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Guidelines for Preparing Stock Assessment Reports Pursuant to the Marine Mammal Protection Act

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SUMMARY OF REVISIONS:

The National Marine Fisheries Service's (NMFS) Office of Protected Resources (OPR) initiated a review of the NMFS: Guidelines for Preparing Stock Assessment Reports Pursuant to the 1994 Amendments to the Marine Mammal Protection Act (MMPA) (NMFS-PD 02-204-01) in July of 2020. This effort focused on reviewing and revising the Guidelines to address several topics that were identified but not finalized during the prior revision of the Guidelines in 2016. In addition, the Guidelines were scheduled for review in February 2021 and, following the finalization of the policy in 2016, several other revision topics were identified.

The review identified eight topics that warranted review: (1) Incorporate and reference NMFS PDS 02-204-03 Reviewing and Designating Stocks and Issuing Stock Assessment Reports under the Marine Mammal Protection Act, (2) Update guidance related to calculating minimum abundance (N_{min}) in post-survey years, (3) Update guidance related to the calculation of N_{min} to address sources of bias and ensure MMPA goals of Potential Biological Removal (PBR) are met, (4) Update guidance related to designating stocks as strategic and related recovery factors, (5) Improve language related to quantifying and including unobserved mortality and serious injury, (6) Update guidance on the inclusion and incorporation of information on climate change, biologically important areas, and habitat issues, (7) Clarify expectations regarding peer-review of information included in SARs, and (8) Data sources and criteria used for documenting human-caused mortality and serious injury. In addition to these, other minor revisions include those that improve readability, clarity, and ensure all sections of the Guidelines are well connected and updated to align with the revisions related to the eight topics. Other minor revisions were made to ensure consistency with forthcoming revisions to NMFS Serious Injury Determination Policy: Process for Distinguishing Serious from Non-Serious Injury of Marine Mammals (NMFS-PD 02-038-01). See Section 4 for further detail on the most recent revisions.

Signed _____
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Guidelines for Preparing Stock Assessment Reports Pursuant the Marine Mammal Protection Act

1. Introduction

Section 117 of the Marine Mammal Protection Act (MMPA) requires that the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (FWS) develop Stock Assessment Reports (SARs) for all marine mammal stocks in waters under U.S. jurisdiction (U.S. waters). These SARs are to be based upon the best scientific information available. SARs are not required for stocks that have a remote likelihood of occurring regularly in U.S. waters (e.g., stocks for which only the margins of the range extend into U.S. waters or that enter U.S. waters only during anomalous current or temperature shifts).

The MMPA requires SARs to include, among other things, information on how stocks were identified, a calculation of Potential Biological Removal (PBR), and an assessment of whether incidental commercial fishery takes are "insignificant and approaching zero mortality and serious injury rate," as well as other information relevant to assessing stocks. SARs are to be reviewed annually for "strategic stocks" and stocks for which significant new information is available, and at least once every three years for all other stocks. This document provides guidelines for how these topics are to be addressed in the SARs.

The MMPA provides some general guidance for developing the SARs. More detailed guidelines were developed at a PBR workshop in June 1994 and were used in writing the original draft SARs. The draft guidelines and initial draft SARs were subjected to public review and comment in August 1994. Final guidelines and SARs for stocks under NMFS' jurisdiction were completed in 1995 (Barlow et al. 1995). In 1996, representatives of NMFS, FWS, regional Scientific Review Groups (SRGs), and the Marine Mammal Commission reviewed NMFS' guidelines and proposed minor changes; after public review and comment, these changes were finalized in 1997 (Wade and Angliss 1997). NMFS' guidelines were officially updated again in 2005, following a similar revision process beginning with a workshop in September 2003 (NMFS 2005). In February 2011, NMFS again convened representatives of the SRGs and agencies to review and, as appropriate, recommend revisions to its guidelines. Those recommended revisions (Moore and Merrick 2011) were made available for public review and comment, and revisions for most of the topics addressed at the 2011 workshop were finalized in 2016. In July 2020, NMFS convened an internal working group to address the remaining topic revisions from the 2011 workshop, as well as several topics that warranted revisions following its 2016 guideline revisions. Those revisions are included here.

It is anticipated that the guidelines will be revised based on additional scientific research and experience gained in their application. NMFS will review and, as needed, revise the guidelines at least every 5 years. When the agency recommends revisions to the guidelines, those revisions will be made available for public review and comment prior to acceptance. Furthermore, the guidelines in this document are not prescriptive; however, any departure from these guidelines must be fully discussed and justified within any affected SAR.

2. Objective

The intent of these guidelines is to: (1) provide a uniform framework for the consistent application of the MMPA throughout the country; (2) ensure that the values used to calculate PBR help meet the goals of the MMPA; (3) provide guidelines for evaluating whether commercial fishery takes are insignificant and approaching a zero mortality and serious injury rate; and (4) ensure the federal government's approach is clear and open to the public. It is important to note that the structure of these guidelines do not necessarily correspond to the structure that should be used in a SAR (see Appendix C for a suggested SAR template).

NMFS interprets the primary intent of the 1994 MMPA amendments and the guidelines developed pursuant to the Act related to PBR as a mechanism to respond to the uncertainty associated with assessing and reducing human-caused mortality and serious injury (M/SI) of marine mammals[1]. Accordingly, this mechanism is increasingly conservative under increasing degrees of uncertainty. The MMPA requires calculating PBR for all stocks, including those that are considered endangered or threatened under the Endangered Species Act (ESA) and those that are managed by other authorities, such as the International Convention for the Regulation of Whaling. However, in some cases, allowable takes under these other authorities may be less than PBR calculated under the MMPA owing to the different degrees of "risk" associated with, and the treatment of, uncertainty under each authority. Where there is inconsistency between the MMPA and ESA regarding the take of listed marine mammals, the more restrictive mortality requirement takes precedence. Nonetheless, PBR must still be calculated for these stocks, where possible, and discussed in the text of the SARs. As directed in the MMPA, PBR is calculated as "...the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population."

For all stocks of marine mammals in U.S. waters, Section 117 of the MMPA requires SARs to include PBR, human-caused M/SI, and classification as to whether a stock is "strategic." However, it should be noted that co-management, between the federal government and Alaska Native Organizations, for subsistence removals of marine mammals is specifically addressed in Section 119 of the MMPA. Under the auspices of Section 119 of the MMPA, NMFS entered into cooperative agreements with Alaska Native Organizations to conserve marine mammals and provide co-management of subsistence use by Alaska Natives. NMFS develops management programs for stocks subject to subsistence harvests through the co-management process, which should include a sound research program to identify and address uncertainties concerning the status of these stocks. Following consultation with co-management partners regarding scientific and other relevant information, NMFS will calculate PBR and determine strategic status for stocks subject to subsistence harvest.

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[1] For the purposes of implementing Section 101(a)(5)(E) of the MMPA, NMFS has developed criteria that are related to, but distinct from, PBR. See NMFS Procedure 02-204-02 Criteria for Determining Negligible Impact under MMPA Section 101(a)(5)(E).

3. Guidance

3.1 Defining and Designating Stocks

In 2019, NMFS established the procedural directive 02-204-03: *Reviewing and Designating Stocks and Issuing Stock Assessment Reports under the Marine Mammal Protection Act* (NMFS 2019). Prior to this, stock designations were reviewed and made as part of the SAR development process, and as such, guidelines for making stock designations were included in the "Definition of Stock" section in previous versions of this procedure. With the establishment of NMFS-PD-02-204-03, the stock designation process, including identifying demographically independent populations (see below), now occurs separate from, and before the development of SARs. A summary of how stocks are defined and designated is included here for context to provide guidelines on the stock designation information that should be included in the SARs. If there is any confusion regarding the stock reviewing and designation process, please note that NMFS PD 02-204-03 supersedes this procedural directive and governs that process.

"Population stock" or stock is the fundamental unit of legally-mandated conservation under the MMPA. The MMPA defines population stock as:

"a group of marine mammals of the same species or smaller taxa in a common spatial arrangement, that interbreed when mature."

To fully interpret this definition, it is necessary to consider the objectives of the MMPA. Section 2 (Findings and Declaration of Policy) of the MMPA states that "...species and population stocks of marine mammals...should not be permitted to diminish beyond the point at which they cease to be a significant functioning element in the ecosystem of which they are a part, and, consistent with this major objective, they should not be permitted to diminish below their optimum sustainable population." Further, it states "...the primary objective of their management should be to maintain the health and stability of the marine ecosystem. Whenever consistent with this primary objective, it should be the goal to obtain an optimum sustainable population keeping in mind the carrying capacity of the habitat." Therefore, stocks must be designated in a manner that is consistent with these goals. As noted in NMFS-PD-02-204-03, whenever possible, a single demographically independent population (DIP) of marine mammals should be designated and managed as a stock. Here, a DIP is defined as:

a group of animals for which the population dynamics are more a consequence of births and deaths within the group (internal dynamics) than immigration or emigration (external dynamics).

NMFS treats DIP delineation and stock designation as separate processes. DIP delineation is the responsibility of NMFS Science Center staff and involves evaluating and interpreting the scientific lines of evidence supporting whether groups of animals are demographically independent, including determining the geographic range of the groups (which may shift through time, especially for migratory species). The DIP delineation process occurs separately from the SAR process and is described in Martien et al. (2019). Stock designation is the collective responsibility of the NMFS Science Center, Regional Office, Office of Protected Resources, and Office of Science and Technology staff and is the process of officially making a stock a management unit that will then be described and assessed in SARs. Stock designation considers

whether individual DIPs can be effectively managed as stocks, occurs after DIP delineation, and is described in NMFS-PD-02-204-03.

Many types of information can be used to help identify DIPs (e.g., distribution and movements, population trends, morphology, life history, genetics, acoustic call types, contaminants and natural isotopes, parasites, and oceanographic habitat). Different population responses (e.g., different trends in abundance) between geographic regions may also be an indicator of demographic independence. Martien et al. (2019) discuss the utility of different types of data in evaluating demographic independence, and how to combine multiple lines of evidence when delineating DIPs. They also discuss the use of the "best scientific information available" (MMPA Section 117(a)), which is likely to vary among species, when delineating DIPs.

In the absence of robust data to inform DIP delineation, a species' geographic range should be divided into areas that represent defensible stocks to serve as management units. Examples of such areas include, but are not limited, to distinct oceanographic regions and semi-isolated habitats, particularly those that may have high rates of human-caused M/SI. Such areas have often been found to represent the geographic range of DIPs when sufficient information is available. In cases where there are large geographic areas from which data on DIPs of marine mammals are lacking, information from other parts of the species' range may be considered to draw inferences by analogy.

In most cases, if sufficient evidence exists to delineate a DIP, it should be designated as a stock and assessed as such in a SAR. In practice there may be some situations (anticipated to be relatively few) where it would be impractical, or there are insufficient data or analytical tools, to assess and manage at the DIP level (see NMFS-PD-02-204-03 for examples). In addition, when distinct population segments (DPSs) have been established under the ESA, it may be pragmatic to designate a stock comprising more than one DIP of a single DPS. NMFS-PD-02-204-03 outlines questions to consider when determining when it would be appropriate to combine multiple DIPs into a single stock and provides a process and direction for subsequently designating stocks within SARs.

