

Marine Biology

An Introduction to Ocean Ecosystems

SECOND
EDITION



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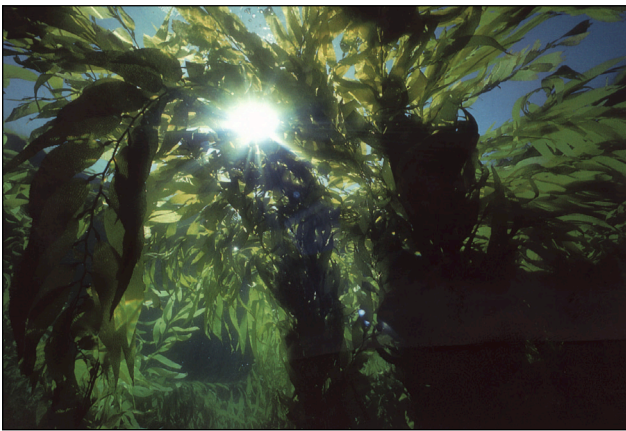
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Swaying peacefully in the cold, sunlit waters of our Pacific coast are the forests of the sea. Giant kelp forms the trees of the forest while a vast array of other protists, plants, and animals dependent on the kelp complete the community. Conditions required for kelp to grow are uncommon, as the huge, fast-growing organisms require sunny, cold waters to thrive. Only in certain parts of the Pacific coast of the Americas and in limited areas off the coasts of Australia, New Zealand, and South Africa are they able to grow.

The Structure of Kelp



Sunlight filters through giant kelp blades in this kelp forest off the coast of California.

Anchoring itself to the rocky ocean bottom with rootlike structures known as **holdfasts** (with branches called **haptera**), the kelp can reach 30 meters toward the surface, sometimes growing one meter in a single day. Large, simple blades, which are leaflike in structure, gather sunlight and convert it to sugars through photosynthesis. An air bladder, or **pneumatocyst** (new MA toe sist), is filled with gases and keeps the blade afloat, maximizing its light-gathering potential. Many blades grow together at the top of the kelp and form a canopy

at the water's surface. Like the canopy in a terrestrial forest, this is the most productive part of the kelp. A narrow stipe, or stemlike structure, transports nutrients from the blades in the sunny canopy to parts growing farther down in shadowed waters.

Kelp reproduces by alternation of generations. The kelp produces spores that settle to the bottom and grow into microscopic egg- or sperm-producing structures. The mobile sperm swims to the egg and produces a zygote, which grows into a new kelp.

Invertebrates of the Kelp Forest

Each individual kelp organism supports a large and interesting community of animals. It is along the stipe and blades and within the holdfasts that these animals find food and shelter. The kelp forest has its share of animals that feed directly on the kelp, and others that feed on these herbivores.

The top snail is a kelp eater, and the holes in the blades and stipe of the plant testify to the snail's appetite. Other animals attach themselves to the blades but do not eat the kelp. The tiny colonial bryozoan reaches tiny stinging tentacles outward to gather its prey of plankton from its stationary position on a kelp

blade. Perfectly camouflaged, kelp crabs and decorator crabs scurry about on the blades and stipe, scavenging for food.

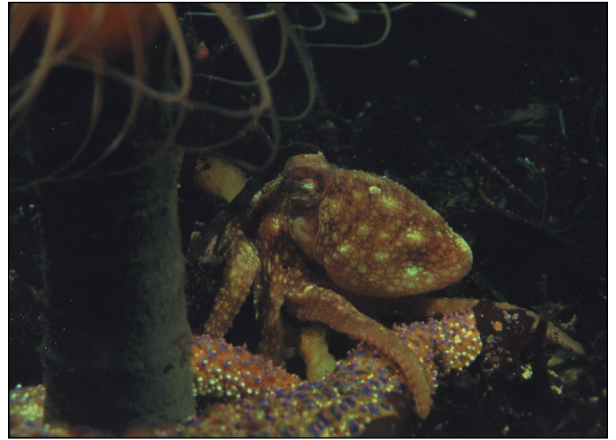
Within the holdfasts, numerous invertebrates, including brittle stars, crabs, sea stars, and worms, find shelter from predators. Some will live out their lives here, but others, like the sea stars and crabs, remain only while very young and small. They will move on when they are large enough to brave life in the kelp forest.

