

True Plants

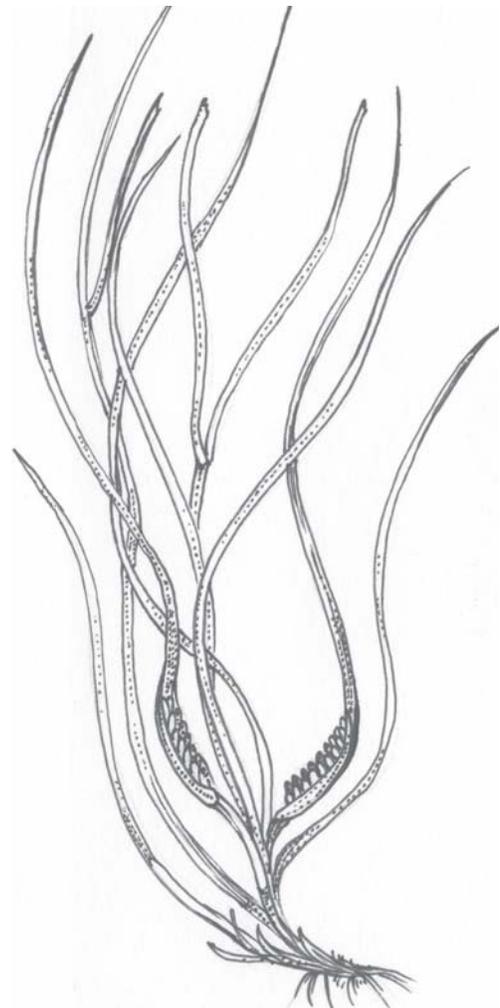
The kingdom Plantae includes green plants such as ferns, mosses, grasses, trees, and flowering plants. Some true plants produce flowers; others don't. The plants with which we are most familiar are the vascular plants. The term "vascular" refers to systems of tubes that carry fluids within an organism. Our blood vessels are our vascular tissues.

Vascular plants have roots that absorb water and nutrients from the soil. These are carried to the leaves by vascular tissue (xylem) in the stem. The leaves, in turn, use sunlight through the process of photosynthesis to produce food (sugar), which is carried throughout the plant by other vascular tissue (phloem).

There are, however, few marine vascular plants. The most common vascular plants in the rocky intertidal zone are two species of *Phyllospadix*, commonly called surf grass. "Eelgrass," *Zostera*, is found more commonly in quiet areas such as bays and marshes.

While *Phyllospadix* is not a true grass, it does have vascular tissues, roots, stems, and leaves, and it produces flowers. Pollination takes place under water. It looks like a grass with long, tough, dark green blades.

When submerged, *Phyllospadix* is supported in an upright position by the water. When exposed, however, it collapses, commonly forming a grass-like mat on intertidal rocks.



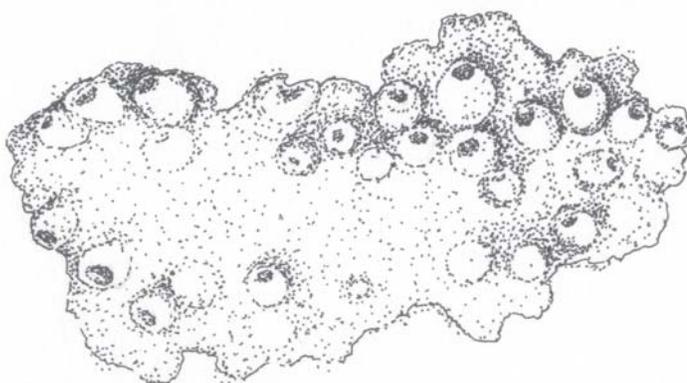
Surf Grass (*Phyllospadix* spp.)
30 to 50 cm (12-20") tall
zone 4

Common Animals

Phylum Porifera - sponges

Several kinds of sponges can be found in Mendocino coast tide pools. Most form thin sheets that may cover several square feet of rock. Many are pink, red, or purple. They feed on plankton and detritus. Occasionally an erect sponge such as the cream colored *Leucosolenia* may be found in deeper areas of the tide pools.

Haliclona is an encrusting sponge up to 4 cm (1 ½") thick, and may be from lavender to purple in color. There are volcano-like holes through which water exits the sponge after entering through tiny openings in the rest of the sponge. Sponges feed on food filtered from the water. They are soft, but not slimy.