Stock designation and DIP delineation information should be summarized within the Stock Definition and Geographic Range section of the SARs. This information should include a summary of the lines of evidence that support DIP delineations and cite any supporting documents where this information is detailed (see NMFS-PD-02-204-03). When two or more DIPs are combined and designated as a single stock (e.g., because there are impracticalities, such as insufficient data or analytical tools to assess and manage at the DIP level), the Stock Definition and Geographic Range section should: (a) describe the identified DIPs; (b) provide a summary of the factors impeding individual management of the DIPs and what additional data or tools are needed to manage DIPs on their own (e.g., see questions in B. Combining Multiple DIPs in NMFS (2019)); (c) describe how the DIPs are being combined (e.g., into a single stock, into several regional stocks); and (d) cite NMFS-PD-02-204-03. Similarly, when two or more DIPs of a single DPS established under the ESA are combined and designated as a single stock for pragmatic reasons, the Stock Definition and Geographic Range section should: (a) describe the identified DIPs and their relation to the designated DPS; (b) describe how the DIPs are being combined (e.g., into a single stock corresponding with the DPS designation); and (c) cite NMFS-PD-02-204-03 and any supporting documents. Finally, regardless of the reason, when DIPs are

combined to form a single stock or in cases where it is plausible that a stock contains more than one DIP, DIP-specific information (e.g., minimum population abundance, PBR, human-caused M/SI, etc.), if available, should be included in the SAR in the relevant section. However, the stock-wide minimum population abundance, maximum net productivity rate, PBR, and human-caused M/SI should still be provided and the Status of the Stock determination should be based on the stock as a whole.

The Stock Definition and Geographic Range section should include a description of what is known about the geographic range of the stock (and a map if appropriate), including any known stock boundaries if applicable, and any uncertainty regarding the stock range. This section should also describe temporal variability (e.g., seasonal, inter-annual) in geographic range and depict these changes in a map if appropriate. When DIPs are designated as stocks (individually or combined), the geographic range of the stock is the geographic range of the DIP(s), identified using information on distribution, movement, and/or habitat preference of the animals that comprise the DIP(s). Depending on the data available, this geographic range may be well known or poorly understood. As such, the description of the geographic range of a stock will differ based on the level of information available. When DIPs cannot be delineated and a species' range is divided into defensible units for management purposes (e.g., a semi-isolated area where human-caused M/SI is concentrated, see above), the geographic range of the stock is equal to the area determined to represent the management unit. In either case, a stock's geographic range should not be based on anthropogenic boundaries (e.g., political boundaries such as the U.S. Exclusive Economic Zone (EEZ)), as such areas do not represent true biological and ecological ranges and are counter to the MMPA objective of maintaining stocks as functioning elements of their ecosystems. However, some stocks may be assessed based solely on data from the U.S. EEZ or otherwise use this boundary as a reference point when the geographic range is poorly understood. If applicable, this section of the SAR should state whether the stock is transboundary (see Section 3.5.3 below) (i.e., occurs outside the U.S. EEZ).

3.2 Potential Biological Removal Elements and Population Trend

The 1994 amendments to the MMPA mandate that, as part of the SARs, PBR must be calculated for each marine mammal stock in U.S. waters. PBR is defined as "the maximum number of animals, not including natural mortality, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population." In addition, the MMPA states that PBR is calculated as the product of three elements: the minimum population estimate (N_{min}); half the maximum net productivity rate ($0.5R_{max}$); and a recovery factor (F_r). The guidelines for defining and applying each of these three elements are described below (Section 3.2.1; Section 3.2.3; and Section 3.2.4). Additional guidelines on the calculation of PBR are provided in Section 3.2 of this document. The SAR should provide a description of any uncertainties in the elements of the PBR equation and evaluate the effects of these uncertainties on the estimate.

An underlying assumption in the application of the PBR equation is that marine mammal stocks exhibit certain population dynamics. Specifically, it is assumed that a depleted stock is depleted due to excessive human-caused M/SI that once properly managed, will allow the stock to naturally grow toward its optimum sustainable population (OSP), and that some surplus growth may be removed while still allowing recovery. There are unusual situations, however, where the

formula Congress added to the MMPA to calculate PBR ($N_{min}*0.5R_{max}*F_r$) results in a number that is not consistent with the narrative definition of PBR; that is, there are situations where a stock is below its OSP and is declining or stable due to factors other than human-caused M/SI. Thus, for unknown reasons, the stock's population dynamics do not conform to the underlying model for calculating PBR. In such unusual situations, the PBR section of the SAR should contain the following information: 1) the value of PBR calculated using the standard formula; 2) a statement (and relevant citations) regarding the other factors that are known or hypothesized to be contributing to the trend in the stock's abundance; and 3) a statement regarding implications of this (e.g., "therefore, maintaining human-caused M/SI below the calculated value of PBR may not be sufficient to allow the stock to reach or maintain OSP.")

3.2.1 Minimum Population Estimate

The minimum population (N_{min}) is defined in the MMPA as an estimate of the number of animals in a stock that:

> "(A) is based on the best available scientific information on abundance, incorporating the precision and variability associated with such information; and,
>
> "(B) provides reasonable assurance that the stock size is equal to or greater than the estimate."

Consistent with this MMPA definition, N_{min} should be calculated such that a stock of unknown status would achieve and be maintained within OSP with 95% probability. Population simulations have demonstrated (Wade 1994, 1998) that this goal can be achieved by defining N_{min} as the 20th percentile of a log-normal distribution based on an estimate of the number of animals in a stock (which is equivalent to the lower limit of a 60% 2-tailed confidence interval):

$$N_{min} = \hat{N}/\exp(0.842 * (\ln(1+CV(\hat{N})^2))^{1/2})$$

where $\hat{N}$ is the abundance estimate and $CV(\hat{N})$ is the coefficient of variation of the abundance estimate. If abundance estimates are believed to be biased, appropriate correction factors should be applied to obtain unbiased estimates of N. In such cases, the coefficient of variation for $\hat{N}$ should include uncertainty in the estimation of the correction factor. In cases where a direct count is available, such as for many pinniped stocks, this direct count could alternatively be used as the estimate of N_{min}. Other approaches could also be used to estimate N_{min} if they provide the same level of assurance that the stock size is equal to or greater than that estimate. Regardless of how N_{min} is derived, the SAR should note the geographic extent represented by this N_{min} and how this compares to the stock range (e.g., represents the full stock range, part of the range, etc.). If N_{min} is not representative of the full stock range and thus negatively biased, this should also be noted when providing the final PBR calculation. In general, abundance or density estimates from one area should not be extrapolated to unsurveyed areas to estimate range-wide abundance. But, informed interpolation (e.g., based on habitat associations) may be used to fill gaps in survey coverage and estimate abundance and N_{min} over broader areas as appropriate and supported by existing data. Additional sources of known or suspected biases that were not accounted for in the estimation of N_{min} (e.g., timing of survey relative to animal movement out of the survey area) should also be explicitly stated, along with their implications.

The most recent abundance estimate becomes a decreasingly reliable measure of current abundance with time, given uncertainty about how much the population may have grown or declined since the last survey. Therefore, the most recent estimate of N_{min} becomes less reliable with time at providing reasonable assurance that the stock size is presently greater than or equal to the N_{min} estimate. The rationale for defining N_{min} as the 20th percentile of the distribution for the population size estimate follows from "base case" trials conducted as part of the PBR performance testing by Wade (1998). For the base case trials, models assumed a four-year survey interval, such that simulated abundance estimates were not updated for four years at a time, and a value for F_r of 1.0. Thus, no post-survey adjustment to N_{min} is needed for stocks surveyed at least every four years. Additional "bias trials" were conducted to evaluate performance of the PBR management framework under a suite of potential situations that differed from the simplest (base) case and to tune the F_r parameter accordingly so that management objectives would still be met under these situations. One bias trial evaluated the influence of surveying stocks every 8 rather than 4 years. The use of $F_r = 0.5$ was sufficient for managing such stocks; thus no post-survey adjustment of N_{min} is needed when a stock is surveyed every 8 years, as long as there are no other reasons for further reducing F_r below 0.5 (see Wade 1998).

For stocks surveyed less frequently than 8 years (or for stocks surveyed every 5–8 years but where F_r is less than 1.0 for reasons other than survey frequency), using an F_r of 0.5 might not provide reasonable assurance that MMPA management objectives will be met. Thus, beginning nine years after the most recent survey (or five years for stocks where F_r is less than 1.0 for reasons other than survey frequency), or as otherwise deemed appropriate value, the value of N_{min} should be adjusted to account potential abundance changes that may have occurred since the last survey. A variety of approaches could be applied to account for uncertainty in $\hat{N}$, including but not limited to:

- Determining a plausible distribution of the population growth rate, *r*, and using simulations to project the distribution of $\hat{N}$ to years following the survey, incorporating both uncertainties in the original abundance estimate, and in the assumed distribution of *r*. The selected distribution of *r* may be relatively uninformed (e.g., uniform across some plausible range) or potentially informed by indicators of trend available following the most recent survey.
- When a sufficient time series of abundance estimates is available, it may be reasonable to estimate the population trend (and the uncertainty in this trend) and project the future population accordingly, assuming the past trend has continued to the current year.
- Using the most recent estimate of N_{min} if population stability can be justified.
- Tailoring the methods of Wade (1998) to the actual survey frequency (e.g., 10 years) and other circumstances pertaining to estimating human-caused M/SI and PBR parameters for the stock, and identifying the appropriate recovery factor or percentile to use for N_{min} rather than 20th.

In the first two approaches above, N_{min} can be obtained as the 20th percentile of the projected distribution of $\hat{N}$.

It is theoretically possible to project N_{min} indefinitely. However, at some point, confidence in the projected N_{min} may be lost depending upon, for example, how confident one is that the assumed

distribution of *r* or the extrapolation of past trends represents reality, or if there are significant underlying ecological changes. If it is ultimately determined that there is no reliable basis for projecting N_{min}, it should be considered unknown. In such cases, PBR cannot be determined, but this is not equivalent to considering PBR equal to zero. See the Status of Stocks section (Section 3.5) for further guidance on such situations.

3.2.2 Population Trend

The SARs will describe information on current population trends. The SAR should also provide a description of any uncertainties concerning the population trend, and evaluate the effects of these uncertainties on the trend.

3.2.3 Maximum Rate of Increase

One-half the maximum rate of increase (R_{max}) is defined in the MMPA as "one-half of the maximum theoretical or estimated net productivity rate of the stock at a small population size," where the term "net productivity rate" means "the annual per capita rate of increase in a stock resulting from additions due to reproduction, less losses due to natural mortality." Default values should be used for R_{max} in the absence of stock-specific measured values. To be consistent with a risk-averse approach, these default values should be near the lower range of measured or theoretical values (or 0.12 for pinnipeds and sea otters, and 0.04 for cetaceans and manatees). Substitution of other values for these defaults should be made with caution, and only when reliable stock-specific information is available on R_{max} (e.g., estimates published in peer-reviewed articles or accepted by review groups such as the SRGs or the Scientific Committee of the International Whaling Commission).

Details on rounding and precision of PBR elements, and on averaging more than one estimate of abundance to calculate N_{min}, can be found in Appendix A of this document.

