

Take a Role in the Kelp Forest

Lesson by Pat Rutowski, Monterey, CA

Key Concept

1. Like forests on land, kelp forests are complex communities with many kinds of plants and animals.

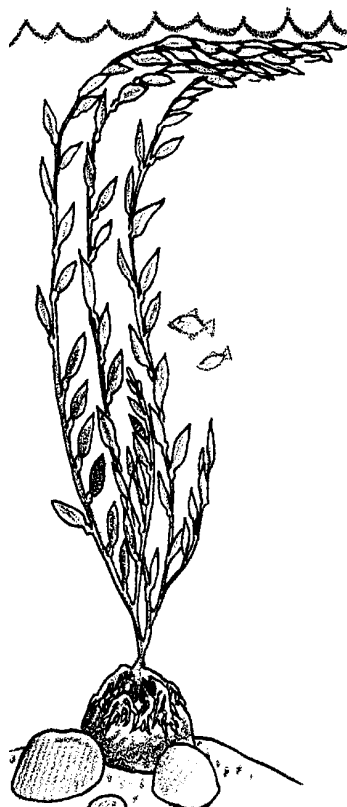


Background

Kelp forests are complex communities comprised of a great variety of interacting animals and plant. Scientists called ecologists study the three general types of relationships seen in the kelp forests:

- (1) relationships among organisms of the same kind;
- (2) relationships among organisms of different kinds; and
- (3) those between organisms and the nonliving environment.

Ecologists study these three types of relationships as they occur in a particular volume of space called an ecosystem. An ecosystem is composed of two major parts: the nonliving environment which



is the physical surroundings, and the living environment which is the biological community. The nonliving environment includes the energy, nutrients, and living space that members of the biological community require for their existence.

Physical Surroundings of a Kelp Forest

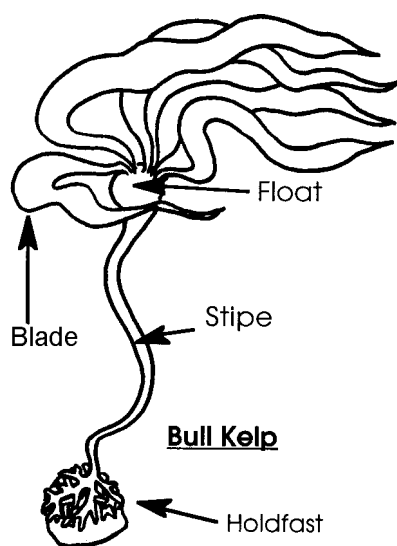
What are some of the physical components of the kelp forest ecosystem? Kelp forests grow in cool, nutrient-rich waters along temperate coasts. In general, the kelp plants do well where water temperatures do not exceed 70°F (21°C) during the year. This may be due to the relationship between water temperature and nutrient capacity: as temperature rises, the amount of nutrients dissolved in sea water decreases. Nutrients required by kelp forests include carbon, nitrogen, phosphorus, and other trace elements necessary for biochemical reactions. Kelp forests are found along the west coast of North America from California to Alaska. They are also found off the coasts of Chile, New Zealand, northern Europe, and Japan.

Water motion from currents and waves is also an important physical component. Kelp plants thrive near cool, nutrient-rich currents. During strong storms, water motion and shifting sand may be strong enough to rip plants right off the bottom, resulting in the tangling and death of many kelp plants. In general, kelp plants attach their holdfasts to rocky surfaces.

Kelp plants are consumers, organisms which manufacture their own food using the sun's light energy. If the water is cloudy, sunlight won't penetrate very deeply into the water and kelp plants won't be able to grow. Depending on water clarity, kelp can grow at depths between 10 and 100 feet (3 and 30 meters).

While the kelp forest is affected by the environmental conditions around it, so the growth of the kelp forest changes the physical environment. A dense growth of plants can provide protection against strong water motion. Kelp and other algae also provide living spaces for small organisms that hide among the holdfasts and blades. In addition, the hard surfaces left vacant when storms rip kelp away, provide new living space for small seaweeds and attached animals such as sponges and bryozoans to colonize. Kelp and other algae in the kelp forest also add oxygen to the water as they photosynthesize. The surface growth, or canopy, of kelp can influence the amount of sunlight that reaches the sea floor, which in turn influences the growth of other marine plants in the forest. In many ways the physical presence of the kelp plants influences the structure of the biological community.