Encrusting Sponge (*Haliclona* sp.)
up to 4 cm thick x 90 cm wide (1.5" x 36")
zone 3-subtidal

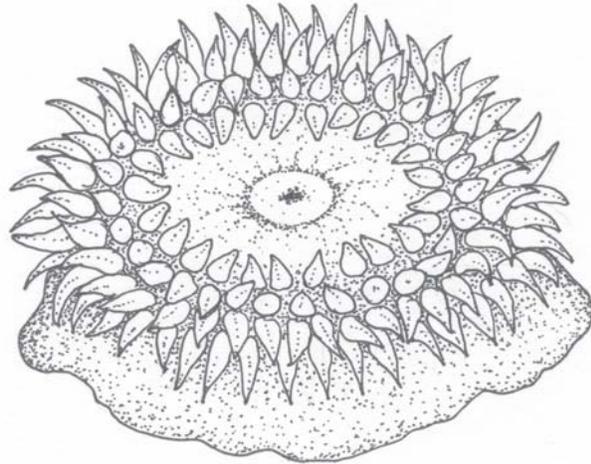
Phylum Cnidaria - jellyfish, sea anemones, corals, and their relatives

The cnidarians are characterized by having a digestive system consisting of a sac-like body cavity with a single opening. Food enters and waste exits through the same opening. Their most unique characteristic, though, is the “stinging cells” or cnidocytes. These tiny cells shoot harpoon-like nematocysts that inject their prey with a paralyzing poison. Some species such as the Portuguese Man-Of-War can be very painful or even deadly. Fortunately, local species are not so dangerous. “Jellyfish” don’t generally live in the intertidal areas, but they may be found washed up there.

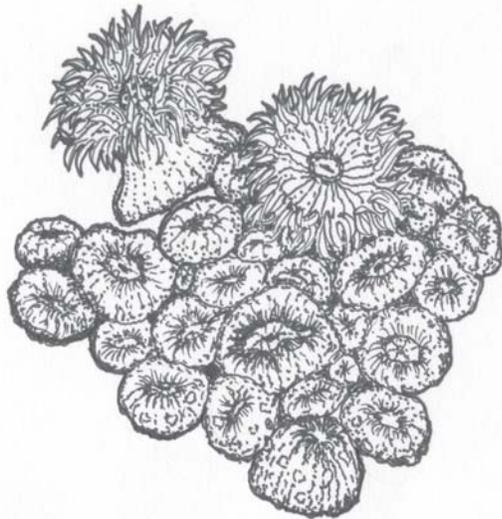
Several types of sea anemone occur intertidally. The most common are the giant green and the aggregating anemones. Anemones feed by stinging prey such as small crustaceans or fish that come in contact with their tentacles. They then pull the food into their central body cavity where it is digested. When they open up again, the waste is washed away by water action.

Cnidaria (continued)

The giant green anemone (*Anthopleura xanthogrammica*) can be up to 30 cm (12") in diameter and 30 cm (12") tall. It is found in low tide pools attached to rocks. It may be partially covered with bits of rock and shell fragments. The green color is due in part to algae that live within the tissues of the anemone.



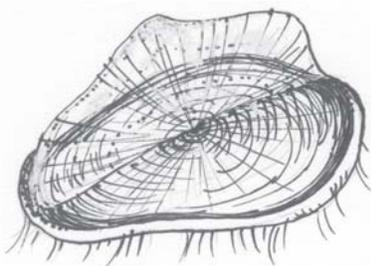
Giant Green Anemone
(*Anthopleura xanthogrammica*)
to 30 cm (12") tall and 30 cm (12") across
zone 3 to subtidal



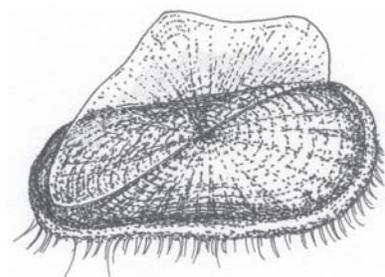
Aggregating Anemone
(*Anthopleura elegantissima*)
individuals to 5 cm (2") across
zone 3

Anthopleura elegantissima is the aggregating anemone. They often form a squishy layer that looks like sand covering rocks in the mid-intertidal zone. These large colonies, which may cover several square meters, are made up of clones of individual animals up to 5 cm (2") in diameter. They were formed by the process of budding, in which an individual anemone splits into two, forming two new individuals. The sand and rocks that cover the aggregating anemone may protect it from sun and drying at low tide - a natural sunscreen!