3.2.4 Recovery Factor

The MMPA defines the recovery factor (F_r) as being between 0.1 and 1.0. The intent of Congress in adding F_r to the definition of PBR was to ensure the recovery of populations to their OSP levels, and to ensure that the time necessary for populations listed as endangered, threatened, and/or depleted to recover was not significantly increased as a result of human-caused M/SI. The use of F_r less than 1.0 allocates a proportion of expected net production towards population growth and compensates for uncertainties that might prevent population recovery, such as biases in the estimation of N_{min} and R_{max}, or errors in the determination of stock structure. Population simulation studies (Barlow et al. 1995, Wade 1998) demonstrate that the default F_r for stocks of endangered species should be 0.1, and that the default F_r for depleted and/or threatened stocks and stocks of unknown status should be 0.5.

The default status of a stock should be considered as "unknown." Stocks known to be within OSP (e.g., as determined from quantitative methods such as dynamic response or back-calculation), or stocks of unknown status that are known to be increasing, or stocks that are not known to be decreasing taken primarily by aboriginal subsistence hunters, could have higher F_r values, up to and including 1.0, provided there have not been recent increases in the levels of

human-caused M/SI. Recovery factors for ESA-listed stocks can be changed from their default values (e.g., Taylor et al. 2003), but only after careful consideration and where available scientific evidence confirms that the stock is not in imminent danger of extinction. Values other than the defaults for any stock should usually not be used without the approval of the SRG, and scientific justification for the change should be provided in the SAR.

The recovery factor can be adjusted to accommodate additional information and to allow for management discretion as appropriate and consistent with the goals of the MMPA. For example, if human-caused M/SI includes more than 50% females, the recovery factor should be decreased to compensate for the greater effect of this mortality on the population (or increased if less than 50% female). Similarly, declining stocks, especially ones that are threatened or depleted, should be given lower recovery factors, the value of which should depend on the magnitude and duration of the decline. The recovery factor of 0.5 for threatened or depleted stocks or stocks of unknown status was determined based on the assumption that the coefficient of variation of the human-caused M/SI estimate is equal to or less than 0.3. If the CV is greater than 0.3, the recovery factor should be decreased to: 0.48 for CVs of 0.3 to 0.6; 0.45 for CVs of 0.6 to 0.8; and 0.40 for CVs greater than 0.8.

Recovery factors could also be increased in some cases. If human-caused M/SI estimates are known to be relatively unbiased because of high observer coverage, then it may be appropriate to increase the recovery factor to reflect the greater certainty in the estimates. Thus, in an instance where the observer coverage was 100% and the observed fishery was responsible for virtually all human-caused M/SI on a particular stock, the recovery factor for a stock of unknown status might be increased to a value higher than 0.5 (reflecting less concern about bias in mortality, but continued concern about biases in other PBR parameters and errors in determining stock structure). Recovery factors of 1.0 should be reserved for cases where there is assurance that N_{min}, R_{max}, and the estimates of human-caused M/SI are unbiased and where the stock structure is unequivocal.

3.3 Annual Human-caused Mortality and Serious Injury

In 2012, NMFS established the policy directive 02-238: *Process for Distinguishing Serious from Non-Serious Injury of Marine Mammals* (NMFS 2012a), which clarifies and provides NMFS' interpretation of the regulatory definition of a serious injury (50 CFR 229.2). Along with this policy, NMFS established the procedural directive 02-238-01: *Process for Distinguishing Serious from Non-Serious Injury of Marine Mammals* (NMFS 2012b), which provides guidelines for distinguishing between serious and non-serious injuries of marine mammals for the purposes of the MMPA. NMFS-PD-02-238 and NMFS-PD-02-238-01 were both renewed with no changes in 2014. This section has guidelines on what information on human-caused mortality and serious injury should be included in the SARs, after serious injury determinations are made following NMFS-PD-02-238-01. If there is any confusion regarding the serious injury determination

process, please note that NMFS-PD-02-238-01[2] supersedes this procedural directive and governs that process.

The SARs should contain a complete description of what is known about human-caused M/SI for the covered time period. Data used in the SAR must represent the best available scientific information and follow established NMFS guidelines and criteria to carefully consider whether the M/SI should be considered human-caused, and thus counted against PBR. Sources of best available scientific information may vary by region and species. Potential sources include, but are not limited to: fisheries observer and logbook data; strandings data; entanglement response data; fishermen self-reports; authorized and unauthorized scientific research takes; and opportunistic but reliable reports of mortality or injury. There may be rare instances of opportunistic reports of mortality or injury (e.g., commercial fishery related mortality/injury self-reports, observer programs, and stranding and entanglement response programs) where NMFS or a partner has not already evaluated the reliability of the report or the source of the mortality or injury. In those cases, the SAR author should evaluate whether the case should be considered as a human-caused M/SI, and counted against PBR, based on the applicable criteria or guidelines described below.

Established criteria and guidelines should be used to determine reliability of reports and also applied to all summarized data. Examples of national criteria and guidelines include NMFS' serious injury determination policy NMFS-PD-02-238 and procedure NMFS-PD-02-238-01, national stranding network guidelines, and national criteria on confirmation of reports of large whale entanglements. Regional criteria and guidelines should be used when information specific to a species, stock, or situation has been developed (e.g., Maze-Foley et al. 2019).

A summary of all human-caused M/SI should be provided in each SAR as the first paragraph under "Annual human-caused mortality and serious injury." This summary should include information on all human-caused M/SI (e.g., U.S. commercial fishery-related M/SI, other M/SI from unidentified fishing or non-fishing gear, recreational fisheries, foreign fisheries, tribal fisheries, strandings with contributory human interactions, vessel strikes, power plant entrainment, illegal shooting, scientific research, subsistence harvest, and M/SI reports from otherwise authorized human activities, etc.). If there are no major known sources of human-caused M/SI beyond those quantified in the SAR, this should be explicitly stated. In addition, the SAR should include a description of any additional uncertainties concerning human-caused M/SI, along with an evaluation of the potential effects of these uncertainties on the human-caused M/SI estimates. Finally, the SAR should note the geographic extent represented by the human-caused M/SI data, and how this may bias total human-caused M/SI estimates compared to the stock range (e.g., represents the full stock range, part of the range, etc.). Additional sources of known or suspected biases that were not accounted for in estimating total human-caused M/SI (e.g., temporal biases due to incomplete observer coverage across seasons) should also be explicitly stated, along with their implications.

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[2] NMFS is in the process of revising NMFS-PD-02-238-01. Following public comment and finalization, NMFS-PD-02-238-01, including any revisions, will still supersede any information provided here and govern NMFS' serious injury determination process.

In some cases, human-caused M/SI occur in areas where more than one stock of the same or similar species of marine mammals occurs. When biological information (e.g., photo-identification, genetics, morphology) is sufficient to identify the stock in which a human-caused M/SI, then the human-caused M/SI should be associated only with that stock. When one or more human-caused M/SI cannot be assigned directly to a stock, then those human-caused M/SI may be partitioned among stocks within the appropriate geographic area, provided there is sufficient information to support such partitioning (e.g., based on the relative abundances of stocks within the area, statistical approaches such as Carretta 2018, etc.). When the human-caused M/SI estimate is partitioned among overlapping stocks, the SARs will contain a discussion of the potential for over- or under-estimating stock-specific human-caused M/SI. In cases where human-caused M/SI cannot be assigned directly to a stock and available information is not sufficient to support partitioning those human-caused M/SI among stocks, the total unassigned human-caused M/SI should be assigned to each stock within the appropriate geographic area. When human-caused M/SI are assigned to each overlapping stock in this manner, the SARs will contain a discussion of the potential biases in the estimates of stock-specific human-caused M/SI.

If human-caused M/SI estimates are available for more than one year, a decision will have to be made about how many years of data should be used to estimate annual human-caused M/SI. It is inappropriate for these Guidelines to prescribe which years of data should be used, because the case-specific choice depends upon the quality and quantity of data. Generally, human-caused M/SI estimates in the SARs will include the most recent five years for which data have been analyzed, as this can account for inter-annual variability. However, information more than five years old may be used if it is the most appropriate information available in a particular case, particularly if, when averaged, it achieves a statistically unbiased estimation with a CV of less than or equal to 0.3, which is the CV value upon which the PBR framework was originally performance-tested (Wade 1998). In some cases, it may not be appropriate to average over as many as five years even if the CV of an estimate is greater than 0.3. For example, if within the last five years a fishery has changed (e.g., fishing effort or the M/SI rate per unit of fishing effort has changed), it may be more appropriate to use only the years after the change to most accurately reflect the current level of annual human-caused M/SI mortality. When human-caused M/SI data from multiple years are used, they should be averaged because true human-caused M/SI rates vary from year-to-year. Generally an un-weighted average should be used, but there may be specific circumstances that warrant a weighted mean. In either case, the type of mean and justification for its use should be described in the SAR.

When data are insufficient to overcome small-sample bias in human-caused M/SI estimates for the purpose of comparing the estimates to PBR (Moore and Merrick 2011; see Appendix A), SARs should include a statement on small-sample bias associated with the human-caused M/SI estimates. For observed fisheries in which no bycatch is documented, SARs should consider stating the probability of obtaining this outcome (no documented bycatch) when bycatch actually does exist, and an upper confidence limit for bycatch, given the observer coverage level (Curtis and Carretta 2020).

3.3.1 Undetected Human-caused Mortality and Serious Injury

Human-caused M/SI of marine mammals are documented through systematic (e.g., fishery observer programs) and opportunistic (e.g., strandings, at-sea sightings, rookery surveys)

observations. Most data on human-caused M/SI likely represent only a fraction of the true total human-caused effects (Williams et al. 2011). The undetected human-caused M/SI that comprises the difference is sometimes referred to as "cryptic" (Laist and Wray 1995, Coggins et al. 2007, Gilman et al. 2013, Pace et al. 2021, Ponce et al. 2010). Undetected M/SI includes both natural mortalities and anthropogenic sources such as fisheries bycatch, illegal shootings, vessel strikes, and anthropogenic sound.

SARs focus on human-caused M/SI, both detected and undetected. The undetected portion is often difficult to quantify but should be addressed in SARs where possible. In cases where systematic fisheries observer data exist but coverage is incomplete (<100%), total bycatch is routinely estimated by extrapolating observed bycatch rates to total fishing effort, thus accounting for undetected events (e.g., Benaka et al. 2019). When M/SI data are opportunistically obtained, it is more difficult to estimate undetected M/SI. Where annual estimates of abundance and mortality are available from population models, it is straightforward to calculate the amount of undetected mortality by comparing annual mortality estimates to observed mortalities (Pace et al. 2017, 2021). For some coastal species, "carcass recovery" rates (i.e., the ratio of detected carcasses to the estimated number of total carcasses theoretically available for detection) can be used. These can be developed by tracking individual animals over their lifetime (Wells et al. 2015); combining estimates of abundance and annual survival to estimate the number of total (detected and undetected) number of deaths (Carretta et al. 2016, Harting et al. 2021); comparing observed strandings to estimated mortalities from population models (Pace et al. 2021); and using drift models (Peltier et al. 2012, Young et al. 2019). Existing estimates of carcass recovery rates range from near-zero for many pelagic species (Williams et al. 2011), <10% for common dolphins (Peltier et al. 2012), 33% for an embayment population of coastal bottlenose dolphins (Wells et al. 2015), 36% for North Atlantic right whales (Pace et al. 2021), and 46% for Hawaiian monk seals (Harting et al. 2021). Most stocks lack estimates of undetected M/SI or carcass recovery rates. For pelagic species, strandings alone provide little insight into levels of undetected M/SI due to low probabilities of stranding and detection (Faerber and Baird 2010, Williams et al. 2011).