The Biological Community of a Kelp Forest

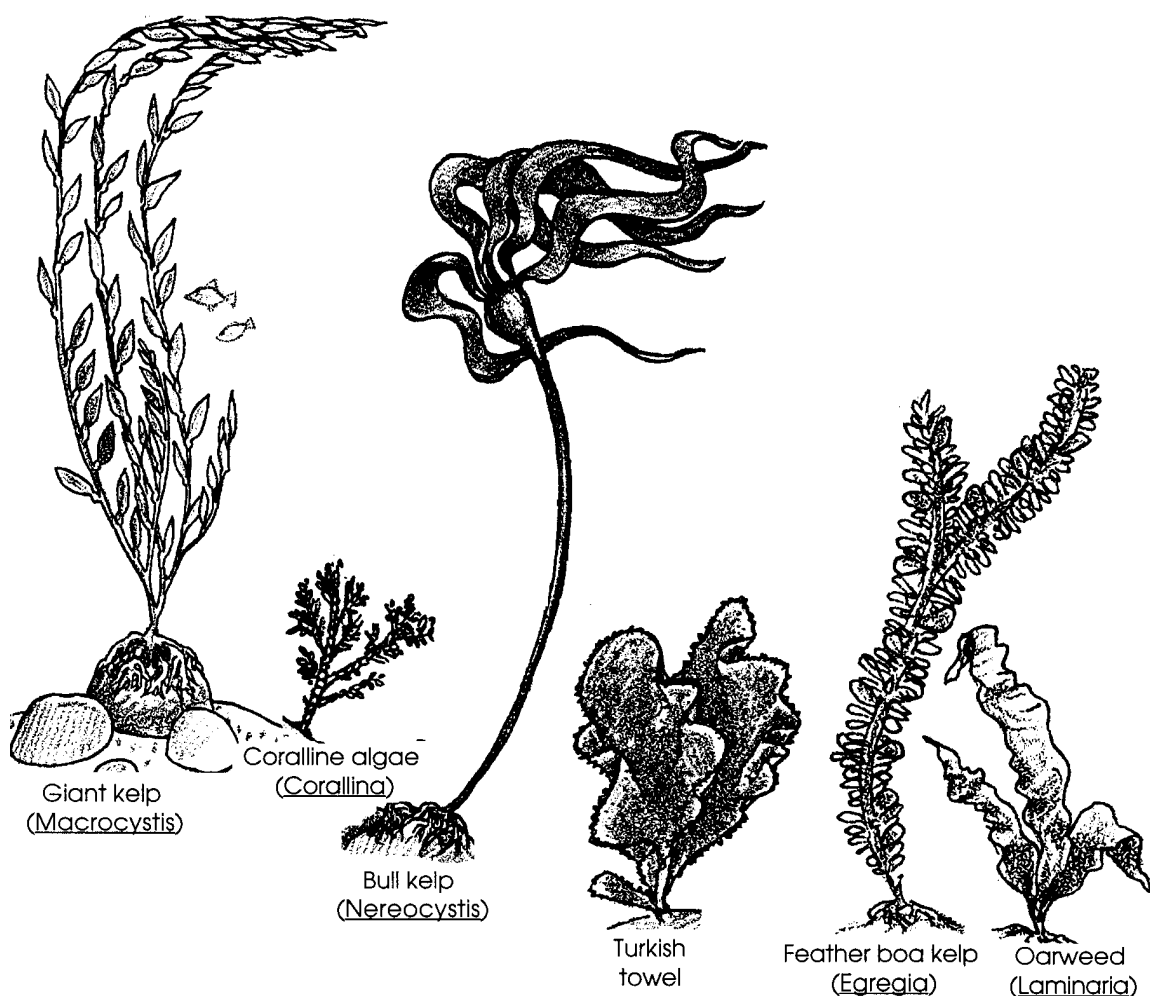


The largest and fastest growing plants in the world, kelp plants are well-suited for life near temperate shores. Since these seaweeds are bathed in seawater and the water contains the oxygen, carbon dioxide and nutrients the algae need, the algae are able to exchange nutrients and gases through any part of the plant. They do not need roots to pick up these materials from soil. The branched holdfast looks like a root, but it simply serves to attach the plant to hard surfaces.

