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Process for Distinguishing Serious from Non-Serious Injury of Marine Mammals

Process for Injury Determinations

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Guidelines for Distinguishing Serious from Non-Serious Injury of Marine Mammals Pursuant to the Marine Mammal Protection Act

I. Introduction

The Marine Mammal Protection Act (MMPA) requires NMFS to estimate annual levels of human-caused mortality and serious injury to marine mammal stocks (section 117) and to categorize commercial fisheries based on their level of incidental mortality and serious injury of marine mammals (section 118). Based on results of a 1997 workshop discussing the impacts of injuries of marine mammals incidental to commercial fishing operations (Angliss and DeMaster, 1998) and specific regional experience with injury events, NMFS Science Center and Regional Office staff developed regional techniques for assessing and quantifying the serious injuries of marine mammals. Although these regional techniques helped to accomplish the MMPA's mandates, NMFS needs a nationally consistent and transparent process for effective conservation of marine mammal stocks and management of human activities impacting these stocks.

Accordingly, NMFS convened a workshop in 2007 to review performance under existing guidance, gather current scientific information, and update guidance based on the best available information (Andersen *et al.*, 2008). Based on results of the 2007 workshop, NMFS Headquarters, Regional Office, and Science Center subject matter specialists developed recommendations for national guidance. These recommendations and results from new analysis of existing NMFS data have been incorporated into this Procedural Directive. This document will serve as the basis for analyzing injury reports (e.g., observer, disentanglement, and stranding program reports) of marine mammals and incorporating the results into Stock Assessment Reports (SARs) and marine mammal conservation management regimes (e.g., MMPA List of

Fisheries [LOF], Take Reduction Teams [TRTs], Take Reduction Plans [TRPs], ship speed regulations).

This Procedural Directive: (1) provides the process and criteria for distinguishing human-caused serious from non-serious injuries of marine mammals; (2) provides a uniform framework for the consistent application of sections 117 and 118 of the MMPA across NMFS; and (3) ensures NMFS's approach for distinguishing serious from non-serious injuries of marine mammals is clear and transparent to the public. This Procedural Directive is organized by the following sections:

- Section II describes the basis for the criteria to distinguish between serious and non-serious injuries;
- Section III outlines NMFS's injury determination review process to ensure consistency across regions and the application of the best available science;
- Section IV outlines the process for assessing and documenting the injury status of marine mammals after successful post-interaction mitigation efforts;
- Section V describes the process for accounting for cases where the severity of an injury cannot be determined (CBD);
- Section VI describes the process for assigning injury severity when estimating injuries from fishery observer data; and
- Sections VII-IX outline NMFS's criteria for distinguishing serious from non-serious injuries of marine mammals by taxonomic group: large cetaceans (all mysticetes and sperm whales, section VII), small cetaceans (all odontocetes except sperm whales, section VIII), and pinnipeds (all except walrus, section IX). Further, sections VIII and IX for small cetaceans and pinnipeds, respectively, include additional methods for accounting for remaining CBD cases that are not covered by the processes presented in sections V and VI. Criteria for distinguishing serious from non-serious injuries of sirenians, polar bears, walrus, and sea otters, which are managed by the U.S. Fish and Wildlife Service, are not included in this Procedural Directive.

At least once every five years or when new information becomes available, NMFS will review and consider revisions, if necessary, to this Procedural Directive based upon the best available scientific information, input from the MMPA Scientific Review Groups, as appropriate, and experience gained in implementing the process and criteria. If significant revisions are indicated during the review, NMFS will consider making these available for public review and comment prior to acceptance.

II. Basis for the Serious Injury Criteria

This section describes the basis for the criteria to distinguish between serious and non-serious injuries for each taxonomic group of marine mammals. The intent of the procedures described in this document is to correctly and consistently categorize a documented injury or injury event as a serious injury or a non-serious injury. These methods are not meant to estimate the actual level of impact to a population. NMFS's interpretation of the serious injury definition (an injury that is *more likely than not* to result in mortality, as described in the Policy Directive) coupled with the approach described in this procedural directive is expected to allow NMFS to evaluate the majority of documented injury events, providing a more accurate estimation of total annual

human-caused serious injury and mortality to marine mammals. However, NMFS recognizes the results still underestimate serious injury and mortality, given the likelihood of undetected and unreported events.

The procedures provide guidance for all injury events with the exception of noise-related injuries, because NMFS scientists making injury determinations are unlikely to detect noise-related injuries in live animals and because the state of science on identifying noise-related injuries in live marine mammals is still developing. The procedures provide guidance for cases that are data poor, data rich, or require consideration of additional contributing factors. For “data poor” cases, in which information on the nature of the injury is available but follow-up on the condition of the injured animal to confirm its death or survival is not possible, the criteria in sections VII-IX provide the most complete guidance on determining injury status. Therefore, the criteria in sections VII-IX should be applied when assessing the information received in observer, disentanglement, or stranding program reports of injury events that lack detailed information regarding the injury and/or the final injury outcome. For “data rich” cases in which additional detailed information regarding the injury is available and/or the condition of the injured animal is known or can be tracked over time, the available case specific data can be used in lieu of, or in addition to, the criteria laid out in sections VII-IX to make the injury determination.

The data that NMFS receives regarding marine mammal injury events vary greatly by region, source (e.g., general public, observer, disentanglement, and stranding programs), and quality. NMFS developed the process and criteria presented in this document to account for the range of data quantity and quality when assessing injury reports and take into account the best available information for each injury case. For many small cetaceans and pinnipeds, fisheries observer programs provide the majority of injury data used in the stock assessments. Observers are trained how to document marine mammal interactions with fishing operations, providing a standard injury dataset. Large cetaceans, however, are rarely caught during observed fishing operations. Most reports of injuries to large whales are anecdotal, may be made by untrained persons and lacking adequate documentation to assess the severity of an injury. However, individual identification in some large whale species has provided additional documentation of individual’s injuries through time and, in many cases, a final injury outcome (i.e., death or survival). These “longitudinal” injury data provide a dataset to make injury determinations for injuries with similar characteristics. Such longitudinal data are not available for observed fisheries interactions because injured animals are released and rarely resighted. Necropsies and monitoring of haul out sites or coastal dolphin populations provided the basis for determinations for some pinniped and small cetacean injury categories, but many fishery interaction injury prognoses were based on expert opinion from the 2007 Serious Injury Technical Workshop (Andersen *et al.* 2008).

Because of these differences in source and nature of injury data, criteria for serious injury determinations were developed separately for large cetaceans, small cetaceans, and pinnipeds. In addition, the types and impacts of injuries differ between these broad taxonomic groups. For example, collisions with large vessels have a significant impact to some large whale populations, but large vessels have not been reported as having a significant impact on small cetacean and pinniped populations in U.S. waters. Conversely, a fishing hook embedded in the head of a

baleen whale is most likely not lethal; however, such an injury is likely to have a much more significant impact to a dolphin or sea lion.

The injury determinations in section VII are largely based on an analysis of data on injury events with known outcomes, with the exception of a few criteria that are based on expert opinion from the 2007 Serious Injury Technical Workshop (Andersen *et al.*, 2008). Specifically, the results of an analysis of known outcomes of national large whale injury events from 2004-2008 were used in binomial tests to estimate the likelihood of the observed rate of mortality being higher or lower than 50%. The results of the binomial tests measured the reliability of categories' observed ratios of deaths to events. (See section VII for additional details on the binomial test and prorating techniques).

In contrast to section VII, the injury criteria and determinations for small cetaceans and pinnipeds in sections VIII and IX are based almost entirely on expert opinion from the 2007 Serious Injury Technical Workshop (Andersen *et al.*, 2008) because data on documented injuries and outcomes (i.e., survival or death of the animal) in the wild are not available for most small cetaceans and pinnipeds.

Sections VII-IX each include a table with injury determinations for different injury categories and relevant additional criteria. For many of the same reasons listed above, Table 1 (included in section VII) is presented in a slightly different format than Tables 2 and 3 (included in sections VIII and IX, respectively). The injury categories for Table 1 are broader in scope than those presented in Tables 2 and 3. This is largely because Table 1 was developed using the available existing data on documented injury events and outcomes; therefore, similar injury types were combined into more general categories based on the information provided in the data (see section VII for additional details). By contrast, the categories listed in Tables 2 and 3 are more specific and correspond to the types of information generally recorded in reports of injuries to small cetaceans and pinnipeds. This approach was determined to be more useful to NMFS Science Center staff responsible for distinguishing serious from non-serious injuries of small cetaceans and pinnipeds because resightings of injured animals and data on the survival or death of injured animals are generally not available (see sections VIII and IX for additional details).

Tables 1-3 each include a column with additional details and factors to consider when assigning injuries to a specific category and, therefore, when making an injury determination. In Table 1, this column provides detailed criteria for each injury category, based on the available data on large whale injury outcomes. Small cetacean and pinniped data on injury outcomes are largely lacking and thus injury determinations are primarily based on expert opinion. This resulted in a number of categories that have 'case specific' injury determinations, indicating that additional factors must be evaluated before the injury can be assigned as a serious or non-serious injury. In Tables 2 and 3, the last column provides the additional factors relevant to a case specific injury determination for each injury category. Additionally, Tables 2 and 3 are followed by an expansive list of factors that should be considered for all case specific events, regardless of the type of injury. Specific criteria for each injury category are also included in the description paragraphs immediately preceding each table.

III. Annual Injury Determination Process

The general annual process for making and documenting injury determinations is as follows:

Step 1- Initial injury determination: Annually, NMFS Science Center staff will compile all available information on injury events and make serious, non-serious, or CBD determinations for each reported injury event. For the majority of cases, the Science Center staff will first apply the criteria presented in sections VII-IX, which are meant to provide guidance in situations where there are available data on the injury but follow-up on the condition of the injured animal to confirm its death or survival is not possible. However, for cases that are data rich (i.e., sufficient detail on the injury is available and/or the condition of the injured animal can be tracked over time), those data can be used in lieu of, or in addition to, the criteria laid out in sections VII-IX.

Step 2- Determination Staff Working Group information exchange: Science Center staff responsible for annually distinguishing serious from non-serious injuries circulate the injury determinations and a summary of the information on which the determinations were based to the NMFS Determination Staff Working Group¹ or an appropriate subset of this working group familiar with the species and/or cause of injury (e.g., fishing gear, vessel strikes) involved. Determination Staff Working Group members may consider the preliminary injury determinations and provide input for those species or fishing gear types with which they are most familiar, as appropriate. Science Center staff responsible for injury determinations may consider comments from other Determination Staff Working Group members and/or continue discussions on individual determinations, as needed.

Step 3- Regional Office review: An overview of the preliminary injury determinations is provided to the Regional Office for review and input. This review may take place before or as part of Steps 4 or 5 below

Step 4- Report Preparation: The Science Center staff responsible for distinguishing serious from non-serious injuries complete a written report documenting the annual injury determinations for that region. While the format of these written reports may vary depending on the needs and clearance processes of each Science Center, each report will include: (1) a summary of the information on which each injury determination is based; (2) the criteria from sections VII-IX on which each injury determination is based; and (3) justification for any departure from the criteria in Sections VII-IX (e.g., by citing a peer-reviewed document, such as NMFS Technical Memoranda or scientific publications, where additional information is available on a specific case to justify departure from the criteria in sections VII-IX).

¹ The “NMFS Determination Staff Working Group” is composed of NMFS staff in each Science Center responsible for distinguishing serious from non-serious injuries of marine mammals. The membership of this group is considered unofficial and/or fluid, depending on staffing and duty changes in each Science Center.

Step 5- Scientific Review Group review: An overview of the preliminary injury determinations (similar to the information provided to the Regional Offices in Step 3) and/or a draft of report prepared in Step 4 is provided to the regional Scientific Review Groups for review and input.

Step 6- Report Clearance: The injury determination reports follow the formal review and publication processes specific to each Science Center.

Step 7- Inclusion of Injury Determinations in the annual SARs and marine mammal conservation management regimes: As is the current practice, a summary of all serious injury and mortality will also be presented in the SARs (citing the Science Centers injury determination reports) and used for the purposes of marine mammal conservation management regimes (e.g., LOF, TRTs, TRPs). If there are unresolved CBD cases (i.e., CBD cases that still cannot be assigned as serious or non-serious after applying the methodology outlined in sections V and VI), the SARs should consider whether these remaining CBD cases would change the status of the stock (e.g., strategic or non-strategic) if each CBD case were determined to be serious or non-serious. The SARs should provide information on injuries that were mitigated, as described below in Section IV.

