NOAA Technical Memorandum NMFS-NE-154

Report of the Joint Scientific Review Group Workshop, April 13-14, 1999, Seattle, Washington

U. S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Northeast Region
Northeast Fisheries Science Center
Woods Hole, Massachusetts

November 1999

NOTE ON SPECIES NAMES

The NMFS Northeast Region's policy on the use of species names in all technical communications is generally to follow the American Fisheries Society's lists of scientific and common names for fishes (*i.e.*, Robins *et al.* 1991[a]), mollusks (*i.e.*, Turgeon *et al.* 1998[b]), and decapod crustaceans (*i.e.*, Williams *et al.* 1989[c]), and to follow the Society for Marine Mammalogy's guidance on scientific and common names for marine mammals (*i.e.*, Rice 1998[d]). Exceptions to this policy occur when there are subsequent compelling revisions in the classifications of species, resulting in changes in the names of species (*e.g.*, Cooper and Chapleau 1998[e]). Also, the "sportsman's singular" will be used for plural references to the common names of species (*e.g.*, blue crab, bluefin tuna, and humpback whale, instead of blue crabs, bluefin tunas, and humpback whales).

[a]*Robins, C.R. (chair); Bailey, R.M.; Bond, C.E.; Brooker, J.R.; Lachner, E.A.; Lea, R.N.; Scott, W.B. 1991. Common and scientific names of fishes from the United States and Canada. 5th ed.* Amer. Fish. Soc. Spec. Publ. *20; 183 p.*

[b]*Turgeon, D.D. (chair); Quinn, J.F., Jr.; Bogan, A.E.; Coan, E.V.; Hochberg, F.G.; Lyons, W.G.; Mikkelsen, P.M.; Neves, R.J.; Roper, C.F.E.; Rosenberg, G.; Roth, B.; Scheltema, A.; Thompson, F.G.; Vecchione, M.; Williams, J.D. 1998. Common and scientific names of aquatic invertebrates from the United States and Canada: mollusks. 2nd ed.* Amer. Fish. Soc. Spec. Publ. *26; 526 p.*

[c]*Williams, A.B. (chair); Abele, L.G.; Felder, D.L.; Hobbs, H.H., Jr.; Manning, R.B.; McLaughlin, P.A.; Pérez Farfante, I. 1989. Common and scientific names of aquatic invertebrates from the United States and Canada: decapod crustaceans.* Amer. Fish. Soc. Spec. Publ. *17; 77 p.*

[d]*Rice, D.W. 1998. Marine mammals of the world: systematics and distribution.* Soc. Mar. Mammal. Spec. Publ. *4; 231 p.*

[e]*Cooper, J.A.; Chapleau, F. 1998. Monophyly and interrelationships of the family Pleuronectidae (Pleuronectiformes), with a revised classification.* Fish. Bull. (U.S.) *96:686-726.*

Contents

Appendices

Tables

Figures

Acronyms

AKFSC	=	Alaska Fisheries Science Center
AKSRG	=	Alaska Scientific Review Group
ATSRG	=	Atlantic Scientific Review Group
CV	=	coefficient of variation
ESA	=	Endangered Species Act
ETP	=	Eastern Tropical Pacific
IDCP	=	International Dolphin Conservation Program
IUCN	=	International Union for the Conservation of Nature and Natural Resources
JSRG	=	Joint Scientific Review Group
LOF	=	List of Fisheries
MMPA	=	Marine Mammal Protection Act
NEFSC	=	Northeast Fisheries Science Center
NERO	=	Northeast Regional Office
NMFS	=	National Marine Fisheries Service
OMB	=	Office of Management and Budget
OPR	=	Office of Protected Resources
PBR	=	potential biological removal
PSRG	=	Pacific Scientific Review Group
SAR	=	stock assessment report
SEFSC	=	Southeast Fisheries Science Center
SERO	=	Southeast Regional Office
SRG	=	scientific review group
SWFSC	=	Southwest Fisheries Science Center
USFWS	=	U.S. Fish and Wildlife Service
ZMRG	=	zero mortality rate goal

SUMMARY

As required under the Marine Mammal Protection Act's (MMPA's) 1994 amendments, three scientific review groups (SRGs) were formed in 1994 to review marine mammal stock assessments prepared by the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS). The SRGs jointly met for the first time on October 12 and 13, 1994, in Seattle, Washington. Between 1994 and 1999, individual SRGs met on a semiannual or annual basis to review annual stock assessment reports (SARs) and to address other technical issues.

Beginning in 1997, it became clear that there was a need for the SRGs to meet jointly again to address issues of common concern. As a result, a second joint meeting was held in Seattle, Washington, on April 13 and 14, 1999. The general objectives of the second joint meeting were to provide a forum for comments and exchange of information among SRGs, and to develop joint recommendations on common issues.

The SRGs recommended that NMFS and the USFWS should:

1. Finalize as soon as possible the definition of the zero mortality rate goal.

2. Proceed to use the best scientific evidence available to make serious injury determinations, using the guidelines specified in the report of the Serious Injury Workshop (Angliss and DeMaster 1998).

3. Emphasize collection of life history data and voucher specimens when collecting data on stranded animals, in addition to pathology data, especially for unusual stranding events.

4. Work with treaty tribes to collect information on takes, so that these data can be included in SARs.

5. Document all takes of marine mammals by source.

6. Publish all SARs every year, review and revise the SARs for strategic stocks every year, and review and revise the stock assessment reports for nonstrategic stocks at least once every 3 yr.

7. Establish specific reclassification criteria for all species or distinct population segments listed as endangered or threatened under the Endangered Species Act, and specific declassification criteria for all stocks designated as depleted under the MMPA.

8. Use a standardized framework for categorizing risk for species listed as endangered when assigning recovery factor values.

9. Replace the phrase "population stock" in the text of the upcoming reauthorized MMPA with the phrase "management stock."

10. Use the potential biological removal guidelines for stock definition contained in Wade and Angliss (1997).

11. Receive recommendations from the SRGs as letters addressed to the NOAA Assistant Administrator for Fisheries, and (if relevant) to the appropriate USFWS Regional Director, with copies sent to the appropriate NMFS Regional Administrators and Regional Science and Research Directors.

12. Post recommendations from the SRGs, as well as minutes and reports from SRG meetings, on a NMFS website. An e-mail list should be created to announce the availability of new material on this website.

13. Provide substantive written responses to any SRG written recommendations in a timely fashion, certainly not later than the next SRG meeting.

14. Provide every year to the SRGs, copies of the meeting reports of the funding process associated with the NMFS's strategic goal of "Recover Protected Species," including the recommended spending plans.

15. Secure additional funding for marine mammal research.

INTRODUCTION

BACKGROUND

Three regional scientific review groups (SRGs) were created by the 1994 reauthorization of the Marine Mammal Protection Act (MMPA). Section 117(d) of the MMPA required the Secretary of Commerce to establish three independent regional SRGs representing Alaska, the Pacific Coast (including Hawaii), and the Atlantic Coast (including the Gulf of Mexico). The SRGs review the science that goes into the stock assessment reports (SARs) prepared by the National Marine Fisheries Service (NMFS) and the U.S. Fish and Wildlife Service (USFWS), as mandated by Section 117(a) of the act.

The MMPA provides the following text regarding the SRGs:

Sec. 117(d) Regional Scientific Review Groups.

(1) Not later than 60 days after the date of enactment of this section [June 29, 1994], the Secretary of Commerce shall, in consultation with the Secretary of the Interior (with respect to marine mammals under that Secretary's jurisdiction), the Marine Mammal Commission, the Governors of affected adjacent coastal States, regional fishery and wildlife management authorities, Alaska Native organizations and Indian tribes, and environmental and fishery groups, establish three independent regional scientific review groups representing Alaska, the Pacific Coast (including Hawaii), and the Atlantic Coast (including the Gulf of Mexico), consisting of individuals with expertise in marine mammal biology and ecology, population dynamics and modeling, commercial fishing technology and practices, and stocks taken under section 101(b). The Secretary of Commerce shall, to the maximum extent practicable, attempt to achieve a balanced representation of viewpoints among the individuals on each regional scientific review group. The regional scientific review groups shall advise the Secretary on--

(A) population estimates and the population status and trends of such stocks;
(B) uncertainties and research needed regarding stock separation, abundance, or trends, and factors affecting the distribution, size, or productivity of the stock;
(C) uncertainties and research needed regarding the species, number, ages, gender, and reproductive status of marine mammals;
(D) research needed to identify modifications in fishing gear and practices likely to reduce incidental mortality and serious injury of marine mammals in commercial fishing operations;
(E) the actual, expected, or potential impacts of habitat destruction, including marine pollution and natural environmental change, on specific marine mammal species or stocks, and for strategic stocks, appropriate conservation or management measures to alleviate any such impacts; and
(F) any other issue which the Secretary or the groups consider appropriate.

(2) The scientific review groups established under this subsection shall not be subject to the Federal Advisory Committee Act (5 app. U.S.C.).

(3) Members of the scientific review groups shall serve without compensation, but may be reimbursed by the Secretary, upon request, for reasonable travel costs and expenses incurred in performing their obligations.

(4) The Secretary may appoint or reappoint individuals to the regional scientific review groups under paragraph (1) as needed.

Section 117(a) of the MMPA required that the first of the marine mammal SARs be prepared in consultation with the SRGs, and not later than August 1, 1994. These initial SARs were prepared by NMFS and USFWS staff, and submitted for SRG review at meetings held on October 12 and 13, 1994, in Seattle, Washington. These meetings included not only the first meeting of each of the individual SRGs, but also included a joint meeting of the three SRGs.