Thousands of the jellyfish-like by-the-wind-sailors (*Verella*) are often found washed up on Mendocino beaches. These are generally considered to be colonies of animals that form a cellophane-like sail.



By-The-Wind-Sailor
(*Verella varella*)
about 6 cm (2.5") long
wash up from pelagic zone
(ocean)

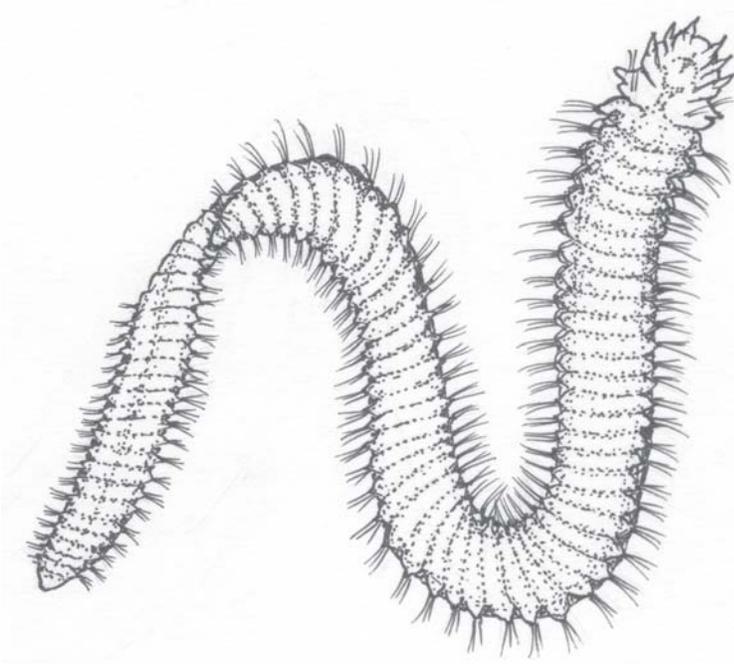


Phylum Annelida - segmented worms

Worms are generally classified into three groups: flat, round, and segmented. While there are many flatworms and round worms that live in the intertidal zones, students are most likely to find various segmented worms.

An important group of segmented worms is the polychaete group, sometimes called bristleworms. Some of these move about freely, while others build tubes of calcium, leathery mucus, or sand and mucus. Many polychaetes have biting jaws and/or tentacles on the head. Many of the tube worms are tube-dwelling filter feeders, with feathery tentacles.

The little white tube worm *Spirorbis* is commonly found on kelp blades, rocks, or the shells of mussels or other organisms in the mid to low tide zone. The shell is a small white coil up to about half a centimeter (1/4") across. Red-orange gills might be seen protruding from the opening if the animal is underwater.



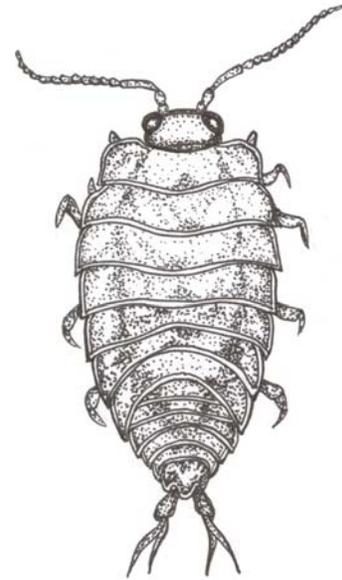
A common polychaete worm is the mussel worm (a.k.a. bristle worm, pile worm, clam worm), *Nereis*, which can grow to 30 cm (1') long during its reproductive phase. It can be found well hidden among barnacles and mussels, and under rocks throughout the intertidal zones. The biting mouth parts are normally hidden in a sheath.

