

Coral Reef Habitats



Lesson at a Glance

Students will create/compare and contrast models of reef habitats found in the Northwestern Hawaiian Islands and the main Hawaiian Islands.

Objectives

Students will be able to:

- Describe different coral reef habitats
- Build models of reef habitats.

Background Information

Three hundred years ago, scientists thought corals were plants. They didn't seem to move around. They were more common in clear, sunlit waters. And, many of them grew into shapes reminiscent of bushes or trees. Today we know that corals are amazing animals. The coral that make up an important part of the solid structure of our reefs are actually colonies of thousands of individual animals that are connected to each other, and that build a framework to live in by extracting minerals from seawater. In this way they provide places to live for thousands of other kinds of reef organisms.

Corals are soft-bodied animals that share a similar body plan with their close relatives, jellyfish and sea anemones. Each of these animals has a sac-like gut with a single opening (the mouth) surrounded by a ring of tentacles. Imbedded in these tentacles are hundreds or thousands of tiny stinging cells that are used for defense and to capture prey. If the animal can use its body to swim around in the water (e.g. jellyfish) it is called a medusae, if the animal lives attached to the bottom (e.g. sea anemones) or to skeleton created by a colony (e.g. corals), then the individual animals are called polyps.

Most coral polyps are tiny animals, roughly the size of a grain of rice. But when many thousands of polyps are growing together in a colony, they can reach the size of a car. When many colonies grow next to and on top of each other, together with the algae and other organisms that make shells and skeletons that build up over time, the result is a coral reef.



Many corals have more than one way of getting the food they need to grow. With their stinger-lined tentacles, coral can capture tiny animals that drift by in the currents. This plankton includes tiny crustaceans and mollusks that you could barely see without a microscope, as well as the eggs and larvae of reef creatures. Corals also get food from a type of single celled algae that lives inside their tissues. These algae are called zooxanthellae and they have a symbiotic relationship with reef-building corals. Zooxanthellae use the energy from sunlight to convert water and carbon dioxide into sugar. The zooxanthellae use some of that sugar themselves, but much of it is available for use by the coral polyps that the algae are living in.

Corals come in many different shapes and sizes and have been given names like Brain coral, Elkhorn coral and Mushroom coral.

Reef building corals require certain water conditions in order to live and grow. These include water that is warm, clear and with salt content near the ocean average.

Materials Needed:

- Desk Size paper or bulletin Board
- Materials for creating corals. These could be made from pens and crayons or 3-D models.
- Materials for creating fish. (various types and colors of paper, pens, crayons etc)
- Pop-Up Reef worksheet
- Who am I? worksheet
- Fish Clues and Fish Colors worksheets.

Student Activities

This is a project for individual students, small groups or could be a class activity. The object is to create a coral reef ecosystem. This needs to include corals, algae, and animals you might find in a coral reef.

1. Create a Reef

Encourage students to make 2 separate models of reef ecosystems, one found in the Northwestern Hawaiian Islands and one from the main Hawaiian Islands. They need to start by doing some brainstorming of what they might find on these reefs. The videos will give them some