Section 117(c) of the MMPA requires that marine mammal stock assessments be reviewed on a regular basis and revised as necessary. Between 1994 and 1999, individual SRGs met on a semiannual or annual basis to review the annual SARs and to address technical issues. Beginning in 1997, it became clear that another joint SRG meeting would be necessary. This report summarizes the results of the joint SRG meeting held on April 13 and 14, 1999, at the Alaska Fisheries Science Center in Seattle, Washington. The agenda and participants for that meeting are contained in Appendices I and II.

MEETING OBJECTIVES

The general objectives of the meeting were to: 1) provide a forum for comments and exchange of information among SRGs, and 2) develop recommendations on issues of common concern to the three SRGs.

Considerable discussion centered on whether consistency was necessary among the three separate SRGs, and whether this should be an objective of the meeting. The Joint Scientific Review Group (JSRG) decided that consistency would be addressed as appropriate to specific topics. The guidelines on potential biological removal are a good example of where consistency among SRGs was considered essential.

GENERAL ISSUES

ROLE OF SCIENTIFIC REVIEW GROUPS

Standardization of the Recommendation Process, the Relationship between Different SRGs and NMFS, and the Future Role of the SRGs

The SRGs were created to provide independent review of NMFS ("agency") stock assessments. It was noted that there was mistrust by some groups (*e.g.*, fisheries, environmental) of the agency acting on its own to carry out statute provisions without such an oversight group. It was agreed that the vision of independent oversight has been realized within the SRGs. The SRGs have been constructive as they have held the agency accountable for deadlines, quality of assessments, and technical rigor.

Recommendations coming from the SRGs usually fall into the category of "grey literature," but should at least be presented to the agency in a professional format (*e.g.*, letterhead). The concept of sharing comments and recommendations to a larger distribution base was considered important, especially for those in more remote areas. A suggestion was made to place all minutes and recommendations on a website as a matter of public record. This was considered appropriate as it would minimize the work of the SRG chairs in distributing paper copies. Specific joint recommendations are provided later in the "Joint Recommendations" section.

The JSRG expressed concern about a lack of NMFS responsiveness to official SRG correspondence. Agency replies were frequently a simple "thank you," and lacked detail about what action the agency had taken. Some SRG members asserted that many recommendations are not addressed; therefore, future letters from the SRG should ask for a response within a specific time period (*e.g.*, 2 wk). However, it was noted that a response could not be realistically expected within 2 wk for items addressing future research or funding. The JSRG felt the agency reply should address actions being taken, as well as why action was not taken on a specific recommendation. It was suggested was that because the SRGs meet twice a year, an agency response could be presented at the next meeting addressing all recommendations from the previous meeting. The SRGs agreed that they needed to follow up by tracking their recommendations. It was also suggested that the SRGs prioritize their recommendations to the agency.

Discussion occurred about where documents should be sent within NMFS for maximum effect. The general decision was that correspondence should be addressed to the NOAA Assistant Administrator for Fisheries, with copies sent to appropriate USFWS Regional Directors, NMFS Regional Administrators, and NMFS Regional Science and Research Directors. Copies of SRG recommendations, along with SRG minutes, should be posted on the website of the NMFS Office of Protected Resources (OPR), and notices sent to all parties concerned with the recommendations (*e.g.*, members of all SRGs and the Marine Mammal Commission).

Representatives from NMFS were asked to provide an overview of the relationships of NMFS fisheries science centers and regional offices with the respective SRGs, and on the future role of SRGs.

The Northeast Fisheries Science Center's (NEFSC's) relationship with the Atlantic Scientific Review Group (ATSRG) has been good, but scope of input from the ATSRG to the NEFSC should be broadened. The ATSRG has been requested to provide recommendations on substantive management issues facing NMFS, for example, review of data for changing the categorization of the squid/mackerel/butterfish fishery under the MMPA Section 118 "List of Fisheries" (LOF). SRG review is vital for guidance on SAR recommendations such as the bottlenose dolphin stock separation question.

The Southeast Fisheries Science Center (SEFSC) receives advice from a number of groups and agencies to guide its decisions on its research programs for marine mammals. In addition to the ATSRG, these advisory groups include the Marine Mammal Commission, NMFS Southeast Regional Office (for specific management needs), regional fishery management councils, take reduction teams, implementation teams, etc. Specific advice from the ATSRG and other groups is most useful in formulating annual research and spending plans to address topical issues in the NMFS Southeast Region. ATSRG advice is frequently cited in the Atlantic SARs to support statements on stock status and related issues. It is particularly helpful when the ATSRG provides advice aiding in the establishment of research priorities for protected species.

The Alaska Scientific Review Group (AKSRG) has been instrumental in providing recommendations to the Alaska Fisheries Science Center (AKFSC) that increased organizational resources for responding to critical issues (*e.g.*, Cook Inlet beluga whale surveys). Many of the recommendations made by the AKSRG have been implemented by the agency. All of the AKSRG research recommendations have been adopted by the AKFSC. Recommendations and explanations from the minutes of the AKSRG meetings are often cited in the Alaska SARs as justification for a particular choice of stock structure, recovery factor, etc.

Pacific Scientific Review Group (PSRG) recommendations have influenced many of the research activities of the Southwest Fisheries Science Center (SWFSC). For example, the Pacific Offshore Cetacean Take Reduction Team was reluctant to accept the NMFS view that an observer program was needed to reduce takes in the Monterey Bay setnet fisheries. With the review and support of the PSRG, that program was established.

NMFS regional office representatives supported the aforementioned views expressed by fisheries science center staff.

SRG recommendations hold weight in critical decisions within the OPR. These SRG recommendations often support the basis for management decisions (*e.g.*, bottlenose

dolphin stock structure) by the OPR Director, especially for decisions on funding priorities under the allocation process for NMFS's strategic goal of "Recover Protected Species."

SRG members' opinions varied on the relationship between the SRGs and NMFS. The AKSRG has consistently tried to keep a clear distinction between its scientific advisory role, and the policy decisions that are the responsibility of NMFS. The ATSRG has a similar view, but members noted that for many historical issues in the Atlantic (*e.g.*, bottlenose dolphin, harbor porpoise, and northern right whale), scientific recommendations have not always been adopted by NMFS. Things have improved with recent staff additions in the NEFSC and SEFSC. Some SRG members recognized that the lack of NMFS personnel in both the NEFSC and SEFSC influences NMFS's ability to respond to SRG demands. Regardless, the SRG should set goals high, because this reinforces the need for personnel.

The JSRG was concerned about an overall lack of a national vision for marine mammals within NMFS. This statement caused some debate because some SRG members felt that regions needed the ability to operate independently, while others felt that even with a national vision, regional power would often prevail. Some members were discouraged by lack of an agency response, and wondered if the process was worth the SRGs' effort. However, it was pointed out that SRG recommendations are valuable outside the agency as advocacy groups can use them to make sure resources are allocated where they need to be so allocated. AKFSC staff commented that the record shows that money is going to high priority species, it is just that the total dollars are very limited, which means all issues cannot be addressed. In addition, significant efforts are being made to plan for upcoming years from a national perspective. While the JSRG recognized this may be true within the marine mammal budget, resources in general were not equally allocated among different protected species groups (West Coast salmon was given as an example). After listening to the discussion, the JSRG concluded that NMFS needed to make its overall mission more clear to the SRGs, and that NMFS should include the SRGs on the distribution list for the marine mammal funding panel report.

Scientific Review Group Review of Stock Assessment Reports and Primary Documents

An overall recommendation was made that the SRGs review the science that goes into the SARs, including the design of research and how data are being analyzed. This recommendation would mean making NMFS science available to SRG members with specific areas of expertise. Some suggested that this step would be a maturation of the function of the SRG, permitting it to function more as a formal peer-review group. The issue of formal review of NMFS unpublished documents cited in SARs is addressed Appendix III. Some of the calculations used in SARs are mechanical, while other issues, such as stock structure, provoke discussion. Debate also addressed whether there was a need to go to the data level, or whether the SRGs should just provide critical questions for NMFS to address.

The JSRG agreed that data in SARs should be thoroughly refereed. SEFSC staff commented that there is a precedent for a few controversial fish stock assessments that could serve as a model for marine mammal stock assessments. Those fish stock assessment documents were elevated to the NMFS Office of Science and Technology for subsequent review by outside entities. When the controversial aspects of those assessments could not be resolved at that level, then those documents were forwarded to the National Research Council for resolution.

PROPOSED DEFINITION OF ZERO MORTALITY RATE GOAL

Section 118(b) of the MMPA specifies a zero mortality rate goal (ZMRG) for the effects of U.S. commercial fisheries on marine mammal stocks. That section also mandates that a report be submitted to Congress by April 20, 2001, reviewing progress made by those fisheries in reaching the ZMRG. The present draft NMFS policy has been to select for the ZMRG a mortality rate that would delay recovery time by not more than 10% of that which would occur in the absence of fisheries effects. SARs must describe whether: 1) a fishery has met the ZMRG, 2) a marine mammal stock has an overall insignificant mortality rate, and 3) that stock is approaching fisheries-effected zero mortality and serious injury rates. The JSRG expressed considerable concern that this definition had not yet been finalized.

It was noted that the International Dolphin Conservation Program (IDCP) -- developed through Congress -- has established ZMRG-based mortality limits for Eastern Tropical Pacific (ETP) dolphins. The IDCP agreement placed international management of ETP dolphins in line with the U.S. definition of the ZMRG. The IDCP defines the ZMRG as 0.1% of the minimum population size estimate (N_{min}), which is considered adequately small to be negligible. This IDCP definition of the ZMRG yields similar results to the NMFS definition of the ZMRG as 10% of a stock's potential biological removal (PBR).