Bristle Worm (*Nereis* sp.)
to 30 cm (12") long
various zones, depending on species

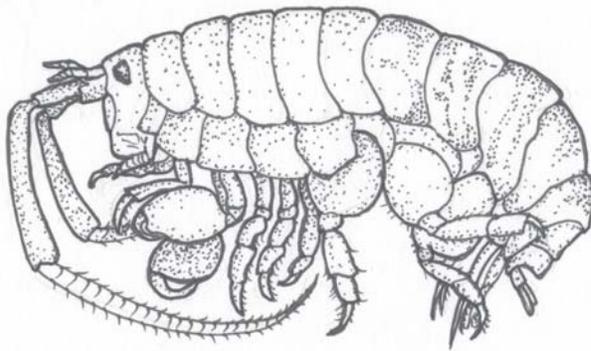
Phylum Arthropoda - joint-footed animals - crabs and their relatives

Arthropods are the “joint-footed” animals. They have an exterior skeleton (**exoskeleton**) and jointed **appendages**. They are a wide ranging and varied group which includes insects, spiders, sow bugs, crabs, shrimp, and many other familiar organisms. Few insects or spiders live in the tide pools, but crustaceans such as crabs are well represented.

A common crustacean at the beach is the “rock louse,” *Ligia*. It is classified as an isopod, indicating that all of its feet or legs (-pod) are similar (iso-, as in isosceles triangle). (The terrestrial sow bug and pill bug are isopods.) These flattened crustaceans resemble cockroaches. Rock lice stay above the tide zone and can often be found scurrying among the rocks scavenging for food. Other isopods are more commonly found in clumps of algae and under rocks. They breathe air, but must keep their gills moist.



Rock Louse (*Ligia* spp.)
2.5 cm (1") long
zone 1



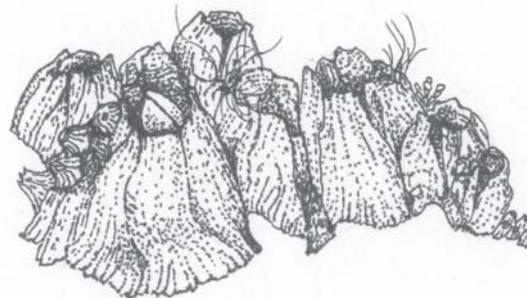
Beach Hopper (*Megalorchestia* spp.)
to about 3 cm (1.25") long
zone 1

Closely related to isopods are amphipods, which have longer legs at both front and back. Amphipods are generally taller than they are wide. Most common are the “beach hoppers” of the genus *Megalorchestia* (formerly *Orchestoidea*) and “sand fleas” (genus *Trekorchestia* [formerly *Orchestia*]).

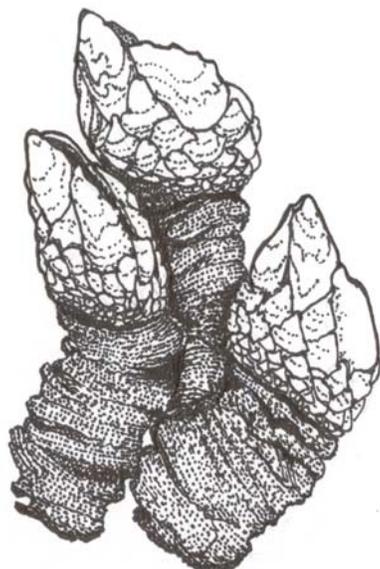
Anthropoda (continued)

Several kinds of barnacles can be found in the intertidal zone. Barnacles are essentially crustaceans that, as immature animals called larvae, attach the back of their heads to rocks or other substrata and spend the rest of their lives using their feathery “feet” to sweep the water and kick food such as plankton into their mouths! Two of the more common types are the acorn barnacles (*Balanus*) and the stalked barnacle (*Pollicipes*).

Acorn barnacles (*Balanus*) and the smaller “buckshot barnacles” (*Chthamalus*) resemble little volcanoes. The “volcano” is made up of plates that can be closed tightly when the animal is threatened or exposed to the air at low tide. This ability to close tightly enables them to live fairly high up on the rocks in the splash zone. The small (6 mm diameter) buckshot barnacle can reach a population density over 60,000 per square meter!