IV. Assessing and Documenting the Injury Status of Marine Mammals after Successful Post-Interaction Mitigation Efforts

Marine mammals that become entangled in or hooked by fishing gear or marine debris are sometimes released or break free from the gear, but remain hooked or entangled in a portion of the gear. In some instances, those entangled or hooked animals are sighted at a later date or time and NOAA undertakes mitigation efforts to disentangle or dehook the animal (e.g., via the large whale disentanglement program). This section establishes NMFS' process for assessing and documenting cases where an animal is disentangled or dehooked at some time after an interaction with fishing gear. This section does not apply to situations where commercial fishermen or others release animals from gear in real-time (i.e., at the time of the interaction). Rather, this section specifically addresses cases where NOAA, NMFS, or authorized stranding and disentanglement network partners work to disentangle or dehook an animal post-interaction (i.e., at some time after the initial interaction). Cases where the animal is released by fishermen in real-time will be considered in the same manner they have been in the past (i.e., the injury determination is made after the fishermen releases the animal from the gear and that single determination is reflected in both the LOF and SARs).

Previously, if an entangled or hooked marine mammal was determined by NMFS to be seriously injured from the entanglement or hooking event but was later successfully released from the gear and determined to have no or non-serious injuries once the gear was removed, the interaction was not included as a serious injury in the SAR because the animal was not removed from the population; thus, the interaction was also not used when classifying fisheries on the LOF and informing management (e.g., take reduction planning). However, this previous approach does not accurately reflect the rate of entanglement and potential serious injury inflicted by a fishery. This previous approach may even lead to an underestimation of total serious injury and mortality

of marine mammals because it relies on opportunistic detection and post-interaction intervention by NOAA to mitigate injury effects. As a result of the 2007 workshop, NMFS revisited whether marine mammals successfully disentangled or dehooked at some date or time after the interaction occurred should be considered when classifying fisheries on the LOF and informing management (e.g., take reduction planning). Therefore, the following paragraphs establish NMFS's updated process for assessing and documenting these cases.

If an animal requires post-interaction intervention to be released from fishing gear or marine debris, a determination of the severity of the injury will be made by applying the criteria in sections VII-IX, in the field or as part of a rehabilitation effort, before the animal is disentangled or dehooked.

- For cases where the animal is determined to be seriously injured and NOAA and/or an authorized partner successfully disentangles or dehooks the animal and the animal is determined to have no or non-serious injuries when released, it will be recorded as a serious injury when classifying fisheries on the LOF and informing management (e.g., take reduction planning), but will be recorded as a non-serious injury when compared to PBR in the SARs. In this way, the fisheries classifications on the LOF will reflect a more accurate level of serious injury and mortality of marine mammals that is occurring incidental to commercial fishing operations. Further, recording that the animal as a non-serious injury when assessing the status of stocks in the SARs will reflect the fact that the animal likely survived its injuries post-intervention and was not removed from the population.
- For cases where the animal is determined to be seriously injured and NOAA and/or an authorized partner successfully disentangles or dehooks the animal and it is determined to still have serious injuries when released, the animal will be recorded as a serious injury when classifying fisheries on the LOF, informing management (e.g., take reduction planning), and when comparing to PBR in the SARs.
- For an animal determined to be seriously injured and NOAA and/or an authorized partner disentangles or dehooks the animal, but its injuries require treatment in a rehabilitation center and despite successful treatment (i.e., it can survive in human care) is deemed not able to be released back into the wild, the animal will remain recorded as a serious injury when classifying fisheries on the LOF, informing management (e.g., take reduction planning), and when comparing to PBR in the SARs. The animal is accounted for in this manner because it is removed from the wild population as a result of its injuries and is no longer a functioning part of the wild population.

To denote the injury events with different pre- and post-mitigation injury determinations, NMFS will include all human-caused serious injuries in the SARs, regardless of the outcome from subsequent mitigation efforts. For serious injuries from fishing gear, NMFS will denote these determinations in the SARs' fishery interaction tables. NMFS will further indicate which serious injuries, if any, were mitigated (e.g., through disentanglement or rehabilitation efforts), resulting in the animal no longer being considered seriously injured. NMFS will include standard language in the SARs indicating which injuries were successfully mitigated and, therefore, while considered serious injuries for the purposes of the LOF and management (e.g., take reduction planning), are not included in the comparison of serious injuries and mortalities to the PBR when assessing the status of the affected stock. Additionally, since the cases described in this section

are all post-interaction efforts and are therefore not recorded by a systematic fishery observer program, they are not used in extrapolations of interactions.

V. Accounting for Cases where the Severity of an Injury Cannot Be Determined (CBD)

Both large and small marine mammal injury datasets contain numerous events that lack sufficient detail to assess injury severity. Stranding or fishery observer reports may include insufficient information to make an injury determination. Fisheries observers often have only a brief opportunity to see a marine mammal hooked or entangled in fishing gear before it is released, and this is sometimes further compromised by low light or high sea states. Entangled or vessel struck whale reports often contain only evidence that a line was on a whale or that a whale was hit. In some cases, the severity of an injury may depend on other, unknown additional factors, such as age, reproductive status, or body condition of the injured animal. And lastly, the current state of veterinary knowledge or clinical data about the impact of certain injuries might be insufficient to make a determination.

Previously, the extent to which NMFS incorporated injury cases assigned as CBD into assessments of human impacts on the status of marine mammal populations varied by Science Center. The exclusion of these CBD cases from existing tallies or estimates of human-caused serious injuries to marine mammals has resulted in only minimum values of serious injury and mortality. The distortion of the minimum values from the true rates has been compounded by the unknown number of dead and dying animals that were never detected and/or reported to NMFS, and therefore, never included in analyses of human-caused serious injury and mortality of marine mammals. It is likely that only a proportion of the CBD cases have represented human-caused serious injuries. Under the procedures described in this Procedural Directive, NMFS staff should apply appropriate methods, based on the best available scientific information, to assign CBD cases as either serious or non-serious injuries for management and reporting purposes. Such methods can be based on fishery observer data, when available (see section VI for examples), or historical information from any data source that provides a valid basis for prorating (see sections VII-IX for examples).

NMFS recognizes the results from these procedures still will not provide estimates of the actual rates of human-caused serious injury and mortality to marine mammals given the likelihood of undetected and unreported events. However, NMFS's interpretation of the serious injury definition (an injury that is *more likely than not* to result in mortality, as described in the Policy Directive) coupled with the approaches described in this procedural directive is expected to allow NMFS to evaluate the majority of documented injury events, providing a more accurate assessment of human-caused serious injury and mortality to marine mammals.

VI. Assigning Injury Severity when Estimating Injuries from Fishery Observer Data

In cases where data on injuries to marine mammals are available from a systematic fishery observer program (including NMFS fishery observer programs and state or other observer programs NMFS has deemed to be comparable to its own programs), the observer database can be used to assign injury severity as part of the statistical analysis for estimating overall mortality and serious injury of marine mammals. If sample sizes are sufficient, the proportions of animals

determined to be seriously vs. non-seriously injured within the observer database can be used to prorate undetermined cases (including any documented CBD cases and all estimated injuries). The following is a hypothetical example to illustrate an application of such a prorating method:

- 1) *Determination of injury events based on observer reports:* The observer program documents two injuries of species X in fishery/gear type Y during a given fishing year. Based on the information in the observer reports, the Science Center staff responsible for assessing injury severity determines that one of the injuries is serious and the other is CBD.
- 2) *Statistical extrapolation of annual serious injury and mortality levels in a fishery based on fishing effort and observer coverage levels:* Based on the two documented injuries, the level of observer coverage, and the total effort in fishery Y during the fishing year, Science Center staff conduct a statistically-based analysis that estimates a total of 13 injuries for the entire fishing year. One of the documented injuries was determined to be serious; the remaining 12 injuries (1 documented injury determined to be CBD and 11 estimated injuries) are prorated as described in the next two steps.
- 3) *Review of database to determine the proportion of assignable historic injuries:* The Science Center staff reviews the observer program database on injuries caused by interactions between species X and fishery Y, to determine the proportion of all injuries that were “assignable” (i.e., for which a determination of serious or non-serious injury could be made). This may require pooling data over multiple years to achieve adequate sample sizes for estimating the proportions of serious vs. non-serious injuries; however, pooling should only be done for years in which fishing practices (and hence, injury outcomes) are expected to be comparable. For example, if there are marked changes in gear used (e.g., because of new regulations), and these changes could influence injury severity, then the database should be limited to the period following the change. In this hypothetical example, the appropriate database indicated that half of assignable cases were determined to be serious and half were non-serious.
- 4) *Pro-rate the extrapolated injury level based on the proportions found in the review of the database:* The remaining 12 cases without unknown outcomes are pro-rated based on the known proportions in the database. In this example, 6 of the 12 cases are assigned as serious injuries and 6 as non-serious. Combining this with the one documented injury that was determined to be serious, the total 13 estimated injuries represent 7 serious injuries and 6 non-serious injuries.

The methodological details of this prorating approach are expected to vary slightly among fisheries, because the nature of the available data is likely to differ. Prorating may, for example, also include a proportion of animals killed rather than injured, if a fishery both kills and injures marine mammals incidentally during fishing operations. Specific methods used for each fishery should be documented in the technical reports that present estimates of marine mammal mortality and serious injury.

VII. Large Cetacean Serious Injury Determination Process

A. Introduction to the Large Cetacean Injury Determination Process

The process described below is intended for evaluation of injury events involving mysticetes and sperm whales. The large cetacean injury categories and criteria are designed to allow categorization of most reports--both those with extensive documentation as well as reports containing few details--and to accurately assign a prognosis (i.e., death or survival) to these observed events. These categories and criteria were derived from multiple sources, including an analysis of known outcomes of large cetacean injury events, expert opinion from Serious Injury Workshop reports (Angliss and DeMaster, 1998; Andersen *et al.*, 2008), technical memoranda (e.g., Glass *et al.*, 2008), contract reports (e.g., Robbins, 2010), scientific peer-reviewed papers (e.g., Vanderlaan and Taggart, 2007), discussions of the NMFS Determination Staff Working Group, and consultations with veterinarians and pathobiologists. Many of the large cetacean injury categories differ from those presented in Andersen *et al.* (2008) due to refinements made during continued discussions and consultations, and the introduction of a quantitative approach based on the analysis on known outcomes of national large cetacean injury events (see below and Appendix I). The resulting large cetacean injury categories and criteria are detailed in subsection E and summarized in Table 1.

Most injury categories below used the results of a quantitative analysis of known outcomes of national large whale injury events from 2004-2008 to assign types of injuries as serious or non-serious. This time period was used because the data were the most comprehensive and of relatively high quality. The categories used were kept very general to provide reasonable sample sizes for analysis, and, as much as possible, were made mutually exclusive to ensure consistent categorization of events. For each injury category, the number of events in which the injury type resulted in the whale's death (including whales last seen in deteriorating health, i.e., skin discoloration, lesions near the nares, fat loss, or increased cyamid loads) was divided by the total number of events with that type of injury for which the outcome (i.e., death or survival) was known. This provided the proportion of serious injury outcomes for each category. Despite collapsing the data into very general injury categories, many of the categories still contained small sample sizes. Therefore, before assigning categories with proportions higher than 50% as a serious injury, a binomial test was applied to each category to estimate the likelihood of the rate of mortality being higher or lower than 50%. The results of the binomial tests measured the reliability of categories' observed proportions of deaths to events, and thereby indicated if future data collection might change the observed rate from higher than 50% to lower than 50% or vice versa. A relatively low significance threshold ($\alpha = 0.10$) was chosen prior to testing to maximize category assignment of an injury event to a percentage interval. Although adjusting the alpha to 0.10 increases the risk of falsely rejecting the null hypothesis that the rate of serious injury for a category does not differ from 50%, this was a practical concession given the nature of the data. The results of the analysis are tabulated in Appendix I. The proportions of serious injury outcomes for each category will be recalculated annually, incorporating the latest verified injury reports to improve the rate estimates.

The binomial test for three categories (L2, L5a, and L10) resulted in deaths-to-events rates likely higher than 50% (given $\alpha = 0.10$). The first two categories (L2 and L5a) were assigned

serious injury determinations in accordance with the Policy Directive. The third (L10), however, is prorated due to a potential bias of observed records within this category—specifically the increased likelihood of detection of more severe entanglements. This is discussed in more detail in subsection E. The method of prorating is described at the end of this paragraph. Three categories (L3, L5b, and L6c) are assigned non-serious injury determinations because no events of these types within the 2004-2008 dataset resulted in death or significant deterioration of a whale's health. The binomial tests for four injury categories resulted in equivocal odds (L6a, L6b, L7a and L11), and for two additional categories (L7b and L12) the proportion of deaths was less than 50%. To capture the probability of serious injury of these six categories, the proportions generated by the division of the number of lethal events by the total number of events from the original analysis is used as a multiplier to prorate the serious injury rate of each of these categories. For example, if 10 events are assigned to L11 (“vessel strike laceration”), which has an odds ratio of 0.52, the resulting value is 5.2. This value would then be added to the total number of serious injury events for the period. For L6a, however, peer reviewed publications indicate such events are likely to result in death, and therefore any event placed in this category is counted as a serious injury. Expert opinion was relied upon for four injury types for which outcome data were not available (categories L1, L4, L8, and L9).