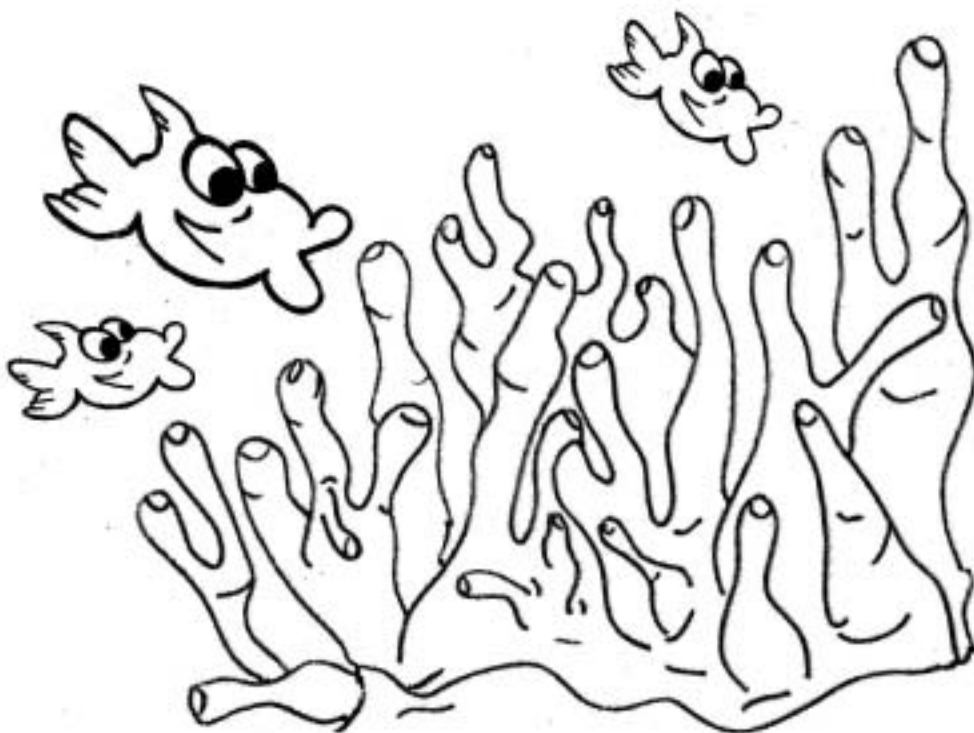


information. They may also want to check out the hawaiianatolls.org website and the Waikiki Aquarium's website for more information.

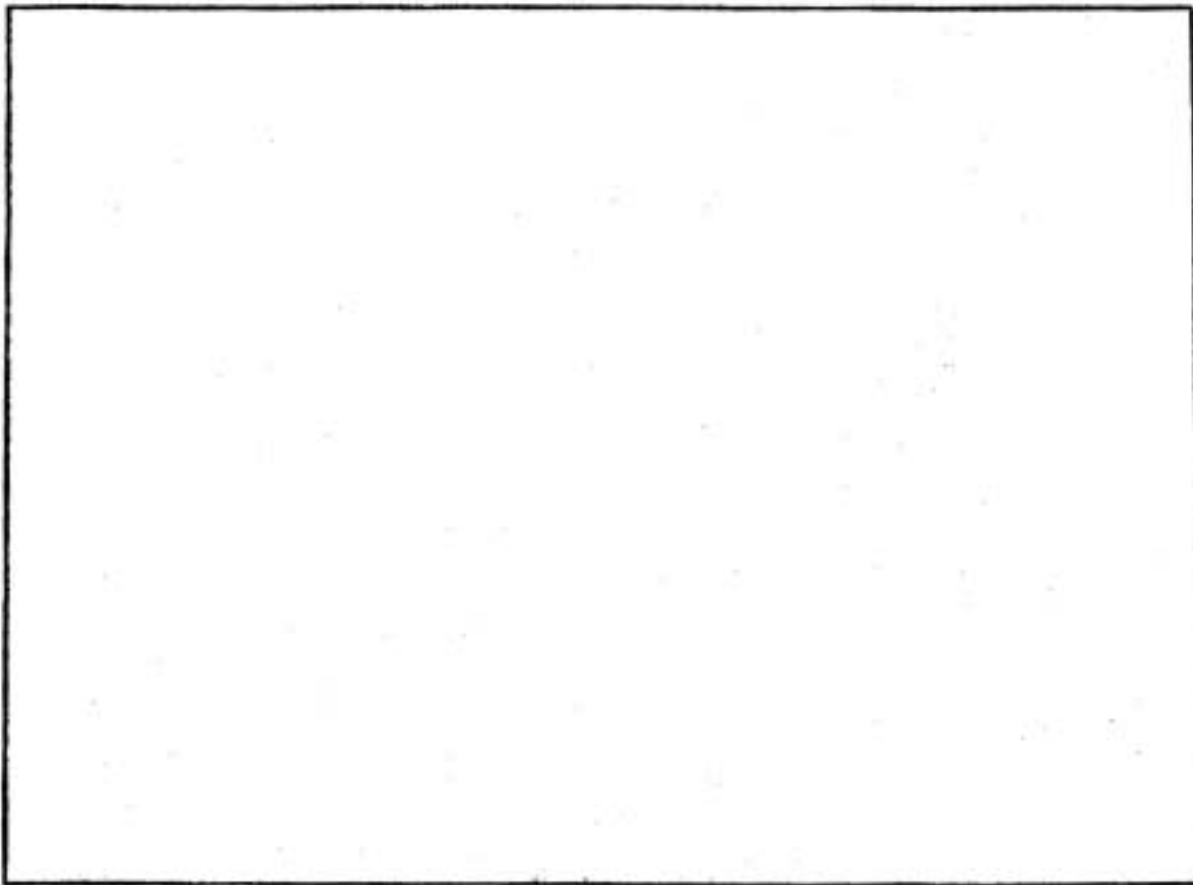
These models could be a poster, a bulletin board or a 3-D model. They need to include different types of corals, algae and different kinds of animals. Good line drawings of some of the corals and animals can be found on the kidscience.net website. Go to Kidstuff, then the Reef Detectives, then the Reef Critters.

