A New Approach to Classifying the Central North Pacific Stock of Humpback Whales Under the U.S. Endangered Species Act

by

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The U.S. Endangered Species Act (ESA) was enacted by Congress in 1973 in response to increasing evidence of the extinction, or danger or threat of extinction of certain species of fish, wildlife, and plants in the United States. A key objective of the ESA is to provide policy for the identification, protection, and conservation of such species. Though this objective remains well intended, the ESA itself has proved to be vague and therefore challenging if not difficult to implement. The Act classifies "endangered" as "any species which is in danger of extinction throughout all or a significant portion of its range" and "threatened" as "any species which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range." Moreover, the Act provides no objective criteria for deciding when a species should be placed (listed) on the Act's List of Endangered and Threatened Wildlife (referred to as the List), recategorized from endangered to threatened (downlisted) , or removed from the list altogether (delisted). Rather, the Act identifies five general factors that are to be considered in classifying a species as endangered or threatened under the ESA. As a result, listing and recovery actions for marine mammals as well as other species are widely inconsistent. Of the 20 marine mammal species listed under the ESA, only 6 have Recovery Plans (Table 1). Within these plans, criteria to delist a species vary greatly.

Due to concern about overutilization and inadequate protective regulations, 8 of the 11 species of large cetaceans--blue, fin, sei, humpback, right, bowhead, gray and sperm whales--were listed as threatened with extinction under the Endangered Species Conservation Act (ESCA) of 1969 and subsequently as endangered under the ESA in 1973 (which replaced the ESCA). However, in the last 15 years management practices for large whales have changed considerably. For example, in 1985-86 the International Whaling Commission (IWC) imposed a moratorium on commercial whaling of large whales and subsequently has worked to develop a new regime for managing levels of take by commercial whalers should the moratorium be lifted. In recent years, several prominent whale biologists have proposed that certain stocks of large whales be considered for removal from the ESA's List of Endangered and Threatened Wildlife. Their reasoning is that 1) the original justification for listing is no longer valid for all the stocks originally listed as endangered and 2) certain stocks of large whale species have been protected for many years and have increased significantly in abundance since the early 1970s. A case in point is the recovery of the eastern North Pacific stock of gray whales and its removal from the List in June 1994.

In addition to the way in which whales are managed, the ESA itself has changed over the last 15 years. For example, amendments to the ESA in 1988 require the National Marine Fisheries Service and the U.S. Fish and Wildlife Service to develop specific criteria to determine when a stock should be removed from the List. Towards this goal, a joint project between the Alaska Fisheries Science Center's National Marine Mammal Laboratory (NMML) and the University of Washington (UW) was initiated in 1995 to establish such criteria for several stocks of large whales, including humpback, fin, bowhead, and right whales that inhabit the North Pacific Ocean. The two principal investigators for the project were Drs. Glenn VanBlaricom (UW) and Douglas DeMaster (NMML), with funding for the project from the National Marine Fisheries Service (NMFS) Office of Protected Resources to support a Ph.D candidate at the UW (Ms. Leah Gerber). Of central importance to the project has been the the central stock of North Pa-

Table 1. Summary of marine mammal species on the List of Endangered and Threatened Wildlife. * indicates those species for which a Recovery Plan has been finalized.

Species Name	*Status*
Amazonian manatee	Endangered
West African manatee	Threatened
West Indian manatee*	Endangered
Dugong	Endangered
Marine otter	Endangered
Southern sea otter*	Threatened
Gulf of California harbor porpoise	Endangered
Chinese river dolphin	Endangered
Eastern stock, Steller sea lion/ Western stock, Steller sea lion* (same recovery plan)	Threatened Endangered
Caribbean monk seal	Endangered
Hawaiian monk seal*	Endangered
Mediterranean monk seal	Endangered
Guadalupe fur seal	Threatened
Blue whale	Endangered
Bowhead whale	Endangered
Fin(back) whale	Endangered
Humpback whale*	Endangered
Right whale*	Endangered
Sei whale	Endangered

cific humpback whales because it is one of the stocks of large whales that is most likely in need of reclassification under the ESA.