JSRG members suggested that consistency of the NMFS's ZMRG definition with the IDCP's ZMRG defintion should be given consideration, particularly because the IDCP definition was based on earlier U.S. ZMRG policy. The JSRG recommended that the ZMRG definition be finalized before the ZMRG progress report is sent to Congress; if the opposite occurs, the report's findings might be inappropriate.

PROPOSED GUIDELINES FOR SERIOUS INJURY DETERMINATIONS

A workshop was held in April 1997 to develop specific criteria for determining what constitutes a serious injury for marine mammals captured incidental to fishing operations (Angliss and DeMaster 1998). Guidelines based on the workshop's recommendations were subsequently drafted and did provide guidance on serious injury determination. However, the publishing of these guidelines was stalled at the Office of Management and Budget (OMB) because of the difficulty of meeting OMB's new review requirements for publishing federal "regulations." The seriousness of a lack of guidelines is highlighted by the Atlantic and Pacific longline fisheries which induce a high level of serious injury. The impact that these fisheries have on marine mammal populations is significantly underestimated when serious injuries are not explicitly considered.

Agreement was reached that the SRGs should review the injury determinations made by NMFS using the proposed serious injury guidelines. These determinations are likely to be controversial during review by take reduction teams, and an effort needs to be made to ensure adequate outside review. The JSRG recommended that SRGs operate as if the draft guidelines were in place, and use them as guiding principles because: 1) some animals are being taken and released alive, but none are currently counted as serious injuries or mortalities; 2) criteria must be used consistently; and 3) the best available scientific advice on serious injury determinations is found in the workshop guidelines.

MARINE MAMMAL PROTECTION ACT REAUTHORIZATION

NMFS has convened a task force of staff from the fisheries science centers, regional offices, and headquarters to develop agency comments on the reauthorization of the MMPA. Presently, these comments are undergoing internal review, and are subject to modification. Discussion surrounding some of the sections under review was led by SWFSC staff (J. Barlow).

The JSRG agreed that statutory issues were outside the scientific advisory role of the SRGs, and that comments specific only to stock assessment reports or other science-related issues are appropriate. As NMFS refines the list of recommendations, the SRGs could be asked for advice on specific science-related topics.

STRANDING PROGRAMS

This agenda topic resulted from an observation made during a recent training class conducted by NMFS on the West Coast on the collection of pathology samples from carcasses. The observation was that NMFS was emphasizing pathology sampling at the expense of collection of basic life history information. NMFS noted that, overall, the national stranding program does not have a policy of focusing on pathology at the expense of life history information, and that the workshops were directed at pathology because training was needed.

NATIVE TAKE

A number of specific cases were discussed, including Cook Inlet beluga, bowhead whale, and Steller sea lion. It was noted that an emergency listing under the Endangered Species Act (ESA) does not immediately authorize the government to restrict Native harvest. Rather, the formal rulemaking process identified in the MMPA must be followed, which typically takes 6-12 mo. For Cook Inlet beluga, voluntary comanagement agreements are being developed to restrict Native subsistence harvests during summer 1999. The degree to which these agreements will be successful is uncertain.

The issue of managing Native subsistence harvests in the immediate vicinity of Anchorage was discussed. It was noted that at present this is only a problem for the Cook Inlet beluga stock. Part of the problem stems from the classification of Anchorage as a Native village by NMFS regulations; this classification allows the sale of marine mammal products to a large community. As such, large numbers of animals taken for subsistence purposes can be sold at financial gain to a few individuals. The human demand for beluga muktuk and meat in the Anchorage area has contributed to this beluga stock being overharvested.

Some subsistence takes are included by NMFS in the SARs, but not all such takes are reported to NMFS. The JSRG agreed that NMFS should include, where possible, all Native harvests as part of mortality estimates provided in the SARs, including those from treaty tribes.

STOCK ASSESSMENT REPORT ISSUES

SCHEDULE FOR STOCK ASSESSMENT REPORT REVISION

Timing of SAR production was discussed. It was pointed out how the timing of SAR production affects the subsequent year's LOF production.

One of the main issues discussed was whether a consistent schedule and format were necessary nationwide. The MMPA requires review of strategic stocks every year, but other stocks can be evaluated on a 3-yr cycle. Different regions handle revisions differently. Some SRG members proposed publishing a full document every year, while others proposed annual reporting only on strategic stocks for which significant new information is available. Others noted that there are other interested constituents, including Congress, which could favor publishing a full document every year.

After considerable discussion, the JSRG recommended that NMFS should: 1) publish all SARs every year; 2) review and, if necessary, revise strategic stock assessments every year; and 3) review and, if necessary, revise nonstrategic stocks at least once every 3 yr.

STANDARDS FOR INCLUDING INFORMATION IN STOCK ASSESSMENT REPORTS

The PBR guidelines (Wade and Angliss 1997, p. 34) specify that "the methods and analyses that produce the estimates of abundance and mortality that are used in the SARs should be published in peer-reviewed scientific journals, where possible, or in a similar forum that is most appropriate, such as a *NOAA Technical Memorandum*." P. Clapham proposed more rigorous guidelines on how scientific information should be used within the SAR. These criteria are presented in Appendix III. In summary, Appendix III considers scientific literature in a hierarchical fashion. Level I, the primary or peer-reviewed literature, should be recognized in the SAR. If desired, NMFS may seek additional reviews of such literature, and also report the findings of those reviews in the SAR. Level II, the non-peer-reviewed literature, should not automatically be included in the SAR. NMFS should solicit internal and/or external review of such literature to elevate its status to peer-reviewed. If the work is not appropriate for formal review (Level III), such as presentation abstracts or anecdotal information, then NMFS should obtain a written summary of the work so that it can be formally reviewed. Anecdotal information should generally not be included.

It was recognized that the SAR should include the "best available information," but it may take years for scientific results to appear in peer-reviewed journals, and some information such as traditional knowledge may never be appropriate for such journals. However, the guidelines in Appendix III should, in principle, be followed. A possible amendment is that all non-peer-reviewed literature used in a SAR should be available, in written form, at the relevant fisheries science center.

The JSRG encouraged NMFS to formalize more rigorous guidelines for including information in SARs, such that Appendix III principles were followed. The JSRG also reiterated its previous position that SARs should not be cited as primary literature.

RECOVERY FACTORS FOR ENDANGERED SPECIES ACT-LISTED SPECIES

Update on Endangered Species Act Downlisting and Delisting Criteria

Two sets of criteria are being developed by NMFS to objectively determine when an ESA-listed marine mammal species should be reclassified. These criteria will be published in peer-reviewed journals. At this time, NMFS has not adopted either set of criteria, and has not recommended any changes in listings.

The JSRG recommended that NMFS and the USFWS establish specific reclassification criteria for all species or distinct population units listed as endangered or threatened under ESA.

Protocol to Assign Recovery Factors

The current PBR guidelines set the default recovery factor, F_r, for endangered species at 0.1 (Wade and Angliss 1997) to allow a small fishery take while simultaneously providing for quick recovery. In other words, any human-induced mortality, including fishing mortality, cannot prolong by more than 10% the recovery time which that species would exhibit in the absence of human-induced mortality. However, some species (*e.g.*, many humpback stocks) are known to be increasing and are at low risk of extinction. Thus, a recovery factor value of 0.1 may not be warranted, and such stocks may be candidates for reclassification. The JSRG encouraged NMFS to start the reclassification process for such stocks.

Because the reclassification process is long and complicated, some SRG members wanted to adjust the recovery factor until the species is reclassified. This adjustment could be a further gradation of the recovery factor to match the differing levels of risk facing the stock. The questions were: 1) What criteria should be used to determine which species can safely be adjusted?; and 2) What recovery factor values are reasonable?

B. Taylor presented a discussion paper (Appendix IV) in which the setting of a recovery factor for endangered species as high, medium, and low risk was standardized using information on: 1) the present abundance estimate and its precision, 2) the presence or absence of a trend in abundance, and 3) three biological risk factors. It was indicated that the most influential factors were a critical abundance estimate of 1,500 animals, and the stock boundaries used to obtain the abundance estimate.

The JSRG thanked B. Taylor and others for initiating the discussion and for focusing attention on the need for a protocol for assigning reasonable recovery factor values for endangered species. However, no protocol was agreed upon by the JSRG. SRG members indicated that additional time was needed to investigate which criteria should be used, what cutoff points for the criteria are reasonable, and what are the influence and robustness of these criteria and cutoff points. Issues brought up that should be considered in future work included: 1) should absolute abundance or abundance relative to K (*i.e.*, the carrying capacity of the habitat) be used; 2) should criteria be constant for all species or be species-specific; 3) should the default level of $F_r = 0.1$ be used for any species with a declining abundance trend; 4) the protocol being consistently used by all SRGs; 5) the protocol being able to result in three preset recovery

factor values that reflect high, medium, and low risks of extinction; 6) should the protocol be presented as a decision tree, matrix, or list of qualitative factors; 7) how should a population that is stable be treated in the protocol; 8) how should a population that is both small and thought to be at K be treated in the protocol; 9) should any of the criteria be weighted or given a higher priority; 10) is there a hierarchical or equal ranking of the criteria; and 11) the protocol being easy to present and scientifically defendable.

The JSRG agreed that a standardized framework for categorizing risk for endangered species should be considered. The JSRG recommended that a working group, composed of NMFS, USFWS, and SRG representatives, continue to develop the draft proposal (Appendix IV) as well as alternative strategies, and present a revised proposal to the SRGs at their next individual meetings. The JSRG also recommended that the proposed framework include three standard recovery factor values that could be used to specify whether there is a high, medium, or low risk of extinction for an endangered stock.