When possible, total human-caused M/SI reported in SARs and compared to PBR should be corrected for the undetected portion using the best available scientific information. This may include, but is not limited to, extrapolating observed bycatch rates to total fishing effort (e.g., Benaka et al. 2019), using published carcass recovery estimates (e.g., Wells et al. 2015), or comparisons of expected to detected mortality from population models (e.g., Pace et al. 2021). When correcting for undetected human-caused M/SI in SARs, assumptions regarding the probability of detecting human-caused vs. natural mortality through strandings or at-sea sightings should be addressed with supporting documentation. For stocks where a lack of data preclude quantitative assessment of undetected human-caused M/SI, the SAR should note that reported values represent a minimum estimate or at least a negatively-biased accounting of total human-caused M/SI.

For many marine mammal stocks, it is not possible to estimate the undetected fraction of human-caused M/SI. However, in some cases, it may be appropriate to rely on estimates from other stocks to inform those that lack stock-specific information. For example, many pelagic stocks (e.g., beaked whales, pelagic large whales) lack data on undetected mortality and carcass recovery rates. In these cases, SAR authors may evaluate application of correction factors

derived from data rich species (e.g., coastal common bottlenose dolphins), which represent "best case" scenarios for carcass recovery due to their relatively high stranding probabilities (Wells et al. 2015, Carretta et al. 2016). Before applying correction factors to other stocks, authors should consider whether differences in abundance, demography, distribution, differing vulnerability to and intensity of anthropogenic sources of mortality, gear types, and stranding probabilities permit such assumptions.

Differentiating between natural and anthropogenic sources of M/SI from strandings may not be possible if carcasses are in poor condition. Also, it may not be possible to distinguish between specific sources of human-caused M/SI. For example, a stranded animal with rope marks could have been killed by a variety of fisheries that use ropes (e.g., commercial or recreational gillnet, pot/trap, trawl) or by non-fishery ropes (e.g., anchor lines). Stranding data may also be biased with regard to anthropogenic sources of mortality. For example, a healthy whale quickly killed by a vessel strike may be more likely to float and strand than a whale killed slowly by chronic entanglement (Moore et al. 2020, Pace et al. 2021). In some regions, quantitative estimates of vessel strike and gillnet mortalities are available for the same whale stocks (Rockwood et al. 2017, Carretta 2020). Here, if the ratio of strandings attributable to vessel strikes vs. gillnets differs appreciably from the ratio of estimated mortalities from each source, this may indicate a bias in stranding probabilities by source. Such biases may be used to correct observed stranding numbers by source and to further develop carcass recovery estimates. For the intensively-studied population of North Atlantic right whales, Pace et al. (2021) found that the percentage of documented serious injuries attributed to entanglements (87%) was approximately 75% higher than the percentage of necropsied whales (49%) whose cause of death was entanglement related. This suggests a negative bias in stranding probabilities of entanglement mortalities and/or a negative bias in the ability to positively-identify entanglement mortalities from strandings. These types of biases may differ between anthropogenic sources, gear types, and regionally within multiple stocks of the same species (i.e., coastal vs. pelagic bottlenose dolphin stocks). If data and methods exist to apportion or prorate undetected M/SI by source, this should be done in the SAR, along with any caveats in their application. In the absence of robust methods to support apportioning, ratios from known sources collected over an appropriate time period may be used to apportion, with the caveat that while this information is the best available, it may be highly uncertain.

Where multiple estimates of human-caused M/SI exist for a given source, including estimates that correct for undetected mortality (e.g., gillnet bycatch estimates from observer program data and opportunistic gillnet entanglement cases from strandings/sightings), both sources should be reported and evaluated in the SAR. In most cases, the higher of the two estimates should be used unless it is known to be positively biased due to double-counting pitfalls that cannot be reconciled. If there is a reason to believe multiple estimates are mutually exclusive, it may be appropriate to sum both estimates, if evidence supports doing so. Where possible, the SAR should note differences and potential biases in human-caused M/SI from different data sources (e.g., stranding data vs. fisheries observer programs).

3.3.2 Incidental Commercial Fishery Mortality and Serious Injury

Information about M/SI incidental to U.S. commercial fishing should be provided, including data sources such as observer programs, logbooks, fishermen self-reports, strandings, and other

sources, where appropriate. It is expected that this section of the SARs will include all pertinent information that is subsequently used to classify fisheries under Section 118 of the MMPA. Therefore, comprehensive information on incidental fisheries-related mortality, serious injury, serious injury averted (i.e., human intervention or self-release prevented a serious injury), and non-serious injury that is needed for developing the MMPA List of Fisheries should be provided here.

The SAR should present information on M/SI incidental to U.S. commercial fisheries for the time period assessed as a table, providing the name of the fishery, observed M/SI, estimated extrapolated M/SI and associated CV, percent observer coverage, and the average annual M/SI estimate for each fishery. Because U.S. commercial fisheries are subject to regulation under MMPA Section 118, M/SI from such fisheries should be clearly separated from other fishery-related M/SI (e.g., M/SI incidental to recreational fishing or foreign fishing beyond the U.S. EEZ) in the SARs to the extent it is technically feasible.

Serious injuries averted (e.g., through human intervention or self-release) and non-serious injuries are not counted against PBR in the SAR but are used to develop the List of Fisheries under Section 118 of the MMPA and inform management (e.g., take reduction planning and negligible impact determinations). When a serious injury is averted and its determination changed (e.g., serious injury becomes non-serious following human intervention or the animal self-releases), the SARs should denote the injury events with different pre- and post- injury determinations (see NMFS-PD-02-238-01, Section IV). The SARs should specifically indicate which serious injuries from fishing gear, if any, were averted (e.g., mitigated or involved self-release), resulting in the animal no longer being considered seriously injured (NMFS-PD-02-238-01). The tally of serious injuries that were averted can be located in the fishery interaction tables (as a column, row, or footnote) or in a new table, but the author should describe these by year, and if known, by fishery or gear type. In the event that only non-serious injuries of the stock are associated with a particular fishery, this should be noted in the SAR with reference to the supporting documentation (e.g., injury report).

There is a general view that marine mammal mortality information from logbook or fishermen self-reported data can only be considered as a minimum estimate of mortality, although exceptions may occur. Logbook or self-reported information can be used to determine whether the minimum mortality is greater than PBR (or greater than 10% of the PBR), but it should not be used to determine whether the human-caused M/SI is less than PBR (or 10% of PBR). Logbook data for fishermen reports should not be used as the sole justification for determining that a particular stock is not strategic or that its U.S. commercial fishery related M/SI rate is insignificant and approaching zero.

For fisheries without observer programs, information about incidental M/SI from logbooks, fishermen self-reports, strandings, and other sources should be included where appropriate. When these other sources of data are used, particularly as a significant component of the measure of annual human-caused M/SI, the following language should be added to the SAR: “It is important to stress that this human-caused mortality and serious injury estimate results from an actual count of verified human-caused mortalities and serious injuries and should be considered a minimum.” Such information should be presented in brackets to distinguish it from estimates of total human-caused M/SI in the fishery. If such information is not included in the table, but

reports such as fishermen self-reports are available, those reports should be described in the text and any concern with the quality of that report should be noted. Fishermen self-reports of human-caused M/SI should not be included if they represent fishing effort that was observed and for which incidental human-caused M/SI was estimated based on observer coverage. M/SI by those fisheries not regulated under MMPA Section 118 (e.g., incidental to recreational fisheries), should be distinguished from M/SI incidental to U.S. commercial fisheries. Further guidelines on averaging human-caused M/SI across years and across different sources of human-caused M/SI can be found in Appendix A of these guidelines.

3.3.3 Other Sources of Human-Caused Mortality and Serious Injury (Including Foreign Fisheries and Non-commercial U.S. Fisheries)

Information on known or confirmed cases of human-caused M/SI from other sources should be included in the SAR. However, because many stocks are subject to human caused M/SI that is unmonitored or not fully quantified, authors of the SARs should add a subsection to the Human-Caused Mortality and Serious Injury section to include a summary of the most prevalent potential sources of human caused M/SI that are not monitored or fully quantified (e.g., foreign fisheries, recreational fisheries, tribal fisheries, vessel strikes, marine debris, other lethal or injurious human-interactions). Data sources and reports discussed above can be used to supply the information for this section. Careful consideration should be given to confirming that cases from these data sources and reports should be used in injury determinations and whether the injured or dead animals with evidence of a human interaction should count against PBR. Further, published research that summarizes or estimates human-caused M/SI can be included in the SAR as it may count against PBR for the stock. See also the Undetected Mortality discussion (Section 3.3.1) for further guidelines on handling the discussion and quantification of undetected mortality.

3.3.4 Mortality Rates

Section 118 of the 1994 MMPA Amendments reaffirmed the goal set forth in the Act when it was enacted in 1972 that the incidental take of marine mammals in commercial fisheries is to be reduced to insignificant levels approaching a zero mortality and serious rate, and further requires that this goal be met within seven years of enactment of the 1994 Amendments (April 30, 2001). This commercial fisheries-specific goal is referred to as the “zero mortality rate goal” (ZMRG). The SARs are not meant to be the means by which NMFS determines that a fishery has achieved the ZMRG. A review of progress towards the ZMRG for all fisheries was submitted to Congress in August 2004.

However, Section 117 of the amended MMPA requires that SARs include descriptions of U.S. commercial fisheries that interact with (i.e., kill or seriously injure) marine mammals, and these descriptions must contain “an analysis stating whether such level is insignificant and is approaching a zero mortality and serious injury rate.” As established in regulation (69 FR 43338), this analysis should be based on whether the total M/SI for a stock in all commercial fisheries with which it interacts is less than or equal to 10% of the calculated PBR for that stock. The following wording is recommended (typically in the “Status of Stock” section of the SAR):

“The total commercial fishery mortality and serious injury for this stock is (or is not) less than or equal to 10% of the calculated PBR and, therefore, can (or cannot) be considered as insignificant and approaching a zero mortality and serious injury rate.”

3.4 Habitat Issues

The purpose of this section of a SAR is to highlight habitat issues affecting the status of the stock. If there are no known habitat issues or other factors causing a decline or impeding recovery of the stock, this should be stated in the Status of Stock section, and a Habitat Issues section is not needed.

Consideration of habitat concerns for strategic stocks (see Section 3.5.2) is specifically mandated in the MMPA. In Section 117(a)(3) of the MMPA, there is a requirement that SARs: "estimate..., for a strategic stock, other factors that may be causing a decline or impeding recovery of the stock, including effects on marine mammal habitat and prey[.]" The term “other factors” is interpreted as factors other than direct human-caused M/SI that may cause a decline or impede the recovery of a stock. These factors include, but are not limited to, effects to prey or habitat, infectious disease, contaminants, climate change and variability, species vulnerability to climate changes, and environmental factors (e.g., sea surface temperature) that affect marine mammal survival or reproduction. If data indicate that any such habitat-related factor(s) may currently be causing a decline or impeding recovery of a strategic stock, then a separate section titled “Habitat Issues” should be included in the SAR; this section should characterize the problem and the effect(s) to the stock and include citations to publications where the details can be found.

While Section 117(a)(3) of the MMPA is specific to strategic stocks, habitat is important to all species and stocks. Given this, if data indicate a habitat-related issue is likely causing a decline in, or adversely affecting the status of, a non-strategic stock, a Habitat Issues section may also be included in SARs for stocks that are not strategic.