It is important to note here that NMFS recognizes using a threshold vessel length of 65' for injury categories L6a, L6b, L7a, and L7b is not optimal, and vessels smaller than 65' are known to seriously injure or kill large cetaceans. NMFS also recognizes there are other potential factors (e.g., propeller diameter and speed, angle of strike, age and size of whale, etc.) that likely play a role in the injury severity to large cetaceans struck by vessels, especially in whether it causes a laceration and/or blunt trauma injury, where the former is more readily detected rather than the latter if the condition of the whale is known. Scientific literature shows that both vessel speed and mass play a role in understanding the severity of a vessel strike on a marine mammal, for blunt force trauma related injuries (Wright *et al.*, 1995; Laist *et al.*, 2001; Pace and Silber, 2005; Calleson and Frohlick, 2007; Kite-Powell *et al.*, 2007; Vanderlaan and Taggart, 2007; Wang *et al.*, 2007;). Specifically, Vanderlaan and Taggart (2007) concluded that, assuming the mass of vessels represented in the data they analyzed were much greater than the mass of the whales struck, then vessel speed is sufficient to predict the probability of a lethal injury to a whale. However, there are other variables and factors, such as propeller characteristics (i.e., propeller diameter), that influence the severity of sharp force trauma to marine mammals resulting from vessel strikes, which are not correlated to vessel size, except in very large ships (Calleson and Frohlick, 2007; Wright *et al.*, 1995). The distinction between blunt force and sharp trauma for these injury categories is important because the condition of the whale is not likely known if these injury categories are applied.

Given that the mass of a vessel and its mass relative to the mass of the whale play a role in the severity of an injury to a whale, and a mass or length threshold has not been defined in the scientific literature as it has for speed, NMFS considered the best available information to define injury categories for this policy. NMFS chose the vessel size (65') and speed (10 knots) threshold for injury categories L6a, L6b, L7a, and L7b because they are the vessel length and speed currently regulated under NMFS' Final Rule to Implement Speed Restrictions to Reduce the Threat of Ship Collisions with North Atlantic Right Whales (hereafter referred to as “ship speed rule”) (73 FR 60173, October 10, 2008). Length is being used as a proxy for mass in these

injury categories because this information is more readily available when a vessel strike is confirmed. The specific length of 65' was identified in the NMFS ship speed rule not because data indicated that a 65' vessel has a more severe strike compared to a smaller vessel, but because 65' is a category that is commonly understood by the maritime community and is reflected in established United States Coast Guard regulations. However, NMFS noted in the ship speed rule that vessels less than 65' may also pose a threat to large cetaceans and that the agency will consider measures in the future to address vessel classes below 65'. Therefore, if and when the 65' threshold is changed in the ship speed rule, or should such a threshold be identified in the scientific literature, the injury categories and their associated analyses defined in this policy will be updated to reflect those changes.

B. Application of Large Cetacean Injury Determination Process

Each large whale injury event is assigned to the appropriate category (or categories) listed in Table 1 using the best available information and scientific judgment. Well-documented events are likely to be placed in one of the more specific injury categories in the top rows (L1-L9) of the table, while poorly documented events will fall into one of the more general categories in the bottom rows (categories L10-L12). The criteria described in the category descriptions in subsection E below should be used to properly assign injuries to categories. Events that can be assigned to several specific injury categories are recorded as serious injuries if any one of the applicable specific categories has a serious injury determination. If an event includes injuries that fit into more than one category, the determination with the highest level of severity is assigned (e.g., an injury that fits into both a non-serious and a prorated category is placed in the prorated category with the highest prorating value). An event is recorded as a non-serious injury only if the injury does not fit in either a serious injury or prorated category. Events that have two or more injuries that separately fit into only non-serious injury categories will be assessed to determine if combined effect of the multiple injuries compound to increase the severity of the injury event. Events should be placed in the general injury categories (L10-L12) only if they cannot be placed in a more specific injury category above.

More detailed information or extended observation may justify a determination differing from the guidance of this table. An animal that is fully disentangled would generally be considered not seriously injured, unless there is additional evidence of a serious injury. Any injury leading to an indication of significant health decline (e.g., skin discoloration, lesions near the nares, fat loss, increased cyamid loads) is considered a serious injury.

C. Accounting for Large Cetacean Events where the Severity of an Injury Cannot Be Determined (CBD)

The more general injury categories (L10-L12) accommodate many events that lack the detail required for a clinical assessment of an injury, and should reduce the number of events for which the severity of an injury cannot be determined. Events that still cannot be assigned should be tallied by species (or to the highest taxonomic resolution possible) and these numbers included in the annual serious injury determination report.

D. Assessing and Documenting the Injury Status of Large Cetaceans after Successful Post-Interaction Mitigation Efforts

Large cetacean injuries that are successfully mitigated--primarily disentanglement from commercial fishing gear--may change an event's assignment from a category with a serious injury determination to a non-serious determination. Events that would have been serious injuries prior to mitigation should be tallied separately as serious injuries. These events are not counted against PBR in the SAR, but are included in the recorded takes for the LOF and associated management measures. See section VI for more information on this process.

E. Large Cetacean Injury Categories and Criteria (summarized in Table 1)

L1: "Ingested gear or hook(s)"- serious injury

If there is no additional information indicating the impact is not lethal, a confirmed case of ingested gear or hook(s) is counted a serious injury. Any indication of the ingestion of gear or hooks is placed in this category. An event is not placed in this category if it is not apparent that gear or hook(s) go down the throat. If gear or hook(s) is known to be in the mouth but it is unknown whether the gear is ingested or goes down the throat, the animal is placed in category L10 for evidence of entanglement. The ingestion of gear or hooks by a marine mammal is cited as a serious injury in multiple publications, including Andersen *et al.* (2008), Carretta *et al.* (2004), and Angliss and DeMaster (1998).

L2: "Constricting wrap"- serious injury

A constricting wrap includes any line that encircles any body part and has sufficient tension to either indent the skin or to not shift with whale's movement. This category is also applied if a line is likely to become constricting as the whale grows. Any event with indication at the time of reporting that an attached line is heavily weighted, the whale is anchored, or the whale has a discolored appendage resulting from attached line is counted in this category as a serious injury. Analysis of known outcomes of whale entanglements found 84 of 85 events (99%) involving constricting wraps resulted in the whales' deteriorating health or death. Constricting wraps of gear can cause lacerations, partial or complete fin amputation, organ damage, or muscle damage and interfere with mobility, feeding, and breathing. Chronic tissue damage from line under pressure can compromise a whale's physiology. Fecal samples from entangled whales had extremely high levels of cortisol (Rolland *et al.*, 2005), an immune system hormone. Extended periods of pituitary release of cortisol can exhaust the immune system, making a whale susceptible to disease and infection. Unless additional information proves the injury is not lethal, a case with indication of a constricting wrap is counted as a serious injury.

L3: "Loose wrap, bridled or draped gear" – non-serious injury

Loose gear includes any configuration of line that moves or shifts freely with a whale's movement and does not indent the skin. Verification of complete absence of constricting wraps is required before an event is assigned to this category. If the absence of constricting wraps cannot be verified, the case is assigned to category L10. The analysis of events with known outcomes assessed the condition of 14 whale entanglement events involving non-constricting gear prior to any disentanglement efforts and found none

resulted in the whales' deteriorating health or death. Loose wraps of gear damage tissue and can result in disfigurement, but do not appear to elicit the same immune system response as constricting gear. However, any event involving only loose gear is still counted as a serious injury if there is indication that the whale's health has significantly declined as a result of the entanglement. Indications of significant health decline include skin discoloration, lesions near the nares, fat loss, or increased cyamid loads.

L4: "*External hook*" – *non-serious injury*

A confirmed case of a fishing hook of any size on any external part of a large cetacean is counted as a non-serious injury. If any part of the hook is visible, it is considered external. Any trailing line is assessed using categories L2 or L3. Large cetacean experts participating in the 2007 Workshop indicated that an external fishing hook of any size on any part of a large cetacean is likely non-serious injury (Andersen *et al.*, 2008). However, any event involving an external fishing hook is still counted as a serious injury if there is indication that the whale's health has significantly declined as a result of the hook. Indications of significant health decline include skin discoloration, lesions near the nares, fat loss, or increased cyamid loads.

L5a: "*Deep laceration*" – *serious injury*

Any incision or tearing that potentially penetrates the body cavity or cuts into the skeletal structure, or a deep laceration at the insertion of the flippers or flukes where major arteries are near the skin surface, is counted as a serious injury. Confirmation of body cavity penetration, skeletal damage, or artery severing is not required to assign a case to this category. Lacerations that do not penetrate the body cavity or damage the skeleton, or that only partially sever a fluke or flipper without severing a major artery (i.e., are away from the insertion point), are assigned to category L5b. Analysis of known outcomes of whale injuries found 12 out of 12 events (100%) involving deep, non-entanglement (non-wrapping) lacerations resulted in the whales' deteriorating health or death. Large cetacean experts participating in the 2007 Workshop indicated that penetration of the body cavity, skeletal damage or a deep wound that leads to significant blood loss is likely to result in the death of a marine mammal (Andersen *et al.*, 2008).

L5b: "*Superficial laceration*" – *non-serious injury*

An incision or tear that does not go deeper than the blubber layer or only partially severs a flipper or fluke lobe is counted as a non-serious injury. Criterion L5a is considered if a laceration is potentially deeper than the blubber layer or is near the insertion point of a fluke or flipper. If details surrounding the event are lacking and, therefore, it is uncertain whether an event should be assigned to criteria L5a or L5b, assign the event to category L11. Out of 9 events involving shallow lacerations or only partial fluke or flipper severing, none resulted in health decline or death. However, any event involving a superficial laceration is still counted as a serious injury if there is indication that the whale's health has significantly declined as a result of the entanglement. Indications of significant health decline include skin discoloration, lesions near the nares, fat loss, or increased cyamid loads.

L6a: “*Vessel much greater in size than whale or vessel $\geq 65'$ and > 10 knots*” – serious injury

Any collision involving a vessel that is much greater in size than a whale traveling faster than 10 knots, or a vessel 65 feet or more in length traveling faster than 10 knots is counted as a serious injury regardless of the apparent condition of the whale immediately following the strike. Five out of 6 (83%) whales struck by a vessel 65 feet or more in length and traveling faster than 10 knots either showed signs of deteriorating health at the last sighting or died. Although a high proportion of events of this type resulted in death, this sample size was too small for the binomial test to establish the likelihood of the rate of mortality being higher or lower than 50%. However, results from separate studies (e.g., Pace and Silber, 2005; Vanderlaan and Taggart, 2007) support a designation of such events as serious injuries. Internal injuries from vessel collisions, which include fractures, organ damage, and internal hemorrhages, are not evident externally and typically are not detected unless the struck whale washes ashore and a necropsy is performed (Campbell-Malone *et al.*, 2008). See the discussion in subsection A above for information on why NMFS chose a 65' threshold for this injury category. If and when the 65' threshold is changed in the NMFS ship speed rule, upon which the 65' threshold in this injury category is based, the injury categories defined in this policy will be updated to reflect those changes.

L6b: “*Vessel smaller in size than whale or vessel $< 65'$ and > 10 knots*” – prorated

Any collisions involving vessels smaller in size than the whale traveling faster than 10 knots, or vessels less than 65 feet in length traveling faster than 10 knots are prorated. To prorate, the number of events assigned to this category within the assessment period is multiplied by 0.20. An event is assigned to this category if there is no information on the injury to the whale, but there is information on the size and speed of the vessel that struck the whale. If there is information on the whale following a strike (e.g., injuries to the animal, presence of blood, behavior of the animal), the injury event will be assigned to another appropriate category based on that information. One out of 5 (20%) whale strikes by a vessel less than 65 feet in length and traveling faster than 10 knots resulted in the whale's deteriorating health and likely death. Although only a small proportion of events of this type resulted in death, this sample size was too small for the binomial test to establish the likelihood of the rate of mortality being higher or lower than 50%. However, the prorating reflects the probability that some of these events will cause serious injury. Further, a strike to a calf by a vessel of any size and traveling greater than 10 knots will be considered a serious injury. If there is indication that the whale's health has significantly declined following any collision, it is counted as a serious injury. Indications of significant health decline include skin discoloration, lesions near the nares, fat loss, or increased cyamid loads. See the discussion in subsection A above for information on why NMFS chose a 65' threshold for this injury category. If and when the 65' threshold is changed in the ship speed rule, upon which the 65' threshold in this injury category is based, the injury categories defined in this policy will be updated to reflect those changes.

