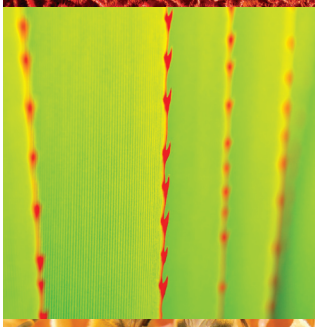
ECOREGION: PACIFIC ISLANDS



Set in the largest body of water in the world, the Pacific Islands are surrounded by an astonishing 63.8 million square miles of water.[1] The Pacific Islands are composed of the State of Hawai'i, the territories of Guam and American Samoa, the Commonwealth of the Northern Mariana Islands, the Republic of Palau, and the Federated States of Micronesia and the Republic of the Marshall Islands. Among the most remote and pristine of these islands, the Northwestern Hawaiian Islands include dozens of tiny islands, **atolls**, and **shoals** and are spread over more than 1,200 miles in the Pacific Ocean.[2] Various forces over thousands of years have shaped the landscape of the Pacific Ocean, which contains more islands and reefs than all the other oceans and seas combined—an estimated 20,000 to 30,000—as well as the deepest trench in the world.[3,4]

Nearly the entire rim of the Pacific Ocean basin is ringed with volcanoes and earthquake areas, which have helped to develop islands and coral reefs that provide an incredibly diverse array of habitat types for many species.[5] Island habitats include rocky cliffs, rivers, wetlands, and mountain forests.[6] Coral reef habitats form around these islands when free-swimming coral larvae attach to the submerged edges of islands. Developed coral reefs provide a dazzling underwater landscape that hosts many types of species, including fish and sea turtles.[7] Together, this array of habitats, from underwater coral reefs, to sandy, low lying beaches and mountain rainforests, is home to a list of species as varied as the landscapes they inhabit. Species that call these habitats home include birds such as shearwaters, petrels, and boobies, as well as fish such as sharks, bony fish, and rays.[8]

IMPACTS OF CLIMATE CHANGE

Climate change will affect all of the types of habitats present in the Pacific Islands ecoregion. Islands are at particular risk from sea level rise and more intense tropical storms because they are low-lying. It is estimated that global average sea level will rise between 0.6 and 2 feet in the next century.[9] The Northwestern Hawaiian Islands are especially at risk from climate change due to their concentration of endangered and threatened species. Most of these islands are low-lying and are vulnerable to increases in global average sea level. Further increases in sea level are anticipated due to thermal expansion of the warming oceans along with the melting of glaciers and ice caps. Sea level rise will flood many coastal Hawaiian areas, threatening habitat for the endangered Hawaiian monk seal along with sea turtles and millions of seabirds.[10]

According to the Intergovernmental Panel on Climate Change (IPCC), climate change impacts such as increased intensity of tropical storms, higher concentrations of carbon dioxide, and sea level rise will affect marine ecosystems such as coral reefs.[11] Increases in sea surface temperature of about 1 to 3°C (1.8 – 5.4°F) may cause more frequent coral bleaching events and widespread mortality. In addition, these climate changes are very likely to interact with existing stressors on marine systems, including nutrient loading, chemical pollution, and damage from tropical cyclones. For example, increased carbon dioxide concentrations may further decrease coral growth rates.[12]

SPOTLIGHT ON A SPECIES

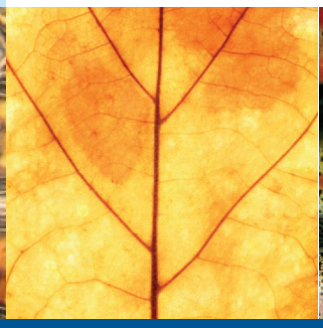
The Hawaiian monk seal, *Monachus schauinslandi*, gets its name from its solitary nature and because the folds of skin on its head resemble a monk's hood. This seal is one of the many species that live in the Pacific Islands and are being affected by climate change.[13] Occurring mostly in the Northwestern Hawaiian Islands, the monk seal relies on specific island habitats for raising its young and requires coral reefs and other marine habitats for finding food.[14,15] Because human activities and climate change threaten both of these habitats, the monk seal population has been decreasing and the seal is now one of the most endangered animal species in the world. It is estimated that there are only 1,200 individuals alive today.[16]