TRANSBOUNDARY STOCKS (EXTENDING BEYOND THE U.S. EXCLUSIVE ECONOMIC ZONE)

The PBR guidelines (Wade and Angliss 1997, p. 56) advise that for transboundary stocks where there is no international management agreement, it may be reasonable to use the fraction of time in U.S. waters as the percent of the PBR to be allocated to U.S. fisheries, or to use the abundance estimate of the portion of the population residing in U.S. waters as the basis of the PBR allocation. These guidelines have not been applied to all stocks because of different quantities and qualities of available data. In addition, concerns exist about whether the guidelines are legally correct.

Because of these problems, the JSRG was unable to suggest ways to consistently handle transboundary stocks. Each stock situation will, therefore, continue to have to be handled on a case-by-case basis, using the best available information.

STOCK DEFINITION

The definition of a stock provided in the existing PBR guidelines (Wade and Angliss 1997, p. 55-56) is useful in most cases. However, it is difficult to define stocks for species with limited data. This difficulty has led to inconsistencies. Another way to state the problem is, "Should the lumping or splitting strategy of stock definition be used?" Examples of difficult cases are: 1) stocks that appear to have a genetic cline, 2) stocks that are thought to be part of a biological population that extends outside the area used in the abundance estimate, 3) regions of the ocean that appear to have a mixture of stocks that are indistinguishable (at least by eye), and 4) stocks that have separate breeding and feeding grounds. Because of such situations, additional guidelines are needed.

Several case studies were discussed. The North Atlantic humpback whale stock has a maternally-specific feeding ground in the Gulf of Maine, and breeding grounds in the Caribbean. (A similar situation exists for the North Pacific humpback.) Those humpback whales using the Gulf of Maine feeding ground have distinct genetic characteristics that are a result of maternal fidelity. The JSRG agreed that this feeding group is a stock according to the guidelines presented in Wade and Angliss (1997), and so, the stock definition in the SARs should be modified. However, NMFS should be careful to define and manage different stocks consistently with respect to feeding and breeding ground stock determinations.

Another case discussed was the sperm whale stock in the central and eastern Pacific Ocean. Sperm whale occur in waters between the California/Oregon/Washington coast and Hawaii, and the animals at the eastern and western extremes of this region are genetically different. The question is, "Where is the line between the two stocks?" The guidelines specify that in cases of lack of data, the assessment can be on a management stock which is not the same as a population stock. These animals represent such a case, and until more data are available, there is no other way to define the stock.

To clarify the definition of a stock, the JSRG recommends that the phrase "management stock" replace "population stock" in the text of the upcoming reauthorized MMPA. The JSRG also recommends that NMFS uniformly apply the present PBR guidelines to all stocks.

R_{max} VALUES USED IN POTENTIAL BIOLOGICAL REMOVAL CALCULATIONS

The discussion of R_{max} (*i.e.*, the theoretical or estimated maximum net productivity rate of a stock when it is at a small size) focused on when values other than the default should be used. The PBR guidelines (Wade and Angliss 1997, p. 58) state that "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 MMPA Scientific Review Groups or the Scientific Committee of the International Whaling Commission)." The JSRG recognized that R_{max} is a theoretical value, and that in many cases, values measured in the field are not an adequate substitute. Exceptions to this include cases such as the North Atlantic right whale which is at extremely low abundance levels, some seal species where there are long time series of data that can adequately measure $R_{max,}$ and studies that adequately show the default value is too low.

The JSRG recognized that considerable data are needed to deviate from the default, but did not provide any further guidance on this issue.

INCIDENTAL-TAKE REPORTING METHODS

The JSRG recognized that incidental-take reports differ in approach among the different regions. A discussion on the methods used in the different regions led to several suggestions that could make the reports more consistent. These suggestions are: 1) in the "Other Mortality" section of the SARs, the actual number of bullet- and pellet-wounded stranded animals should be reported, if possible; 2) explanations of the quality of the mortality estimates should be included (*e.g.*, a mortality estimate may be very imprecise due to low observer coverage); 3) the average annual mortality estimate from a fishery should include only years that had the same type of fishing practices and/or extrapolation method (for example, observer coverage versus logbook reports); and 4) for fisheries that have on- and off-watch phases, bycatch rates could be estimated for each phase and then combined in an appropriate way.

JOINT RECOMMENDATIONS

1. The JSRG recommended that NMFS finalize as soon as possible the definition of the ZMRG.

2. Noting the legislative requirement to include information on serious injuries in the SARs, the JSRG recommended that NMFS and the USFWS proceed to use the best scientific evidence available to make determinations of which injuries are serious, including use of the guidelines specified in the report of the Serious Injury Workshop (Angliss and DeMaster 1998).

3. The JSRG recognized the importance of collecting, from stranded animals, life history data and voucher specimens to fully evaluate potential human-related impacts. Therefore, the JSRG recommended that NMFS and the USFWS, when collecting pathology data on stranded animals, collect life history data and voucher specimens, especially for unusual stranding events.

4. The JSRG recognized that treaty tribes do not fall under the authority of the MMPA, and therefore, information on takes of marine mammals by treaty tribes (*i.e.*, bycatch in fisheries) may not be collected. Therefore, the JSRG recommended that NMFS and the USFWS attempt to work with treaty tribes to collect this information so that it can be included in SARs. Additionally, the JSRG recommended that NMFS and the USFWS make all efforts to document all takes of marine mammals, regardless of source.

5. The JSRG recognized there were differences among regions in the schedule being used for the revision and publication of SARs. The JSRG recommended that NMFS and USFWS:
   a) publish all SARs every year,
   b) review and revise as necessary the SARs for strategic stocks every year, and
   c) review and revise as necessary the SARs for non-strategic stocks at least once every 3 yr.

6. The JSRG recommended that NMFS establish:
   a) specific reclassification criteria for all species or distinct population segments listed as endangered or threatened under ESA, and
   b) specific declassification criteria for all stocks designated as depleted under the MMPA.

7. The JSRG requested a standardized framework for categorizing risk for endangered species. The JSRG agreed that three levels of risk should be specified and that they be assigned specific recovery factor values. The JSRG recommended that a working group composed of NMFS, USFWS, and SRG representatives continue to develop the draft proposal, consider alternative strategies, and present a revised proposal to the SRGs by their next meetings.

8. The JSRG recommended that the phrase "management stock" replace "population stock" in the text of the upcoming reauthorized MMPA. The JSRG also recommended that NMFS uniformly apply the present PBR guidelines to all stocks.

9. Recognizing that the definition of stocks can often be difficult, particularly when there is a lack of information, the JSRG agreed that the definition of stocks contained in the PBR guidelines (Wade and Angliss 1997) is useful, and recommended that it be consistently implemented by NMFS and the USFWS.

10. The JSRG believed that communication between the SRGs and the agencies, as well as other groups, should be standardized and improved, and recommended:
    a) In general, recommendations from the SRGs to the agencies should be sent as letters addressed to the NOAA Assistant Administrator for Fisheries, and (if relevant) to the appropriate USFWS Regional Director, with copies sent to the appropriate NMFS Regional Administrators and Regional Science and Research Directors. It was also recognized that some specific issues might be more appropriately addressed to NMFS Regional Administrators.
    b) To provide for a wider distribution, recommendations from the SRGs, as well as minutes and reports from their meetings, should be posted on a NMFS website. It was also suggested that an e-mail list be created to announce the availability of new material on this website. The list should include all SRG members, as well as other interested parties such as the Marine Mammal Commission. The

SRGs, after discussion with NMFS personnel, further suggested this could be most easily accomplished by having the SRG chair or NMFS SRG liaison directly transfer electronic files to an OPR contact for posting on the OPR website.

c) The JSRG expects that it will receive substantive written responses to their written recommendations in a timely fashion, certainly not later than by their next meeting.

d) The JSRG requested copies every year of the meeting reports of the funding process, including the recommended spending plans, associated with the NMFS's strategic goal of "Recover Protected Species."

11. The JSRG agreed that additional funds are needed to adequately support priority research needs that have been identified by the separate SRGs. Therefore, the JSRG recommended that NMFS and the USFWS secure additional funding for marine mammal research.

ACKNOWLEDGMENTS

Dr. Douglas DeMaster made available the facilities and support of the NMFS's National Marine Mammal Laboratory, Seattle, Washington. Dr. Paul Wade was responsible for providing logistical support for the meetings.

Dr. Debra Palka and Ms. Laurie Allen deserve special thanks for acting as rapporteurs for the workshop. The report was greatly improved through reviews by members of the three SRGs -- particularly Chairs Robin Brown, Jim Gilbert, and Lloyd Lowry -- and by Dr. Fredric Serchuk.

REFERENCES CITED

Angliss, R.P.; DeMaster, D. 1998. Differentiating serious and non-serious injury of marine mammals taken incidental to commercial fishery operations: report of the Serious Injury Workshop; 1-2 April 1997; Silver Spring, MD. *NOAA Tech. Memo. NMFS-OPR*-13; 48 p.

Wade, P.R.; Angliss, R.P. 1997. Guidelines for assessing marine mammal stocks: report of the GAMMS Workshop; April 3-5, 1996; Seattle, WA. *NOAA Tech. Memo. NMFS-OPR*-12; 93 p.