L6c: “*Vessel any size ≤ 10 knots*” – non-serious injury

A strike that involves a vessel of any size traveling 10 knots or less is counted as a non-serious injury. An event is assigned to this category only if there is no information on the

injury to the whale. If there is information on the whale following a strike (e.g., injuries to the animal, presence of blood, behavior of the animal), the injury event will be assigned to another appropriate category based on that information. Zero out of 6 collisions involving whales struck by vessels of any size (known and unknown) traveling 10 knots or less resulted in the whales' deteriorating health or death. However, if there is indication that the whale's health has significantly declined following any collision, it is counted as a serious injury. Indications of significant health decline include skin discoloration, lesions near the nares, fat loss, or increased cyamid loads.

L7a: "*Vessel much greater in size than whale or vessel $\geq 65'$ and speed unknown*" – prorate

Any collisions involving vessels much greater in size than a whale traveling at an unknown speed, or vessels 65 feet or more in length traveling at an unknown speed are prorated. To prorate, the number of events assigned to this category within the assessment period is multiplied by 0.56. An event is assigned to this category only if there is no information on the injury to the whale. If there is information on the whale following a strike (e.g., injuries to the animal, presence of blood, behavior of the animal), the injury event will be assigned to another appropriate category based on that information. Five out of 9 (56%) whales struck by a vessel 65 feet or more in length and traveling at an unknown speed either showed signs of deteriorating health or died. This sample size was too small for the binomial test to establish the likelihood of the rate of mortality being higher or lower than 50%. However, a strike to a calf by a vessel of any size when speed is unknown will be considered a serious injury. Further, if there is indication that the whale's health has significantly declined following any collision, it is counted as a serious injury. Indications of significant health decline include skin discoloration, lesions near the nares, fat loss, or increased cyamid loads. See the discussion in subsection A above for information on why NMFS chose a 65' threshold for this injury category. If and when the 65' threshold is changed in the ship speed rule, upon which the 65' threshold in this injury category is based, the injury categories defined in this policy will be updated to reflect those changes.

L7b: "*Vessel smaller in size than whale or vessel $< 65'$ and speed unknown*" – prorate

A strike that involves a vessel smaller than a whale traveling at an unknown speed, or a vessel less than 65 feet in length traveling at an unknown speed is prorated. To prorate, the number of events assigned to this category within the assessment period is multiplied by 0.14. An event is assigned to this category only if there is no information on the injury to the whale. If there is information on the whale following a strike (e.g., injuries to the animal, presence of blood, behavior of the animal), the injury event will be assigned to another appropriate category based on that information. One out of 7 (14%) whales struck by a vessel less than 65 feet in length and traveling at unknown speed resulted in the whales' deteriorating health or death. The binomial test results indicate it is likely that the rate of mortality from this type of event is lower than 50%. The prorating reflects the probability that some of these events will cause serious injury. However, a strike to a calf by a vessel of any size when speed is unknown will be considered a serious injury. Further, if there is indication that the whale's health has significantly declined following any collision, it is counted as a serious injury. Indications of significant health decline include skin discoloration, lesions near the nares,

fat loss, or increased cyamid loads. See the discussion in subsection A above for information on why NMFS chose a 65' threshold for this injury category. If and when the 65' threshold is changed in the ship speed rule, upon which the 65' threshold in this injury category is based, the injury categories defined in this policy will be updated to reflect those changes.

L8: “*Dependent*” – *serious injury*

Unless additional information proves a dependent calf survives the loss or serious injury of its mother, a confirmed case involving a dependent calf of a dead or seriously injured mother is counted as a serious injury to the calf. The cause of the mother's death or serious injury is also assigned to the calf. Large cetacean experts participating in the 2007 Workshop indicated that a dependent (i.e., non-weaned calf) will die if the mother is seriously injured or killed (Andersen *et al.*, 2008).

L9: “*Brought on deck*” – *serious injury*

If no additional information proves the impact is not lethal, a confirmed case of a large cetacean being removed from the water and brought on deck for any length of time is a serious injury. Large cetacean experts participating in the 2007 Workshop indicated that substantial stress and injuries will occur if a large cetacean is removed from the water and brought on the deck of a vessel (Andersen *et al.*, 2008).

The following injury/information criteria encompass confirmed reports that are insufficiently documented to assign to one of the criteria above with a high degree of certainty.

L10: “*Evidence of entanglement*” – *prorate*

This category encompasses confirmed events involving gear attached to a whale but lack the necessary detail to assign to one of the L1-L4 categories. Events falling in this category are prorated. To prorate, the number of events assigned to this category within the assessment period is multiplied by 0.75. Of the 114 documented entanglement events with known outcomes from 2004-2008, 85 (75%) either resulted in the whales' deteriorating health or death, or would have resulted in the whales' death if not for intervention (40 were disentangled from constricting wraps). The binomial test indicated that it is likely the rate of mortality is higher than 50% given these data. However, there is a potential bias in the analysis for this category. The subset of events with known outcomes was extracted from a total of 228 confirmed entanglement events reported during 2004-2008. Events with known outcomes are likely biased by a higher probability of detection of more severe entanglements, including whales examined on the beach and identified as entanglement mortalities. This statement has some additional support from a systematic survey of humpback whale scars that found 2 of 6 entanglement cases involving greater injuries were witnessed in progress and reported, while only 1 of 20 cases involving apparently minor injuries was reported (Robbins, 2010). This scar study also suggests that, based on observed tissue damage, the majority of scars acquired in 2008 were from minor entanglements. Although more severe or prolonged entanglements may be more likely to be reported, the 0.75 prorating reflects the probability that some confirmed entanglement reports lacking detail will be of minor events. However, if there is indication that the whale's health has significantly declined

following any entanglement, it is counted as a serious injury. Indications of significant health decline include skin discoloration, lesions near the nares, fat loss, or increased cyamid loads.

L11: “*Vessel strike laceration*” – *prorate*

Any confirmed reports of non-entanglement lacerations (non-wrapping incisions or tearing of the skin) that lack the detail to assign to the L5a or L5b categories are assigned here. This category is also used for observations of blood in the water without further details on the injury. The rate of serious injury for this category is prorated by multiplying the number of events assigned to this criterion by 0.52. Of all 25 documented non-entanglement laceration events from 2004-2008, 13 (52%) resulted in the whales’ deteriorating health or death. The binomial test results indicate that the rate of mortality from this type of event does not differ from 50%. Though blunt-force injuries--such as contusions and skeletal fracturing--can result from vessel strike, these types of internal injuries are typically not observable in live whales. If there is indication that the whale’s health has significantly declined following any collision, it is counted as a serious injury. Indications of significant health decline include skin discoloration, lesions near the nares, fat loss, or increased cyamid loads.

L12: “*Vessel strike observed*” – *prorate*

A confirmed case of a vessel strike for which no other information on the whale or vessel is available is assigned to this category and prorated. To prorate, the number of events assigned to this category is multiplied by 0.36. Of all 33 vessel strike events used in the categories above (all sizes and speeds), 12 (36%) resulted in the whales’ deteriorating health or death. The binomial test results indicate it is likely that the rate of mortality from this type of event is lower than 50%. The prorating reflects the probability that some of these events will cause serious injury. A strike to a calf by a vessel of unknown size traveling at an unknown speed will be considered a serious injury. Further, if there is indication that the whale’s health has significantly declined following any collision, it is counted as a serious injury. Indications of significant health decline include skin discoloration, lesions near the nares, fat loss, or increased cyamid loads.

TABLE 1: Summary of Large Cetacean¹ Injury Categories and Criteria

Instructions: Each large cetacean injury event is recorded to the appropriate injury/information category using all available information and scientific judgment, as described in the Procedural Directive. Criteria L10 - L12 accommodate events that lack details necessary for assignment to a more specific category. For a single injury event to which several categories apply, the injury determination with the highest level of severity is assigned. More detailed information or extended observation on an individual case/animal may justify a determination differing from the guidance of this table. An animal that is fully disentangled would generally be considered not seriously injured, unless there is additional evidence of a serious injury. Any injury leading to apparent significant health decline (e.g., skin discoloration, lesions near the nares, fat loss, increased cyamid loads) is a serious injury.

Category	Injury/ Information	Injury Determination	Criteria
L1	Ingested gear ² or hook(s)	SI ³	Swallowed, not simply draped through mouth
L2	Constricting wrap	SI	Tightly wrapped line anywhere on body that indents the skin or does not shift with whale's movement, or line that is likely to become constricting as the whale grows. Indication that a whale that is heavily weighted, anchored or has a discolored appendage is sufficient evidence of constricting gear
L3	Loose wrap, bridled or draped gear	NSI ⁴	Loosely wrapped gear that moves or shifts freely with whale's movement. Absence of constricting gear must be confirmed
L4	External hook	NSI	Fishing hook of any size on any part of the body (i.e., not ingested)
L5a	Deep laceration ⁵	SI	Laceration with the potential to affect major artery (e.g., laceration or severing at insertion of flipper/fluke), penetrating body cavity, or cutting bone
L5b	Superficial laceration	NSI	Laceration not deeper than blubber layer, does not affect major artery, or cut bone
L6a	Vessel much greater in size than whale or vessel $\geq 65'$ and >10 knots	SI	Struck by vessel much greater in size than the whale and traveling greater than 10 knots, or struck by vessel equal or greater than 65' and traveling greater than 10 knots, and no information on injury to the whale
L6b	Vessel smaller in size than whale or vessel $<65'$ and >10 knots	Prorate ⁶ : 0.20	Struck by vessel smaller in size than the whale and traveling greater than 10 knots, or struck by vessel less than 65' and traveling greater than 10 knots, and no information on injury to the whale. A strike to a calf by a vessel of any size and traveling greater than 10 knots will be considered a serious injury

¹ For the purposes of this table, "large cetaceans" include all mysticetes and sperm whales.

² For the purposes of this table, "gear" is defined as any portion of fishing gear excluding the hook, which is considered separately.

³ SI = Serious Injury.

⁴ NSI = Non-Serious Injury.

⁵ For the purposes of this table, "laceration" is defined as a ragged incision or a tearing of the skin. Lacerations are caused by trauma that results in stretching, tearing, crushing, shearing, or avulsion of the tissue. Trauma, including blunt and sharp force trauma, includes a wound or bodily harm caused by an extrinsic agent.

⁶ "Prorate" means the number of events assigned to a given category within the assessment period is multiplied by the prorate number provided for that category.

L6c	Vessel any size ≤ 10 knots	NSI	Struck by vessel of any size traveling at equal or less than 10 knots and no information on injury to the whale
L7a	Vessel much greater in size than whale or vessel $\geq 65'$ and speed unknown	Prorate: 0.56	Struck by vessel much greater in size than the whale traveling at an unknown speed, or struck by vessel equal or greater than 65' and traveling at unknown speed, and no information on injury to the whale. A strike to a calf by a vessel of any size when speed is unknown will be considered a serious injury
L7b	Vessel smaller in size than whale or vessel $< 65'$ and speed unknown	Prorate: 0.14	Struck by vessel smaller than the whale traveling at an unknown speed, or struck by vessel less than 65' and traveling at unknown speed, and no information on injury to the whale. A strike to a calf by a vessel of any size when speed is unknown will be considered a serious injury
L8	Dependent ⁷	SI	Dependent calf of a dead or seriously injured mother
L9	Brought on deck	SI	Whale removed from water and brought on deck
L10	Evidence of entanglement	Prorate: 0.75	Confirmed entanglement but insufficient information available to place in any of the L1-L4 criteria with a high degree of certainty
L11	Vessel strike laceration	Prorate: 0.52	Whale confirmed with non-entanglement related laceration but lacking details to place in either criteria L5a or L5b with a high degree of certainty. Includes observation of blood in water
L12	Vessel strike observed	Prorate: 0.36	Confirmed vessel strike report where there is insufficient detail to assign event to criteria L6a – L7b with a high degree of certainty. A strike to a calf by a vessel of unknown size traveling at an unknown speed will be considered a serious injury

⁷ “Dependent” for a large cetacean means a non-weaned calf. Weaned calves and juvenile large cetaceans are no longer dependent on their mothers.

VIII. Serious Injury Determination Process for Small Cetaceans

A. Introduction to the Small Cetacean Determination Process

The process described below is intended for evaluation of injury events involving all odontocetes except sperm whales. The injury categories and criteria and associated injury determinations for small cetaceans were derived predominantly from expert opinion and data presented at the 2007 Serious Injury Technical Workshop (Andersen *et al.*, 2008) because, unlike for large whales, there is limited information available on known outcomes of various injuries for small cetaceans. In some cases, additional considerations from the 1997 Serious Injury Workshop (Angliss and DeMaster, 1998), from subsequent discussions and analyses of the NMFS Determination Staff Working Group, or from multiple external experts were included, and these are indicated in the descriptions below. The resulting small cetacean injury categories and criteria are detailed in subsection E and summarized in Table 2.

