MARINE MAMMAL COMMISSION
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William T. Hogarth, Ph.D., Director
National Marine Fisheries Service
1315 East–West Highway, Room 14564
Silver Spring, MD 20910

Dear Dr. Hogarth:

The Marine Mammal Commission held its annual meeting on 12–14 October 2005 in Anchorage, Alaska, to review issues and concerns related to science and conservation of marine mammals and marine ecosystems in Alaska and adjacent regions of the Arctic. The potential effects of contaminants, disease, and harmful algal blooms were discussed at this meeting. We had discussed these same topics at a 2003 workshop sponsored by the Commission on future directions in marine mammal research. I am enclosing a copy of a recently published book that resulted from the future directions meeting. It includes chapters on these three areas of concern, as well as other threats to marine mammals and marine ecosystems. Each chapter provides recommendations for research to better understand the nature and effects of each category of threat. Here, we provide brief comments and recommendations on contaminants, disease, and harmful algal blooms as they pertain to Alaska and arctic marine mammals and ecosystems.

**Contaminants**

In spite of their remote location from human population centers, the marine ecosystems of Alaska and the Arctic have been and continue to be exposed to a wide range of contaminants from point sources (e.g., coastal development, oil and gas operations, military activities) as well as from air and ocean currents that distribute the byproducts of human activities occurring thousands of miles away. Tissues of a number of arctic marine mammals have been found to contain contaminants such as polychlorinated biphenyls (PCBs) that approach, or in some cases exceed, concentrations that have been associated with changes in neurobehavior, immune function, and reproduction in captive harbor seals and other laboratory animals (mink, otter, and monkey). Transient killer whales appear to carry the highest contaminant concentrations, but it has not yet been possible to evaluate effects in these animals. The polar bear, another top predator, also carries high concentrations of PCBs. Studies conducted on bears at Svalbard suggest these contaminants may be causing or contributing to dysfunction of immune and reproductive systems, as well as decreased cub survival. At certain locations in Alaska waters, some northern fur seals, Steller sea lions, and minke whales also carry sufficiently high concentrations of these contaminants to affect immune function. Investigating contaminant-related issues is difficult because the animals may be difficult to study and, even at serious levels of exposure, effects are likely to be insidious rather than obvious. Furthermore, the effects of contaminants, when combined with the effects of other risk factors, may be cumulative.

Importantly, contaminants may affect not only marine mammals, but also the people in subsistence-based communities who rely on seals, whales, and walruses for a significant portion of their diet.

Over the past several decades, studies of contaminants in marine mammals have focused primarily on documenting contaminant levels of only a few chemicals with little assessment of their physiological, demographic, and ecological consequences. Assessment of contaminant levels in the environment and in marine mammal tissues (e.g., establishment of baselines and trends, identification of contaminant hot spots) is important, but future research also must investigate the consequences of exposure using, for example, measures of behavior and physiology, biomarkers, and long-term studies of reproduction and survival. This will require studies of free-ranging and captive animals. In the field, sampling is needed to determine levels of contaminants in tissues and provide a basis for inferring effects on the animals' health and population dynamics. Laboratory studies, including the use of captive animals, are needed to investigate cause-and-effect mechanisms. Although controlled studies using live marine mammals may encounter considerable resistance, we know of no other way to identify the levels of exposure to various contaminants that may pose serious threats to wild populations. Even retrospective investigations of unusual mortality events fall short of providing the definitive information needed for decisive management.

The research capabilities (infrastructure, personnel, funding) needed for those types of investigations generally are not available at present. They will require long-term planning and commitment, as well as cooperation among the Service's Marine Mammal Health and Stranding Program, the National Oceanic and Atmospheric Administration's Oceans and Human Health Program, and programs run or sponsored by other agencies (e.g., the National Institutes of Health and the Environmental Protection Agency). The Marine Mammal Commission recommends that the Service continue to support and develop such cooperative programs because of their current utility and their potential to provide essential information in the future. To that end, we draw your attention to the chapter by O'Hara and O'Shea in the enclosed book. These authors provide a detailed discussion of contaminants and their known and potential effects on marine mammals, as well as recommendations to guide long-term planning and research. Their recommendations are based, in part, on the report (also enclosed) of a 1998 contaminants workshop sponsored by the Commission to assess effects and guide future research. The Commission believes that more research is needed if scientists and managers are to understand and prevent significant, adverse ecological consequences from the presence of an ever-increasing number of chemicals into the marine environment.