Acorn Barnacle (*Balanus* sp.)
to about 2 cm (3/4") wide
and 1 cm (3/8") high
Chthamalus zone 1, others zone 1-3



Stalked Barnacle (*Pollicipes*)
to 10 cm (4") long
zone 3-4

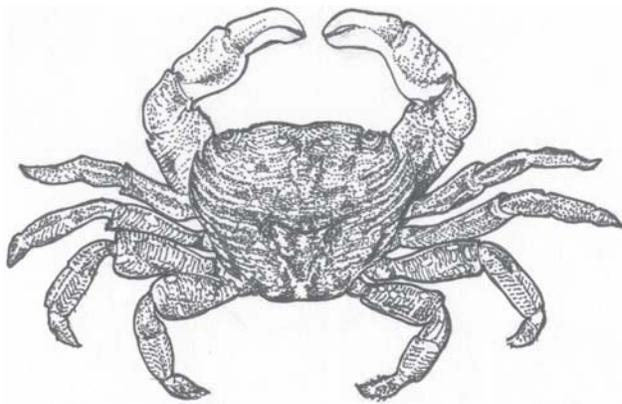
Stalked barnacles such as *Pollicipes* are often found among the mussel beds in clusters. There is a fleshy stalk with protective plates at the end. Like other barnacles, they feed by filtering food from the water with feathery feet and close up tightly when threatened or when the tide is out.

Anthropoda (continued)

Shrimps and crabs belong to the crustacean order Decapoda, so-named because they have 10 legs. Several kinds of shrimp may be found in local tide pools. The most common is *Heptacarpus*, the broken back shrimp. It is about 3 cm (1") long, with a sharp bend near the tail. It is usually a transparent green color and can be found under rocks and among the algae.

Crabs

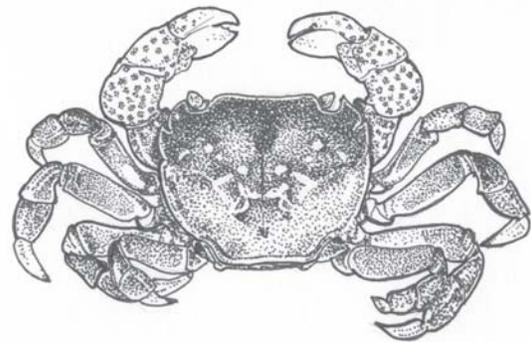
Crabs are crustaceans that have 10 legs (decapods), including their large “pinchers.” The shed skin/shell of crabs are called “molts.” The head and thorax are fused to form a “cephalothorax.” Crabs’ abdomens are curled under their bodies. Females have abdomens that are wider and more rounded than males. They generally carry their eggs underneath their cephalothorax, protecting them with their wide abdomen.



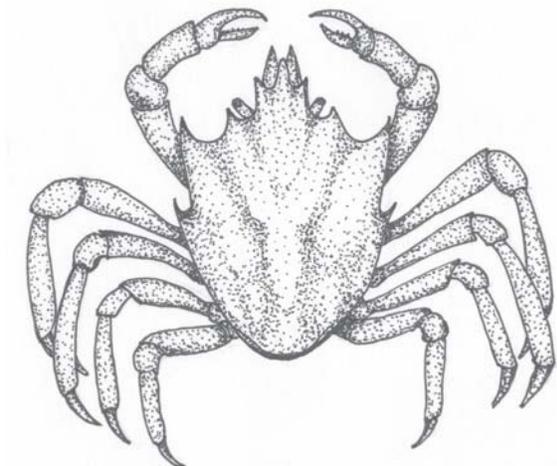
Green or Lined Shore Crab
(*Pachygrapsus crassipes*)
carapace (main shell) to 4.7 cm (1.75") wide
zone 2

The lined shore crab, *Pachygrapsus crassipes*, is sometimes erroneously called a rock crab. It is most common in Zone 2, the high intertidal zone. They have excellent eyesight and will scurry away if they see you coming. They mostly eat algae, but will feed on dead animals if the opportunity arises. Living in Zone 2, they can withstand a variety of temperatures, salinities, and exposure to air.

The purple shore crab, *Hemigrapsus nudus*, is also known as the spotted shore crab. It is generally found in Zone 3 and has behaviors similar to the lined shore crab. As a dweller of Zone 3, it can not tolerate as much exposure as can the lined shore crab.