APPENDIX I

Joint Scientific Review Group Workshop Agenda
April 13-14, 1999, Seattle, Washington

1. Introduction and logistics
   - 1.1. Rapporteur, and protocol for producing final minutes
   - 1.2. Objectives for the meeting
   - 1.3. Approval of draft agenda
2. General issues
   - 2.1. Role of the SRGs
     - 2.1a. Standardization of the recommendation process, the relationship between different SRGs and NMFS, and the future role of the SRGs
     - 2.1b. SRG review of SARs and primary documents
   - 2.2. ZMRG proposed definition
     - 2.2a. Status update (Eagle)
   - 2.3. Serious injury proposed guidelines
     - 2.3a. Status update (Eisele)
   - 2.4. MMPA reauthorization
     - 2.4a. NMFS activities (Barlow)
     - 2.4b. Is there a role for the SRGs?
   - 2.5. Stranding programs
     - 2.5a. Proposed recommendation to change focus to collection of data relevant to monitoring populations (Heyning)
   - 2.6. Native take issues and discussion
3. Stock assessment report issues
   - 3.1. Schedule for SAR revision
     - 3.1a. Status quo (annual revision and publication)
     - 3.1b. Alternative schedules
   - 3.2. Standards for inclusion of data/estimates/information into SARs
     - 3.2a. Proposed citation standards (Clapham)
     - 3.2b. Discussion
   - 3.3. R_{max} values used in PBR calculations
     - 3.3a. Guidelines for use of observed rates instead of defaults
   - 3.4. Incidental take reporting methods
     - 3.4a. Standardization of reports in SAR tables
     - 3.4b. Other issues
   - 3.5. Recovery factors for ESA-listed species
     - 3.5a. Review of NMFS activities on ESA reclassification criteria (DeMaster)
     - 3.5b. Proposed starting point for discussion (Taylor)
     - 3.5c. Other issues/discussion
   - 3.6. Stock definition
     - 3.6a. Issues
     - 3.6b. Case study descriptions to illustrate issues/problems
   - 3.7. Transboundary stocks (extending beyond the U.S. Exclusive Economic Zone)
     - 3.7a. Issues (Read)
4. Conclusion
   - 4.1. Approval of joint recommendations
   - 4.2. Other

List of Documents for the Joint Meeting

1. "Recovery Factors for Endangered Marine Mammals: A Discussion Paper for the Joint SRG Meetings," by B.L. Taylor, P.R. Wade, D.P. DeMaster, and J. Barlow.
2. "Citation Standards for Stock Assessment Reports," by P. Clapham.
3. "Current PBR Guidelines," from Wade and Angliss (1997).

APPENDIX II

Joint Scientific Review Group Workshop Participants

SRG MEMBERS PRESENT

Alaska SRG
Carl Hild
Charlie Johnson
Denby Lloyd
Lloyd Lowry (Chair)
Beth Mathews
Craig Matkin
Jan Straley
Kate Wynne

Atlantic SRG
James Gilbert (Chair)
Robert Kenney
James Mead
Andrew Read
Randall Wells

Pacific SRG
Hannah Bernard
Robin Brown (Chair)
Mark Fraker
John Heyning
Chuck Janisse
Steven Jeffries
Katherine Ralls
Michael Scott
Terry Wright

OTHERS ATTENDING (all affiliations are NMFS unless otherwise noted)

Laurie Allen [Northeast Regional Office (NERO)]
Jay Barlow (SWFSC)
Diane Borggaard [Southeast Regional Office (SERO)]
Kaja Brix (Alaska Regional Office)
Phillip Clapham (NEFSC)
Douglas DeMaster (AKFSC)
Tom Eagle (OPR)
Cathy Eisele (OPR)
Tina Fahy (Southwest Regional Office)
Rosa Meehan (U.S. Fish and Wildlife Service-Alaska)
Richard Merrick (NEFSC)
Katie Moore (OPR)
Keith Mullin (SEFSC)
Marcia Muto (AKFSC)
Debra Palka (NEFSC)
Simona Perry (AKFSC/University of Washington)
Steven Swartz (SEFSC)
Barb Taylor (SWFSC)
Kimberly Thounhurst (NERO)
Cindy Tynan (NWFSC)
Paul Wade (OPR)
Kathy Wang (SERO)
Sharon Young (Humane Society of the United States)

APPENDIX III

A Proposal for Categorization of Scientific Information, and for Protocols for Inclusion of Information by NMFS in Its Management Documents

Phillip J. Clapham
NMFS Northeast Fisheries Science Center, 166 Water St., Woods Hole, MA 02543

INTRODUCTION: THE PROBLEM

NMFS is required by statute to consider the "best available information" when formulating management actions which may affect the status of protected marine animal populations, or which may have social or economic impact on humans. Since the statute does not define "best available information," there has been much debate regarding the type of scientific (or other) information that should be considered when formulating such actions, and how such information should be treated in documents relating to the issue at hand.

The purpose of this proposal is to provide criteria for how (and whether) scientific information is categorized and used during the preparation of agency documents relating to management actions. Three proposed levels (*i.e.*, categories) of informational material are defined, and the proposed protocol for using such material is described.

LEVEL 1: PEER-REVIEWED SCIENTIFIC STUDIES

TYPE OF MATERIAL

Level 1 materials are largely represented by papers in scientific journals that have been subjected to formal peer review (*i.e.*, refereed) prior to acceptance and publication. The materials also include the SARs.

NMFS POLICY AND PROTOCOL

Refereed papers are the primary currency of the scientific process, and NMFS routinely encourages scientists to publish all of their work as refereed papers so that such work becomes available for consideration and use by both managers and other scientists. All scientific journal papers have theoretically undergone some level of formal review by referees who are considered sufficiently familiar with the species or issue concerned to provide an objective and qualified judgment regarding the quality of the work. The SARs also fall into this category since they undergo formal review by one of the three SRGs, as well as being open to public comment.

Level 1 material which has been relied upon during the preparation of any NMFS document must be cited. However, NMFS recognizes that the quality of peer review for scientific papers varies considerably from journal to journal, and even within journals. Consequently, NMFS -- through the appropriate fisheries science center -- may seek additional formal review of a paper from qualified scientists either inside or outside the agency, and include the results of these reviews in NMFS documents relating to the issue at hand.

LEVEL 2: NON-PEER-REVIEWED SCIENTIFIC DOCUMENTS

TYPE OF MATERIAL

Level 2 materials are represented by complete documents such as reports, proceedings, or unpublished manuscripts that have not been subjected to a formal peer-review process, but that contain sufficient information to potentially permit such review to occur.

NMFS POLICY AND PROTOCOL

Non-peer-reviewed material may contain errors of fact, method, interpretation, and/or logic. Indeed, it is rare for a manuscript submitted to a journal to be accepted for publication without changes -- sometimes minor, often major. NMFS believes that uncritical acceptance of non-peer-reviewed information when determining management actions is unwise and potentially damaging to the resource being managed and to the management process itself. Consequently, non-peer-reviewed material will not automatically be included in any NMFS document about the issue at hand.

However, in cases in which the material appears to be relevant, and is sufficiently detailed to allow for evaluation by qualified referees, the appropriate fisheries science center will solicit internal and/or external review of the material. If the results of such review support the conclusions of the material, or are otherwise useful in management considerations, then those materials will be included in NMFS documents about the issue.

LEVEL 3: UNREVIEWED MATERIAL NOT IN DOCUMENT FORM

TYPE OF MATERIAL

Level 3 materials are represented by unreviewed work for which peer review is impossible because there is no written record, or a record which provides insufficient detail to adequately assess the quality of the work involved. Examples include talks, abstracts from meetings, popular articles, and anecdotal information.

NMFS POLICY AND PROTOCOL

Because of the impossibility of verifying the scientific quality of the information involved in this category, such material will generally not be included in NMFS documents relating to an issue unless there is compelling reason to do so. If the material appears to be of considerable importance to the management of a protected species, an effort will be made by the appropriate fisheries science center to secure a written summary of the work that is sufficiently detailed for it to be formally peer reviewed. If this occurs, the material would become a Level 2 document and would be treated according to the protocols described above.

APPENDIX IV

Recovery Factors for Endangered Marine Mammals: A Discussion Paper for the Joint Scientific Review Group Workshop

Barbara L. Taylor[1], Paul R. Wade[2], Douglas P. DeMaster[3], and Jay Barlow[1]

[1]NMFS Southwest Fisheries Science Center, 8604 La Jolla Shores Dr., La Jolla, CA 93028
[2]NMFS Office of Protected Resources, c/o NMFS National Marine Mammal Laboratory, 7600 Sand Point Way, N.E., Bldg. 4, Seattle, WA 98115
[3]NMFS National Marine Mammal Laboratory, 7600 Sand Point Way, N.E., Bldg. 4, Seattle, WA 98115

This working paper was presented at the workshop for consideration as a scheme for assigning recovery factors to endangered species. The scheme was proposed by the authors as a way to facilitate discussion of the issue. It was presented as a "straw man," and not as a final proposal. Discussions at the workshop led to revisions of the scheme. Those revisions are presented in Appendix V.

R.L. Merrick

The PBR guidelines in the 1994 amendments to the MMPA currently set a default recovery factor, F_r, for endangered species at 0.1, a tenth of the potential PBR (Wade and Angliss 1997). In other words, any human-induced mortality in a marine mammal cannot prolong by more than 10% the recovery time which that species would exhibit in the absence of human-induced mortality. The idea behind the use of recovery factors for endangered species is to allow a small kill while striving to allow recovery from a dangerously low abundance as quickly as possible.

Experience implementing the PBR scheme has highlighted the need for further gradations of the recovery factor to match the differing levels of risk facing the suite of species classified as endangered. For example, the right whale in both the North Pacific and North Atlantic continues to remain at perilously low abundance, and requires the maximum protection the MMPA will allow ($F_r = 0.1$). On the other hand, most stocks of the humpback whale in these same ocean basins are known to be increasing, and already are at much lower risk than when they were originally listed as endangered.