It is preferable to have all such information related to habitat issues included together in this one section, but occasionally there may be times where it is useful to make note of a habitat issue in a different section of the SAR, or provide reference to the Habitat Issues section. As is the case for all sections of the SAR, the Habitat Issues section should only be a summary of the issue and should reference publications.

3.5 Status of Stocks

This section of the SARs should present a summary of four types of “status” of the stock: (1) current legal designation under the MMPA and ESA, (2) status relative to OSP (within OSP, below OSP, or unknown), (3) designation of strategic or not, and (4) a summary of trends in abundance and human-caused M/SI. Additional guidelines on status related to OSP and strategic status are provided below (Sections 3.5.1 and 3.5.2). Consistent with the objectives of the MMPA, the “status” of the stock (1–4) should be based on an evaluation of information from the entire stock range (i.e., geographic range of the DIP(s) or area determined to represent a defensible management unit). In cases where information is not available for the entire stock range, the status should be based on an evaluation of the information available for as much of the stock range as possible. Regardless, the SAR should clearly describe the data used to inform the

status of the stock by referencing other sections of the SAR and note the geographic extent of these data.

The Status of Stock section should also include a summary of issues, such as habitat, affecting the status of the stock, if applicable (see Section 3.4). If there are no known habitat issues or other factors causing a decline or impeding recovery, then this should be stated in the Status of Stock section. Based upon descriptions of levels of uncertainties from the SAR sections on Stock Definition and Geographic Range, Elements of the PBR Formula, Population Trend, and Annual Human-Caused Mortality and Serious Injury, the Status of Stock section should also evaluate and describe any consequences of these uncertainties on the assessment of the stock's status.

3.5.1 Optimum Sustainable Population

Stocks that have evidence suggesting at least a 50% decline, either based on previous abundance estimates or historical abundance estimated by back-calculation, should be noted in the Status of Stock section as likely to be below OSP. The choice of 50% does not mean that the lower bound of a stock's OSP range is at 50% of historical numbers, but rather that a population below this level would be below OSP with high probability. However, without further analysis and completing the requirements in Section 115 of the MMPA, determination of stock status with regard to whether it is depleted (or, by extension, strategic based on depleted status) cannot be made. Similarly, a stock that has increased back to levels pre-dating the known decline may be within OSP; however, additional analyses may determine a population is within OSP prior to reaching historical levels.

3.5.2 Strategic Status

Section 3(19) of the MMPA defines the term "strategic stock" as a marine mammal stock:

> *(A) "for which the level of direct[3] human-caused mortality[4] exceeds the potential biological removal level;*
>
> *(B) which, based on the best available scientific information, is declining and is likely to be listed as a threatened species under the Endangered Species Act of 1973 [16 U.S.C. 1531 et seq.] within the foreseeable future; or*
>
> *(C) which is listed as a threatened species or endangered species under the Endangered Species Act of 1973 (16 U.S.C. 1531 et seq.), or is designated as depleted under [the MMPA]."*

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[3] The term direct in 3(19)(A) is interpreted to mean that any such human-caused mortality to be compared to PBR must be the result of human activity.

[4] NMFS' regulations define serious injury as "any injury that will likely result in mortality" (50 CFR 229.2). As a matter of policy (NMFS-PD-02-238), NMFS interprets serious injury as "any injury that is 'more likely than not' to result in mortality, or any injury that presents a greater than 50 percent chance of death to a marine mammal. Thus, both human-caused mortality and serious injury are considered in comparison to PBR for the purposes of designating stocks as strategic."

Per MMPA section 117(a)(5), SARs shall categorize the status of the stock as one that either:

> *(A) has a level of human-caused mortality and serious injury that is not likely to cause the stock to be reduced below its optimum sustainable population; or*
>
> *(B) is a strategic stock, with a description of the reasons therefor;"*

The following section provides guidelines for evaluating whether a stock warrants strategic status in SARs based on sections 3(19)(A–C) of the MMPA.

3.5.2.1 Strategic Status Determinations Based on Section 3(19)(A)

To evaluate whether a stock warrants strategic status based on 3(19)(A), information on human-caused M/SI of the stock and on the stock's PBR (and thus N_{min}) is necessary. However, the level of information available on human-caused M/SI for any given stock can vary. human-caused M/SI is considered complete for a stock when human-caused M/SI of the stock is estimated for each likely significant source of human-caused M/SI for the full range of the stock such that the sum (i.e., total) of human-caused M/SI estimates across sources reasonably represents the total human-caused M/SI the stock experiences. Any information short of this is considered incomplete or absent, examples of which include but are not limited to: (a) information is only representative of a portion of the stock range; (b) information is only representative of a portion of time of the year (e.g., season); (c) information is not available for all likely significant sources of human-caused M/SI; (d) information on human-caused M/SI is available for a region that includes multiple stocks but with no method available to assign human-caused M/SI to individual stocks; (e) information on human-caused M/SI only represents observed human-caused M/SI and there is a strong reason to suspect substantial undetected human-caused M/SI (see Section 3.3.1); (f) there are injury cases where the severity of an injury cannot be determined (see NMFS-PD-02-238-01); and (g) there is no stock-specific information on human-caused M/SI. Similarly, the level of information available on N_{min} for any given stock can vary. In some cases, there may be an estimate of N_{min} for the entire stock range, while in others an estimate of N_{min} may be unavailable or only represent a portion of the stock range.

As noted above, strategic status should be determined for the entire stock, and thus be based on an evaluation of the available information for the entire stock range. When PBR is available for the entire stock range and there is complete information on human-caused M/SI, determining strategic status is straightforward. However, when PBR is not determined (i.e., N_{min} is not available), only represents a portion of the stock range, or when stock-specific human-caused M/SI information is unavailable or incomplete, strategic status should be determined based on the best available scientific information for the given situation. The following section provides guidelines for evaluating strategic status as it relates to the level of information available for N_{min} and human-caused M/SI.

Range-wide estimate for Nmin available, complete human-caused M/SI information available

If an estimate of N_{min} is available for the stock's entire range and the available stock-specific information (e.g., estimated 5-year average) on human-caused M/SI is considered complete, total human-caused M/SI (i.e., the sum of all human-caused M/SI estimates across sources) can be directly compared to PBR. If total human-caused M/SI is greater than PBR, the stock warrants

strategic status based on 3(19)(A). Conversely, if total human-caused M/SI is less than or equal to PBR, the stock does not warrant strategic status based on 3(19)(A).

Range-wide estimate for N_{min} available, incomplete human-caused M/SI information available

If an estimate of N_{min} is available for the stock's entire range, but stock-specific information on human-caused M/SI is incomplete, total human-caused M/SI (i.e., the sum of all human-caused M/SI estimates across sources) should be considered a minimum, and the stock may or may not warrant strategic status. If the minimum human-caused M/SI is greater than PBR, the stock warrants strategic status based on 3(19)(A). If minimum human-caused M/SI is less than or equal to PBR, the stock may or may not warrant strategic status based on 3(19)(A). In such cases, the best available scientific information regarding plausible human-caused M/SI beyond the minimum should inform strategic status designations.

For example, if minimum human-caused M/SI is far below PBR and there is reason to believe that if complete information were available, total human-caused M/SI would not be much greater than the minimum estimate, the stock would not warrant strategic status based on 3(19)(A). In contrast, if minimum human-caused M/SI is below PBR but there is a strong reason to believe that if complete information were available, total human-caused M/SI would exceed PBR, the stock would warrant strategic status based on 3(19)(A). The rationale for the final designation (strategic or not) should be stated in the SAR in the Status of Stock section.

Range-wide estimate for N_{min} available, no information on human-caused M/SI available

If an estimate of N_{min} is available for the stock's entire range, but there is no stock-specific information on human-caused M/SI available, the stock does not warrant strategic status based on 3(19)(A) as the lack of information is an insufficient basis for designating a stock as strategic. However, the best available scientific information on plausible total human-caused M/SI may be discussed in the SAR and used to inform whether the stock may warrant strategic status without designating the stock as such.

Estimate for N_{min} unavailable or only represents a portion of the stock range, complete human-caused M/SI information available

If there is no estimate of N_{min} for the stock or the available N_{min} is only representative of a portion of the stock range, but complete stock-specific information on human-caused M/SI is available, the stock may or may not warrant strategic status. The value of N_{min} that would result in total stock-specific human-caused M/SI exceeding PBR should be calculated and used to judge whether the stock range-wide minimum abundance is likely greater or less than this "critical N_{min}" value based on the best available scientific information. The critical N_{min} can be found by solving the PBR equation for N_{min}, which yields:

$$N_{min} = \frac{2PBR}{R_{max} \cdot F_r}$$

By substituting the total stock-specific human-caused M/SI for PBR, and using the appropriate default R_{max} value for the taxa and an appropriate F_r value, the critical N_{min} can be calculated. If the best available scientific information for the stock suggests its range-wide minimum abundance is likely less than the critical N_{min}, the stock warrants strategic status based on

3(19)(A). If the best available scientific information for the stock suggests its range-wide minimum abundance is likely greater than the critical N_{min}, the stock does not warrant strategic status based on 3(19)(A). However, stocks for which N_{min} becomes unavailable should not change strategic status solely because of an inability to estimate N_{min}.

Estimate for N_{min} unavailable or only represents a portion of the stock range, incomplete human-caused M/SI injury information available

If there is no estimate of N_{min} for the stock or the available N_{min} is only representative of a portion of the stock range, and the available stock-specific information on human-caused M/SI is incomplete, the stock may or may not warrant strategic status. As above, incomplete stock-specific information on human-caused M/SI should be considered a minimum and this minimum can be used to calculate a critical N_{min}, which here would correspond to the N_{min} that would result in the minimum human-caused M/SI exceeding PBR.

If the best available scientific information for the stock suggests that its range-wide minimum abundance is likely less than the critical N_{min}, the stock warrants strategic status based on 3(19)(A). However, if the best available scientific information for the stock suggests that its range-wide minimum abundance is likely greater than the critical N_{min}, the stock may or may not warrant strategic status based on 3(19)(A). In such situations, discretion should be used to judge the likely upper bounds of both the range-wide N_{min} and the total human-caused M/SI to determine whether the stock warrants strategic status, keeping in mind that stocks should not change strategic status solely because of an inability to estimate N_{min}.

Estimate for N_{min} unavailable or only represents a portion of the stock range, no information on human-caused M/SI information available

If there is no estimate of N_{min} available for the stock or the available N_{min} is only representative of a portion of the stock range, and no stock-specific information on human-caused M/SI is available, the stock does not warrant strategic status based on 3(19)(A), as the lack of information is an insufficient basis for designating a stock as strategic. However, the best available scientific information on plausible total human-caused M/SI and range-wide N_{min} may be discussed in the SAR and used to inform whether the stock may warrant strategic status without designating the stock as such. This should follow the same process described above for calculating a critical N_{min}, keeping in mind that stocks should not change strategic status solely because of an inability to estimate N_{min}.

3.5.2.2 Strategic Status Determinations Based on Section 3(19)(B)

To evaluate a stock's strategic status based on 3(19)(B), information on whether the stock is declining and is likely to be listed as a threatened species under the ESA within the foreseeable future is necessary.

Determining whether a stock is declining should be based on the information provided in the "Current Population Trend" section of the SAR. Ideally, such information will include a quantitative assessment of the current population trend to inform whether a stock is declining, but sometimes the data necessary to conduct such an assessment are not available. In these cases, a qualitative assessment of the current population trend may be provided in the "Current Population Trend" section and can be used to inform whether a stock is declining. If a stock is

not known to be declining (i.e., its trend is increasing, stable, or unknown), the stock does not warrant strategic status based on 3(19)(B), regardless of whether it is likely to be listed as threatened under the ESA.