Purple or Spotted Shore Crab
(*Hemigrapsus nudus*)
carapace (main shell) to 5.6 cm (2.25") wide
zone 3

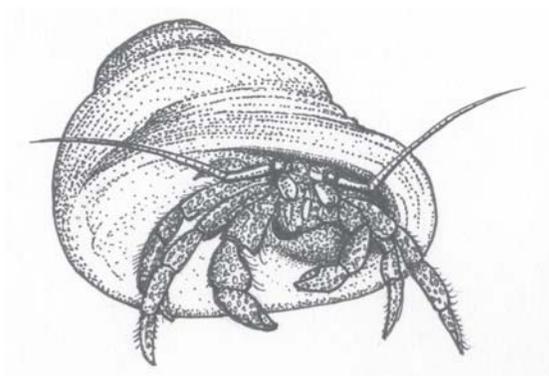
Anthropoda (continued)

Kelp Crab (*Pugettia* spp)
carapace to 9.3 cm (3 5/8") wide
zone 3-4

Another common tide pool crustacean includes the porcelain crabs, *Petrolisthes* spp. Technically they aren't true crabs because they have eight thoracic legs, rather than ten. Their bodies are extremely flat and may vary from brown to gray-green in color. The edges of their large claws will often be colored with bright blue and red. These "crabs" are closely related to hermit crabs. Their limbs break off easily, so handle carefully if at all!



Porcelain Crab (*Petrolisthes* spp.)
carapace to 2.4 cm (1") wide
zone depends on species



Hermit Crab (*Pagurus* spp.)
to 2 cm (3/4") long
zone depends on species

The kelp crab, *Pugettia producta*, is a member of the "spider crab" group, so named because of their long legs. They are often found in clumps of kelp (brown algae), in the lower intertidal zone (Zone 3 or 4). They feed primarily on kelp and take on its color, resulting in very effective camouflage.

The hermit "crabs," *Pagurus* spp., like the porcelain crab, aren't technically true crabs. These small animals will eat almost anything that they can catch. They often inhabit periwinkle or turban snail shells. They have elongated bodies that they curl into the twists of the snail shells. As they grow, they must find larger shells. The shell protects the soft body, and the large "pincher" can be used to close off the opening of the shell when the animal retreats into it.

Phylum Mollusca - shelled animals

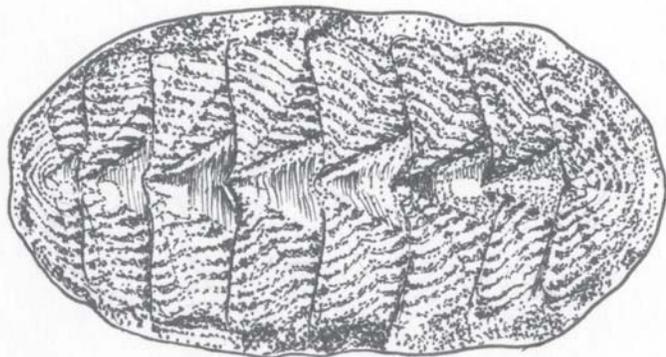
Molluscs are soft bodied animals with various numbers of shells. This is a very large group, with members found in the sea, in fresh waters, and on land. Generally, the body is soft, forming a sort of flap or tent, called the mantle. The mantle covers the gills and secretes the shell (if any). Many molluscs use a “rasping tongue, called a **radula**, which they use to scrape algae from rocks or to feed on other animals, as do the whelks.

There are four main groups of molluscs:

- Chitons have a series of 8 separate overlapping shell plates.
- Gastropods, the snails and slugs, have 1 shell or none.
- Bivalves such as clams, mussels, and oysters have 2 shells.
- Cephalopods, the squids and octopuses, generally lack external shells, but may have an internal remnant of a shell, as the squids do. The beautiful chambered nautilus is a cephalopod, but it doesn't live along the California coast.