**Disease**

Although much remains to be learned about the role of diseases in marine mammal population dynamics, it is clear that they pose significant population-level risks. The frequency of disease-related mortality events appears to be increasing in marine mammal populations. Such events may involve thousands or even tens of thousands of animals (e.g., recent harbor seal die-offs in northern Europe). Small populations, such as the endangered Hawaiian monk seal, are particularly vulnerable to diseases. For example, a morbillivirus outbreak is one of two plausible hypotheses to

explain the recent loss of one-third to one-half of the largest remaining colony of the endangered Mediterranean monk seal.

Although diseases are natural processes, their occurrence and effects may be exacerbated by human activities that increase marine mammal susceptibility or exposure. In Alaska and the Arctic, disease risks are likely to increase in coming decades due to climate warming and its cascade of effects, which may include reduced quantity and quality of habitat, resulting in poor body condition of marine mammals and increased susceptibility to disease. Impacts also are likely from increased exposure to zoonotic disease vectors (e.g., *Brucella*) that may spread northward by changing climate conditions. Here, too, the effects of disease may be insidious but significant, and may combine with the effects of other risk factors. In the coming decades, zoonotic diseases in particular may have a significant and conceivably devastating effect on subsistence communities in the Arctic.

The Marine Mammal Commission commends the Service for its ongoing efforts to develop programs that address issues related to marine mammal disease. Nonetheless, the Commission also believes that such programs will need considerable additional support and development in the coming years if they are to be effective in describing the role of disease in marine mammal conservation and preventing or mitigating the influence from human activities. To that end, the Marine Mammal Commission recommends continued support for existing programs to investigate marine mammal diseases. We also draw your attention to the chapter by Gulland and Hall in the enclosed book, which we think would be a useful guide for future NOAA/NMFS efforts. Those authors provide a detailed discussion of disease and its potential effects on marine mammal conservation, as well as recommendations to guide long-term planning and research.

**Harmful Algal Blooms**

Harmful algal blooms are signaling serious changes in, and degradation of, marine ecosystems. Although algal blooms occur naturally, their increasing frequency and distribution indicate that conditions in many ecosystems, including those in Alaska waters, are changing. Blooms may result from changes in physical conditions (nutrients, temperature, salinity, or light), may significantly alter water quality (decreased oxygen levels, increased presence of toxins), and may have ecological effects on marine mammals both directly (via inhalation or ingestion) and indirectly (via food web effects and bioaccumulation). Although such effects have been observed primarily in waters off the East, Gulf of Mexico, and West Coasts of the lower 48 states, they have recently occurred in Arctic and sub-Arctic regions. Die-offs of California sea lions and various small cetaceans from exposure to domoic acid off California and manatees and small cetaceans from exposure to brevetoxins (red tides) off Florida have become regular events, causing not only morbidity and mortality of marine mammals and other marine life but also consuming considerable amounts of the limited resources available for scientific, veterinary, and management response. We understand that multiple federal agencies are becoming involved in the investigation of harmful algal blooms in an effort to understand their causes and their ecological and socioeconomic effects. Because these events may significantly affect marine mammals, marine ecosystems, and coastal communities, the Marine Mammal Commission supports these investigations and efforts to address the underlying causes. A chapter by Van Dolah in the enclosed book describes harmful algal blooms

and their potential mechanisms for effects on marine mammals, and makes recommendations for future research to provide the information needed to describe, prevent, and mitigate such effects when possible. We hope you will find that chapter informative and useful as a guide for future research.

**Summary**

Contaminants, disease, and harmful algal blooms all pose potentially significant, but poorly understood, risks to Alaska marine mammals, ecosystems, and coastal communities. The severity of those risks will undoubtedly increase over time. The primary challenge with regard to each of these threats will be to manage them so as to prevent significant population-level effects on marine mammals and other living resources, as well as to ensure adequate protection of coastal subsistence communities. The former will require an understanding of exposure levels, the mechanisms by which marine mammals are affected, and the net effects on reproduction and survival. Although progress has been made with respect to each of the threats, further characterization is needed to facilitate management. This will require additional infrastructure, expertise, and resources that will only become available as a result of thoughtful, long-term planning. The Marine Mammal Commission's meeting on future directions in research, in which many NOAA scientists participated, generated information to facilitate such planning. The Commission hopes you find the enclosed book useful in that regard. We would be pleased to meet with you to discuss these and other issues. Please let us know if you have any questions about the above comments and recommendations.

Sincerely,

David Cottingham
Executive Director

Enclosure