

# Comparison of marine animal biology



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Marine mammals are similar to all other mammals: they're warm blooded, have either hair or fur, nurse their young with milk and even breathe air using their lungs. The one distinguishing feature, however, is that marine mammals spend most, if not all of their lives, in the ocean. The five groups of marine mammals are as follows: pinnipeds ( *seals, sea lions, and walruses* ), cetaceans ( *whales, dolphins, porpoises* ), sea otters, sirenians ( *dugong, and manatees*) and polar bears. Most of these marine mammals have a thick layer of fat (blubber) that they depend on to maintain body heat and have streamlined bodies that reduce water resistance.

Marine mammals are seen as considerable consumers at most trophic levels and their prey ranges from fish to other marine mammals and can affect their ecosystems significantly (Bowen 1997) It should be noted that marine mammals play an important role in maintaining their aquatic ecosystems as well. Elimination of one or more species can have various impacts, leading to an increase in some species populations, while leading to declines in others.

Presently, not much research has been conducted on the effect that marine mammals have on their ecosystems. This has led to limitations in assessing both top-down ( *consumer controls lower trophic levels*) and bottom-up ( *the resources control upper trophic levels*) control. Experimentation in the ocean and on marine mammals has been considered infeasible, as marine mammals are long-lived, large, and mobile, making it financially and ethically difficult to conduct experiments. (Baum and Worm 2009) Research is further limited by the various temporal and spatial scales on which interactions occur.

Because of the difficulty experienced in conducting large-scale marine experiments, smaller mesocosm experiments with simpler communities have been set up. These often include observing the predator, prey and prey resource. It should be noted that in these experiments, it is easier to manipulate the relationships using various scenarios. It is also possible to observe the non-consumptive effects, henceforth referred to as NCE, by observing the time spent in foraging patches or in travelling between feeding grounds.

Predators do not always affect their prey directly, i. e. via consumption. Often, they also have indirect effects (NCE's), which causes their prey to spend less time feeding, or to feed in less productive feeding grounds and to spend more time conserving its energy. A set of case studies conducted by Wirsing et al. (2008) focused on the effects of predators on three different marine mammals: the bottlenose dolphins ( *Tursiops* sp. ), harbor seals ( *Phoca vitulina* ), and dugongs ( *Dugong dugon* ). It was observed that in each of the three species, the individuals either spent less time in dangerous, but more profitable feeding grounds or adjusted their feeding habits to conserve more energy. (Wirsing et al. 2008) Each of the three species also faced predation by other marine mammals and sharks.

Sea otters are considered to be a keystone species, defined as an organism that helps define the entire ecosystem. Estes et al. s' (1998) paper ( *Killer Whale Predation on Sea Otters Linking Oceanic and Nearshore Ecosystems*) focused on the reduced role of sea otters as a keystone species. Having a diet composed primarily of invertebrates such as sea urchins, clams, and crabs, sea otters effect sea kelp density. They noted that sea otters faced an

increase in predation by killer whales. Killer whales feed on harbor seals and Stellar sea lions. These pinnipeds experienced a population decline linked to a decline in fish stocks. This led to the killer whales expanding their diet by feeding on sea otters instead. After facing increased predation, the sea otters faced a population decline, leading to an increase in sea urchin density. This led to an overgrazing of the kelp forests, causing a density decline. (Estes et al. 1998)

Gray whales (*Eschrichtius robustus*) have been known to play an important role in restructuring the benthos. A study conducted estimated that gray whales can turn over between 9% and 27% of benthic substrate annually in the northern Bering Sea. This causes a release of nutrients from deep waters (Kanwisher and Ridgway, 1983) and provides a habitat for juveniles of their prey (amphipods) and for other colonizing species. (Nerini 1984)

Roman and McCarthy (2010) proposed that marine mammals play a significant role in delivering recycled nitrogen back to the surface waters and released up to 77% of the nutrients used by mammals and birds.

A study conducted by Oliver and Slattery (1985) examined the effects that the feeding of gray whales had at sites in the Bering Sea and in British Columbia. They noted that at the sites observed, gray whale feeding although disruptive, led to various invertebrates settling in the feeding pits. They also noted that compared to adjacent, undisturbed sediments, the feeding pits had more abundant invertebrates and scavengers and for short periods of time, an increase of tube dwelling species. (Bowen 1997)

Marine mammals are also quite helpful when it comes to evaluating the health of aquatic ecosystems. They do so by acting as sentinel species ( *defined as organisms that are used by humans to detect risks by providing advance warnings* ). They can provide early warnings about anthropogenic impacts, both current and potential, on marine mammals and other marine organisms.