Determining whether a stock is likely to be listed as threatened within the foreseeable future under the ESA should be based on an evaluation under section 4 of the ESA (50 CFR 424.11). An independent evaluation to inform a stock's strategic status under the MMPA is not necessary and should not be conducted. For the purposes of designating stocks as strategic based on 3(19)(B), stocks that belong to species that are *proposed* to be listed as threatened or endangered[5] under the ESA are considered likely to be listed as threatened under the ESA within the foreseeable future.

Thus, if a stock is declining *and* the species to which the stock belongs is proposed to be listed as threatened or endangered under the ESA, the stock warrants strategic status based on 3(19)(B). Note that if the species to which the stock belongs is not ultimately listed as threatened or endangered under the ESA (i.e., final rule has a finding of "not warranted"), the stock would no longer warrant strategic status unless it meets one of the other criteria for strategic designation.

3.5.2.3 Strategic Status Determinations Based on Section 3(19)(C)

To evaluate a stock's strategic status based on 3(19)(C), information on the stock's current ESA listing status and MMPA depleted status are necessary. If the species to which the stock belongs is currently listed as threatened or endangered under the ESA, or the stock is designated as depleted under the MMPA, the stock warrants strategic status based on 3(19)(C).

3.5.3 Transboundary Stocks

In transboundary situations where a stock range spans international boundaries or the boundary of the U.S. EEZ, the best approach is to evaluate all sources of human-caused M/SI (U.S. and non-U.S.) relative to PBR for the stock's entire range. Such an approach is consistent with the MMPA objective of maintaining stocks as functioning elements of their ecosystems and basing a stock's status on information from the entire stock range (see Section 3.5). In general, abundance or density estimates from one area should not be extrapolated to unsurveyed areas to estimate range-wide abundance (and PBR) to allow for comparisons to human-caused M/SI. But, informed interpolation[6] (e.g., based on habitat associations) may be used to fill gaps in survey coverage and estimate abundance and PBR over broader areas as appropriate and supported by existing data.

If range-wide estimates of PBR and/or human-caused M/SI are not available, a transboundary stock's status should still be determined following the guidelines presented above (Section 3.5), and PBR and total human-caused M/SI should be reported so that they represent as much of the

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[5] Endangered is included here because the ESA defines a threatened species to mean "any species which is likely to become an endangered species in the foreseeable future..." Thus, a species that is proposed to be listed as endangered has likely already met the requirement of likely to be listed as threatened within the foreseeable future.
[6] "Informed interpolation" specifically refers to the use of a model-based method for interpolating density between transect lines, such as habitat-based density modeling and other forms of spatial modeling.

stock range as possible. However, if this PBR and total human-caused M/SI are not comparable for managing marine mammals under U.S. jurisdiction, the SAR should also calculate and provide an apportioned PBR and/or human-caused M/SI as follows. For migratory transboundary stocks, if it is reasonable to do so, a time-apportioned PBR should be calculated and provided based on the fraction of time the stock spends in waters under U.S. jurisdiction. For non-migratory transboundary stocks (e.g., stocks with broad pelagic distributions that extend into international waters), an area-apportioned PBR should be calculated based on abundance estimates relevant to managing marine mammals under U.S. jurisdiction. In some cases (e.g., migratory transboundary stocks where some animals may never enter waters under U.S. jurisdiction), these two approaches (time and area) may need to be combined. When an apportioned PBR is calculated and provided, if appropriate, a corresponding human-caused M/SI should also be provided such that it is comparable to the apportioned PBR and represents data relevant to managing marine mammals under U.S. jurisdiction. Methods for deriving time- or area-apportioned estimates of PBR and human-caused M/SI should be clearly noted in the SAR, along with their rationale. The apportioned estimates should not be conflated with the stock-wide estimates (which may or may not be available) or be the primary basis for assessing the status of the stock (see Section 3.5).

3.6 Ensuring Appropriate Peer Review of New Information

The process for developing SARs and guidelines herein are to designed to ensure that marine mammal management decisions are based on the best scientific information available. As influential scientific assessments, all scientific information used in support of the SARs should meet the peer review requirements described in the Office of Management and Budget (OMB) Bulletin on peer review[7] and NOAA Information Quality Act (IQA) guidelines[8] to ensure the information is not only high quality but is available for management decisions in a timely fashion. To meet these requirements, prior to using new information not previously used to support a SAR for a particular stock, such information must be cleared following NMFS Guidance on Internal Review and Approval of Fundamental Research Communications (NMFS 2014) or subjected to external peer review (e.g., by the SRG, Center of Independent Experts, or scientific journal).

Data from a given time period used to support a SAR may not necessarily have been published or previously subjected to independent peer review prior to inclusion in a draft SAR, as this process can take months or years to complete. In other cases, data pertinent to assessments of stocks are routinely collected and analyzed but are not suitable as stand-alone external peer-reviewed publications. NMFS considers SRG review to constitute peer review and to meet the requirements of the OMB Peer Review Bulletin and NOAA IQA guidelines. As such, SRG review of data is sufficient for NMFS to consider it the best scientific information available. In cases where information to be incorporated into draft SARs has not yet been published or subjected to external peer review, NMFS may rely on SRG review to meet peer-review requirements.

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[7] https://www.whitehouse.gov/sites/whitehouse.gov/files/omb/memoranda/2005/m05-03.pdf
[8] https://www.noaa.gov/node/6009

However, differing levels of complexity and the extent of new, non-peer-reviewed information to be incorporated into draft SARs warrant different levels of peer review. In addition, while in some cases it may be appropriate to directly incorporate new information in draft SARs for peer review by the SRGs, other times new information should be reviewed by the SRGs prior to inclusion in draft SARs, even if it has already been externally peer-reviewed. Below are three general levels of peer review that should be considered by SAR authors, in consultation with Science Center leadership.

> Level 1 - For routine data updates and analyses using methods unchanged from previously peer-reviewed and published analyses for the affected stock, there is no need for additional peer review prior to including such information in draft SARs for SRG peer review[9]. However, it is expected that the SRG will review the application of these previously peer-reviewed data and/or methods. Some examples of new information that fall into Level 1 include annual updates on abundance, trends, human-caused M/SI, and genetics, as long as such information employs methods that are not substantively changed from previously peer-reviewed and published analyses.
>
> Level 2 - For data and analyses using methods similar to, but significantly modified from, previously peer-reviewed and published data and analyses for the affected stock, or for data and analyses/methods already in use for the assessment of one stock but now being applied to a different stock, NMFS should consult with the SRG about further peer review, including that of the SRG, before such information is included in the draft SAR. Some examples of new information that fall into Level 2 include new parameterization of an existing model to estimate abundance for a stock and an abundance estimation method already used for one stock being applied to a different but similar stock for which it has not been previously applied.
>
> Level 3 - For use of novel data sources, analyses using completely novel methods, or methods newly applied to the assessment of multiple stocks, an independent peer review of the analyses should be conducted prior to including such information in a draft SAR. Where possible, documentation of the new approach should be considered for peer-reviewed publication. In cases where a peer-reviewed publication is pending, such new information should undergo SRG review before it is incorporated in the draft SAR. Some examples of new information that fall into Level 3 include the use of a newly developed model to improve abundance estimates for a stock and the application of a method to estimate abundance for multiple stocks for which the method has not been previously applied.

Regardless of what level of peer review is appropriate, all supporting documentation (e.g., draft manuscripts, reports, etc.) related to new information incorporated into the SARs must be available upon request during the time of public comment, and published by the time the SARs are final. In addition, the Science Center should document any deviations from the above guidance on the above peer review at the various levels.

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[9] Per NMFS (2012), serious injury determinations should be explicitly reviewed by the SRGs. However, this review may occur concurrently with the review of the SARs in which these determinations are included.

3.7 Ensuring Appropriate Quality Assurance and Quality Control

Once the scientific information has been appropriately peer reviewed and incorporated into a draft SAR, the draft SAR itself should meet basic standards of clarity and scientific integrity and adhere to the standards for Fundamental Research Communications established by NOAA (2016) and NMFS (2014). As such, at a minimum, and prior to review by the SRG, draft SARs should go through Science Center internal review and clearance procedures to meet quality assurance and quality control requirements. The objective of this review and clearance is to ensure scientific integrity by highlighting any inconsistencies or weaknesses in data, methodology, findings, or structure of the SARs prior to submission to the SRGs. Individual Science Centers determine their respective quality assurance and quality control requirements, which may include technical review by other internal scientists, and are responsible for ensuring draft SARs meet these requirements before going to the SRGs for review.

4. Summary of changes from the 2016 Guidelines

In July 2020, NMFS OPR began coordinating efforts to revise NMFS PDS 02-204-01. The focus of this effort was to update the Guidelines to address several topics that were identified but not finalized during the prior revision of the Guidelines in 2016. In addition, NMFS PDS 02-204-01 was scheduled for review in February 2021 and, following the finalization of the policy in 2016, several other revision topics were identified.

Below is a summary of the eight topics addressed by the 2023 revisions to the Guidelines. In addition to these, other minor revisions were made to improve readability, clarity, and ensure all sections are well connected and updated to align with the revisions related to the eight topics and forthcoming revisions to NMFS Serious Injury Policy (NMFS-PD 02-038-01).

Topic 1: Incorporate and reference NMFS PDS 02-204-03 Reviewing and Designating Stocks and Issuing Stock Assessment Reports under the Marine Mammal Protection Act

NMFS PDS 02-204-03 established NMFS procedure for reviewing and designating stocks in the development of the SARs, including how stock designations relate to DIPs, as well as DPSs in cases where marine mammals are also listed under the ESA. NMFS PDS 02-204-03 was finalized in 2019. The revisions to the Guidelines summarize NMFS PDS 02-204-03 and incorporate the directive by reference. They describe the distinction between the delineation of DIPs and the designation of stocks established by NMFS PDS 02-204-03 and remove text that is no longer relevant as it relates to defining stocks, which is replaced with direction to rely on Martien et al. (2019) for DIP delineation and NMFS PDS 02-204-03 for stock designation. They also provide additional guidance on how to define ranges given the possible DIP delineation and resulting stock designation outcomes. Finally, the revisions remove text on prospective stocks that was deemed no longer relevant given the process laid out in NMFS PDS 02-204-03.

Topic 2 and 3: (2) Update guidance related to calculating N_{min} in post-survey years (3) Update guidance related to the calculation of N_{min} to address sources of bias and ensure MMPA goals of PBR are met

Previous versions of the Guidelines state that if 8 years have transpired since the time of an abundance survey, the minimum population abundance, or N_{min}, is considered unknown. This creates a challenge for managing stocks. The revisions remove the 8-year expiration of

abundance data for use in calculating N_{min}. They provide additional detail on the survey frequency assumed in the original PBR performance testing scenarios conducted by Wade (1998) and note that if survey data are older than was assumed in these scenarios, N_{min} should be adjusted to account for uncertain post-survey abundance changes. The revisions provide a non-exhaustive list of potential options for making such adjustments to N_{min} and note that at some point even with adjustments, N_{min} will become unreliable and should be considered unknown on a case-by-case basis.