We propose, for discussion by the SRGs, a decision tree to standardize setting the default recovery factor for these differing risk levels. The objective of our proposal is to focus discussion and elicit recommendations and modifications rather than to make the decision tree a final recommendation. In that spirit, we conclude with a list of currently endangered species and of what recovery factors would result from the tree.

Perhaps the most informative factors influencing risk of extinction are absolute abundance and trends in abundance. When populations become very small, in the low hundreds, they are subject to more risks than large populations. For example, the remaining population may be spatially restricted and more vulnerable to natural and human-caused disasters. Social systems may be disrupted as has been seen for the Hawaiian monk seal. For cetaceans, particularly those such as the blue whale without known areas of breeding concentration, finding a mate may even become difficult. At what abundance do these problems start? With the monk seal, it appears that these difficulties began even before the species declined to its current estimated abundance of 1,400.

Using crude but general models, we explored whether we could get a better idea of the abundance below which our concerns increase rapidly. We know that populations are occasionally reduced by natural or human-caused events, such as red tides, El Niños, and pollution events. To evaluate the risk that such chance events pose to species, we need to know both the frequency and magnitude of such events. Of course, we don't have such data for any marine mammal.

We can get an idea of how such events might affect marine mammals through some crude modeling exercises. Figure IV-1 shows the probability of extinction of whales and seals in five generations, which is the time frame set by the International Union for the Conservation of Nature and Natural Resources (IUCN) for the endangered category. The model has the following features: 1) no density dependence (*i.e.*, births equal deaths, with the annualized rate of each being 0.035 for whales and 0.10 for seals); 2) a generation time of 25 yr for whales, and 9 yr for seals; and 3) a probability of 10% that 1 yr in every 10 will have a given amount of decrease in the annualized survival rate. The different lines in the figure show the different extinction probabilities associated with two variables: 1) the initial population abundance, and 2) the size of the decrease in the annualized survival rate (over a plausible range given the respective life history strategies of whales and seals) in one out of every 10 yr. Note that for an initial abundance of 1,000 seals, even assuming a 50% reduction in the annualized survival rate once in every 10 yr, there is a <5% chance of extinction in five generations. Thus, under even this high level of stochasticity, a species numbering 1,000 would not warrant being listed as endangered using the IUCN criterion that requires a 10% chance of extinction in five generations.

For the Hawaiian monk seal, this model's measure of safety goes against what we know, most likely because the simple model doesn't consider many factors known to affect small populations, such as population spatial structures, mating systems, or genetic factors. Further, the Hawaiian monk seal may be one of those species that experiences density-dependent reductions in the population growth rate at relatively low populations levels (*i.e.*, carrying capacity may be relatively small).

For the sea otter, Ralls *et al.* (1996) use the effective population size (N_e -- the actively breeding part of the population) of 500 suggested by Mace and Lande (1991) as the threshold for listing as endangered. This effective population size of the sea otter translates to a census population size (N_{min}) of 1,850.

Because the special risk factors facing small populations are unknown, and in some cases unknowable, for most endangered species, we find it much more biologically justifiable to use the existing knowledge of monk seal and sea otter population dynamics as the basis for suggesting a lower abundance threshold for extinction safety, than to rely on this model's results. We therefore recommend a lower threshold -- 1,500 animals -- in the decision tree, a value which is between the estimated abundances of the monk seal and sea otter.

We next consider current trends in abundance because a species' risk is largely determined by its population growth rate as indicated by trends in abundance. Clearly, we should be less concerned about a species that is known to be increasing than a species that is known to be decreasing or for which there are no trend data. Recovery factors should reflect this differing risk by treating species with different trends accordingly. In terms of risk, species with unknown trends should be placed somewhere between species with known increasing or decreasing trends.

We propose that the recovery factor be tuned according to this ranking of risk by changing the allowed increase in time to recovery. Currently, most endangered species are treated as being at the highest level of risk, and the recovery factor has been tuned so that the PBR would not result in an increase in recovery time (over a population recovering with no human-induced mortality) of greater than 10%. We propose adding two additional levels of risk within the endangered category: medium risk with a 15% increase in recovery time allowed, and low risk with a 25% increase allowed (Table IV-1). Note that from Table IV-1 that choosing to increase recovery time by 35% equates to $F_r = 0.5$ in the high coefficient of variation (CV) case, which is currently the default recovery factor for threatened species. Thus, the suggested increases in recovery time for medium and low risk levels within the endangered category were chosen to be intermediate between the level chosen for endangered (high risk), $F_r = 0.1$, and the level for threatened, $F_r = 0.5$.

The risk to species currently listed as endangered and known to be declining depends again on abundance. Managers want to be certain that their actions can keep abundance higher than the threshold of 1,500. We arbitrarily chose a management action period of 20 yr to halt the decline in abundance. Thus, we would want an abundance that, at the initial rate of decline, would remain >1,500 after 20 yr of operation. The declining threshold would be governed by Equation 1:

$$N_{d\text{-}threshold} = \frac{1{,}500}{e^{r \cdot 20}} \qquad (1)$$

where $N_{d\text{-}threshold}$ is the number of animals associated with the declining threshold, r is the current trend in abundance (approximately the exponential rate of growth), and the time period is 20 yr to reach an abundance of 1,500. Populations below the declining threshold would be considered high risk, while those above the threshold would be considered medium risk (Figure IV-2).

The future remains uncertain even for species with increasing abundances. New sources of mortality might arise that reverse positive trends, and we want to make sure that we can detect those sources of mortality and take action before the species reaches the abundance threshold of 1,500. Of course, species with unknown trends in abundance have the same needs.

We base our declining-trend threshold on our ability to detect a serious decline, which we define as 10%/yr (close to the rate of decline for the Steller sea lion). We can rearrange the formula for exponential growth (Equation 2):

$$N_t = N_0 \, e^{rt} \qquad (2)$$

where N_t is the number of animals after some period of time, t, in years, N_0 is the initial number of animals, and r is the trend in abundance, to yield an abundance threshold reflecting our trend objectives (Equation 3):

$$N_{t\text{-}threshold} = \frac{1{,}500}{e^{-0.1 \cdot T}} \qquad (3)$$

where $N_{t\text{-}threshold}$ is the number of animals associated with the declining-trend threshold, and T is the number of annual surveys required to detect a decline of 10%/yr. Table IV-2 shows the number of years it would take to detect a 10%/yr decline with different levels of precision and with an assumption of equal Type I and Type II errors (as calculated using Gerrodette's *trends.exe* program, assuming exponential growth, assuming CV $\propto 1/\sqrt{N}$, and using a z-test). It is more likely that surveys will only occur once every 4 yr. Thus, Table IV-2 shows results for both 1- and 4-yr survey intervals.

We also contrast the use of different α levels. Clearly, the number of years required to detect a trend depends strongly on the evidence required to say a trend is statistically significant. Using the typical high standard of $\alpha = \beta = 0.05$ to reject the null hypothesis results in requiring rather absurdly high abundances with low precision levels when we assume that surveys occur once every 4 yr. In contrast, accepting evidence of a serious decline with a substantial risk of a Type I error ($\alpha = 0.25$) results in a much lower declining-trend threshold for abundance. In other words, there is a tradeoff between: 1) incorrectly pushing the red button of alarm only very infrequently ($\alpha = 0.05$), but requiring a very high abundance to attain that low error rate (*i.e.*, large overprotection error); and 2) being willing to accept a one-in-four chance of incorrectly pushing the red button, but substantially reducing the overprotection error of requiring a much higher abundance for safety than may be necessary.

It should be noted that this declining-trend threshold results in detecting a trend just when the abundance threshold is met. The SRGs may consider adding a safety measure of several years to attempt to halt a decline before the abundance threshold is met. Table IV-3 shows the declining-trend thresholds with a constant 5-yr safety cushion added to allow time for vigorous management actions. Note that even though we should choose among the options presented in Tables IV-2 and IV-3, given current abundances and precision levels, the recovery factor is unaffected for any stock of endangered species.

Species that are above both the abundance and declining-trend thresholds, and that are known to be increasing, would receive the lowest-risk recovery factor (end point J, Figure IV-2). All other cases would be subject to a further risk evaluation that considers other forms of risk. The first consideration is whether the species is vulnerable to a natural or human-caused catastrophe. Species with single populations within an ocean basin are automatically considered vulnerable. If the species is highly concentrated at some period at a location vulnerable to catastrophe, then that species should also be considered more vulnerable and receive a higher level of protection. We propose that "vulnerable to catastrophe" be defined as >50% of the species within the range vulnerable to a potential catastrophe. The type of catastrophe will need to be considered on a case-by-case basis.

Finally, populations that naturally experience large fluctuations in abundance are known to be more vulnerable to extinction. Thus, we propose that a species/stock receive a more conservative recovery factor if it qualifies for at least one of the following: 1) species consists of a single population within an ocean basin, 2) >50% of the species is vulnerable to a catastrophe at some point, or 3) large fluctuations in abundance are common (Figure IV-2).

Table IV-4 shows the currently listed endangered species and Cook Inlet beluga for discussion purposes. The required data for the decision tree are listed along with the current and proposed recovery factors.

The decision tree leaves several items undefined. We recommend the following definitions: abundance is N_{min}, a decline uses $\alpha = 0.25$ for the significance criterion, an increase uses $\alpha = 0.05$ for the significance criterion, and the rate of decline used in projecting a declining population over the next 20 yr is $r_{best} - 1s_{\bar{x}}$ (where r_{best} is the best estimate of the current trend in abundance, and $s_{\bar{x}}$ is standard error of the mean).

It would also be useful for the SRGs to discuss how subsistence harvest should interact with determination of recovery factor values. That is, should NMFS and the USFWS try to be less risk averse with their PBR management approach (*e.g.*, setting values for recovery factors) when applied to marine mammal species harvested for subsistence purposes by Alaskan Natives?