Sea otters, bottlenose dolphins and manatees have been described as the sentinels of coastal ecosystems. (Moore 2008) Moore also states that the polar bear and the ringed seal, both dependent on sea ice, act as the “ clearest examples of sensitivity to environmental change” (Moore 2008, Derocher et al . 2004, Stirling 2002) Polar bears are considered to be apex predators in their habitat (the Arctic) and are indicators of the health of the ecosystem.

In her paper, Moore utilizes gray whales as an example of a valuable sentinel mammal. After being removed from the endangered and threatened species list in 1994, a number of dead whales started appearing on Mexican beaches to the Alaskan migration corridor (in 1999 and 2000). The emaciated appearances of the stranded whales led to speculations about a decline in the benthic productivity. As profiles of isotopes and fatty acids in the blubber of whales can be used to gain insight about their diet, whales act as a sentinel species by reflecting the health of their ecosystems. Furthermore, their migratory patterns and distributive patterns can also act as indicators of their ecosystems. Whales can act as sentinels to a change that has been spanning a large area over a number of years. (Moore 2008)

The Southern Sea Otter is not only a keystone species (as mentioned above) but is also considered to be a valuable marine sentinel. Because of their habitats (shallow, coastal waters) and their feeding habits, any pathogens that they accumulate reflect the conditions locally. (Jessup et al. 2004)

Sea otters often prey on shellfish and benthic invertebrates, which can contain the contaminants and infectious pathogens that they [sea otters] seem to be susceptible to. Because the same shellfish that the sea otters eat are also harvested for human consumption, the overall health of the sea otter can have implications for human health as well. (Jessup et al. 2004) A decline in sea otter health is indicative of a decline in the marine ecosystem that supports the sea otter.

Understanding the role of marine mammals in their aquatic ecosystems is of great importance. In addition to acting as indicators of the overall health of their marine ecosystems, they also have impacts on populations of their prey, which can have a further impact on species lower in the trophic cascade. By observing the roles that these marine mammals play, the negative impacts of climate change can be observed, and strategies for conservation can be generated.

### References

1. Baum, J. K., & Worm, B. (2009). Cascading top-down effects of changing oceanic predator abundances. *Journal of Animal Ecology*, 78 (4), 699-714. doi: 10. 1111/j. 1365-2656. 2009. 01531. x

2. Bowen, W. (1997). Role of marine mammals in aquatic ecosystems. *Marine Ecology Progress Series*, 158 , 267-274. doi: 10.3354/meps158267
3. Derocher, A. E., Lunn, N. J., & Stirling, I. (2004). Polar Bears in a Warming Climate. *Integrative and Comparative Biology*, 44 (2), 163-176. doi: 10.1093/icb/44. 2. 163
4. Estes, J. A., Tinker, M. T., Williams, T. M., & Doak, D. F. (1998). Killer Whale Predation on Sea Otters Linking Oceanic and Nearshore Ecosystems. *Science*, 282 (5388), 473-476. doi: 10.1126/science. 282. 5388. 473
5. Jessup, D., Miller, M., Ames, J., Harris, M., Kreuder, C., Conrad, P., & Mazet, J. (2004). Southern Sea Otter as a Sentinel of Marine Ecosystem Health. *EcoHealth*, 1 (3). doi: 10.1007/s10393-004-0093-7
6. Kanwisher, J. W., & Ridgway, S. H. (1983). The Physiological Ecology of Whales and Porpoises. *Scientific American*, 248 (6), 110-120. doi: 10.1038/scientificamerican0683-110
7. Moore, S. E. (2008). Marine mammals as ecosystem sentinels. *Journal of Mammalogy*, 89 (3), 534-540. doi: 10.1644/07-mamm-s-312r1. 1
8. Nerini, M. (2012). Chapter 18: A review of Gray Whale Feeding Ecology. In *The Gray Whale: Eschrichtius Robustus* . Burlington: Elsevier Science.
9. Oliver, J. S., & Slattery, P. N. (1985). Destruction and Opportunity on the Sea Floor: Effects of Gray Whale Feeding. *Ecology*, 66 (6), 1965-1975. doi: 10.2307/2937392

10. Roman, J., & McCarthy, J. J. (2010). The Whale Pump: Marine Mammals Enhance Primary Productivity in a Coastal Basin. *PLoS ONE*, 5 (10), e13255. <http://doi.org/10.1371/journal.pone.0013255>
11. Stirling, I. (2002). Polar Bears and Seals in the Eastern Beaufort Sea and Amundsen Gulf: A Synthesis of Population Trends and Ecological Relationships over Three Decades. *Arctic*, 55, 59-76. Retrieved from <http://www.jstor.org/stable/40512420>
12. Wirsing, A. J., Heithaus, M. R., Frid, A., & Dill, L. M. (2008). Seascapes of fear: Evaluating sublethal predator effects experienced and generated by marine mammals. *Marine Mammal Science*, 24 (1), 1-15. doi: 10.1111/j.1748-7692.2007.00167.x