Topic 4: Update guidance related to designating stocks as strategic and related recovery factors

The MMPA defines the term "strategic stock" as a marine mammal stock: (A) for which the level of direct human caused mortality exceeds the potential biological removal level; (B) which is declining and is likely to be listed as a threatened species under the ESA within the foreseeable future; or (C) which is listed as a threatened species or endangered species under the ESA or is designated as depleted under the MMPA. While applying criterion A or C may be relatively straightforward, applying criterion B is more subjective and previous versions of the Guidelines did not provide any guidance related to criterion B. The revisions provide explicit guidelines for making strategic determinations based on each part of Section 3(19) of the MMPA (A-C). For 3(19)(A), the guidelines provide direction for how to assess strategic status given varying levels of information on the minimum population size, which is necessary for calculating the PBR level, and human-caused M/SI. For 3(19)(B), the guidelines direct SAR authors to rely on information to be included in the SAR on the stock's trend and whether the stock is proposed to be listed under the ESA to inform strategic status. Finally, straightforward guidelines are provided for determining strategic status under 3(19)(C) based on a stock's current depleted status under the MMPA and listing under the ESA.

Topic 5: Improve language related to quantifying and including unobserved mortality and serious injury

In recent years, estimates of unobserved or "cryptic" mortality of marine mammals, particularly of large whales, have been developed and in some cases, have been incorporated into the SARs. However, previous versions of the Guidelines did not provide guidance specific to incorporating this information and whether or not it should be considered and counted against PBR. The revisions summarize the concept of undetected mortality and the state of the science as it relates to estimating undetected mortality in marine mammals and its inclusion in SARs. They then provide specific guidance directing SAR authors to correct human-caused M/SI estimates for undetected mortality using the best available scientific information when possible and include several examples of how this may be accomplished. Guidance is also given on using data from other stocks and how to appropriately deal with apportioning undetected mortality by cause, various biases that may exist, and multiple estimates of human-caused M/SI.

Topic 6: Update guidance on the inclusion and incorporation of information on climate change, biologically important areas, and habitat issues

Inclusion of information on the effects of climate change in SARs has been a subject of discussion among SRGs. In addition, NMFS is in the process of completing climate vulnerability assessments (CVAs) for marine mammal stocks, and efforts are underway to develop guidance on using climate information in various ESA and MMPA contexts. Somewhat related, for

endangered/threatened stocks, the SARs generally include information about critical habitat designations, while SARs may or may not include a description of biologically important areas when identified for a stock. The revisions provide a new section entitled "Habitat Issues," which was mentioned in the previous version of the Guidelines as a possible section in the SARs, but with little specific guidance. The new text provides guidance on the purpose of the habitat issues section of a SAR (to highlight habitat issues affecting the status of the stock), and when such section may be warranted. It describes what type of information should be included in this section and provides direction on the level of detail to include. The revisions focus on strategic stocks, given the requirements of the MMPA, but note that in some cases, a habitat issues section may be included for non-strategic stocks when warranted.

Topic 7: Clarify expectations regarding peer-review of information included in SARs

Previous recommendations from the SRGs indicate that the peer-review expectations for information included in the SARs may not be clearly laid out in the Guidelines. The revisions provide two new sections entitled "Ensuring Appropriate Peer Review of New Information" and "Ensuring Appropriate Quality Assurance and Quality Control." The first section summarizes NOAA's mandates to ensure that management decisions are based on the best available scientific information and provides direction for how this requirement may be met when including new information in draft SARs. It then describes three levels of peer review and how the different types of new information that may be included in the SARs fit into each level, with specific direction given on what level of review should be considered in each circumstance. The second section directs SAR authors to ensure draft SARs follow appropriate Quality Assurance and Quality Control procedures, which may vary by Science Center.

Topic 8: Data sources and criteria used for documenting human-caused mortality and serious injury

Implementation of the 2016 guidelines resulted in some inconsistencies in how SARs report information on human-caused M/SI and the criteria used for such information. Such inconsistencies have led to differing estimates of human-caused M/SI among SARs and other NMFS documents. Additionally, under the previous Guidelines, there was a lack of consistency in the SARs as it relates to human-caused injuries, especially fishery entanglements/ingestions, that were determined to not be seriously injured and therefore, not counting against PBR, particularly when there was intervention. The revisions revise the existing section titled "Annual Human-caused Mortality and Serious Injury." Specifically, the revisions divide this section into several new sections including sections on "Undetected Mortality and Serious Injury" (see topic 5 above), "Incidental Commercial Fishery Mortality and Serious Injury," and "Other Sources of Human-Caused Mortality and Serious Injury (Including Foreign Fisheries and Non-commercial U.S. Fisheries)," and this now includes the existing "Mortality Rates" section. Within these sections, additional guidance is given on the data sources and criteria that should be considered regarding human-caused M/SI. Guidance is also provided on how to include information on non-serious injuries, including serious injuries that were averted due to intervention.

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Appendix A. Technical Details

Technical details are provided for appropriate PBR and human-caused M/SI calculations. The first section provides details on precision and rounding issues. The second section provides details for combining more than one abundance estimate for calculating N_{min}. The third section contains details for calculating the estimate of annual human-caused M/SI and its associated variance.

Precision and Rounding

The following rules on precision and rounding should be applied when calculating PBR and other values:

(a) N (the abundance estimate), CV(N), R_{max}, and F_r should be reported in the SAR to whatever precision is thought appropriate by the authors and involved scientists, so long as what is reported is exactly what the PBR calculation is based on.

(b) PBR should be calculated from the values for (a) to full precision, and not be calculated from an intermediary rounded off N_{min}. However, N_{min} should be reported as a rounded integer.

(c) PBR and human-caused M/SI should be reported with one decimal place if they are below 10. Otherwise, PBR and human-caused M/SI should be reported as a rounded integer.

(d) If PBR and human-caused M/SI round to the same integer, the SAR will report both values to the precision necessary to determine which is larger. This would also be done if 10% of PBR and human-caused M/SI round to the same integer.

Computation of Average Abundance and its Variance

When estimates of abundance are available for more than one year or from more than one source in the same year, it may be appropriate to combine those estimates into an average abundance for the time period in question. If true abundance is likely to be significantly changing between years, the unweighted geometric mean may be the most appropriate average to use. However, if true abundance is unlikely to be significantly changing between years, a weighted mean may be the most appropriate average to use (see Appendix 2, p. 312 in Carretta et al. 2009 for more information), where the weights are equal to the inverse of the associated variance:

Error!

where:

$$w_i = \frac{1/var(a_i)}{\sum_{j=1}^{n} 1/var(a_j)} .$$

The variance of a weighted mean of several abundance estimates is calculated as:

$$var(a) = w_1^2 var(a_1) + w_2^2 var(a_2) + \ldots w_2^2 var(a_n) = \sum_{i=1}^{n} w_i^2 var(a_i) \quad .$$

Finally, the variance is parameterized as a CV in the provided equation for calculating N_{min}. The CV is calculated as:

$$CV(a) = \frac{\sqrt{var(a)}}{a}$$

Computation of Average Human-Caused Mortality and Serious Injury and its Variance

When estimates of human-caused M/SI are available for more than one year and/or from more than one source, such as a fishery, it is necessary to calculate an estimate of the mean annual human-caused M/SI along with its associated variance (or CV). The following section provides guidelines for doing this. The guidelines apply to estimates of human-caused M/SI from all sources.

Calculating the Overall Mean Annual Human-Caused Mortality and Serious Injury

First, it is most appropriate for human-caused M/SI estimates from a given source to be averaged UNWEIGHTED across years, as the true human-caused M/SI might be different in each year, and thus is not constant. This is just the simple average of the available estimates of human-caused M/SI. If estimates are available from more than one source, a mean annual human-caused M/SI from each source should be calculated first, and then the annual mean from each source should be summed to calculate an overall estimate of the mean annual human-caused M/SI.

Calculating the Coefficient of Variation of the Mean Annual Human-Caused Mortality and Serious Injury from a Single Source

There are two potential methods for calculating the coefficient of variation (CV) or variance of the mean annual human-caused M/SI from a single source. Method 1 involves using standard statistical formulas for combining the variances of the individual yearly human-caused M/SI estimates (assuming they are available). Method 2 involves estimating the variance empirically from the 2–5 years of point estimates of human-caused M/SI, which is done by calculating the standard deviation of the 2–5 human-caused M/SI estimates and dividing it by the square root of *n*, where *n* is the number of years available. Both methods are valid. However, two points favor Method 1.

First, because the true human-caused M/SI might be different in each year, and thus is not constant, estimating the variance using Method 2 above could overestimate the true variance of the estimates of human-caused M/SI, and this positive bias would be related to how much the human-caused M/SI truly varied from year to year independent of observation error.

Second, Method 1 is likely to give a more precise estimate of the variance because it has more degrees of freedom. Using Method 2 involves estimating the variance from a sample size of just 2–5, and ignores the information that is known about the precision of each individual estimate.

Obviously, Method 2 is the only method that can be used if there are no available estimates of the variance of the human-caused M/SI. Method 1 is the recommended method if the estimates of human-caused M/SI in each year do have an estimated variance (or CV).

Method 1

Table 1 outlines the computations needed for estimates of average human-caused M/SI by *f* sources (for simplicity, here fisheries is used) operating over *n* years. Table 2 gives an example computation for *f*=3 fisheries operating over a horizon of *n*=3 years, and all of the estimates are non-zero. Most variance estimators will provide an estimate of 0 for the variance when the estimated human-caused M/SI is zero; however, the true variance is non-zero. In this case, a more realistic estimate of the variance can be developed by averaging the variances for those years, which have a positive variance. The variance computations in Table 1 are simply modified by dividing by the square of the number of years with a non-zero variance. The computation of the average is unaffected with the zero included in the average (Table 3). In certain circumstances a fishery may have been operating but was not monitored for human-caused M/SI. Missing estimates should be dropped from both the calculation of the average and the variance (Table 4).

Method 2

In Method 2 the only change is in how the variance is calculated for the estimate of average human-caused M/SI for each fishery over *n* years. In Method 2 the variance of the average human-caused M/SI is estimated empirically from the several point estimates of human-caused M/SI available from different years. This is done by calculating the variance of those estimates and dividing it by *n*, where *n* is the number of years used in calculating the average:

$$var(m_{i.}) = \frac{\sum_{j=1}^{n} \frac{(m_{ij}-m_{i.})^2}{n-1}}{n} .$$

The above formula would thus be substituted for the formula for $var(m_{i.})$ presented in Table 1. The second step of combining variances across sources is identical to Method 1.

Table 1. Computation table for average human-caused M/SI for *n* years with *f* fisheries. The human-caused M/SI estimate for fishery *I* during year *j* is m_{ij} and the corresponding variance estimate is v_{ij}. The estimated total human-caused M/SI for year *j* is $m_{.j}$, the sum of human-caused M/SI estimates for each fishery and the variance is $v_{.j}$, the sum of the variances. The average human-caused M/SI for fishery *I* is $_{I.}$ and its variance is v_i, which is the sum of the variances for each year within the fishery divided by the number of years (*n*) squared.