B. Application of the Small Cetacean Injury Determination Process

Each small cetacean injury event is assigned to the appropriate category (or categories) listed in Table 2 using the best available information and scientific judgment. The criteria described in the category descriptions in subsection E below should be used to properly assign injuries to categories. Single injury events that can be assigned to several specific injury categories will be recorded according to the injury category with the highest level of severity. For example, an animal that has both “gear wrapped and loose on any body part” (S8b, case specific) and “ingested gear or hook(s)” (S2, serious injury) will be recorded as seriously injured. Events that have two or more injuries that separately fit into only CBD injury categories will be assessed to determine if combined effect of the multiple injuries compound to increase the severity of the injury event.

C. Accounting for Small Cetacean Events where the Severity of an Injury Cannot Be Determined

Injury events that remain CBD following application of the criteria and evaluation of relevant additional factors should, when possible, be assigned the injury severity for the majority of comparable injuries for similar taxa and injury type. This approach is similar to the approach for large whales (section VII) except that the injury severity is assigned based on past serious injury determinations rather than known injury outcomes (which are largely lacking for small cetaceans). This CBD assignment approach would apply only when appropriate fishery observer data are unavailable or insufficient to prorate CBD cases as described in Section VI.

The proportions of serious vs. non-serious determinations for a type of injury may be estimated by Science Center staff using any relevant and appropriate data (e.g., observer records for comparable fisheries, stranding networks, disentanglement networks, Law Enforcement and U.S. Coast Guard reports). Under this method, Science Center staff will assign all remaining CBD cases to be the same determination as for the majority of similar assignable cases. Evaluations should be done only for similar taxonomic groups (i.e., dolphins, beaked whales) and for the same injury type (e.g., deep laceration to head) or fishery characteristics (e.g., longline fisheries, small-mesh gillnet fisheries). For example, if 12 out of 20 (60%, the majority) of documented

cases of dolphins with propeller lacerations to the head were determined to be serious, and 40 percent were non-serious, then all of the CBD cases for bottlenose dolphins observed with that type of injury would be designated as serious. In cases where data on assignable injury events are limited in one region or where sample sizes are small, data can be pooled across regions to provide a more robust sample set on which to base the severity assignment of a CBD injury event. Statistical evaluations, such as the binomial probability tests applied to large whale data above, are encouraged when appropriate to aid in evaluating whether an injury is more likely to be serious or non-serious based on the available data. If sample sizes of similar assignable cases are insufficient to determine whether an injury is more likely to be serious or non-serious, prorating can be used, as described in Section VII-A for large whales (see also Appendix I). All CBD cases that are assigned or prorated based on previous assignable injury events should be indicated as such in the serious injury determination reports and SARs.

D. Assessing and Documenting the Injury Status of Small Cetaceans after Successful Post-Interaction Mitigation Efforts

Small cetacean injuries that are successfully mitigated may change an event's assignment from a category with a serious injury determination to a non-serious determination. Events that would have been serious injuries prior to mitigation should be tallied separately as serious injuries. These events are not counted against PBR in the SAR, but are included in the recorded takes for the LOF. See section VI for more information on this process.

E. Small Cetacean Injury Categories and Criteria

S1: “A free-swimming animal observed at a date later than its human interaction, exhibiting signs of declining health believed to be resulting from initial injury (e.g., a marked skin discoloration, fat loss)”- *serious injury*

Small cetacean experts on the NMFS Determination Staff Working Group included this criterion to account for animals that are resighted (which is rare for most small cetacean species) at some time after an injury event exhibiting marked signs of health decline as a result of the injury. In those cases, the initial injury is a serious injury because it resulted in the animal's health decline.

S2: “Ingested gear or hook(s)”- *serious injury*

The ingestion of gear or hooks by a marine mammal is cited as a serious injury in multiple publications, including Andersen *et al.* (2008), Wells *et al.* (2008), Carretta *et al.* (2004), and Angliss and DeMaster (1998). In addition, small cetacean experts participating in the 2007 Serious Injury Technical Workshop (Workshop) indicated that the ingestion of gear by small cetaceans is a serious injury. Data from bottlenose dolphins in Florida show that fishing hooks (including partial hooks) embedded in the throat, goosbeak, or esophagus, or line wrapped around the goosbeak, generally lead to death, although there is some chance of survival if the hook(s) does not become embedded (Wells *et al.*, 2008). In addition, death from gear ingestion was not immediate, with most of the retrieved carcasses being emaciated (Wells *et al.*, 2008).

S3: *“Visible blood loss”- case specific*

Small cetacean experts participating in the 2007 Workshop indicated that an injury with visible blood loss is case specific. Blood loss indicates that the animal is “injured” (50 Code of Federal Regulations 229.2), and observation may provide additional information to determine whether the bleeding injury is serious or non-serious. Injuries with persistent bleeding would be considered a serious injury, whereas injuries where the bleeding stops relatively quickly may not be considered a serious injury. Additional factors about the injury need to be considered before making a determination of severity (see Table 2), such as the amount of blood and the location of the bleeding injury.

S4: *“Animal brought on vessel deck following entanglement/entrapment (excluding scientific research targeting marine mammals and authorized as such under a NMFS scientific research permit, where the animal is brought on and placed on the vessel deck in a controlled manner)”- serious injury*

Small cetacean experts participating in the 2007 Workshop indicated that a small cetacean brought on the vessel deck following an interaction is seriously injured because such handling causes substantial stress to the individual and subjects the individual to a high risk of later death due to capture myopathy or hidden injuries. NMFS-permitted marine mammal scientific research is not included in this criterion because the permit for the research requires a certain level of care be taken during the research not to harm the animal. In these cases, the animal is brought on and placed on the vessel in a controlled manner, causing no harm or a significantly lower level of injury than an animal brought on board in an uncontrolled manner (e.g., pulled on by fishing gear).

S5a: *“Hook(s) in head (excluding criterion S5b), regardless of the presence of gear”- serious injury*

A small cetacean hooked in the head (near the eyes) is considered seriously injured by Angliss and DeMaster (1998). Small cetacean experts participating in the 2007 Workshop agreed with Angliss and DeMaster (1998) that a small cetacean with a hook in the head, including the eyes, blowhole, and mouth, is seriously injured because of the potential for ingesting attached gear, impairing feeding, breathing, or sight, or acting as a conduit for infection.

S5b: *“Hook(s) confirmed in lip only, external tissue outside of teeth, no trailing gear”- case specific*

Small cetacean experts participating in the 2007 Workshop indicated that a small cetacean with a confirmed hook in the lip only, including only external tissue outside of the teeth, is case specific. A hook in the lip can pull out and could be considered non-serious unless there are other circumstances that would increase the severity, such as impairing the ability to feed, prolonged struggle while hooked that could lead to capture myopathy, or the presence of other injuries. Additional factors about the injury and hooking event need to be considered before making a determination of severity (see Table 2).

S5c: *“Hook(s) in any body part, but hook(s) is removed or pulls out”- case specific*

Small cetacean experts on the NMFS Determination Staff Working Group included this criterion to account for cases where an animal is hooked and the hook is removed naturally over time or by human intervention. This injury is case specific because the location of the hook and the manner in which it is removed (i.e., pulls out cleanly vs. roughly) impacts the severity of the injury. Additional factors about the injury need to be considered before making a determination of severity (see Table 2).

S5d: *“Hook(s) in appendage or body (excluding criterion S5a), without trailing gear or with trailing gear that does not have the potential to: 1) become a constricting wrap on animal; 2) be ingested; 3) accumulate drag; or 4) become snagged on something in the environment, anchoring the animal”- case specific*

Small cetacean experts participating in the 2007 Workshop indicated that a small cetacean hooked in an appendage or the body (excluding the head), without trailing gear or with trailing gear that does not have the potential to cause additional constricting wrapping, anchoring or ingestion, is case specific. Additional factors about the injury need to be considered before making a determination of severity (see Table 2).

S6: *“Gear attached to free-swimming animal with potential to: 1) become a constricting wrap on animal; 2) be ingested; 3) accumulate drag; or 4) become snagged on something in the environment, anchoring the animal”- serious injury*

A small cetacean entangled with trailing gear is considered seriously injured by Angliss and DeMaster (1998). Small cetacean experts participating in the 2007 Workshop agreed with Angliss and DeMaster (1998) and further indicated that a small cetacean with attached gear that has the potential to entangle the animal is seriously injured because the gear may become constricting (S8a) and/or cause the animal to drown as a result of dragging gear for extended periods of time.

S7a: *“Anchored, immobilized, or entrapped and not freed”- serious injury*

Small cetacean experts participating in the 2007 Workshop indicated that an entanglement that immobilizes or significantly impairs the movement of a small cetacean is a serious injury because small cetaceans must generally eat every day and would be unable to do so if immobilized by an entanglement or entrapment. Also, a small cetacean may tire quickly as a result of its small body size, interfering with its ability to reach the surface to breathe, and it may be susceptible to capture myopathy as it struggles to free itself.

S7b: *“Anchored, immobilized, entangled, or entrapped before being freed without gear attached”- case specific*

Small cetacean experts participating in the 2007 Workshop indicated that a small cetacean released without gear attached following an entanglement or immobilization is case specific. Capture myopathy considerations suggest some of these animals may subsequently die because the health of the animal may be compromised to a greater extent the longer it is immobilized by an entanglement or entrapment. Also, small cetaceans may be unable to feed while entangled or entrapped and/or have increased difficulty reaching the surface. The longer the animal is immobilized, anchored, or

entrapped, the longer it may go without food or regular access to oxygen. Additional factors about the injury need to be considered before making a determination of severity (see Table 2).

S8a: *“Gear wrapped and constricting on any body part or is likely to become constricting as the animal moves or grows”- serious injury*

Small cetacean experts participating in the 2007 Workshop indicated that a small cetacean with constricting wraps of line around any body part, or line that is likely to become constricting as the animal grows or because of the animal's movement, is seriously injured. This is a serious injury because the constricting wraps of gear can cause lacerations, fin amputation, organ damage, or muscle damage, and interfere with mobility, feeding, and breathing.

S8b: *“Gear wrapped and loose on any body part”- case specific*

Small cetacean experts on the NMFS Determination Staff Working Group included this criterion to distinguish cases where gear was constricting or had the potential to become constricting (criteria S6 and S8a) from gear that, while wrapped on the animal, is loose and unlikely to become constricting. This injury is case specific because gear that is loosely wrapped around a small cetacean can either work its way off the animal, never become constricting or accumulate drag (resulting in a non-serious injury), or become constricting (resulting in a serious injury, see criterion S8a). Therefore, additional factors about the injury need to be considered before making a determination of severity (see Table 2), such as the amount and size of the gear relative to the size of the animal.

S9: *“Body trauma not covered by any other criteria”- case specific*

Small cetacean expert participants and the 2007 Workshop included this criterion to incorporate general body trauma, including lacerations, that is not specified in any other criteria. Small cetacean experts indicated that body trauma was case specific because additional factors about the injury need to be considered before making a determination of severity (see Table 2), such as the location on the body (e.g., a laceration on the dorsal midline, including the peduncle, may be more serious than a laceration over the animal's ribcage; eye injuries and head trauma may be more serious than trauma to other body parts), the depth (e.g., a deep laceration or other trauma reaching the bone or penetrating muscle or organs is more serious than a superficial wound) and cleanliness of the wound.

S10: *“Visible fractures, excluding pectoral fins (see criterion S13d for pectoral fin fractures)”- serious injury*

Small cetacean experts participating in the 2007 Workshop indicated that a visible fracture is a serious injury. Fractures that are visible can include open fractures (i.e., when a broken bone punctures the skin and exposes the wound to the open air) and closed fractures (i.e., when a broken bone does not puncture the skin) and are usually severe enough to interfere with everyday activities necessary to small cetaceans' survival, such as mobility, feeding, and defense. Pectoral fins are covered separately in criterion S13d.