REFERENCES CITED

Mace, G.M.; Lande, R. 1991. Assessing extinction threats: toward a reevaluation of IUCN threatened species categories. *Conserv. Biol.* 5:148-157.

Ralls, K.; DeMaster, D.P.; Estes, J.A. 1996. Developing a criterion for delisting the southern sea otter under the U.S. Endangered Species Act. *Conserv. Biol.* 10:1528-1537.

Wade, P.R. 1998. Calculating limits to the human-caused mortality of cetaceans and pinnipeds. *Mar. Mammal Sci.* 14:1-37.

Wade, P.R.; Angliss, R.P. 1997. Guidelines for assessing marine mammal stocks: report of the GAMMS Workshop; April 3-5, 1996; Seattle, WA. *NOAA Tech. Memo. NMFS-OPR*-12; 93 p.

Table IV-1. Required recovery factor values to attain different percentage increases in recovery time for different levels of precision (expressed as coefficients of variation, or CVs). (Taken from Wade 1998.)

Percentage Increase in Recovery Time	Precision Level	
	Low CV (0.2)	High CV (0.8)
10%	0.15	0.15
15%	0.20	0.25
20%	0.25	0.35
25%	0.35	0.40
30%	0.35	0.40
35%	0.40	0.50

Table IV-2. The declining-trend threshold abundance required both to maintain at least 1,500 individuals (the abundance threshold) and to be able to detect a 10%/yr decline for different levels of precision [expressed as coefficients of variation (CV) in abundance (N)] and at different levels of significance

	Significance Level for Type I (α) and Type II (ß) Errors							
	α = ß = 0.05				α = ß = 0.25			
CV	Number of Annual Surveys to Detect r = -0.1	Initial N to End at 1,500	Number of Quadrennial Surveys to Detect r = -0.1	Initial N to End at 1,500	Number of Annual Surveys to Detect r = -0.1	Initial N to End at 1,500	Number of Quadrennial Surveys to Detect r = -0.1	Initial N to End at 1,500
0.1	6	2,733	12	4,980	3	2,025	8	3,338
0.2	10	4,077	16	7,430	4	2,238	12	4,980
0.3	13	5,504	20	11,084	6	2,733	12	4,980
0.4	16	7,429	24	16,535	8	3,338	12	4,980
0.5	19	10,029	32	36,799	9	3,689	12	4,980
0.6	22	13,538	36	54,897	10	4,077	16	7,429
0.7	23	14,961	40	81,897	11	4,506	16	7,429
0.8	25	18,273	44	122,176	12	4,980	16	7,429

Table IV-3. Required years and declining-trend threshold abundances for different coefficients of variation, assuming $\alpha = ß = 0.25$, and a 5-yr safety cushion.

CV	Number of Annual Surveys to Detect r = -0.1	Initial N to End at 1,500	Number of Quadrennial Surveys to Detect r = -0.1	Initial N to End at 1,500
0.1	8	3,338	13	5,504
0.2	9	3,689	17	8,211
0.3	11	4,506	17	8,211
0.4	13	5,504	17	8,211
0.5	14	6,083	17	8,211
0.6	15	6,723	21	12,249
0.7	16	7,430	21	12,249
0.8	17	8,211	21	12,249

Table IV-4. Abundance, precision, trend, and recovery factors for endangered species and Cook Inlet beluga. (The end point for use in the decision tree in Figure IV-2 is in italics if a change would be required, and has an asterisk if a change may be required depending on the increase in recovery time chosen for the different risk levels. Note that the only case where choice of the threshold criterion makes a difference -- see Tables IV-1 and IV-2 -- is for the central North Pacific humpback whale, but that both end points I and J result in a low risk rating.)

Species/Stock	Abundance	CV	Trend	Current F_r	Proposed F_r	Decision Tree Point
HI monk seal	1,406	0.09	decreasing	0.10	High	A
Steller sea lion (western)	39,500	0.02	decreasing	0.15	Medium	*C
NP right whale	? (<1,500)	?	?	0.10	High	A
NA right whale	295	?	?decreasing	0.10	High	A
CA/MEX blue whale	2,134	0.27	?increasing	0.10	Medium	*H*
NA blue whale	308	?	?	0.10	High	A
CA/OR/WA fin whale	935	0.63	?increasing	0.10	High	A
NA fin whale	2,700	0.59	?	0.10	Medium	*E*
CA/OR/WA sperm whale	756	0.49	?	0.10	High	A
NA sperm whale	2,698	0.67	?	0.10	Medium	*E*
BCB bowhead whale	8,200	0.07	increasing	0.50	Low	J
NA humpback whale	10,600	0.07	increasing	0.10	Low	**J*
CA humpback whale	597	0.08	?increasing	0.10	High	A
Central NP humpback whale	4,005	0.10	increasing	0.10	Low	**I*, **J*
Western NP humpback whale	394	0.08	?	0.10	High	A

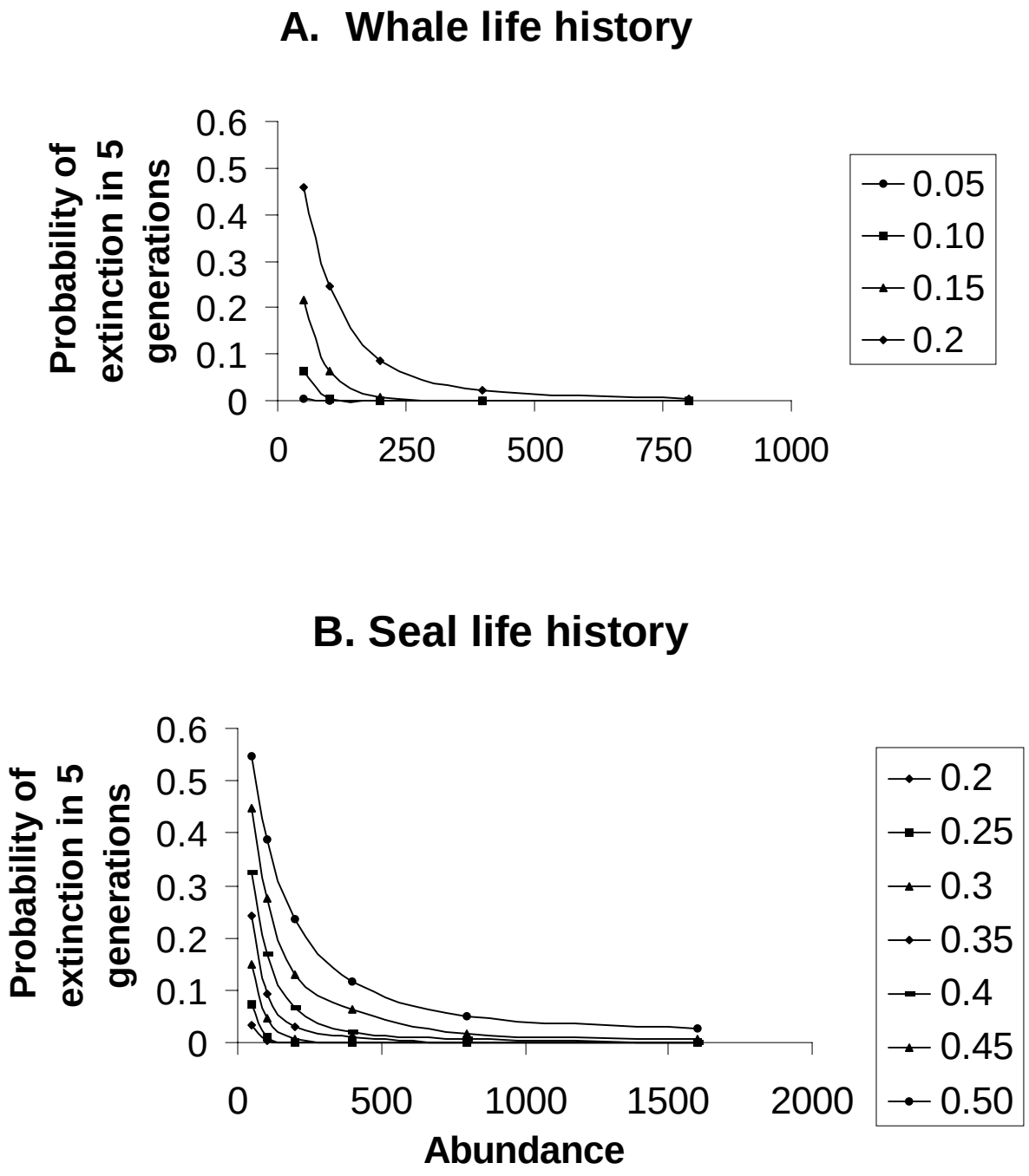

Figure IV-1. Probability of extinction of whales (Chart A) and seals (Chart B) in five generations for different initial abundances and for different decreases (as shown in the boxed legends) in the annualized survival rate for 1 out of every 10 yr. [The model is a simple birth-and-death model with no density dependence (*i.e.*, births equal deaths).]