Fishery	Year 1	Year 2 ...	Year *n*	Average
1	m_{11} var(m_{11})	m_{12} var(m_{12})	m_{1n} var(m_{1n})	$m_{1.} = \sum_{j=1}^{n} m_{1j}/n \quad var(m_{1.}) = \sum_{j=1}^{n} var(m_{1j})/n^2$
2 . .	m_{21} var(m_{21})	m_{22} var(m_{22})	m_{2n} var(m_{2n})	$m_{2.} = \sum_{j=1}^{n} m_{2j}/n \quad var(m_{2.}) = \sum_{j=1}^{n} var(m_{2j})/n^2$
f	m_{f1} var(m_{f1})	m_{f2} var(m_{f2})	m_{fn} var(m_{fn})	$m_{f.} = \sum_{j=1}^{n} m_{fj}/n \quad var(m_{f.}) = \sum_{j=1}^{n} var(m_{fj})/n^2$
Total				$m_{..} = \sum_{i=1}^{f} m_{i.} \quad var(m_{..}) = \sum_{i=1}^{f} var(m_{i.})$

Table 2. Example computation of average human-caused M/SI and its variance for 3 fisheries over 3 years.

Fishery		Year 1	Year 2	Year 3	Average
1	m	10	3	19	10.67
	v	4	2	8	1.56
2	m	2	13	6	7.00
	v	2	14	4	2.22
3	m	6	33	5	14.67
	v	8	23	4	3.89
Total	m				32.33
	v				7.67

Table 3. Example computation of average human-caused M/SI and its variance for 3 fisheries over 3 years when some estimates are zero.

Fishery		Year 1	Year 2	Year 3	Average
1	m	10	0	19	9.67
	v	4	0	8	3.00
2	m	2	13	6	7.00
	v	2	14	4	2.22
3	m	0	0	5	1.67
	v	0	0	4	4.00
Total	m				18.33
	v				9.22

Table 4. Example computation of average human-caused M/SI and its variance for 3 fisheries over 3 years when some estimates are zero and others are missing.

Fishery		Year 1	Year 2	Year 3	Average
1	m		0	19	9.50
	v		0	8	8.00
2	m	2		6	4.00
	v	2		4	1.50
3	m	0	0	5	1.67
	v	0	0	4	4.00
Total	m				15.17
	v				13.50

Guidelines for Minimum Observer Sample Size Requirements

(Avoiding Small-sample Bias when Potential Biological Removal is Small)

Table 6. Recommended data levels to attain approximately unbiased estimation of average annual commercial fisheries-related M/SI, relative to PBR (i.e., if true annual commercial fisheries-related M/SI = PBR) (from Moore and Merrick 2011). "Approximately unbiased" implies median absolute bias <25%. The top table recommends minimum observer coverage (annual average), given a certain PBR and level of data pooling (years of information combined). The bottom table recommends minimum levels of data pooling, given a certain PBR and observer coverage. If true human-caused M/SI = PBR and sampling effort is below the recommended levels, *median* bias is always negative (i.e., true human-caused M/SI > estimate), but the combination of *very* limited sampling (≤5% coverage, ≤5 yrs data pooling) and *very* low human-caused M/SI (e.g., 1/yr) generates bimodal estimation bias, whereby human-caused M/SI is always either underestimated (if no human-caused M/SI is observed) or overestimated (if ≥1 human-caused M/SI event is observed).

	Observer program length (years)								
PBR	1	2	3	4	5	6	7	8	9
1	80%	40%	30%	30%	20%	15%	15%	10%	10%
2	40%	20%	15%	10%	10%	7.5%	7.5%	5%	5%
3	30%	15%	10%	7.5%	7.5%	5%	4%	4%	3%
4	20%	10%	7.5%	5%	4%	4%	3%	3%	3%
5	20%	7.5%	7.5%	4%	4%	3%	3%	2%	2%
6	15%	7.5%	5%	4%	3%	3%	2%	2%	2%
7	15%	7.5%	4%	3%	3%	2%	2%	2%	2%
8	10%	5%	4%	3%	2%	2%	2%	2%	2%
9	10%	5%	3%	3%	2%	2%	2%	2%	1%

Required observer coverage

	Observer coverage											
PBR	1%	2%	3%	4%	5%	7.5%	10%	15%	20%	30%	40 - 70%	80%
1	Always biased	→	→	→	→	→	8	6	4	3	2	1
2	Always biased	→	→	→	8	6	4	3	2	2	1	1
3	Always biased	→	9	7	6	4	3	2	2	1	1	1
4	Always biased	→	7	5	4	3	2	2	1	1	1	1
5	Always biased	8	6	4	4	3	2	2	1	1	1	1
6	Always biased	7	5	4	3	2	2	1	1	1	1	1
7	Always biased	6	4	3	3	2	2	1	1	1	1	1
8	Always biased	5	4	3	2	2	1	1	1	1	1	1
9	9	5	3	3	2	2	1	1	1	1	1	1

Required years of data pooling

Appendix B. Descriptions of U.S. Commercial Fisheries

Commercial Fisheries Table in Each Stock Assessment Report

Sample incidental commercial fisheries M/SI table to be included in Reports. Each commercial fishery noted as interacting with a stock should be included in the table, even if little information is available. Information on the number of incidental injuries and which injuries should be considered serious should be provided in either the table or the text, if appropriate. See discussion in 5.2 of Wade and Angliss (1997).

Table 7. Summary of incidental human-caused M/SI of stock ___ due to commercial fisheries from 1990 through 1994 and calculation of the mean annual SI/M rate. Mean annual SI/M in brackets represents a minimum estimate from logbooks or MMPA reports.

*Note -- numbers indicated with an asterisk are optional -- different preferences have been expressed in different regions.

Fishery Name [1]	Years	Data Type	Range of Observer Coverage	Observed M/SI (in given yrs.)	Estimated M/SI (in given yrs.)	Mean Annual M/SI
groundfish trawl fishery 1	90–94	obs data	53–74%	13, 13, 15, 4, 9	13, 19, 21, 6, 11	14 (0.32)
groundfish trawl fishery 2	90–94	obs data	33–55%	2, 0, 0, 1, 1	4, 0, 0, 3, 3	2 (0.24)
longline fishery 1	90–94	obs data	23–55%	1, 0, 0, 1, 0	2, 0, 0, 4, 1	1.4 (0.15)
drift gillnet fishery 1	90–91	obs data	4–5%	0, 2	0, 29	14.5 (0.42)
Observer program total						31.9 (0.xx)
set gillnet fishery 1	90–93	log book	n/a	0, 1, 1, 1	n/a	[≥.75]*
set gillnet fishery 2	90–93	log book	n/a	0, 0, 0, 2	n/a	[≥.5]*
longline fishery 2	94	mmap reports	n/a	1	n/a	[≥1]*
Minimum total annual M/SI						≥34.2*

[1]The name should be consistent with fishery names in the List of Fisheries.

General Information About a Fishery (Not Stock-specific)

As discussed at the 1996 GAMMS workshop, information on U.S. commercial fisheries should be included either within each SAR, as an appendix, or as a companion document. Information on U.S. commercial fisheries was collected during the preparation of the Environmental Assessment for the proposed regulations implementing Section 118 of the MMPA (NMFS, 1994). The following information, which was provided for each fishery whenever possible, has direct relevance to managing incidental mortalities and serious injuries of marine mammals:

Fishery name: A description of those fisheries that are classified in Category I or II in the List of Fisheries, and those fisheries in Category III that have experienced incidental human-caused M/SI of marine mammals should be provided. The Category of the fishery in the List of Fisheries should be specified in the text.

Number of permit holders: NMFS is required by the MMPA to provide the number of permit holders in each fishery included in the List of Fisheries. Information on the number of permit holders in federal fisheries can often be found in recent amendments to Fishery Management Plans. Information on fisheries that occur within state waters but are managed via an interstate commission may be found in interstate fishery management plans. Information on state fisheries that are managed by individual states can typically be found by contacting the state office responsible for licensing commercial fishing vessels.

Number of active permit holders: Because not all licensed commercial fishers participate actively in each fishery, the number of active permit holders may be different than the number of actual permit holders in a fishery. This is particularly true for fisheries that operate in state waters.

Total effort: Provide an estimate of the total fishing effort, in the number of hours fished, for each fishery. This information is typically available only for fisheries that are both federally managed and observed.

Geographic range: Provide a description of the geographic range of the fishery. The description of the geographic range of the fishery should include any major seasonal changes in the distribution of the fishing effort.

Seasons: Describe the seasons during which the fishery operates.

Gear type: Describe the gear type used in the fishery as specifically as possible. Include mesh size, soak duration, trawl type, depth of water typically fished, etc. if the information is available.

Regulations: Indicate whether the fishery is managed through regulations issued by the federal government, interstate fishery commissions, individual states, or treaty.

Management type: Indicate what types of fishery management techniques are used to manage the fishery. Some examples include limited entry, seasonal closures, and gear restrictions.

Comments: Include any additional relevant information on the fishery.

Appendix C. Stock Assessment Report Template

Below is a suggested template to use for NMFS' marine mammal SARs with a short description of what should be included in each section based on the more detailed guidance provided above.

The sections on Stock Definition and Geographic Range, Population Size, Current and Maximum Net Productivity Rates, Potential Biological Removal, and Annual Human-caused Mortality and Serious Injury should provide a brief description of the primary uncertainties and evaluate the effects of these uncertainties associated with parameters in these sections. In cases where more lengthy discussions of uncertainty are necessary, they should be published separately (e.g., as NOAA Technical Memorandum) and referenced in the SAR.

[SPECIES NAME] ([*Scientific name*]): [Stock Name] Stock

STOCK DEFINITION AND GEOGRAPHIC RANGE

[This section should summarize stock designation and DIP delineation information. This information should include a summary of the lines of evidence that support DIP delineations, and cite any supporting documents where this information is detailed. This section should also include a description of what is known about the geographic range of the stock (and a map if appropriate), including any known stock boundaries if applicable, and any uncertainty regarding the stock range. See Section 3.1 for additional guidance]

POPULATION SIZE

[This section should describe what is known about the size of the stock. It should include specific sub headings entitled "Minimum Population Estimate" and "Current Population Trend" describing these two characteristics of the stock. It may include additional sub headings as appropriate such as "Earlier abundance estimates", "Recent surveys and abundance estimates", "Historical abundance", among others. See Section 3.2.1 and 3.2.2 for additional guidance.]

CURRENT AND MAXIMUM NET PRODUCTIVITY RATES

[This section should describe what is known about the current and maximum net productivity rates. Default values should be used for R_{max} in the absence of stock-specific measured values. See Section 3.2.3 for additional guidance.]

POTENTIAL BIOLOGICAL REMOVAL

[This section of the SAR should provide a summary of the values used to calculate PBR and details its calculation. See Section 3.2 for additional guidance.]

ANNUAL HUMAN-CAUSED MORTALITY AND SERIOUS INJURY

[This section should contain a complete description of what is known about human-caused M/SI for the covered time period. It should include a specific sub heading entitled "Fisheries Information" that describes fishery-related M/SI and may include other sub headings as appropriate, such as "Alaska Native Subsistence/Harvest Information", "Other Mortality", among others. See Section 3.3 for additional guidance.]

HABITAT ISSUES

[This section, if included, should highlight habitat issues affecting the status of the stock. It should only be a summary of the issue and should reference publications. See Section 3.4 for additional guidance.]

STATUS OF STOCK

[This section should summarize four types of "status" of the stock: (1) current legal designation under the MMPA and ESA, (2) status relative to OSP (within OSP, below OSP, or unknown), (3) designation of strategic or not, and (4) a summary of trends in abundance and human-caused M/SI. See Section 3.5 for additional guidance.]

REFERENCES CITED

[This section should include a bibliography of references used to support the SAR.]