- S11: *“Vertebral transection, including fully severed flukes”- serious injury*
Small cetacean experts participating in the 2007 Workshop indicated that an injury including vertebral transection is a serious injury because vertebral transection injuries are most commonly reported as mortalities, indicating the injury is often fatal.
- S12: *“Body cavity penetration by foreign object or body cavity exposure”- serious injury*
Small cetacean experts participating in the 2007 Workshop indicated that body cavity penetration or exposure is a serious injury. Body cavity penetration or exposure can introduce bacteria into the vital organs and the internal cavity, which can lead to massive infection.
- S13a: *“Loss or disfigurement of dorsal fin” - case specific*
Small cetacean experts participating in the 2007 Workshop indicated that the loss or disfigurement of the dorsal fin is case specific because there is evidence that small cetaceans can survive and reproduce without the dorsal fin (Wells *et al.*, 2008). Additional factors about the injury need to be considered before making a determination of severity (see Table 2), such as the nature of the injury causing the loss of the dorsal fin, which will affect the likelihood of survival. Cases of bottlenose dolphins in Florida involving major disfigurement or loss of significant dorsal fin or fluke tissue show that, on average, individuals survived a minimum of 8.7 years with these wounds (Wells *et al.*, 2008). However, these observations include information only on the survivors, and it is unknown what proportion of animals may die as a result of the loss of the dorsal fin (Wells *et al.*, 2008).
- S13b: *“Partially severed flukes, transecting midline”- serious injury*
Small cetacean experts participating in the 2007 Workshop indicated that the partial severing of the flukes that transects the animal’s midline is a serious injury. A partial severing of the fluke that transects the animal’s midline has a high risk for severing major vessels (e.g., arteries, veins), resulting in more severe blood loss. Also, this injury crosses the caudal vertebral column and exposes bone and major vessels to infection.
- S13c: *“Partially severed flukes, not transecting midline” - case specific*
Small cetacean experts participating in the 2007 Workshop indicated that the partial severing of the flukes that does not transect the animal’s midline is case specific. Additional factors about the injury need to be considered before making a determination of severity (see Table 2), such as the nature of the injury causing the partial severing, which will affect the likelihood of survival.
- S13d: *“Partially or completely severed or fractured pectoral fin(s)” - case specific*
Small cetacean experts participating in the 2007 Workshop indicated that a partial severing of the pectoral fin(s) is case specific. Small cetacean experts on the NMFS Determination Staff Working Group included fractured pectoral fins in this criterion to distinguish fin fractures from other bone fractures (S10). Additional other factors about the injury need to be considered before making a determination of severity (see Table 2), such as the nature of the injury causing the severing of the fin(s) and the extent of fin(s)

loss (i.e., full or partial) or the extent of the fracture (i.e., opened or closed), which will affect the likelihood of survival.

S14: *“Social animal separated from group and/or released alone post-interaction” - case specific (excluding criterion S15)*

Angliss and DeMaster (1998) stated that entanglements that result in a small cetacean separated from its group should be considered seriously injured. Small cetacean experts participating in the 2007 Workshop agreed with Angliss and DeMaster (1998) that a small cetacean from a social species separated from its group is case specific. Additional factors about the interaction need to be considered before making a determination of severity (see Table 2), such as the social structure of the individual’s species and where the animal is released (e.g., likelihood of the animal locating its conspecifics). A social animal released alone may be subjected to additional stress and reduced survival (e.g., decreased foraging success, increased predation risk).

S15: *“Dependent animal (i.e., calf, juvenile) released alone post-interaction or dependent animal left with a seriously injured or dead mother” - serious injury*

Small cetacean experts participating in the 2007 Workshop indicated that a dependent (e.g., calf, juvenile) small cetacean separated from its group or mother (i.e., animal is unlikely to locate its group or mother on its own) is seriously injured because a dependant animal released alone would be subjected to significant additional stress and reduced survival.

S16: *“Observed or reported collision with a vessel” - case specific*

Injuries to small cetaceans as a result of a collision with a vessel are not always observed after the vessel strike; therefore, the injury to that individual cannot be assessed. However, many vessel strikes are observed and reported to NMFS without information pertaining to the resulting injury. For example, NMFS receives a report that a bottlenose dolphin was struck by a vessel X feet in length and traveling Y knots, with no information on the animal after the strike. In these cases, small cetacean experts participating in the 2007 Workshop indicated that the severity of an injury to a small cetacean from a collision with a vessel is case specific. Additional factors about the injury need to be considered before making a determination of severity (see Table 2), such as the size and speed of the vessel and the location of the injury. If injury information is available and provided to NMFS, the appropriate criteria from S1-S15 will be considered. For example, NMFS receives a report that a bottlenose dolphin was struck by a vessel X feet in length and traveling Y knots, and the animal swam away with head trauma. In this case, the determination staff would also apply criterion S9 to the injury event.

TABLE 2: Summary of Small Cetacean¹ Injury Categories and Criteria

Instructions: Each small cetacean injury event is recorded to the appropriate injury/information category using all available information and scientific judgment, as described in the Procedural Directive. For a single injury event to which several categories apply, the injury determination with the highest level of severity is assigned. More detailed information or extended observation on an individual case/animal may justify a determination differing from the guidance of this table. Any injury leading to apparent significant health decline (e.g., skin discoloration, fat loss) is a serious injury.			
Category	Injury/Information	Injury Determination ²	Additional factors for evaluating whether “case specific” injuries are serious or non-serious (additional factors at end of table) *
S1	A free-swimming animal observed at a date later than its human interaction, exhibiting signs of declining health believed to be resulting from initial injury (e.g., a marked skin discoloration, fat loss)	SI ³	
S2	Ingested gear ⁴ or hook(s)	SI	
S3	Visible blood loss	Case specific ⁵	Amount of blood, location of the bleeding injury, duration of bleeding
S4	Animal brought on vessel deck following entanglement/entrapment (excluding scientific research targeting marine mammals and authorized as such under a NMFS scientific research permit, where the animal is brought on and placed on the vessel deck in a controlled manner)	SI	
S5a	Hook(s) in head (excluding criterion S5b), regardless of the presence of gear	SI	
S5b	Hook(s) confirmed in lip only, external tissue outside of teeth, no trailing gear	Case specific	Prolonged restraint or struggle that could lead to capture myopathy, size of hook, depth of hooking, impairing ability to feed, presence of other injuries
S5c	Hook(s) in any body part, but hook(s) is removed or pulls out	Case specific	Prolonged restraint or struggle that could lead to capture myopathy, depth of hook, hook pulls out cleanly vs. causes further injury during dehooking, method used to remove hook, length of time hooked
S5d	Hook(s) in appendage or body (excluding criterion S5a), without trailing gear or with trailing gear that does not have the potential ⁶ to: 1) become a constricting wrap on animal; 2) be ingested; 3) accumulate drag; or 4) become snagged on something in the environment, anchoring the animal	Case specific	Prolonged restraint or struggle that could lead to capture myopathy, depth and location of hook, type and amount of gear attached

¹ For the purposes of this table, small cetaceans include all odontocetes except sperm whales.

² This table includes on only those criteria determined to be serious injuries or case specific based on expert opinion at the 2007 Workshop (Andersen *et al.*, 2008) and by small cetacean experts on the NMFS Determination Staff working group. For the purposes of streamlining the information for the reader, criteria determined to be non-serious injuries are not included in this table.

³ SI = serious injury.

⁴ For the purposes of this table, gear is defined as any portion of fishing gear excluding the hook, which is considered separately. Lures are considered gear. Gear also generally refers to any type of debris entangling or attached to the animal.

⁵ Case specific = Could be a serious or non-serious injury, but either 1) there is insufficient information about the impact of a particular injury, or 2) additional factors must be considered on a case-by-case basis to determine the severity

⁶ For the purposes of this table, “potential” as it relates criterion S5d indicates that the trailing gear IS NOT capable of leading to any of the situations listed.

S6	Gear attached to free-swimming animal with potential ⁷ to: 1) become a constricting wrap on animal; 2) be ingested; 3) accumulate drag; or 4) become snagged on something in the environment, anchoring the animal	SI	
S7a	Anchored, immobilized, or entrapped and not freed	SI	
S7b	Anchored, immobilized, entangled, or entrapped before being freed without gear attached	Case specific	Duration of entanglement/entrapment, prolonged restraint or struggle that could lead to capture myopathy, gear type, where/how gear is attached to animal, associated injury (i.e., where directly or indirectly caused by initial entanglement), response of individual animal, method used by human to remove gear from animal
S8a	Gear wrapped and constricting on any body part or is likely to become constricting as the animal moves or grows	SI	
S8b	Gear wrapped and loose on any body part	Case specific	Gear type, amount of gear, potential for snag, potential to lead to criterion S8a, animal body size relative to gear (e.g., because of species or age), effect on animal movement, species sensitivity (e.g., frightens easily)
S9	Body trauma ⁸ not covered by any other criteria	Case specific	Location of wound, depth (e.g., superficial or to the bone, penetrating muscle or organs), length, number of lacerations, cleanliness (i.e., compression vs. tearing)
S10	Visible fracture(s), excluding pectoral fins (see criterion S13d for pectoral fin fractures)	SI	
S11	Vertebral transection, including fully severed flukes	SI	
S12	Body cavity penetration ⁹ by foreign object or body cavity exposure	SI	
S13a	Loss or disfigurement of dorsal fin	Case specific	Cleanliness (i.e., compression vs. tearing), nature of injury causing the loss, extent of fin loss (i.e., full or partial), amount and duration of blood loss
S13b	Partially severed flukes, transecting midline	SI	

⁷ For the purposes of this table, potential as it relates criterion S6 indicates that the trailing gear IS capable of leading to any of the situations listed.

⁸ For the purposes of this table, “trauma” is defined as a wound or bodily harm caused by an extrinsic agent. Blunt trauma is an injury (abrasion, laceration, contusion or skeletal fracture) produced by a blunt object striking the body or impact of the body against a blunt object or surface. Sharp force trauma is an injury caused by a sharp or pointed object creating a penetrating (stab, chop or incision) wound. Laceration is defined as a ragged incision or a tearing of the skin. Lacerations are caused by blunt trauma that results in stretching, tearing, crushing, shearing, or avulsion of the tissue.

⁹ For the purposes of this table, “penetration” is defined as a wound occurring when a foreign object punctures the body. Penetrating wounds can be characterized as one of three types: stab (small external wound that is greater in length into the body than is apparent on the skin surface), incised (clean cuts into the skin which are longer on the skin surface than they are deep), or chop wounds (incised wounds that penetrate deep to the bone, leaving a groove or cut in the bone).

S13c	Partially severed flukes, not transecting midline	Case specific	Cleanliness (i.e., compression vs. tearing), nature of injury causing the loss, amount and duration of blood loss
S13d	Partially or completely severed or fractured pectoral fin(s)	Case specific	Cleanliness (i.e., compression vs. tearing), nature of injury causing the loss, extent of fin loss (i.e., full or partial), amount and duration of blood loss, opened or closed fracture
S14	Social animal separated from group and/or released alone post-interaction (excluding criterion S15)	Case specific	Species (e.g., sensitivity, offshore vs. inshore), location of release (e.g., likelihood of animal locating its conspecifics)
S15	Dependent animal (i.e., calf, juvenile) released alone post-interaction or dependent animal left with a seriously injured or dead mother	SI	
S16	Observed or reported collision with vessel	Case specific	Speed of vessel, size of vessel, hull shape, part of vessel to strike the animal, size of animal compared to size of vessel, behavior of animal after collision, extent and location of wound(s) on animal

* Factors listed in the far right column of Table 2 are unique to the associated injury type. In addition to those listed in this column, the factors that should be considered, if available, when reviewing all case specific injury events in Table 2 include, but are not limited to:

- | | | |
|--|--|--|
| - Species | - Size of injury | - Compounding effects of multiple injuries obtained during a single event |
| - Age or age class (e.g., calf, juvenile, adult) | - Duration of injury (e.g., single event, repeated, chronic) | - Availability of data on multiple sequential events involving the same individual over time |
| - Sex | - Depth of injury (e.g., superficial or to the bone, penetrating muscle or organs) | - Susceptibility of the species to capture myopathy (spinner dolphins and porpoises notoriously sensitive; bottlenose dolphins robust; many others fall in between, with some unknown) |
| - Size of animal | - Cleanliness of injury (e.g., compression, tearing) | - Ability of rehabilitated animal to be released |
| - Overall health (e.g., nutritional status, body condition, pre-existing disease state, pre-existing injuries) | - Environmental condition (e.g., individuals out of their normal habitat, climate stressors) | - Relative effect of blood loss on different species |
| - Behavior during and/or after injury-causing interaction (e.g., dorsal arching, listlessness) | - Social stressors (e.g., social structure of species, separation of social individuals from the group, cow/calf separation) | |
| - Reproductive status (e.g., pregnant, lactating, has dependant calf) | - Cumulative effects of repeated exposures | |
| - Natural history (e.g., indigenous, migratory) | | |
| - Location of injury (e.g., mouth, head, body, fin, tail, internal) | | |

In addition to those factors listed above, the factors that apply to all fishery-interaction related case specific injuries include, but are not limited to:

- | | |
|---|--|
| - Entanglement type (e.g., hooked, anchored, entrapment) | - Habitat where animal is located (e.g., an animal with trailing gear areas of dense gear or an area with vegetation is more likely to risk snagging the gear and becoming anchored) |
| - Amount and size of gear (e.g., size, length and number of branches of line; number of buoys, traps or anchors; volume of netting) | - Entanglement duration |
| - Entanglement constriction (e.g., tight, loose, multiple wraps) | - Existence, type and amount of any trailing gear |
| | - Method of handling the animal during disentanglement |

IX. Serious Injury Determination Process for Pinnipeds

A. Introduction to the Pinniped Determination Process

The process described below is intended for evaluation of injury events involving all pinniped species except walrus. The injury categories and criteria and associated injury determinations for pinnipeds were derived predominantly from expert opinion and data presented at the 2007 Serious Injury Technical Workshop (Andersen *et al.*, 2008), because, unlike for large whales but similar to small cetaceans, there is limited information available on known outcomes of various injuries for pinnipeds. In some cases, additional considerations from the 1997 Serious Injury Workshop (Angliss and DeMaster, 1998), from subsequent discussions and analyses of the NMFS Determination Staff Working Group, or from multiple external experts were included, and these are indicated in the descriptions below. The resulting pinniped injury categories and criteria are detailed in subsection E and summarized in Table 3.

