

MARINE MAMMALS AS ECOSYSTEM SENTINELS AND GUIDES TO HOLISTIC ADAPTIVE MANAGEMENT

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Extreme reductions in Arctic sea ice extent and thickness have become a hallmark of climate change, but impacts to the marine ecosystem are poorly understood. While dramatic seasonal sea ice retreats provide new avenues for commercial access to marine resources, the true cost of expanding anthropogenic activities is uncertain and should be evaluated by the people and animals that live in the Arctic. As top predators, marine mammals must adapt to environmental changes that result from biophysical and anthropogenic forcing and thereby can act as sentinels to ecosystem variability and reorganization. Furthermore, marine mammals are fundamental to the nutrition and cultural heritage of Arctic indigenous people, thereby providing a vital link between ocean and human health. Recent sea ice retreats have influenced the ecology of marine mammals in the Pacific Arctic sector. Walrus now often haul out by the thousands along Siberian and Alaskan coasts in late summer, and reports of harbor porpoise, humpback, fin and minke whales in the Chukchi Sea demonstrate that these temperate cetacean species routinely occur in Arctic waters. These cetaceans join 11 endemic marine mammal species (3 cetacean, 7 pinniped, 1 ursid), all of which are responding to rapid changes in the Arctic Ocean. Fortunately, data from decades-long studies, many conducted in partnership with indigenous people, provide a foundation for the evaluation of impacts of anthropogenic activities on marine mammals in the Pacific Arctic sector. Recently, the Synthesis of Arctic Research (SOAR) project supported the development of peer reviewed papers using these longitudinal data to evaluate the current status of several species of marine mammals and seabirds. Three papers focused on aspects of bowhead whale ecology, an iconic arctic species that is the focus of a locally managed aboriginal hunt – collectively, these papers (i) identified six seasonal core-use areas, (ii) found that whale body condition improved in recent decades and (iii) demonstrated the contribution of whale voices to the underwater Arctic soundscape. It is essential that long-term scientific research on marine mammals be continued and integrated with human use of Arctic seas. In the Pacific Arctic, the Distributed Biological Observatory (DBO) aims to track marine mammal and prey species' responses to ecosystem shifts associated with sea ice loss. Data from this integrated-ecosystem approach could be augmented by information on marine mammal body condition, via the development of a web-based Marine Mammal Health Map (MMHM). Combined, these efforts deliver a 'triad' of data synthesis (SOAR), long-term sampling (DBO) and top-predator condition indices (MMHM), whereby marine mammals can reveal biological responses to physical and anthropogenic forcing throughout the marine ecosystem. This structure supports the goals of various international Pan-Arctic ecosystem monitoring efforts developed by the: (i) Arctic Council Circumpolar Biodiversity Monitoring Program (CBMP) and Arctic Marine Shipping Assessment (AMSA), (ii) International Whaling Commission (IWC) Scientific Committee, (iii) World Wildlife Fund Species Action Plan, and (iv) Inuit Circumpolar Council, among others. An overarching goal of all of these programs is to identify Pan-Arctic eco-health patterns for marine mammals, as a foundation for integrative research, regional response and holistic adaptive management. [14 August 2015]