In the first phase of the project to develop classification criteria for North Pacific stocks of humpback whales, the existing criteria in the Humpback Whale Recovery Plan of 1991 were reviewed. The plan describes three types of recovery-related goals. The first is a biological goal of building and maintaining populations large enough to endure changes in oceanographic conditions, epizootics, anthropogenic stress, environmental catastrophes, or inbreeding depression. The second is a numerical goal to establish desirable population sizes consonant with the biological goal and with continuing human use of the oceans. Specifically, this goal aims to increase humpback whale populations to at least 60% of either the number existing before commercial exploitation began (i.e., historical carrying capacity) or the current carrying capacity of the environment. Because accurate estimates of historical or current carrying capacity are not available, an interim goal in the Recovery Plan is to double existing population sizes within the next 20 years. The third goal is to develop objective criteria to classify stocks of humpback whales as either endangered or threatened.

After an initial review, project personnel questioned the relevance of the second goal of the Humpback Whale Recovery Plan: to increase humpback whale stocks to at least 60% of the carrying capacity. This is because the goal stems from a concept known as the optimum sustainable population level (OSP) used in implementing the Marine Mammal Protection Act, which is unrelated to the definition of endangered under the ESA. The relevance of OSP in ESA classification is doubtful because resource scientists have shown that for most populations, the lower limit of the OSP level (the population level where maximum net production is achieved) is a significantly larger population than the upper limit of what constitutes an endangered population. Further, the plan's interim goal of doubling the population size is also of questionable relevance to ESA classification. This is because unless the absolute abundance of a population is known, it is not possible to determine the likelihood of extinction using only information on trends in abundance.

Given the shortcomings of the existing ESA classification criteria for humpback whales, a new approach was developed by Gerber, DeMaster, and VanBlaricom. The new approach is based on the recommendations of a workshop held at the

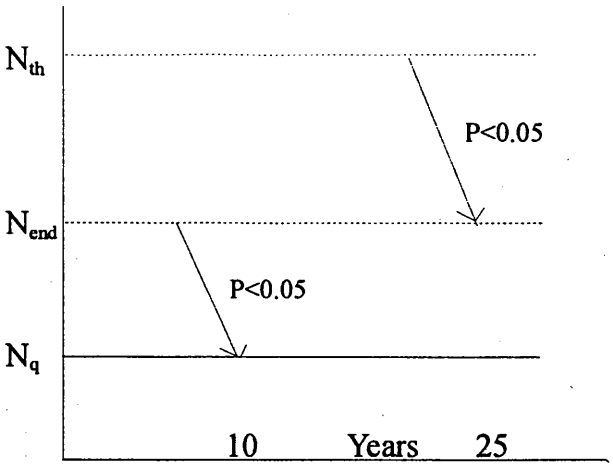

Figure 1. Schematic relationship among quasi-extinction level (N_q), the threshold for endangered (N_{end}), and the threshold for threatened (N_{th}).

NMML in January 1997 and is designed for a stock-specific application. The basic definition for endangered under this approach is a population size, referred to as the threshold level for endangered, below which there is a negligible probability that a population of that size with a specified distribution around the population rate of change would fall below a population level from which extinction would be inevitable in a specified time (Fig. 1). The estimated probability distribution for the rate of change in the analysis is based on available data (in this case the central stock of humpback whales in the North Pacific). Because of uncertainties in information used to estimate the rate of change, the example presented in this article should be considered preliminary.

The new strategy for determining ESA classification criteria for humpback whales incorporates many elements of a population viability analysis, in that it incorporates information on population abundance and trends in abundance, as well as information on uncertainty in both of these parameters. To implement such a strategy, several parameters must be specified. As a starting point, it was assumed that a negligible probability was equal to a 5% chance or less and that a reasonable time for determination of an endangered population was 10 years. It was further assumed that a population of less than 500 individuals was likely to become extinct in the foreseeable future (defined as the quasi-extinction level).

The above definition of endangered formed the basis for the proposed definition of threatened. In this case, the definition of a threatened population is one below a minimum population size (referred to as the threshold level for threatened), where there is a negligible probability that a population of that size with a specified distribution around the population rate of change would fall below the threshold for endangered in a specified period of time. As a starting point we again assumed that a negligible probability was equal to a 5% chance or less. Unlike the parameters for the classification for endangered, however, we assumed a reasonable time for determination of a threatened population was 25 years.

To implement this new approach for evaluating the ESA's endangered classification for the central North Pacific stock of humpback whales, the following steps were taken: 1) information on the current population size was specified, 2) available information on vital rates or changes in abundance over time was used to generate a probability distribution for the population's underlying rate of change (ROC), 3) from the frequency distribution for the ROC the 5th percentile value for ROC was estimated, and 4a) if the 5th percentile ROC was less than 1.0, a backwards population trajectory starting at 500 individuals for a period of 10 years was performed, and the resulting population size was used as the threshold for endangered, or 4b) if the 5th percentile ROC was greater than or equal to 1.0, the threshold for endangered was set at 500 animals. As shown in Figure 2, as the 5th percentile value for ROC is reduced the threshold level for endangered increases. A similar approach also was used to determine a threatened classification for the central North Pacific stock of humpback whales, except that the population trajectory was started at the population level equal to the threshold for endangered, and the number of years for the backwards trajectory was changed to 25 (from 10).