1. Why would holdfasts provide the perfect habitat for juvenile invertebrate animals?
2. How is kelp similar to a tree in a terrestrial forest? How is it different?

Other invertebrates are associated with the kelp forest because they live nearby. The octopus, considered the most intelligent of all invertebrate animals, is one of the most interesting. Capable of living in several other marine habitats, this fascinating animal frequents the rocky areas on which kelp is able to grow. Characterized by eight tentacles with responsive suckers, this mollusk has lost all but a tiny remnant of its shell and is known for its skill in camouflage. It is further classified in the class Cephalopoda, meaning “head foot”; it has undergone an evolutionary process over time known as **torsion**, in which the head and foot region have moved to the same area of the body.

The octopus has a compound eye that is very similar to the mammalian eye and allows it to see very well. This allows the animal to match its surroundings with specialized cells at the surface of its skin. The cells expand and contract to match nearby colors. Octopi also show their mood with color, flushing bright hues when angry or excited and bleaching white when frightened. They are also able to create the illusion of a sharp, bumpy skin texture when predators are near, which presumably makes them appear distasteful. Should this fail to dissuade a predator, the octopus releases a jet of dark ink, hiding its escape.

Octopi enjoy crabs, which they break open with their strong beak, but will feed on other small prey as well. Leading solitary lives in burrows dug in the sediment of soft bottoms or in rock crevices near the kelp forest and other habitats, they emerge only to hunt and mate. Mating requires cooperation between male and female as the male must insert a specialized tentacle into the **siphon** of the female. Once the sperm is deposited, the male departs, but sometimes a portion



The octopus explores rocky crevices with its eight arms—ready to grasp any unfortunate shrimp or crab it encounters.

of the tentacle remains within the female's body. Fishers used to think the piece of tentacle was a parasitic worm as it was found in some animals, but not others. The female lays her fertilized eggs in a safe shelter where she can guard them and oxygenate them. She will remain with the developing young until they hatch, but she will not eat. After the young hatch and join the plankton, the female will go off by herself and die.

Fish of the Kelp Forest

Animals other than invertebrates also make their homes on the kelp plants. A keen eye can spot beautifully camouflaged animals, such as the giant kelp fish, beside a blade. Moving with the blade as it flows with the swell, this fish is nearly indistinguishable from the kelp itself and can approach kelp crabs and other small prey without being noticed. Larger fish in the forest which prey upon them are similarly tricked. Small schools of señoritas dart nervously from the shelter of the blades to grasp at small passing prey, but they quickly return. Having evolved perfect cryptic coloration, many kelp forest animals make hiding within the shadows of the canopy a way of life.

Not all kelp forest animals choose to hide, however. One of the most flamboyant and well-known is the garibaldi, a bright orange bony fish that lives along rock reefs near the kelp forest. It is seemingly unaware of divers and appears to be curious, often approaching within a meter or even centimeters. What is more likely is that the animal is anxious about its territory, which it defends for food and for its developing young, and wants to let its presence be known. Juvenile members of the species can be identified by the presence of small neon-blue spots, which are sometimes carried into adulthood. The bright colors of this inhabitant add color and richness to the forest landscape.

Several other species of fish live within the forests. The wide-mouthed cabezon, the halibut, the kelp bass, the opaleye (named for the pearly color in its eyes), the Pacific sardine, the blunt-snouted sheephead, and the tubesnout are all examples of interesting kelp forest fish.

3. What is the advantage of camouflage?
4. Could an animal adapted for a camouflaged life in the kelp forest survive elsewhere? Explain your answer.

Birds and Mammals of the Kelp Forest

Few birds are associated exclusively with the kelp forests, but some, like cormorants and winter loons, can be seen resting at the surface near the forest canopy and diving periodically in search of small fish to eat. Western grebes, which rise up out of the water in a courtship dance, are also found here.