Have students write about how the 2 different reef ecosystems are similar and how they are different. List things that might have caused the changes. List ideas of what can be done to protect the reef.

2. **Pop-Up Reef**.....see the attached worksheet for directions.
3. **Who am I?**...see the attached worksheet for directions.
4. **Fish Clues and Fish Colors**....see the attached worksheet for directions.



WHO AM I?



Pick a reef animal. Research its habits and environment. Draw a picture of the animal in the box.

I live _____ (where).

I prefer _____ (conditions).

I am made of _____ (structure).

I have _____ (physical adaptations).

I eat _____ (diet).

I hunt/forage/feed _____ (when/where).

I live _____ (life span).

I reproduce _____ (how, how often).

I am threatened by _____ (predators, environmental hazards).

"Pop-up Reef"

Materials Needed

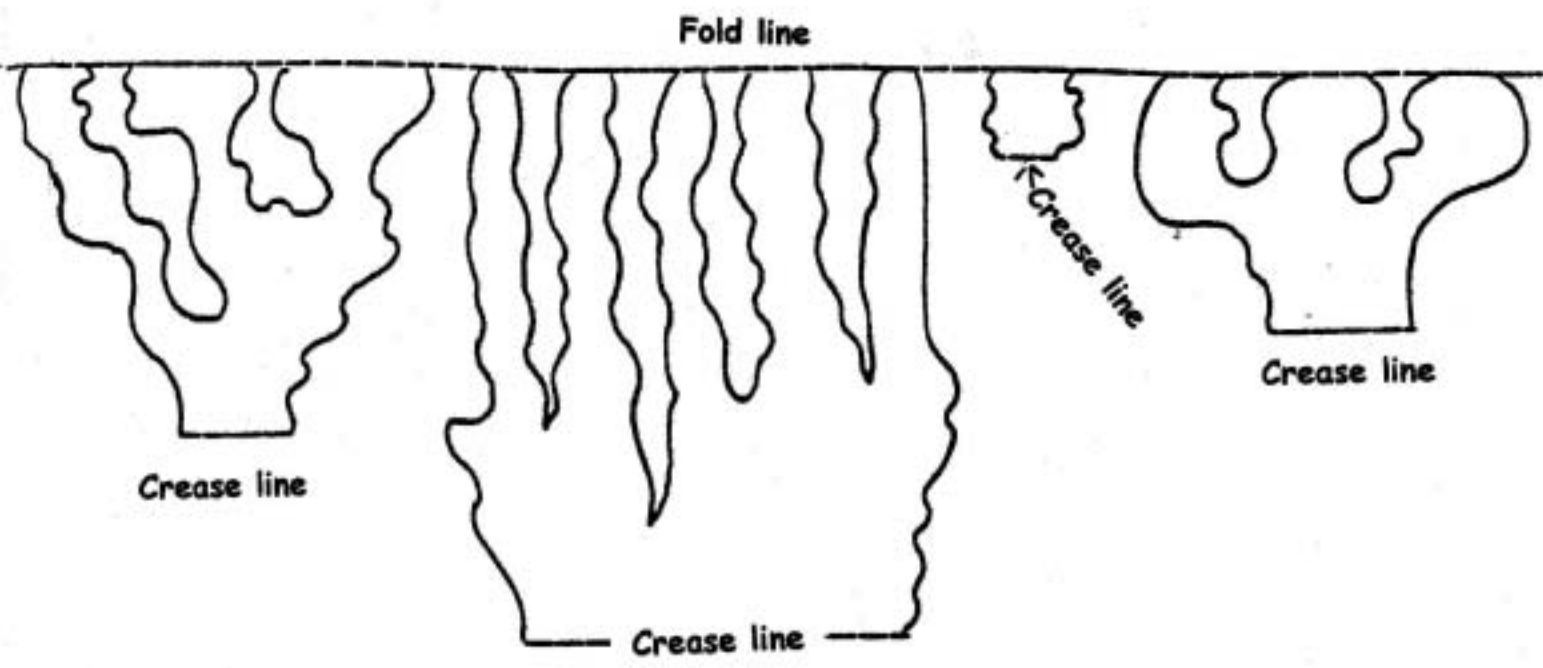
- Reef pattern
- Construction paper/2 sheets of different colors
- Scissors
- Glue
- Colored construction paper to create reef critters