The available data for the central stock of North Pacific humpback whales were used to classify this stock using the approach described above. Where the necessary information from this stock was not available, available information from other stocks of humpback whales was used. Based on the steps outlined in the previous paragraph, the

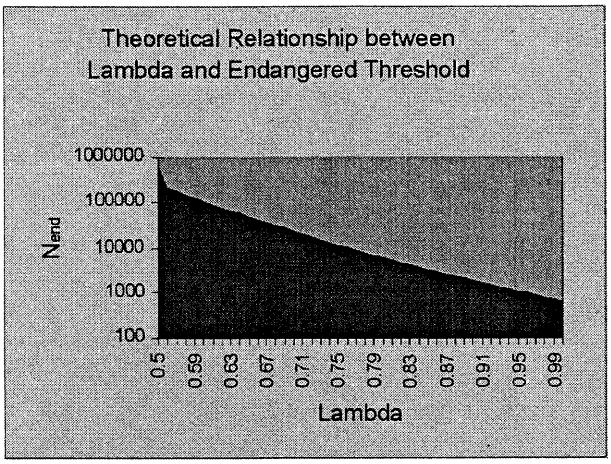

Figure 2. Relationship between the 5th percentile value for the rate of change and the resulting estimate of the threshold level for endangered. In this case, the quasi-extinction level was set at a value of 500 animals.

best available information for this stock indicates that: 1) current abundance is approximately 4,000 animals, 2) the distribution of ROC is centered around 1.04 (i.e., a population growing at 4% per year), 3) the best estimate of the 5th percentile of ROC is 0.93 (i.e., a population with this ROC would be declining at 7% per year), and 4a) the best estimate of current abundance for this stock (i.e., 4,000 animals) was larger than the estimated threshold for endangered; however, the best estimate of current abundance was less than the estimated threshold for threatened. If the previously stated parameters in the model were adopted by NMFS and no other criteria were included in the classification protocol (this is unlikely), the above analysis would be consistent with a recommendation to downlist the central stock of humpback whales in the North Pacific Ocean to a status of threatened.

One of the key features of this new approach to ESA classification is that as uncertainty regarding the ROC increases, the threshold for endangered (and threatened) necessarily increases. Therefore, with less precise information it becomes more difficult to delist or downlist a stock classified as endangered, while with more precise information it becomes less difficult to do so. Therefore, in estimating the variance associated with the ROC it is important to incorporate both parameter estimation error and stochastic error. At this point, the estimated ranges of survival and reproduction for the central North Pacific stock of humpback whales incorporate uncertainty due to areal differences but do not incorporate uncertainty due to changes over time. The importance of not incoporating the uncertainty of how the ROC varies over time remains to be investigated.

Several additional features of this approach remain to be investigated. For example, as the time period for evaluating a population increases (10-year period for endangered and 25-year period for threatened), the threshold levels for endangered and threatened will increase, assuming that the 5th percentile ROC is less than 1.0. Therefore, it is important that agreement be reached regarding the time frame in the proposed classification scheme. Some reviewers of the proposed approach have recommended using a 20-year time interval for both endangered and threatened, while others have recommended using a much longer time period for defining a threatened species. Additional research is needed to resolve how to determine the optimal time period for classifying species under the ESA. Also, it should be noted that the uncertainty associated with the estimate of abundance has not been incorporated into the classification scheme at this point. Finally, the estimated thresholds for endangered and threatened are dependent on the value chosen for the quasi-extinction level. There has been much debate within the conservation biology community regarding a reasonable value or range of values for this parameter. Until a value for this parameter is agreed upon, the approach described in this report can not be implemented.

Additional simulations will be conducted over the next few months to establish the sensitivity of the above approach to uncertainty in the estimate of current population size and the degree to which the results are dependent on the parameters requiring input from the management side of NMFS (e.g., 5% probability of declining to a minimum viable population size, time periods of 10 and 25 years for endangered and threatened, respectively). Comments on the approach described in this report are welcomed. A draft final report including recommendations for classification criteria for humpback, fin, bowhead and right whales is scheduled for September 1998.