An adult monk seal is usually dark grey or brown with a light grey or yellow belly, and weighs anywhere from 375 to 500 pounds. Females are usually larger than males. The monk seal can live to be 25-30 years old.[17] Monk seals spend about two-thirds of their time in the water. They feed on a wide variety of reef fishes, eels, small octopuses, and lobsters.[18,19]

Due to their slow reproductive cycles, monk seal populations are not able to expand rapidly. Females give birth for the first time between the ages of five and ten, usually at the same site each year, and only to one pup per year. Monk seal births have been documented in all months of the year but are most common between February and

Have you ever seen a living fossil?

The Hawaiian monk seal is considered to be a living fossil because features of its body closely resemble those of a species of monk seal that existed along the East Coast of the United States 14 to 16 million years ago.

August.[20] Female seals prefer to give birth on sandy beaches near shallow water in order to protect newborn pups from large waves and sharks.[21]

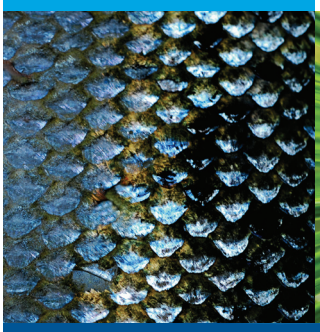
The seals' birthing cycle and their preferred reproductive sites make the loss of beach habitat due to storm erosion and sea level rise a big concern in the Northwestern Hawaiian Islands. Whaleskate Island is an example of the importance of high quality birthing sites. In 1963, Whaleskate Island was the second largest island used by Hawaiian monk seals. In the late 1990s, Whaleskate Island eroded and disappeared. Following this, Trig Island became the most common birthing site. However, pups did not survive well there because they were easy prey for sharks. It is thought that the crowding of females and pups onto Trig Island has increased the shark attacks.[22] Sea level rise is predicted to also shrink Trig Island and affect other island habitats as well, increasing the problems for monk seal survival in the Northwestern Hawaiian Islands.[23]

PROFILING A CLIMATE STEWARD

Every summer, kids ages 9 to 12 have the opportunity to join park rangers in *Keiki o Hawai'i Nei*, a fun-filled 3½ day exploration of Hawai'i Volcanoes and Kaloko-Honokohau national parks. This program helps kids understand and appreciate Hawaii's natural and cultural resources and is different every year.

On the first day in 2008, the kids went on a morning hike to explore the cultural uses of native plants at Kipukapuaulu—a forest oasis of rare endemic plants surrounded by Mauna Loa lava flows. In the afternoon, they visited Keauhou Bird Conservation Center, a San Diego Zoo-managed sanctuary for native Hawaiian birds. The second day, the group spent a full day exploring Kahuku Ranch, using global positioning system (GPS) technology. The third day, the kids monitored the sea turtle population at Kaloko-Honokohau National Historical Park on the Kailua-Kona coast. Finally, on the fourth day, they explored lava formations at Mauna Ulu—a small flank volcano formed near Kilauea's summit during a 1969 -1974 eruption.

Kids who participate in the program get a Hawaii Volcanoes National Park junior ranger badge, certificate, and a compass. They also get involved in protecting their




natural environment. Since climate change may threaten many of the plants and animals of the islands, it is important that kids learn how to identify and monitor them. Many of the species in Hawaii like the monk seal are only found in Hawaii and have adapted to very specific conditions. Even slight increases in temperature or sea level rise from climate change could threaten the species and their habitat. For example, rapid changes in sea level could affect coral species that typically live in shallow waters. Similarly, many of the native birds can only survive at certain temperatures and may have to move to higher elevation to adapt to rising temperatures.

In addition to the junior ranger program, Hawaii Volcanoes National Park has updated its school field trip programs to include climate change impacts in the park and is planning to start a Hawaii Climate Change Leadership Forum for kids. For more information, call the park's Education Center at (808) 985-6019 or visit their website at http://www.nps.gov/havo. Even if you don't live in Hawaii or can't participate in the program, there are plenty of ways to help!

