From Land to Sea

Lesson at a Glance

Islands are connected to the water around them. Students will demonstrate the connections between the land and sea ecosystems.

Objectives

Students will be able to

- Describe both island and sea ecosystems.
- Identify animals that depend on both ecosystems and explain why.
- Make a diagram explaining the connections between land and sea.

Back Ground Information

The Northwestern Hawaii Islands are critical nesting and birthing grounds for the monk seal, turtles and hundreds of thousands of sea birds. The purpose of this activity is to help students understand the connections between the land and sea and how and why animals are dependent upon both ecosystems. See the student readings on the monk seals, the turtles and the sea birds for more information.

Materials needed

- Student Reading pages on the monk seal, turtle and sea birds
- Poster size paper
- Colored pens/poster making materials

Student Activities

Have students read the student reading pages on the monk seal, turtles and sea birds. Encourage them to do more research on the internet. Students are to collect information about these animals and the ecosystems they live in. Using the poster size paper, have them draw the island ecosystem and the surrounding reef and ocean ecosystem. Include the turtles, sea birds and monk seals. Show how these animals are dependent upon both ecosystems. Include any other land to sea connections. Encourage students to write creative stories about the trials and tribulations of some of these animals.

Think about the main Hawaiian Islands. What are some connections between the land and the sea? These could be from the animal point of view or an economical one.

Marine Turtles

English Name	Hawaiian Name	Scientific Name
Hawaiian Green Turtle	Honu	Chelonia mydas agassizi
Hawksbill Turtle	ʻEa	Eretmochelys imbricata
Leatherback Turtle		
Olive Ridley Turtle		

Marine turtles are air-breathing, cold-blooded reptiles that have become highly adapted for life in the sea. Powerful flipper-like limbs and a streamlined body make it possible for these gentle creatures to swim rapidly through the water. Green sea turtles are one of seven species of sea turtles; all of which are listed either as endangered or threatened. In Hawaii, there are four kinds of sea turtle: the endangered Leatherback, Olive Ridley, the Hawksbill and the threatened Green Sea Turtle.

The Hawksbill is known to nest on the Big Island, and the Green Sea Turtle has nests on all islands. The Hawaiian Green Turtle is the more abundant of the two species of marine turtles native to the Hawaiian chain. Green Sea Turtles are primarily vegetarians that feed on marine plants growing in shallow coastal waters. The turtle's common name comes from the color of the fat found inside its body rather than the color of the shell or skin. Most adult Hawaiian Green Sea Turtles are heavily pigmented on the upper surfaces, with some being almost completely black.

Although it is difficult to get an accurate count on how many green sea turtles are in Hawaii, it is believed to be under 1000 breeding females, substantially lower than in pre-Western contact times. Green Sea turtles are found throughout the Main Hawaiian Islands (MHI) and Northwestern Hawaiian Islands (NWHI). Although they historically have nested on all islands, due to beach development and other factors they tend to migrate between their main feeding grounds in the main chain to their breeding and nesting grounds in the NWHI.

In the months of May –September, female turtles who are at least 25 –60 years of age come ashore on quiet, undisturbed, dark, sandy beaches to nest. Nesting takes place on land where the female comes ashore at night several times during each breeding season to bury a clutch of leathery eggs. After crawling from the ocean, a nesting site is selected and excavation first takes place using the front flippers. They dig a pit a few feet deep, then a narrow, circular egg chamber another foot or so deep. The hind flippers then take over and working alternately, carefully scoop out a chamber to receive the eggs. After laying a clutch of around 100 ping-pong ball size eggs, the turtle covers the nest and returns to the ocean before the daylight makes her too warm. Each female will dig up to six nests each season, and 80-90% of all Hawaiian Green Sea Turtles make their nests at French Frigate Shoals. Its long, prehensile tail that extends beyond the hind flippers identifies the adult male. The female's tail barely reaches beyond the end of the shell.

After two months (60 days) of unattended incubation, the small hatchlings work as a group to dig to the surface, possibly attracted by the glimmer of light off the waves. They wait just below the surface until the sand cools down, usually at night, and scamper quickly into the sea. Each hatchling weighs about an ounce, and fits nicely into the palm of an adult's hand. When sexually mature, they will weigh between 200 and 375 pounds, and can be four feet long.