B. Application of the Pinniped Injury Determination Process

Each pinniped injury event is assigned to the appropriate category (or categories) listed in Table 3 using the best available information and scientific judgment. The criteria described in the category descriptions in subsection E below should be used to properly assign injuries to categories. Single injury events that can be assigned to several specific injury categories will be recorded according to the injury category with the highest level of severity. For example, an animal that has both “gear wrapped and loose on any body part” (P8b, case specific) and “ingested gear or hook(s)” (P2, serious injury) will be recorded as seriously injured. Events that have two or more injuries that separately fit into only CBD injury categories will be assessed to determine if combined effect of the multiple injuries compound to increase the severity of the injury event.

C. Accounting for Pinniped Events where the Severity of an Injury Cannot Be Determined

Injury events that remain CBD following application of the criteria and evaluation of relevant additional factors should, when possible, be assigned the injury severity for the majority of comparable injuries for similar taxa and injury type. This approach is the same as that outlined for small cetaceans (section VIII). It is similar to the approach for large whales (section VII) except that the injury severity is assigned based on past serious injury determinations rather than known injury outcomes (which are largely lacking for pinnipeds). This CBD assignment approach would apply only when appropriate fishery observer data are unavailable or insufficient to prorate CBD cases as described in Section VI.

The proportions of serious vs. non-serious determinations for a type of injury may be estimated by Science Center staff using any relevant and appropriate data (e.g., observer records for comparable fisheries, stranding networks, disentanglement networks, Law Enforcement and U.S. Coast Guard reports). Under this method, Science Center staff will assign all remaining CBD cases to be the same determination as for the majority of similar assignable cases. Evaluations should be done only for similar taxonomic groups (i.e., seals, sea lions) and for the same injury type (e.g., deep laceration to head) or fishery characteristics (e.g. small-mesh gillnet fisheries).

For example, if 12 out of 20 (60%, the majority) of documented cases of seals with propeller lacerations to the head were determined to be serious, and 40% percent were non-serious, then all of the CBD cases for a harbor seal observed with that type of injury would be designated as serious. In cases where data on assignable injury events are limited in one region or where sample sizes are small, data can be pooled across regions to provide a more robust sample set on which to base the severity assignment of a CBD injury event. Statistical evaluations, such as the binomial probability tests applied to large whale data above, are encouraged when appropriate to aid in evaluating whether an injury is more likely to be serious or non-serious based on the available data. If sample sizes of similar assignable cases are insufficient to determine whether an injury is more likely to be serious or non-serious, prorating can be used, as described in Section VII-A for large whales (see also Appendix I). All CBD cases that are assigned or prorated based on previous assignable injury events should be indicated as such in the serious injury determination reports and SARs.

D. Assessing and Documenting the Injury Status of Pinnipeds after Successful Post-Interaction Mitigation Efforts

Pinniped injuries that are successfully mitigated may change an event's assignment from a category with a serious injury determination to a non-serious determination. Events that would have been serious injuries prior to mitigation should be tallied separately as serious injuries. These events are not counted against PBR, but are included in the recorded takes for the LOF. See section VI for more information on this process.

E. Pinniped Injury Categories and Criteria

P1: *"A free-swimming animal observed at a date later than its human interaction, exhibiting signs of declining health believed to be resulting from initial injury (e.g., a marked change in body condition, tissue necrosis, emaciation, gangrene)" - serious injury*

Pinniped experts on the NMFS Determination Staff Working Group included this criterion to account for animals that are resighted (while rare for many pinnipeds) at some time after an injury event exhibiting marked signs of health decline as a result of the injury. Therefore, the initial injury is a serious injury because it resulted in the animal's health decline.

P2: *"Ingested gear or hook(s)" - serious injury*

The ingestion of gear or hooks by a marine mammal is cited as a serious injury in multiple publications, including Andersen *et al.* (2008) and Angliss and DeMaster (1998). In addition, pinniped experts participating in the 2007 Serious Injury Technical Workshop (Workshop) indicated that the ingestion of gear, although not generally observed in pinnipeds, is a serious injury. Fishing gear and hooks embedded in the throat or esophagus can lead to death, especially if a hook perforates the wall of the digestive track. Pinnipeds are also known to swallow fishing lures, which has been shown to lead to mortality due to lead poisoning.

P3: *“Visible blood loss”- case specific*

Pinniped experts participating in the 2007 Workshop indicated that an injury with visible blood loss is case specific. Blood loss indicates that the animal is “injured” (50 Code of Federal Regulations 229.2) and observation may provide additional information to determine whether the bleeding injury is serious or non-serious. Injuries with persistent bleeding would be considered a serious injury, whereas injuries where the bleeding stops relatively quickly may not be considered a serious injury. Additional factors about the injury need to be considered before making a determination of severity (see Table 3), such as the amount of blood and the location of the bleeding injury.

P4: *“Animal brought on vessel deck following entanglement/entrapment (excluding scientific research targeting marine mammals and authorized as such under a NMFS scientific research permit, where the animal is brought on and placed on the vessel deck in a controlled manner)”- case specific*

Pinniped experts participating in the 2007 Workshop indicated that a pinniped brought on the vessel deck following an interaction is case specific. Bringing a pinniped onboard a vessel is generally considered a non-serious injury, unless there are other factors to consider that increase the severity of the injury, such as the manner in which the animal is brought onboard (e.g., in net, over a roller, through power block) and the environmental conditions at the time (e.g., high temperatures). Additional factors about the injury need to be considered before making a determination of severity (see Table 3). NMFS-permitted marine mammal scientific research is not included in this criterion because the permit for the research requires a certain level of care be taken during the research not to harm the animal. In these cases, the animal is brought on and placed on the vessel in a controlled manner, causing no harm or a significantly lower level of injury than an animal brought on board in an uncontrolled manner.

P5a: *“Hook(s) in mouth (excluding criterion P5b), regardless of the presence of gear”- serious injury*

A pinniped hooked in the mouth is considered seriously injured by Angliss and DeMaster (1998). Pinniped experts participating in the 2007 Workshop agreed with Angliss and DeMaster (1998) that a hook in the mouth is a serious injury for a pinniped because of the potential for ingesting the gear and/or impairing feeding.

P5b: *“Hook(s) confirmed in head (excluding criterion P5a) or lip only (external tissue outside of teeth), no trailing gear”- case specific*

Pinniped experts participating in the 2007 Workshop indicated that a hook in the head or lip only is case specific. Pinnipeds generally have less soft tissue on the head, so a hook in the head is less likely to lead to a severe injury. However, an animal hooked in the eye region would be seriously injured because hookings in this area could interfere with every day activities necessary to pinnipeds’ survival (e.g., sight). A hook in the lip is generally considered non-serious unless there are other circumstances to consider, such as whether the hook is impairing the ability to feed or the presence of other injuries. Additional factors about the injury need to be considered before making a determination of severity (see Table 3), such as the location on the head and the type of hook. Cases

where an animal is hooked in the head with trailing gear are covered under criteria P5d and criteria P6.

P5c: *“Hook(s) in any body part, but hook(s) is removed or pulls out”- case specific*

Pinniped experts on the NMFS Determination Staff Working Group included this criterion to account for cases where an animal is hooked and the hook is removed naturally over time or by human intervention. This injury is case specific because the location of the hook and the manner in which it is removed (e.g., pulls out cleanly vs. roughly) impacts the severity of the injury. Additional factors about the injury need to be considered before making a determination of severity (see Table 3).

P5d: *“Hook(s) in appendage or body (excluding criteria P5a-c and P12), without trailing gear or with trailing gear that does not have the potential to: 1) become a constricting wrap on animal; 2) be ingested; 3) accumulate drag; or 4) become snagged on something in the environment, anchoring the animal”- non-serious injury*

Pinniped experts participating in the 2007 Workshop indicated that a pinniped hooked in an appendage or the body (excluding the mouth), without trailing gear or with trailing gear that does not have the potential to cause additional constricting wrapping, anchoring or ingestion, is a non-serious injury because the resulting hookings would likely be superficial (e.g., reaching no deeper than the skin or blubber).

P6: *“Gear attached in any manner to free-swimming animal with potential to: 1) become a constricting wrap on animal; 2) be ingested; 3) accumulate drag; or 4) become snagged on something in the environment, anchoring the animal”- serious injury*

A pinniped entangled with trailing gear is considered seriously injured by Angliss and DeMaster (1998). Pinniped experts participating in the 2007 Workshop agreed with Angliss and DeMaster (1998) that a pinniped with attached gear that has the potential to entangle the animal is seriously injured because the gear may become constricting (P8a) and/or cause the animal to drown as a result of dragging gear for extended periods of time, or snagging on other gear and anchoring the animal in place.

P7a: *“Anchored or immobilized and not freed”- serious injury*

Pinniped experts participating in the 2007 Workshop indicated that an entanglement that immobilizes or significantly impairs the movement of a pinniped is a serious injury because pinnipeds may tire quickly, interfering with their ability to reach the surface to breathe, and they may sustain injuries as a result of a struggle.

P7b: *“Anchored, immobilized, or entangled before being freed without gear attached- case specific*

Pinniped experts participating in the 2007 Workshop indicated that a pinniped released without gear attached following an entanglement or immobilization is case specific. Capture myopathy considerations suggest some of these animals may subsequently die because the health of the animal may be compromised to a greater extent the longer it is immobilized by an entanglement. Also, pinnipeds may be unable to feed while entangled and/or have increased difficulty reaching the surface. The longer the animal is immobilized or anchored, the longer it may go without food or regular access to oxygen.

Additional factors about the injury need to be considered before making a determination of severity (see Table 3).

P8a: *“Gear wrapped and constricting any body part or likely to become constricting as the animal moves or grows”- serious injury*

Pinniped experts participating in the 2007 Workshop indicated that a pinniped with constricting wraps of line around any body part, or line that is likely to become constricting as the animal grows or because of the animal's movement, is seriously injured because the constricting wraps can cause lacerations, fin/flipper amputation, organ damage, or muscle damage, and interfere with mobility, feeding, and breathing.

P8b: *“Gear wrapped loosely on any body part”- case specific*

Pinniped experts on the NMFS Determination Staff Working Group included this criterion to distinguish cases where gear was constricting or had the potential to become constricting (criteria P6b and P8a) from gear that, while wrapped on the animal, is loose and less likely to become constricting. This injury is case specific because gear that is loosely wrapped around a pinniped can either work its way off the animal, never becoming constricting or accumulating drag (resulting in a non-serious injury), or it can become constricting (resulting in a serious injury, see criterion P6a and P8a). Therefore, additional factors about the injury need to be considered before making a determination of severity (see Table 3).

P9: *“Body trauma not covered by any other criteria”- case specific*

Pinniped experts participating in the 2007 Workshop included this criterion to incorporate general body trauma not specified by any other criteria. Pinniped experts indicated that body trauma was case specific because additional factors about the injury need to be considered before making a determination of severity (see Table 3), such as the location on the body (e.g., a laceration on the dorsal midline may be more serious than a laceration over the animal's ribcage; eye injuries and head trauma may be more serious than trauma to other body parts), the depth (e.g., a deep laceration, gunshot, or other trauma reaching the bone or penetrating muscle or organs is more serious than a superficial wound) and cleanliness of the wound. In addition, internal damage (e.g., fractured skull) can follow blunt trauma and be missed by external examination (Andersen *et. al*, 2008).

P10: *“Visible fracture, excluding broken appendages (see criterion P13 for broken appendages)”- serious injury*

Pinniped experts participating in the 2007 Workshop indicated that a visible fracture is a serious injury because they can lead to strandings due to thrombosis and lead to secondary infections. Visible fractures can include open fractures (i.e., when a broken bone punctures the skin and exposes the wound to the open air) and closed fractures (i.e., when a broken bone does not puncture the skin) that are usually severe enough to interfere with everyday activities necessary to pinnipeds' survival, such as mobility, feeding, and defense. Fractures to appendages are covered separately under P13.