Several fronds may grow from a holdfast. Each frond consists of a rope-like stipe with blades. During growth seasons, kelp fronds can grow more than 25 cm (10 inches) per day. The flexible stipe allows the frond to

bend with wave and current motion. The blades have floats which help keep the blades close to the water surface and sunlight. The blades also have a large surface area for capturing light energy. The large, wrinkled surface of the blade affects water flow and aids in gas exchange, nutrient absorption, and the ability to capture light energy.

Because kelp plants can photosynthesize (make food and oxygen), these producers are important members of the food web. Producers in the kelp forest include the phytoplankton (microscopic marine algae), kelp plants including giant kelp (*Macrocystis*), bull kelp (*Nereocystis*), oarweed (*Laminaria*) and feather boa kelp (*Egregia*), and red algae such as coralline algae (*Corallina*) and Turkish towel (*Gigartina*).



Important members of the food web of any ecosystem are the consumers, organisms that eat other organisms. These consumers depend on other animals and plants for their food source. Consumers fall into three categories: herbivores, carnivores, and decomposers. Each group has its own special way to obtain the energy and nutrients necessary for maintenance, growth, and

reproduction. Herbivores are plant eaters. Carnivores eat meat in the form of plant eaters or other meat eaters. Decomposers are organisms that use dead plant and animal materials as food. An example of a decomposer is bacteria. Decomposers play an important role in recycling nutrients. They break down organic substances (carbon containing compounds such as sugars), and use the energy and some of the nutrients stored in the “food”. They return the remaining nutrients to the environment where they are available for use by other animals and plants.

The consumers within a kelp forest feed on a variety of plant and animal life. Herbivores, or plant eaters, in a kelp forest include turban snails, kelp crabs, and some fishes such as the halfmoon and opaleye. They feed on a variety of algae found in the kelp forest. Broken fronds of kelp that drift to the bottom become food for abalones, sea urchins, and bat stars. Sea urchins graze on kelp and can strip a plant clean when present in the large numbers that sometimes occur when their predators, like sea otters, are scarce. Animals such as sea cucumbers, brittle stars, and tube worms feed on various drift algae that are broken down into finer pieces (detritus).

In a kelp forest, the carnivores, or meat eaters, include sea stars, rockfishes, crabs, sea otters, and sea lions. Other kelp forest organisms are plankton eaters. Some feed on phytoplankton (drifting microscopic marine plants), some on zooplankton (generally microscopic, drifting animals), and some on both. Plankton eaters include larval invertebrates, filter feeders such as barnacles, and juvenile fishes (e.g., rockfishes, seniorita, kelp and surfperch). Adult kelp bass feed on jellyfish that are swept by currents and trapped in the kelp forest.

In thinking about the biological community, keep in mind that kelp forest plants and animals select their environment. If they make a poor selection, they either don't survive or survive poorly. The distribution of life in a kelp forest occurs in layers along the kelp plants. The surface layer, or canopy, provides shelter and food for otters and shorebirds. Hydroids, bryozoans, turban snails, crabs and isopods live on the blades and stipes. Small fishes such as the seniorita and kelp surfperch, and shrimp-like mysids, and plankton can be found near and among the fronds. A variety of amphipods, brittle stars, sea urchins, crabs, colorful sponges, and the young of fish, clams, and octopus live within and near the tangled, rootlike holdfast. Nearby crevice dwelling animals include the red octopus and wolf eel.

Additional background information for this activity is found in the preceding activities “Algae are Plants, Too” and “Food Chains in the Kelp Forest”.

Materials

For the class:

- pictures of kelp forests and the animals that live there
- transparency, or copies, of “Who Eats Whom?” chart from the preceding lesson, “Food Chains in the Kelp Forest”

Teaching Hints

In “Take A Role in the Kelp Forest”, students investigate some of the many types of animals living in the kelp forest, focusing on how the kelp forest provides the varied habitats needed for survival of this diverse animal community.