From the moment they emerge from the nest, hatchlings face a treacherous life journey. Ghost crabs, fish and sharks prey on hatchlings, and they can become entangled in vegetation or marine debris, and never make it to the water. Some hatchlings become confused, possibly by light on the beach, and travel the wrong direction, again never reaching the ocean. If the hatchling makes it to the water, it will feed on fish eggs, sponges and worms until it reaches adulthood, or about 14 inches. Adult turtles carry out periodic migrations, often over long distances, between resident feeding areas and beaches where reproduction takes place. The nesting beach is believed to be the same site where the turtle itself was originally hatched.

Green sea turtles have played an important role in Hawaii's history. They were used by the ancient Polynesians for food, tools and ornamentation. The ali'i held strict a kapu on Green Sea Turtles and the turtle population was very healthy. During the 1800's turtle hunters decimated the population, including the NWHI. Today, Green Sea Turtles are listed as threatened, which means they are protected from poaching, and harassment in U.S. waters. Green Sea Turtles need two basic habitats to survive. They need quiet, undisturbed beaches, which are dark at night for both basking and nesting, and undeveloped near-shore areas for foraging.

The Hawksbill Turtle is the second species of native Hawaiian marine turtle, but its range is confined to waters around the MHI. The Hawksbill is easily distinguished from the Green Sea Turtle by its pointed hawk-like beak. Also, the horny plates of the juvenile's shell clearly overlap one another. This characteristic often disappears in the adult. Hawksbill feed on crabs and other bottom dwelling marine invertebrates. Their specialized beak is used to probe into coral and rock crevices in search of food.

Two of the greatest threats to the survival of the Green Sea Turtle are marine debris and a disease called fibropapilloma. Marine debris, especially plastics are particularly hazardous to sea turtles. Turtles can become entangled in certain kinds of debris, and often mistake other kinds for food and ingest it. Cigarette lighters, ballpoint pens, and numerous other kinds of plastics have been found in the stomachs of turtles. Plastics can clog the digestive tract of marine animals, including turtles, causing the animal to either starve to death, or a fatal ulcer to form. Fibropapilloma is a viral disease, which causes large tumors to grow on turtles, often to a size that obscures their vision or interferes with avoiding predators and feeding. Scientists are struggling to research and find cures or preventative measures to halt the spread of this disease.

Himschoot, R. (1997). [Northwestern Hawaiian Islands National Wildlife Refuge: Environmental Educational Outreach Program]. Unpublished manuscript & raw data.

Monk Seals

English Name	Hawaiian Name	Scientific Name
Hawaiian Monk Seal	Ilio Holo I Kauaua	Monachus schauinslandi

Only two species of these rare marine mammals remain in the world. One inhabits remote areas of the Mediterranean Sea, and the other lives in the Northwestern Hawaiian Islands (NWHI). A third species formally existed in the Caribbean, but was forced into extinction during the early 1950's by an increase human use of the seal's habitat. The Hawaiian monk seal is considered endemic to Hawaii (other monk seals are a different species).

Monk seals travel over a wide range, but are not really migratory. They make several deep dives when foraging, sometimes-exceeding depths of 400 feet. Although residing in warm waters, monk seals nevertheless still possess a thick layer of blubber like the seals found in cold climates. The food of monk seals consists of eels, lobster, small octopus and reef fish which are captures at night. During the daytime, resting takes place on isolated and undisturbed beaches and rock ledges. Monk seals were listed as endangered under the endangered Species Act in 1976.

Monk seals live mainly in the Northwestern Hawaiian Islands (NWHI), but occasionally can be seen around the Main Hawaiian Islands (MHI). The population is now probably less then 1,200 and appears to be declining. Besides a ciguatera-related die-off around Laysan Island I the 1970's, it is believed the main cause of this decline is a lack of food. Entanglement in marine debris also costs many seals' lives each year. A behavior called "mobbing" has challenged survival rates among young seals, and many young seals are lost each year in shark attacks. Biologists are struggling to not only understand this cryptic and endangered seal, but to preserve the population with numbers which makes a wild population viable.

Monk seals begin reproducing usually around 5 to 6 years of age, and then usually will pup every two years. Between March and July, mother Hawaiian Monk Seals haul out on beaches of the NWHI to give birth to a single, fully developed black pup, weighing around 25 –30 pounds. In preparation for this event, the mother becomes extremely obese and may weigh over 600 pounds. Extra fat reserves are necessary to produce milk for the hungry pup and also to sustain the mother's own body. During the nursing period, she does not go out to sea in search of food, but rather stays continually with her offspring.

When the pup is a few days old, the mother takes it into the ocean for the first swim. Only the shallow protected waters close to shore are used. This is prevent the inexperienced pup from being swept away by strong currents and exposed to deep waters inhabited by sharks. Several swimming lessons a day are carried out for the duration of the nursing period.

