	Entanglement	L2   CBD	1   1	L10   L10	0.75   0.75	L2   L10	1   0.75	Agreed with reviewer that L10 was more appropriate than CBD for the follow-up determination even though entanglement could not be confirmed.
03/01/13	Vessel collision	L5a, L12 (calf)	1	L5a	0	L5a, L12 (calf)	1	Reviewer considered the deep lacerations to be healing, but some wounds remained open, and healing could not be confirmed through follow-up sightings.
01/10/14	Entanglement	L5b, L10   L5b, L10	0.75   0.75	L2   L2	1   1	L2, L5b   L2, L5b	1   1	Agreed with reviewer that there was sufficient supporting evidence to use L2 for the initial and follow-up determinations.
02/10/14	Entanglement	L3, L5b   L5b	1   1	L2   n/a	1   1	L2, L5b   L5b	1   1	Agreed with reviewer that there was sufficient supporting evidence to use L2 for the initial determination.
04/11/15	Vessel collision	L6b (calf)	1	L8	0.2	L6b (calf)	1	Unknown if mother, calf, or both were struck. Reviewer assumed only the mother, but the precautionary scenario that both were struck was considered more appropriate.
02/03/16	Entanglement	L3   n/a	0   0	L10   n/a	0.75   0	L3   n/a	0   0	Considered that there was sufficient supporting evidence to use L3 for the initial determination.

## Appendix A:

Additional interpretation or consideration required in the application of some of the injury categories (NMFS 2012) to large whales injured in Hawaiian waters during 2013–2016. L = large whale category (Table 1 in NMFS 2012).

Injury categories <sup>1</sup>	Application of categories
L2, L3, L10	<p>1) Although not the practice of all members of the NMFS Determination Staff Working Group, particularly members assessing injured whales on their feeding grounds, an entangled humpback whale that showed signs of a significant health decline was still considered to be seriously injured after partial or full disentanglement. The rationale for the serious determination in such cases is that the whales are on their breeding grounds and still have to migrate in order to improve their nutritive condition.</p> <p>2) When follow-up observations indicated that a whale had self-released from entangling gear, the observed entanglement was still reflected in the initial injury determination that may be used for List of Fisheries classification. This approach is different than that used for marine mammals released from gear by fishermen in real-time (i.e., when the injury determination is made after the fisherman releases the animal from the gear; NMFS 2012). However, in the present context, an initial injury determination is needed to account for the unknown duration of the entanglement and the resulting impact to the whale.</p>
L5a, L5b	Although not the practice of all members of the NMFS Determination Staff Working Group, these categories were applied whenever lacerations were reported, even for fishery-related injuries. This use accounted for one or more injuries resulting from an entanglement in the event that the whale was disentangled. That is, if an entanglement caused a deep laceration, that laceration would remain, even if all gear was removed from the whale.
L8	Along with other members of the NMFS Determination Staff Working group, a dependent calf of a mother with an injury of prorated severity was assigned the same prorated injury determination as the mother.
L12	Although not the practice of all members of the NMFS Determination Staff Working Group, this category was applied along with L5a, L5b, or L11 when a whale was observed with clear vessel collision injuries, even if the actual collision was not reported. The rationale for this use is that it prevents a bias in the injury determination process for calves. That is, if a calf was reported struck by a vessel of any size and unknown speed, even with no resulting visible injuries, it would be considered seriously injured because “a strike to a calf by a vessel of any size when speed is unknown will be considered a serious injury” (NMFS 2012). However, a calf with superficial injuries clearly indicating a vessel collision (L5a) would be considered non-seriously injured if the collision itself was not reported. To avoid this determination bias from unreported collisions, L12 was used when observed injuries were sufficient confirmation that a collision had occurred.

<sup>1</sup>Description of injury categories (from Table 1 in NMFS 2012): L2 – constricting wrap; L3 – loose wrap, bridled or draped gear; L5a – deep laceration; L5b – superficial laceration; L8 – dependent calf of a dead or seriously injured mother; L10 – evidence of entanglement; and L12 – vessel strike observed.