Directions

- Place the reef pattern on top of a piece of construction paper.
- Fold both on the center dotted line fold that goes across the paper.
- Cut through both pages on the solid lines.
- Open the construction paper reef up and pop the cut out reef sections forward. Crease on the dotted lines. Keep working on it....it will become a 3-dimentional reef.
- Glue the flat un-popped parts of the popped out reef to another piece of construction paper.
- Create reef critters and algae and add them to the popped out reef.



Pop-up Reef Pattern



"Fish Colors"

Fish can protect themselves by using protective coloration, advertising coloration or camouflage. Color the fish. Name a fish that fits each category.

<u>Type of Coloration</u>	<u>Fish</u>
<u>Countershading</u> The top of the fish is dark and the underside is white.	
<u>False Eye Spots</u> A dark spot is found on the tail end of the fish. It looks like an eye and confuses predators.	
<u>Disruptive Coloring</u> The color pattern on the fish alters the shape making it hard to recognize as a fish.	
<u>Advertising Coloring</u> Some fish have a color pattern on them that tells the rest of the fish that they are the "good guys". They eat the parasites off of other fish.	
<u>Camouflage</u> Camouflage is the ability to protect yourself by blending in with your surroundings.	

"Fish Clues"

The body shape and fins can tell you a lot about where the fish lives and how they move. Read the clues and draw the fish. Can you name a fish for each body shape?

<p><u>Sphere</u> These fish can puff their bodies out with air or water to make themselves too big to swallow.</p>	
<p><u>Compressed</u> These fish are flattened from side to side, This makes them very thin and hard to see when viewed head on. The flattened body lets them dart in and out of the coral.</p>	
<p><u>Arrow Like Fish</u> These are ambush hunters. They float motionless till prey comes by and then lunge out and grab them.</p>	
<p><u>Football Shaped</u> This shape of tail enables them to be swift, powerful swimmers. They live in the open ocean.</p>	
<p><u>Flat-pancake-type-shape</u> These slow swimming fish burrow into the sand to hide. They can camouflage themselves.</p>	

CORAL



Coral are colonial invertebrate marine animals whose skeletons help to build up reefs. Corals are relatives of animals like jellyfish, but unlike them, corals are not free swimming. Coral reef ecosystems are some of the most productive, diverse, complex and beautiful places on earth.

Certain corals are called zooxanthellate corals, and are actually two creatures living together: a coral and a plant-like algae. Because the algae in zooxanthellate corals need light for photosynthesis, those corals are generally limited to shallow water environments less than 20 m (65 ft) deep.

The total number of coral species that live in the reefs of the Hawaiian Islands is relatively low. Scientists think that this is because of the isolation of the Hawaiian Islands. On the other hand, because of this isolation, a number of coral species live nowhere else on earth. Scientists estimate that more than 25% of the corals in Hawaiian waters are endemic.

The coral reefs of the Northwestern Hawaiian Islands (NWHI) encompass over 11,000 square kilometers of coral reef habitat, over 65 % of all coral reefs in the U.S. waters. The reefs are comprised of forty-seven species of hard coral and eight species of soft coral, a diversity that rivals the Main Hawaiian Islands.

Coral reefs are the foundation of an expansive ecosystem that hosts an interdependent association of vertebrates (i.e., monk seals, reef and bottom fish, turtles, birds, and sharks), invertebrates (i.e., corals, anemones, jellyfishes, mollusks, shrimps, crabs, lobsters, sea urchins, sea stars and sea cucumbers), sea grasses and algae.