With a continuous supply of rich milk, the pup grows rapidly, and its coat changes from black to silver gray. By the time five weeks have passed, the pup has increase from a birth

weight for 35 pounds to 140 pounds. During this period, the mother's reserves are depleted and she becomes very thin. Weaning takes place by her sudden and permanent departure from the island. From that day on, the young seal is on its own.

Biologists are concerned because they are finding many adult females who will pup when they're still too thin, so them the mother must wean the pup early in order to avoid her own starvation. However, the pup may not be fat enough to survive long enough to learn to forage. This cycle of starvation has cost may seals their lives, especially in the French Frigate shoals area of the NWHI. The normal life expectancy of a monk seal in the wild is 25 to 35 years.

For those pups that do survive weaning, there exists another immediate danger. Because the population of monk seals has become skewed, with a much higher number of males to females, young pups of both sexes are often "mobbed" by older males. Without their mother's protection, these pups can be overrun by adult males, and often will drown. In response to the mobbing problems in the NWHI, biologists relocated 22 male seals to the MHI in 1994. Although this has alleviated some of the stress on newly weaned seals on the breeding grounds of the NWHI, it has created a strong need for increased education among the public in the MHI as seal-human interfaces increases.

In addition, pups are largely defenseless against the tiger sharks, which live near the pupping beaches. The sharks will prey on the monk seals, turtle hatchlings and adults, and newly fledged seabirds, which land on the water and may struggle to take off again.

A number of seals are lost each year to entanglement in marine debris, especially fishing gear. Even if they are not drowned as a result of this entanglement, seals can either drag gear or become injured in attempts to free themselves. Dragging gear is not only exhausting, but can also impede free movement, making the seal susceptible to shark attacks or unable to feed. Injuries from entanglement can become infected and become fatal for the seal. Because of the high incident of seal entanglement, the Western Pacific Regional Fishery Management (WESPAC) established a Protected Species Zone in 1991, which encompasses the main foraging and breeding grounds of the Hawaiian monk seal.

Balazs, G. H. (1976). *Hawaii's Seabirds, Turtles and Seals*. Honolulu, HI: World Wide Distributors Ltd.

Himschoot, R. (1997). [Northwestern Hawaiian Islands National Wildlife Refuge: Environmental Educational Outreach Program]. Unpublished manuscript & raw data.

Seabirds of the Northwestern Hawaiian Islands

Seabirds have the same basic characteristics of other birds, which enable flight, but also have some additional adaptations to their marine environment, which make them quite different from terrestrial birds. Seabirds spend most of their lives at sea, coming to land only for breeding and nesting. There are around 30 species of seabirds in Hawaii, and many of them can only be found in the Northwestern Hawaiian Islands (NWHI). Biologists are hard at work ensuring the future success of these birds, as well as researching their lives histories in order to better understand them.

Like terrestrial birds, seabirds have hollow bones, feathers, and stream-like bodies, all of which make flight possible. Also like land birds, seabirds can, and many do, migrate many thousands of miles annually. Just as land birds, seabirds have specific bill adaptations to help them catch the food they eat. Finally, just as land birds, seabirds add to the food chain by becoming prey, depositing guano on land and in the ocean, or when they decompose, thereby adding or returning nutrients back to the cycle of life.

Since seabirds spend the majority of their lives at sea, they are adapted to a marine environment. They can eat, sleep and rest at sea, needing land only for a few short months to build a nest and raise their young. Seabirds possess a special gland behind their eyes, which desalinates saltwater, so that they can obtain drinking water from the ocean. They have webbed feet, which allow them to take off and land very skillfully on the water's surface. Many seabirds have their feet placed further back on their bodies, in order to use them to help propel themselves downwards during a dive, or to swim and dig burrows better in some species. Some seabirds also will use their wings to help them swim downwards during a foraging dive. Seabirds have monocular vision, useful in spotting both predators and prey.

Seabirds can live at sea only coming ashore to reproduce. In fact, the sub-adult birds of many species can stay at sea may years before they mature to a breeding age. Seabirds nest in colonies of a few hundred to several thousand and even millions of birds. Each species will usually live within a colony of its own, and each has its own kind of nest. For example, the albatross nest either on open, sandy area or in light vegetation, while many petrels and shearwaters dig out burrows and still other species, such as noddies, some bobbies, and frigatebirds build nests of sticks and twigs and other materials in the branches of low beach bushes. Most of the seabirds of the Hawaiian Islands rear their chicks together, with each parent taking turns either brooding the egg, and chick, or travelling sometimes great distances, out to sea to forage.