- P11: *“Vertebral transection or fully severed flipper(s)” - serious injury*
Pinniped experts participating in the 2007 Workshop indicated that an injury including vertebral transection is a serious injury because vertebral transection injuries are most commonly reported as mortalities, indicating the injury is often fatal. Also, the loss of a fin or flipper can lead to high blood loss, infection, and impacts on the animal’s mobility.
- P12: *“Body cavity penetration by foreign object or body cavity exposure” - serious injury*
Pinniped experts participating in the 2007 Workshop indicated that body cavity penetration or exposure (e.g., gunshot, puncture) is a serious injury. Body cavity penetration or exposure can introduce bacteria into the vital organs and the internal cavity, which can lead to massive infection.
- P13: *“Partially severed or fractured flipper(s)” - case specific*
Pinniped experts participating in the 2007 Workshop indicated that a partial severing of the fin(s) or flipper(s) is case specific. Pinniped experts on the NMFS Determination Staff Working Group included fractured fins or flippers to be more comprehensive concerning injuries observed in the fins and flippers of pinnipeds. Additional factors about the injury affecting the likelihood of survival that need to be considered before making a determination of severity (see Table 3), such as the nature of the injury causing the severing of the fin(s)/flipper(s) and the extent of fin(s)/flipper(s) loss, or the extent of the fracture (i.e., opened or closed), or the impact on the animal’s mobility.
- P14: *“Dependent animal (i.e., pup, juvenile) released alone post-interaction or dependent animal left with a seriously injured or dead mother” - serious injury*
Pinniped experts participating in the 2007 Workshop indicated that a dependent (e.g., pup, juvenile) pinniped separated from its group or mother (i.e., animal is unlikely to locate its group or mother on its own) is seriously injured because a dependant animal released alone would be subjected to significant additional stress and reduced survival.
- P15: *“Observed or reported collision with a vessel” - case specific*
Injuries to pinnipeds as a result of a collision with a vessel are not always observed after the vessel strike; therefore, the injury to that individual cannot be assessed. However, many vessel strikes are observed and reported to NMFS without information pertaining to the resulting injury. For example, NMFS receives a report that a harbor seal was struck by a vessel X feet in length and traveling Y knots, with no information on the animal after the strike. In these cases, pinniped experts participating in the 2007 Workshop indicated that the severity of an injury to a pinniped from a collision with a vessel is case specific. Additional factors about the injury need to be considered before making a determination of severity (see Table 3), such as the size and speed of the vessel and location of injury. If injury information is available and provided to NMFS, the appropriate criteria from P1-P14 will be considered. For example, NMFS receives a report that a harbor seal was struck by a vessel X feet in length and traveling Y knots, and the animal swam away with head trauma. In this case, the determination staff would also apply criterion P9 to the injury event.

TABLE 3: Summary of Pinniped¹ Injury Categories and Criteria

Instructions: Each pinniped injury event is recorded to the appropriate injury/information category using all available information and scientific judgment, as described in the Procedural Directive. For a single injury event to which several categories apply, the injury determination with the highest level of severity is assigned. More detailed information or extended observation on an individual case/animal may justify a determination differing from the guidance of this table. Any injury leading to apparent significant health decline (e.g., skin discoloration, fat loss) is a serious injury.			
Category	Injury/Information	Injury Determination ²	Additional factors for evaluating whether “case specific” injuries are serious or non-serious (additional factors at end of table) *
P1	A free-swimming animal observed at a date later than its human interaction, exhibiting signs of declining health believed to be resulting from initial injury (e.g., a marked change in body condition, tissue necrosis, emaciation, gangrene).	SI ³	
P2	Ingested gear ⁴ or hook(s)	SI	
P3	Visible blood loss	Case specific ⁵	Amount of blood, location of the bleeding injury, duration of bleeding
P4	Animal brought on vessel deck following entanglement/entrapment (excluding scientific research targeting marine mammals and authorized as such under a NMFS scientific research permit, where the animal is brought on and placed on the vessel deck in a controlled manner)	Case specific	Manner in which animal is brought on deck, length of time animal is on deck, environmental conditions (e.g., temperature)
P5a	Hook(s) in mouth (excluding criterion P5b), regardless of the presence of gear	SI	
P5b	Hook(s) confirmed in head (excluding criterion P5a), or in lip only (external tissue outside of teeth), no trailing gear	Case specific	Location on head (e.g., eye), depth of penetration, type of hook, prolonged restraint or struggle that could lead to capture myopathy, size of hook, impairing ability to feed
P5c	Hook(s) in any body part, but hook(s) is removed or pulls out	Case specific	Prolonged restraint or struggle that could lead to capture myopathy, location of hooking on the body, depth of hook, hook pulls out cleanly vs. causes further injury during dehooking, method used to remove hook, length of time hooked

¹ For the purposes of this table, pinnipeds include all pinniped species except walrus.

² This table includes only those criteria determined to be serious injuries or case specific based on expert opinion at the 2007 Workshop (Andersen *et al.*, 2008) and by pinniped experts on the NMFS Determination Staff working group. For the purposes of streamlining the information for the reader, criteria determined to be non-serious injuries are not included in this table.

³ SI = serious injury.

⁴ For the purposes of this table, gear is defined as any portion of fishing gear excluding the hook, which is considered separately. Lures are considered gear. Gear also generally refers to any type of debris entangling or attached to the animal.

⁵ Case specific = Could be a serious or non-serious injury, but either 1) there insufficient information about the impact of a particular injury, or 2) additional factors must be considered on a case-by-case basis to determine the severity.

P5d	Hook(s) in appendage or body (excluding criteria P5a-c and P12), without trailing gear or with trailing gear that does not have the potential ⁶ to: 1) become a constricting wrap on animal; 2) be ingested, 3) accumulate drag; or 4) become snagged on something in the environment, anchoring the animal	NSI ⁷	
P6	Gear attached in any manner to free-swimming animal with potential ⁸ to: 1) become a constricting wrap on animal; 2) be ingested; 3) accumulate drag; or 4) become snagged on something in the environment, anchoring the animal	SI	
P7a	Anchored/immobilized and not freed	SI	
P7b	Anchored, immobilized, or entangled before being freed without gear attached	Case specific	Duration of entanglement, prolonged restraint or struggle that could lead to capture myopathy, type of fishing gear, where/how gear immobilized animal, associated injury (where directly or indirectly caused by initial entanglement), response of individual
P8a	Gear wrapped and constricting any body part or likely to become constricting as the animal moves or grows	SI	
P8b	Gear wrapped loosely on any body part	Case specific	Type and amount of fishing gear, animal body size relative to gear (species, age), effect on movement, species sensitivity
P9	Body trauma ⁹ not covered by any other criteria	Case specific	Location of trauma on body, depth (superficial or to the bone, penetrating muscle or organs) length of laceration(s), number of lacerations, cleanliness (compression vs. tearing), amount and duration of blood loss, risk of infection or disease transmission (e.g., dog bites)
P10	Visible fracture(s), excluding broken appendages (see criterion P13 for broken appendages)	SI	
P11	Vertebral transection or fully severed flipper(s)	SI	
P12	Body cavity penetration ¹⁰ by foreign object or body cavity exposure	SI	

⁶ For the purposes of this table, potential as it relates to criterion P5d indicates that the trailing gear IS NOT capable of leading to any of the situations listed.

⁷ NSI = non-serious injury.

⁸ For the purposes of this table, potential as it relates to criterion P6 indicates that the trailing gear IS capable of leading to any of the situations listed.

⁹ For the purposes of this table, “trauma” is defined as a wound or bodily harm caused by an extrinsic agent. Blunt trauma is an injury (abrasion, laceration, contusion or skeletal fracture) produced by a blunt object striking the body or impact of the body against a blunt object or surface. Sharp force trauma is an injury caused by a sharp or pointed object or a bullet from a gunshot creating a penetrating (stab, chop or incision) wound. Laceration is defined as a ragged incision or a tearing of the skin. Lacerations are caused by blunt trauma that results in stretching, tearing, crushing, shearing, or avulsion of the tissue.

¹⁰ For the purposes of this table, “penetration” is defined as a wound occurring when a foreign object punctures the body, such as a bullet from a gunshot. Penetrating wounds can be characterized as one of three types: stab (small external wound that is greater in length into the body than is apparent on the skin surface), incised (clean cuts into the skin which are longer on the skin surface than they are deep), or chop wounds (incised wounds that penetrate deep to the bone, leaving a groove or cut in the bone).

P13	Partially severed or fractured flipper(s)	Case specific	Cleanliness (clean cut vs. tear), nature of injury causing the loss, extent of fin or flipper loss, opened or closed fracture, dislocation, amount/duration of blood loss
P14	Dependent animal (i.e., pup, juvenile) released alone post-interaction or dependent animal left with a seriously injured or dead mother	SI	
P15	Observed or reported collision with vessel	Case specific	Speed of vessel, size of vessel, hull shape, part of vessel to strike the animal (e.g., propeller, hull), size of animal compared to size of vessel, location of strike on animal's body, extent and location of wound(s) to animal

* Factors listed in the far right column of Table 3 are unique to the associated injury type. In addition to those listed in this column, the factors that should be considered, if available, when reviewing all case specific injury events in Table 3 include, but are not limited to:

- Species
- Age or age class (e.g., calf, juvenile, adult)
- Sex
- Size of animal
- Overall health (e.g., nutritional status, body condition, pre-existing disease state, pre-existing injuries)
- Behavior during and/or after injury-causing interaction (e.g., listlessness)
- Reproductive status (e.g., pregnant, lactating, has dependant pup)
- Natural history (e.g., small home range, large home range)
- Location of injury (e.g., mouth, head, body, flipper/fin, internal)
- Size of injury
- Duration of injury (e.g., single event, repeated, chronic)
- Depth of injury (e.g., superficial or to the bone, penetrating muscle or organs)
- Cleanliness of injury (e.g., compression, tearing)
- Environmental condition (e.g., individuals out of their normal habitat, environmental stressors)
- Social stressors (e.g., social structure of species, separation of social individuals from the group, mother/pup separation)
- Cumulative effects of repeated exposures
- Compounding effects of multiple injuries obtained during a single event
- Availability of data on multiple sequential events involving the same individual over time
- Susceptibility of the species to capture myopathy (some sensitive, others robust, some unknown)
- Ability of rehabilitated animal to be released
- Relative effect of blood loss on different species

In addition to those factors listed above, the factors that apply to all fishery or marine-debris interaction related case specific injuries include, but are not limited to:

- Entanglement type (e.g., hooked, anchored, entrapment)
- Amount and size of gear (e.g., size, length and number of lines; number of buoys, traps or anchors; volume of netting; material of gear)
- Method of handling the animal during disentanglement
- Entanglement constriction (e.g., tight, loose, multiple wraps)
- Habitat where animal is located (e.g., an animal with trailing gear in areas of dense gear or an area with vegetation or on shore is more likely to risk snagging the gear and becoming anchored)
- Entanglement duration
- Existence, type and amount of any trailing gear

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Appendix I:
Results of Quantitative Analysis of Whale Injury Events from 2004-2008

Category	Injury/ Information	Injury Determination	Mortality/ Cases	P (x/r=0.5)	Interpretation (given alpha = 0.10)
L1	Ingested gear or hook(s)	SI	n/a	n/a	n/a
L2	Constricting wrap	SI	84/85 = 0.99	p << 0.0001	likely that rate > 0.5
L3	Loose wrap, bridled or draped gear	NSI	0/14	p << 0.0001	likely that rate < 0.5
L4	External hook	NSI	n/a	n/a	n/a
L5a	Deep laceration	SI	12/12	p = 0.0005	likely that rate > 0.5
L5b	Superficial laceration	NSI	0/9	p << 0.0001	likely that rate < 0.5
L6a	Vessel much greater in size than whale or vessel ≥65' and >10 knots	SI	5/6 = 0.83	p = 0.109	equivocal
L6b	Vessel smaller in size than whale or vessel <65' and >10 knots	Prorate: 0.20	1/5 = 0.20	p = 0.187	equivocal
L6c	Vessel any size ≤10 knots	NSI	0/6	p = 0.0156	likely that rate < 0.5
L7a	Vessel much greater in size than whale or vessel ≥65' and speed unknown	Prorate: 0.56	5/9 = 0.56	p = 0.5	equivocal
L7b	Vessel smaller in size than whale or vessel <65' and speed unknown	Prorate: 0.14	1/7 = 0.14	p = 0.063	likely that rate < 0.5
L8	Dependent	SI	n/a	n/a	n/a
L9	Brought on deck	SI	n/a	n/a	n/a
L10	Evidence of entanglement	Prorate: 0.75	85/114 = 0.75	p << 0.0001	likely that rate > 0.5
L11	Vessel strike laceration	Prorate: 0.52	13/25 = 0.52	p = 0.5	equivocal
L12	Vessel strike observed	Prorate: 0.36	12/33 = 0.36	p = 0.081	likely that rate < 0.5