Preparation

1. Collect pictures of the kelp forest.

Procedure

1. Divide students in groups of four or five. Distribute pictures of the kelp forest community to each group. Have students study the pictures and brainstorm ideas on how the kelp forest is, or is not, a good home for animals. Ask questions like:

What animals live in the kelp forest? (Snails and sea slugs find homes on the blades and stipe. Fish float among the fronds. Sea stars, clams, baby octopus, crabs, brittle stars and worms seek shelter in the holdfasts.)

How is the kelp forest a good home or habitat for animals? (Animals find food and shelter from predators and waves.)

How do animals avoid being seen in the kelp? (i.e., How are animals camouflaged in the kelp?) (They are the same color as the kelp, they float next to the blades and hide among them, they have shapes similar to those of the blades, they live right on its surface.)

What would happen if the kelp forests were destroyed by oil pollution, warming temperatures, too many consumers, or over-harvesting by people? (Answers will vary but will likely include that all of the animals that depend directly (or indirectly) on the kelp will either die, move away, or (if possible) change their life-styles.)

2. Ask each student to assume the character of one of the kelp forest animals and decide how the kelp forest is important to them. Have students present arguments (orally or written) for preserving the kelp forest from the perspective of the creature.

Key Words

biological community - the living environment; a group of organisms living together; any group of interacting organisms

blade - the large leaf-like surface of kelp algae where photosynthesis occurs

canopy - the surface layer of the kelp forest

conservation - in this case, management of a natural resource to prevent over-use and to ensure healthy populations for the future

consumer - organism that cannot produce its own food, but eats other organisms to obtain the energy necessary to sustain life

decomposer - organism that cannot produce its own food but breaks down dead material from which it derives its needed energy and nutrients

ecology - the study of relationships among and between living organisms and the nonliving environment

ecosystem - the nonliving and living environment in a given space

float - in this case, a gas-filled bladder at the base of a kelp blade

frond - the stipe and blades of the kelp algae

habitat - an animal's home where it can fill its basic needs for food, water, shelter, etc.

herbivore - an organism that feeds on plant material

holdfast - the rootlike structure that attaches kelp algae to a substrate

nutrients - minerals and other substances needed for life and growth

organic - composed of carbon compounds, usually referring to those existing in or derived from plants or animals

producer - organism that can make its own food, using inorganic nutrients and energy from the sun

stipe - flexible, rope-like structure where kelp blades attach

substrate - the base on which a sessile (nonmotile) organism lives or grows

Extensions

1. Compile the students' statements written in support of the kelp forest into a book entitled "Save our Habitat - Conserve the Kelp Forest". Read and discuss the book. Be sure to note that conservation means more than protecting a given plant or animal. Sometimes protecting a single animal can result in the loss of other animals (think about protected sea lions eating too many salmon) and that, often, an approach which protects the total ecosystem is necessary.
2. Create a skit in which each of the kelp forest animals plays a part.
3. As a class, create a "no-sew" Kelp Forest Quilt. Follow the directions as outlined by Jean Dinell and Suzy Kuokawa for the "Marine Habitats Quilt."

Marine Habitats Quilt

by Jean Dinell & Suzy Kuokawa


Objective: Create a visual, cooperative project using students' drawings of Marine Habitats.


Materials:


- 1) sq. of construction paper per student
- 2) crayons, paint (if you are water color resisting)
- 3) pictures, books, posters of Marine Habitats
- 4) CREATIVITY and ENTHUSIASM!


Procedure:


- 1) Each student chooses a marine habitat they would like to draw on their square.
- 2) Encourage various types of habitats. Show pictures, books and posters.
- 3) If you're doing a watercolor resist, have the students paint a blue wash over their drawing.
- 4) Glue the squares onto larger square and punch holes in the edges of larger square.
- 5) Sew squares together to form a quilt.
- 6) Enjoy the finished project!



DRAW



WATER-COLOR


MATTE


PUNCH HOLES + Sew together


HANG...


and ENJOY!!



great for Achievement Fairs,
display in Hallways and
classrooms!