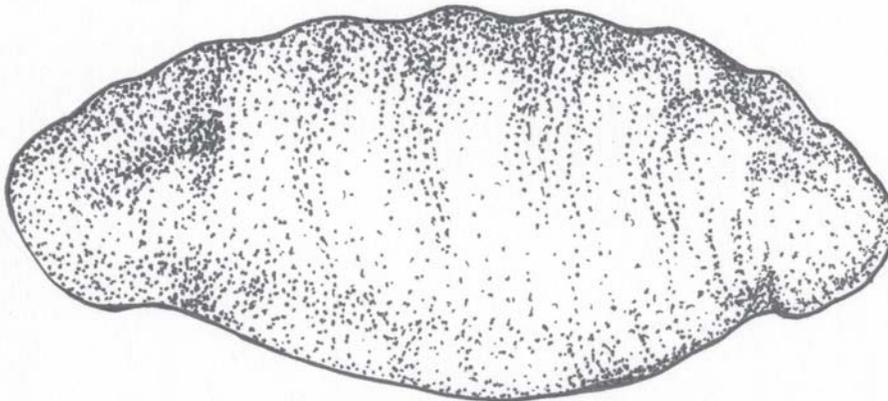
Chitons (Class Polyplacophora [formerly Amphineura]) - 8 shell plates

The lined chiton, *Tonicella lineata*, is often beautifully colored pink to lavender, with red, white, and blue wavy lines. It is found in mid to low tide zones, where its multi-piece hinged shell allows it to conform to curved surfaces, which, in turn, enables it to grip the substrate tightly and resist the pounding waves of the surf zone. They feed by grazing on algae on the rocks.



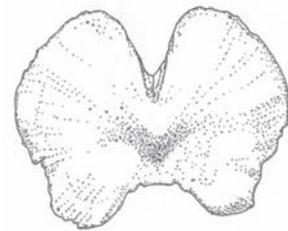
Lined Chiton (*Tonicella lineata*)
to 5 cm (2") long, often shorter
zone 4

The mossy chiton, *Mopalia*, is a little larger than the lined chiton and has stiff hairs around its mantle margin or girdle. During the day, it stays in one place, feeding on algae at night.

Mollusca (continued)

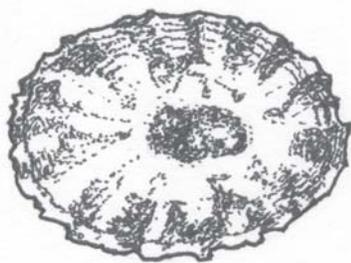
Gumboot or Giant Chiton (*Cryptochiton stelleri*)
to 33 cm (13") long
zone 4-subtidal

The gumboot chiton, *Cryptochiton stelleri*, grows to 33 cm (13") long! The plates are completely covered by a brick-red leathery girdle. Since they are so thick, they are more easily dislodged by waves than the mossy or lined chiton, and they live in more sheltered areas. When they die, their plates (shells) are left behind as "butterfly shells," about 1" across.

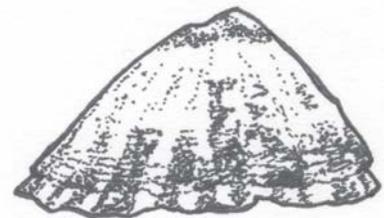


Gastropods (Class Gastropoda) - 1 or no shells

The gastropods include the one-shelled molluscs, like the common garden snail. In some, like the common garden and sea slug, the shell has been lost.



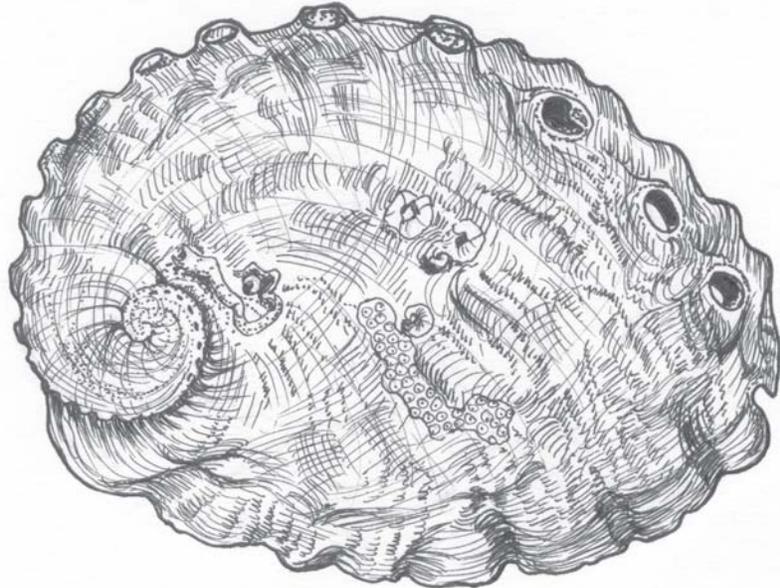
Shield Limpet (*Collisella pelta*)
to 5.4 cm (2 1/8") long and 1.5 cm
(5/8") high
throughout intertidal zones



The shield limpet, *Collisella pelta*, has fine, smooth ridges on a single somewhat flattened, conical shell. It lives in the high tide zone and can clamp down firmly on the rock to protect itself when exposed to the air and predators. Limpets feed by creeping around on the rock, scraping off algae with their radula or "rasping tongue."