Seabirds vary from species to species a great deal. In general, however, it can be said they eat fish, squid, and floating materials such as fish eggs. They live anywhere from 5 to 45 years and can have a wingspan of a few inches up to 11 feet. They weigh from a few ounces up to several pounds and some nest only once a year, while others reproduce twice a year. Some seabirds in Hawaii are plunge divers some dip; some scavenge, and some even obtain a portion of their food requirements through pirating. All are threatened in many ways by human activities, and many of the seabirds found in the

NWHI can no longer be found on the Main Hawaiian Islands (MHI), except in small, remote colonies.

Although the threat of feather hunters (for use in stuffing pillows or adorning hats), or other hunters looking for seals, whales or turtles are no longer a great threat for seabirds, humans still impact them greatly. Food chain contamination, whether natural (ciguatera) or human-caused (DDT or agriculture runoff) effect seabirds, as they are very high up in the food chain. Disturbance of breeding and nesting grounds by humans is not frequent in the NWHI, but remains a problem for seabirds attempting to breed or nest on the MHI. Perhaps, the greatest threat to seabirds, and the most humanly preventable, is the entanglement in marine debris, especially plastics. Of particular threat is fishing gear (the NWHI is now a Protected Species Zone, since 1991, which limits fishing activities in the area), and plastic trash, such as soda rings and small, disposable cigarette lighter. All of these plastics have been found in the boluses of seabirds, and can be fatal through either ingestion, which can block the digestive tract or cause ulcers, or entanglement.

Biologists devote much time in the NWHI to the monitoring and study of the various seabirds found there. On Laysan Island, serious efforts have been made to eliminate introduced grass species, which erode nesting habitat, and out compete native vegetation. On Tern Island, most species of seabirds that nest there are banded and monitored for reproductive success. Banding helps scientist to observe, and identify individual birds, while giving information about site and mate fidelity, as well as age and migration of banded birds. Although the birds are generally left to the course of nature, if a bird has suffered a negative impact at the hands of humans (entanglement, oiling, etc.), refuge staff will make an attempt to assist the bird.

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Rauzon, M.J. (2001). *Isles of Refuge: Wildlife and history of the Northwestern Hawaiian Islands.* Honolulu, HI: University of Hawaii Press.

TenBruggencate, J. (1986). *The Honolulu Advertiser's Wildlife of Hawaii* (1st ed.). Honolulu, HI: The Honolulu Advertiser

Names of Sea and Land Birds of the NWHI

English Name	Hawaiian Name	Scientific Name
Albatross	ka'upu	
Laysan Albatross	moli	Diomedea immutabilis
Black-Footed Albatross		Diomedea nigripes
Short-Tailed Albatross		Diomedea albatrus
Red-Tailed Tropicbird	koa'e 'ula	Phaethon rubricauda
White-Tailed Tropicbird	koa'e kea	Phaethon lepturus
Blue-Faced / Masked Booby	'a	Sula dactylatra
Red-Footed Booby	'a	Sula sula
Brown Booby	'a	Sula leucogaster plotus
Great Frigate Bird	'iwa	Fregata minor palmerstoni
Common Moorhen	'alae 'ula	
Brown Noddy	noio koha	Anous stolidus pileatus
Black Noddy	noio	Anous minutus melanogenys
White-Capped Noddy	noio	Anous minutud melanogenys
Blue-Gray Noddy /Necker Island Tern		Procelsterna cerulea saxatilis
Sooty Tern	'ewa'ewa	Sterna fuscata
Gray-Backed Tern	pakalakala	Sterna lunata
White or Fairy Tern	manu-o-ku	Gygis alba
Bulwer's Petrel	'ou	Bulweria bulwerii
Dark-Rumped Petrel	'ua'u	Pterodroma phaeopygia
Band-Rumped Storm-Petrel	'ake'ake	Oceanodroma castro
Tristram Storm Petrel		Oceanodroma tristrami
Bonin Petrel		Pterdroma hypoleuca
Hawaiian Storm Petrel	oeoe	Oceanodroma castro cryptoleucura
Newell's Shearwater	'a'o	Puffinus puffinus newelli
Christmas Island Shearwater		Puffinus nativitatus
Wedge-Tailed Shearwater	'ua'u kani	Puffinus pacificus chlororhynchus
Laysan Duck		Anas wyvilliana laysanensis
Laysan Finch		Telepiza flavissima
Nihoa Finch		Telespiza ultima
Nihoa Millerbird		Acrocephalus familiaris kingi