FOR MORE INFORMATION

- The National Marine Sanctuaries website provides great information on the Hawaiian monk seal through an expedition log about seal research. http://www.sanctuaries.noaa.gov/missions/2006nwhi/log_070706a.html
- The National Oceanic and Atmospheric Administration's Ocean Service Education website includes a tutorial about atolls and how they form. http://www.oceanservice.noaa.gov/education/kits/corals/media/supp_coral04a.html
- The National Oceanic and Atmospheric Administration's Encyclopedia of the Sanctuaries gives an overview of the Hawaiian monk seal. http://www8.nos.noaa.gov/onms/park/Parks/SpeciesCard.aspx?pID=12&refID=1&CreatureID=1078
- The National Oceanic and Atmospheric Administration's Pacific Islands Fisheries Science Center includes a summary of current Hawaiian monk seal research. http://www.pifsc.noaa.gov/psd/mmrp/monkseals.php
- The Intergovernmental Panel on Climate Change (IPCC) is the definitive source of unbiased climate change science. www.ipcc-wg2.org/index.html

REFERENCES

1. Encyclopædia Britannica. 2008. "Pacific Ocean." Encyclopædia Britannica Online. http://www.britannica.com/EBchecked/topic/437703/Pacific-Ocean
2. National Oceanic and Atmospheric Administration. 2005. Encyclopedia of the Sanctuary: Northwestern Hawaiian Islands. http://www8.nos.noaa.gov/onms/park/Parks/?pID=12
3. United States Department of Commerce. 2007. Advancing NOAA's Priorities Through Regional Collaboration. http://www.ppi.noaa.gov/Regional_Collaboration/Regional_Overviews/PacificIslandsRegionOverview_042407.pdf
4. Encyclopædia Britannica. 2008.
5. United States Department of Commerce. 2007.
6. U.S. Fish and Wildlife Service. 2008. Pacific Region State Maps and Refuges. http://www.fws.gov/refuges/refugeLocatorMaps/Hawaii.html
7. National Oceanic and Atmospheric Administration. 2008. Coral Reef Information System. http://coris.noaa.gov/about/
8. National Oceanic and Atmospheric Administration. 2005.
9. IPCC, 2007: Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change [Parry, Martin L., Canziani, Osvaldo F., Palutikof, Jean P., van der Linden, Paul J., and Hanson, Clair E. (eds.)]. Cambridge University Press, Cambridge, United Kingdom, 1000 pp.
10. Baker, J.D., C.L. Littnan, and D.W. Johnston. 2006. Potential effects of sea level rise on the terrestrial habitats of endangered and endemic megafauna in the Northwestern Hawaiian Islands. Endangered Species Research, 4(1):1-10. http://www.pifsc.noaa.gov/library/pubs/Baker_etal_ESR_2006.pdf
11. IPCC. 2007.
12. Ibid.
13. U.S. Fish and Wildlife Service. 2008. Pacific Islands Fish and Wildlife Office: Endangered Species in the Pacific Islands. http://www.fws.gov/pacificislands/fauna/HImonkseal.html
14. Lowry, L. and A Aguilar. 2008. Monachus schauinslandi. In: IUCN 2008. 2008 IUCN Red List of Threatened Species. www.iucnredlist.org
15. U.S. Fish and Wildlife Service. 2008.
16. National Oceanic and Atmospheric Administration. 2008. Pacific Islands Regional Office: Hawaiian Monk Seal Report. http://fpir.noaa.gov/PRD/prd_hawaiian_monk_seal.html
17. U.S. Fish and Wildlife Service. 2008.
18. National Oceanic and Atmospheric Administration. 2007. Pacific Islands Fisheries Science Center: Hawaiian Monk Seal Report. http://www.nmfs.hawaii.edu/psd/mmrp/natural_hist.php
19 U.S. Fish and Wildlife Service. 2008.
20 Ibid.
21. Baker et al. 2006.
22. National Marine Fisheries Service. 2007. Recovery Plan for the Hawaiian Monk Seal (*Monachus schauinslandi*). Second Revision. National Marine Fisheries Service, Silver Spring, MD. 165 pp. http://www.fpir.noaa.gov/Library/PRD/Hawaiian%20monk%20seal/SHI%20MS%20Recovery%20Plan%20FINAL%20August%202007%20pdf.pdf
23. Baker et al. 2006.