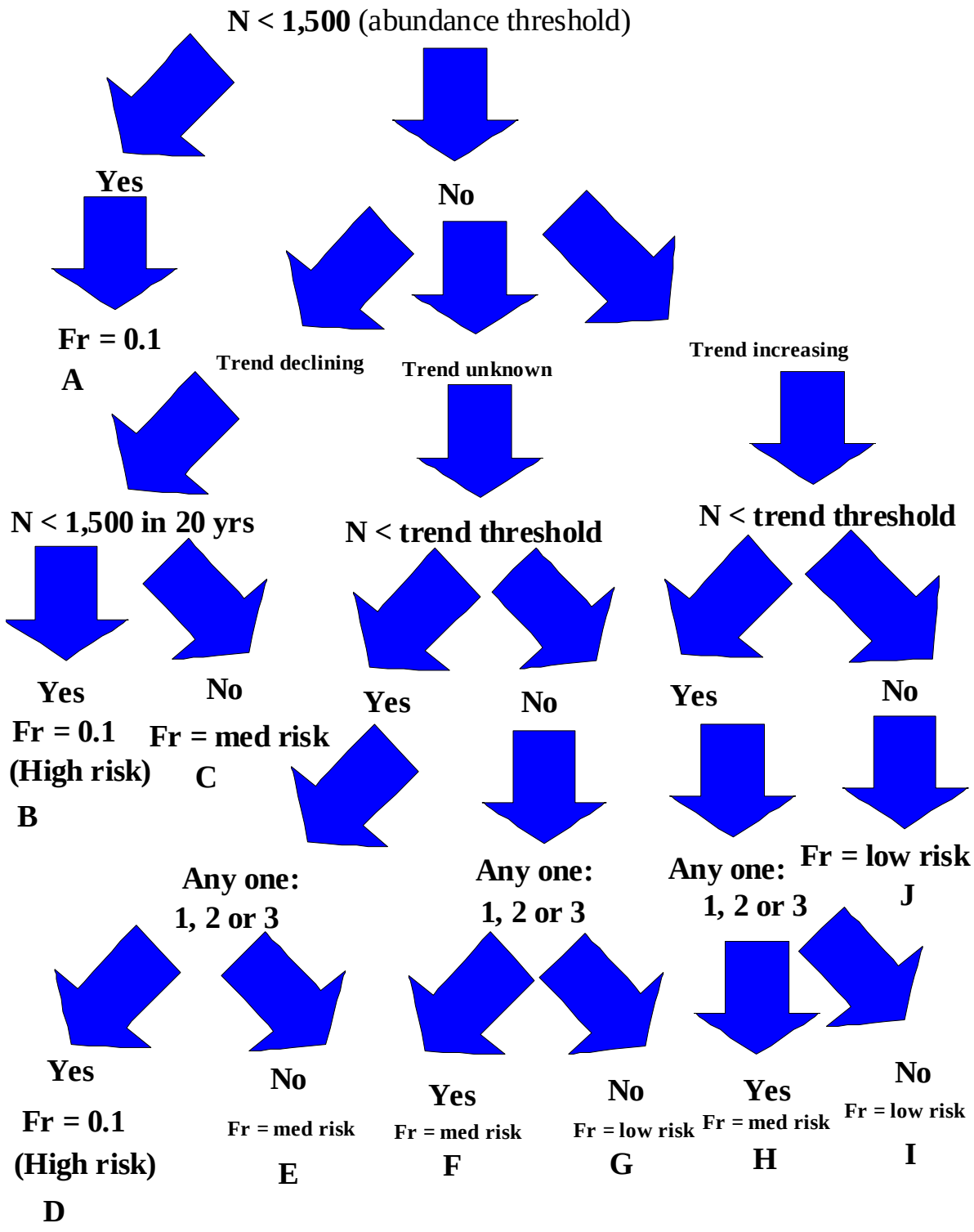

Figure IV-2. Decision tree for the default recovery factor within the endangered category. ("Any one: 1, 2 or 3" refers to the following criteria: 1) species consists of a single population within an ocean basin, 2) >50% of the species is vulnerable to a catastrophe at some point, or 3) large fluctuations in abundance are common.)

APPENDIX V

Recovery Factors for Endangered Marine Mammals: A Revised Decision Tree and Decision Matrix

After the working paper in Appendix IV was presented, the JSRG, along with other workshop participants, discussed other possible schemes for categorizing endangered species for the purpose of assigning a recovery factor. Those discussions led to two new possible schemes that were considered. Changes from the decision tree presented in Appendix IV were proposed with the intent of improving the scheme. However, there was no consensus at the workshop that either new scheme was adequate or acceptable. These two schemes are presented here for the sake of future discussion, as a record of what was considered at the workshop. Neither specific scheme was officially endorsed by the JSRG.

One discussion led to the consideration of a different format. From this discussion, a decision matrix or table was created (Table V-1). Another discussion led to consideration of changes that could be made to the decision tree presented in Appendix IV. The resulting revised decision tree changed the order in which items were considered (Figure V-1). These two schemes were used to categorize stocks, as done in Table IV-4. Categorization by the two new schemes is presented in Table V-2.

Table V-1. Draft decision table or matrix

N_{min}	Decreasing Trend		Unknown Trend		Increasing Trend	
	Vulnerable[a]	Not Vulnerable	Vulnerable[a]	Not Vulnerable	Vulnerable[a]	Not Vulnerable
<500	High	High	High	High	High	High
500-1,499	High	High	High	High	High	Medium
1,500-2,499	High	High	High	Medium	Medium	Low
≥2,500	High	High	Medium	Low	Low	Low

[a]Vulnerable = Either single population, susceptible to variation in abundance, or subject to catastrophe.

Table V-2. Categorization using the two revised draft schemes, a decision tree and a decision matrix, as discussed at the workshop

Species/Stock	N_{min}	CV	Trend	Current F_r	Decision Tree Risk Category (Fig. V-1)	Decision Matrix Risk Category (Tab. V-1)
HI monk seal	1,406	0.09	decreasing	0.10	High	High
Steller sea lion (western)	39,500	0.02	decreasing	0.15	High	High
NP right whale	? (<1,500)	?	?	0.10	High	High
NA right whale	295	?	decreasing	0.10	High	High
CA/MEX blue whale	2,134	0.27	increasing	0.10	Medium	Low
NA blue whale	308	?	?	0.10	High	High
CA/OR/WA fin whale	935	0.63	?increasing	0.10	High	High
NA fin whale	2,700	0.59	?	0.10	High	Low
CA/OR/WA sperm whale	756	0.49	?	0.10	High	High
NA sperm whale	2,698	0.67	?	0.10	High	Medium or low
BCB bowhead whale	8,200	0.07	increasing	0.50	Low	Low
NA humpback whale	10,600	0.07	increasing	0.10	Low	Low
CA humpback whale	597	0.08	?increasing	0.10	High	High or medium
Central NP humpback whale	4,005	0.10	increasing	0.10	Low or medium	Low
Western NP humpback whale	394	0.08	?	0.10	High	High

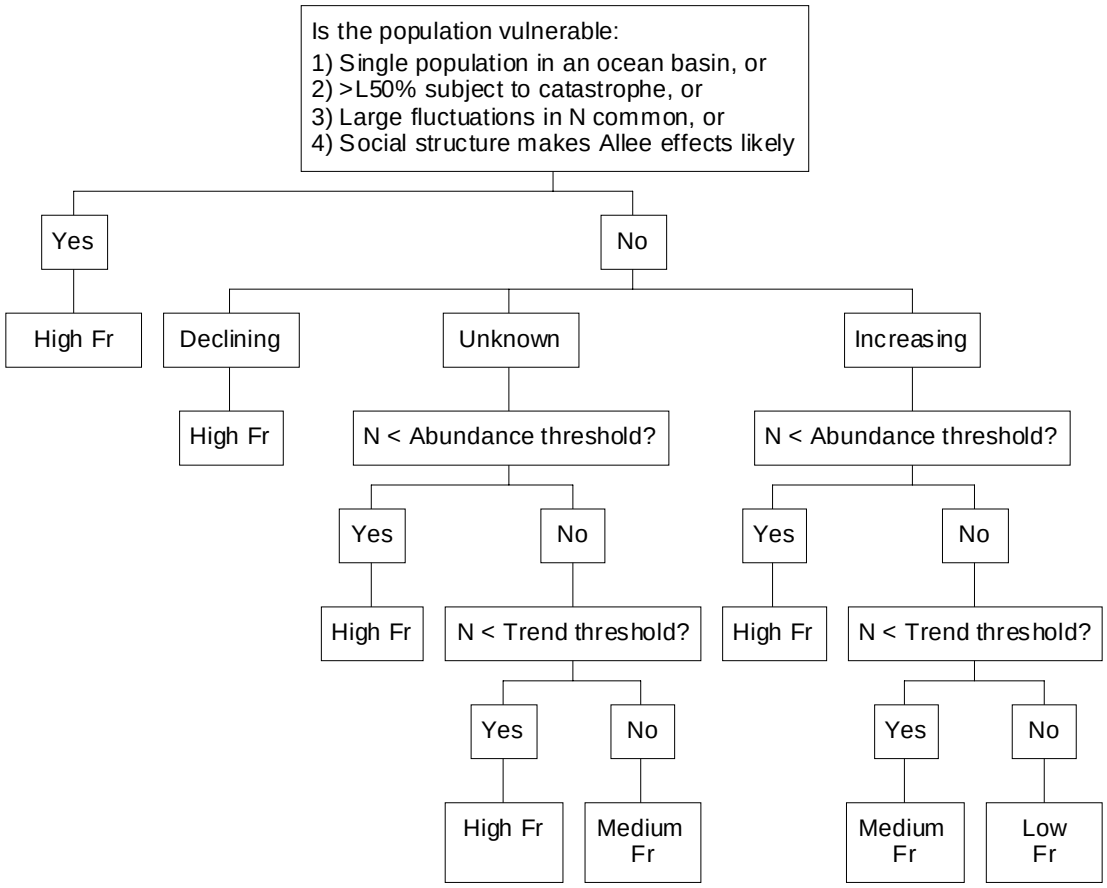

Figure V-1. Revised draft decision tree. (Decision tree from Appendix IV was revised at the workshop with this result.)