Bishop Museum. (2002). *Life on Islands*. Join a Research Expedition to the Northwestern Hawaiian Islands. Retrieved May 22, 2002, from <http://bishopmuseum.org/research/nwhi/biology.shtml>

Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve. (2002). *The Region: The Coral Reef Ecosystem*. Retrieved May 10, 2002, from <http://www.hawaiiireef.noaa.gov/region/region.html>

Related Coral Sites:

Waikiki Aquarium <http://waquarium.otted.hawaii.edu/>
Hawaii Coral Reef Network <http://www.coralreefnetwork.com/>

ALGAE



Algae are photosynthetic organisms that can grow in a variety of places, ranging from hypersaline water to ocean water to freshwater. They vary from small, single-celled forms to complex multicellular forms, like kelps, seagrasses and seaweeds. In the Northwestern Hawaiian Islands, coralline algae is important in the formation of reefs. Many types of algae are used by humans for food (like the limu kohu, above), medicine and other products.

Algae are important as primary producers at the base of the food chain. Hawaiian Green Sea Turtles, for example, spend a lot of time gliding over the reefs, browsing on the seaweeds and algae there.

Algae also provide oxygen for other aquatic life. Unfortunately, with pollution or other environmental damage, algae reproduction may run amok and contribute to mass mortality of other organisms, in the case of algal blooms, for example (Bishop Museum, *Life on Islands*).

Algae & Sea Grass

Based on a 1989 report, approximately 205 known species of macroscopic algae exist for the Northwestern Hawaiian Islands, including Midway and Kure Atolls. Of this list, approximately 48 species are green algae (*Chlorophyta*), 33 species are brown algae (*Phaeophyta*), and 124 species are red algae (*Rhodophyta*). These numbers should increase dramatically with publications currently in preparation and the completion of the taxonomic identification of the 2,055 Northwestern Hawaiian Island algae specimens held by the Bishop Museum in Honolulu (United States Fish and Wildlife Services, *About the Northwestern Hawaiian Islands*).

Bishop Museum. (2002). *Life on Islands*. Join a Research Expedition to the Northwestern Hawaiian Islands. Retrieved May 22, 2002, from <http://bishopmuseum.org/research/nwhi/algae.shtml>

United States Fish & Wildlife Services. (2002). *About the Northwest Hawaiian Islands*. Honolulu, HI: Author.

MARINE INVERTEBRATES



(Photos by Keoki Stender)

Marine invertebrates include a number of very different types of animals: crabs, shrimp, lobsters, clams, sea urchins, starfish, snails, worms, clams, and many others. These animals make up many of the species that make the coral reefs of the Northwestern Hawaiian Islands such a diverse and interesting ecosystem.

Articles: October 11, 2000 - **WHAT ARE SPONGES?**

By Ralph De Felice

Sponges are the most primitive of multicellular animals (metazoa). They have a cellular grade, which means they have no true tissues. Adults are asymmetrical or radially symmetrical. Sponges are exclusively aquatic (water dwelling), most are marine. They are found from deepest oceans to the edge of the seam and from the coldest oceans to the tropics. Sponges play important roles in so many marine habitats but we still know very little about their diversity, biology and ecology as compared with most other animal groups. In many benthic (sea bottom) habitats sponges are often the dominant animals.

Sponges have an amazing range of growth forms, best described as highly irregular and sometimes completely plastic, frequently altered by prevailing external conditions (currents, turbidity, salinity etc.). Sponges come in just about every color imaginable. Adult sponges are sedentary (sessile), attached to the seabed or other substrate for most of their lives, although many have larvae that motile, swimming or crawling away from their parent. Sponges have sexes that are separate, or sequentially hermaphroditic, although most population dispersal and recruitment is asexual (through budding, fragmentation from storm events, etc). Larvae are motile, incubated within the parent or broadcast into the seawater.

Sponges filter sea water to eat, breath and excrete waste products. Sponges often have complex water canal systems running throughout the body, with smaller inhalant (ostia) and larger exhalant pores (oscles). Sponges are able to actively pump up to 10 times their body volume each hour, making them the most efficient vacuum cleaners of the sea. Sponges appear to be very stable, long-lived animals, although growth rates vary enormously between different groups. Some sponges can grow centimeters in weeks, and may have shorter life spans. Others sponges, like the living fossil 'sclerosponges' are VERY slow growing, with the largest known individuals (up to 30cm diameter) thought to be around 5,000 years old (which makes them the oldest living individuals on the planet, if this is true!).

FISH

There are probably more than 240 different species of fish that are found in the Northwestern Hawaiian Islands. This is roughly half the total number of species that are found in the Main Hawaiian Islands. Researchers believe this lower diversity is due to the smaller size of the islands and their surrounding reefs, cooler water temperatures, and a more limited variety of habitats to occupy.

The NWHI are home to an interesting behavior by some of the top predators in the ecosystem. While fledgling albatrosses are learning to fly in the summer months, the NWHI are visited by large numbers of Tiger Sharks. The sharks feed on the birds that can't stay aloft.

Many fish in the NWHI have been tested for ciguatera poisoning and some of the top predator fish are considered to be toxic. Ciguatera poisoning occurs when fish feed on certain types of algae that live in coral reef systems. As smaller fish are eaten by larger ones, the toxins gradually become concentrated in the muscles of the fishes at the top of the food chain.

The reef community is characterized by fewer herbivores, such as surgeonfishes and an increase in carnivores, such as damselfishes, goatfishes, and scorpionfishes. The Northwestern Hawaiian Islands are considered integral to fishes in the Main Hawaiian Islands as sources to replenish commercial and recreational fish and lobster populations.

Bishop Museum. (2002). *Life on Islands*. Join a Research Expedition to the Northwestern Hawaiian Islands. Retrieved May 22, 2002, from <http://www.bishopmuseum.org/research/nwhi/fish.shtml>

Northwestern Hawaiian Islands Coral Reef Ecosystem Reserve. (2002). *The Region: The Coral Reef Ecosystem*. Retrieved May 10, 2002, from <http://www.hawaiireef.noaa.gov/region/region.html>

Fish Links

Hawai'i Coral Reef Initiative Page of the Fish of Hawaii
<http://coralreefnetwork.com/marlife/fishes/fishes.htm>

Bishop Museum's Hawai'i Fishes page
<http://www.bishopmuseum.org/research/natsci/fish/fishimages.html>

Learn more about ciguatera poisoning
<http://www.emedicine.com/emerg/topic100.htm>

Fishes

Approximately 240 fish species were recorded in the Northwestern Hawaiian Islands during a comprehensive fish survey conducted by the State of Hawaii, Department of Land and Natural Resources in 1984. Compared to the 536 fish species known from the Main Hawaiian Islands, Hawaiian Islands National Wildlife Refuge (HINWR) has a relatively low species diversity. Researchers hypothesize that this is due to cooler water temperatures, the relatively small size of the atolls and the islands, and a more limited variety of habitats.

Nonetheless, HINWR reef fish populations are healthy, and the fish biomass is higher than in the Main Hawaiian Islands, due largely to reduced fishing pressures. All trophic levels are well represented, including jacks and several species of sharks. A unique occurrence, peculiar to the Northwestern Hawaiian Islands, is the increased presence of tiger sharks inside lagoons from June to August, which gather to feed on fledging albatross chicks. Pelagic fish species, found outside the lagoons, include yellowfin, albacore, and skipjack tuna; mahimahi; billfish; various sharks; and many others.

Ciguatera tests conducted in the Northwestern Hawaiian Islands identified *Cheilinus unifasciatus* as the most toxic fish species. The authors hypothesized that ciguatera may play a role in the downward population trend of endangered Hawaiian monk seal, although a shortage of prey may play a more important role.

Shallow Reef, Mid Reef & Open Ocean

Shallow Reef

English Name	Hawaiian Name	Scientific Name
Limpets	'opihi	
Periwinkle snail	pupu kolea	Littorina sp.
Nerite Snail	kupe'e	Nerita picea
Sea Lettuce	limu palahala	Ulva fasciata
Rock-Boring Urchins	'ina uli	Echinometra mathaei
Coralline Algae	manamana-ula	Porolithon gardineri
Hermit Crab	unauna	Aniculus maximus
Reticulated Brittlestar	pe'a	Ophiocoma brevipes
Christmas Wrasse	awela	Thalassoma trilobatum
Hawaiian Whitespotted Toby		Canthigaster jactator
Arc-eye Hawkfish	pili-ko'a	Paracirrhites arcatus
Black Tiggerfish	humuhumu'ele'ele	Melichthys niger
Oval Chromis		Chromis ovalis
Saddle Wrasse	hinalea lauwili	Thalassoma duperrey
Blue Coral	ko'a	Montipora flabellata
Antler Coral	ko'a	Pocillopora eyedouxii
Tiger Cowry	leho	Cypraea tigris
Slate Pencil Urchins	punohu	Heterocentrotus mammillatus
Manybar Goatfish	moana	Parupenus multifasciatus
Orange Tube Coral	ko'a	Tubastrea coccinea
Linckia Seastar		Linckia multifora
Triton's Trumpet	pu	Charonia tritonis
Cleaner Shrimp	opae	Lysmata amboinensis
Spotted Boxfish	moa	Ostracion meleagris
Slipper Lobster	ula papa	Scyllarides haani
Yellowfin Goatfish	weke	Mulloidichthys vanicolensis
Hawaiian Cleaner Wrasse		Labroides phthirophagus
Yellow Margin Moray Eel	puhi paka	Gymnothorax flavimarginatus
Bird Wrasse	hinalea'i'iwi	Gomphosus varius
Yellowtail Coris	hinalea 'akilolo	Coris gaimard
Ornate Butterflyfish	kikakapu	Chaetodon ornatissimus
Black Sea Cucumber	loli	Holothuria atra
Cauliflower Coral	ko'a	Pocillopora meandrina
Banded Coral Shrimp	'opae kai	Stenopus hispidus

Mid Reef

Orangeband Surgeonfish	na'ena'e	<i>Acanthurus olivaceus</i>
Reef Triggerfish	humuhumunukunukuapua'a	<i>Rhinecanthus rectangulus</i>
Hawaiian Sergeant	mamo	<i>Abudefduf abdominalis</i>
Hawaiian Dascyllus	alo'ilo'I	<i>Dascyllus albisella</i>
Bluefin Trevally	'omilu	<i>Caranx melampygus</i>
Convict Tang	manini	<i>Acanthurus triostegus</i>
Leatherback	lai	<i>Scomberoides lysan</i>
Pennant Butterflyfish		<i>Heniochus diphreuter</i>
Orangespine Unicornfish	umaumalei	<i>Naso lituratus</i>
Octopus	he'e maui	<i>Octopus cyanea</i>
Trumpetfish	nunu	<i>Aulosomus chinensis</i>
Potter's Angelfish	Anela i'a	<i>Centropyge potteri</i>
Hawaiian Anthias		<i>Psuedanthias thompsoni</i>
Yellow Tang	lau'i pala	<i>Zebrasoma flaescens</i>
Raccoon Butterflyfish	kikakapu	<i>Chaetodon lunula</i>
Hawaiian Squirrelfish	'ala'ihī	<i>Sargocentron xantherythrum</i>
Lobe Coral	ko'a	<i>Porites lobata</i>
Long-spined Urchins	wana	<i>Diadema paucispinum</i>
Goldring Surgeonfish	kole	<i>Ctenchaetus strigosus</i>
Spotted Pufferfish	o'opu hue	<i>Arothron meleagris</i>
Milletseed Butterflyfish	lauwiliwili	<i>Chaetodon miliaris</i>
Moorish Idol	kihikihi	<i>Zanclus cornutus</i>
Longnose Butterflyfish	lau wiliwili nukunuku oi'oi	<i>Forcipiger flavissimus</i>

Open Ocean

Short-winged flying fish	malolo	<i>Parexocoetus brachypterus</i>
Giant Trevellay	ulua aukea	<i>Caranx ignobilis</i>
Dolphinfish	mahimahi	<i>Coryphaena hippurus</i>
Portugese Man-o-war	pa'imalau	<i>Physalia physalis</i>
Mackerel Scad	'opelu	<i>Decapterus macarellus</i>
Yellowfin Tuna	ahi	<i>Thunnus albacares</i>
Tiger Shark	mano	<i>Galeocerdo cuvieri</i>
Spotted Eagle Ray	lupe	<i>Aetobatus narinari</i>
Whitetip Reef Shark	mano lalakea	<i>Triaenodon obesus</i>
White Coral	ko'a	<i>Cirripathes anguina</i>
Whitemargin Unicornfish	kala kea	<i>Naso annulatus</i>
Gray Reef Shark	mano	<i>Carcharhinus amblyrhynchos</i>
Fire Dartfish		<i>Nemateleotris magnifica</i>
Wire Coral	ko'a	<i>Cirripathes anguina</i>
Hawaiian Hogfish	a'awa	<i>Bodianus bilunulatus</i>
Smalltail Wrasse		<i>Pseudojuloides cerasinus</i>
Hawaiian Stingray	hihimanu	<i>Dasyatis hawaiiensis</i>
Peacock Razorfish	laenihi	<i>Xyrichtys pavo</i>
Amberjack	kahala	<i>Seriola dumerili</i>