Mollusca (continued)

The Mendocino coast is famous for its red abalone, *Haliotis rufescens*. The abalone feeds on algae in mid to low tide zones and beyond into deeper water. It can grow to be almost a foot long, but that takes many years! The large muscular foot is eaten, and we need to carefully control how many can be taken by people so that the population doesn't become so small that the remaining abalone are crowded out by urchins. Black and green abalone can be found farther south along California's coast.



Red Abalone (*Haliotis rufescens*)
to 30 cm (12") long and 23 cm (9") wide
zone 4-subtidal

Several turban snails inhabit the intertidal zone along the Mendocino coast.

The black turban snail, *Tegula funebris*, is common in the mid to high tide zones. They feed on algae on the rocks. When threatened, they withdraw into their shell and cover the opening with a trap door-like plate called an operculum. Hermit crabs often move into the shell when the snail dies.

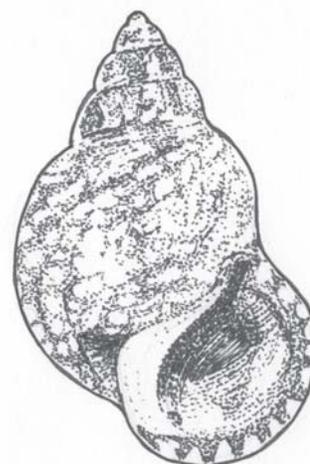


Black Turban Snail
(*Tegula funebris*)
to 3 cm (1 ¼") in diameter
zones 1-3

The brown turban snail, *T. brunnea*, is found in the mid tide zone and below.

Mollusca (continued)

Another common snail is the periwinkle. The genus *Littorina* has several local representatives. These snails can be very abundant in the mid to high tide zones, often clustered in cracks and crevices in the rocks. When exposed to the air, they secrete a mucus “glue” that not only protects them from drying out, but also attaches them to the rock.

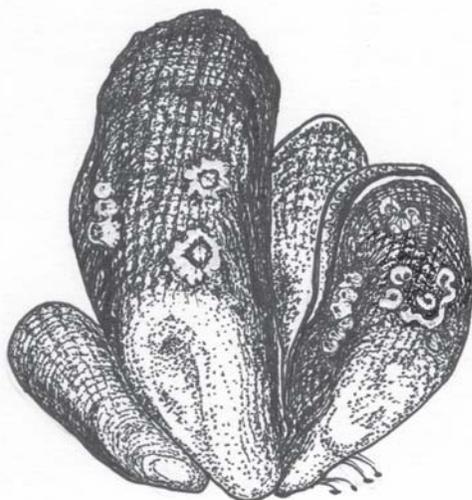


Periwinkle
(*Littorina* spp.)
to 1.9 cm (3/4") long
zones 1-2

Other common tide pool gastropods include a variety of limpets, the olive shell, unicorn snail, whelk, horn snail, and the often spectacularly beautiful nudibranchs or sea slugs.

Bivalves (Class Bivalvia, formerly Pelecypoda) - 2 shells

The bivalves (class Bivalvia) are the 2-shelled mollusks. Some, such as clams, feed by using a siphon to bring sea water in. Food particles are removed by “gills” and the waste is removed through another siphon. Some clams live in the tide pools, including some that actually bore into the rock! One of the most common intertidal animals is the California mussel.



California Mussel
(*Mytilus californianus*)
to 25 cm (10 ") long, but usually shorter
zone 3-subtidal

The California mussel, *Mytilus californianus*, is often found in massive colonies in the mid to high tide zones. Mussels attach themselves to the rock by secreting a liquid that quickly forms strong flexible threads, called byssal threads. Small acorn barnacles, tube worms, and even small sea anemones sometimes attach themselves to the mussel’s shell. Stalked barnacles are often found with the mussels. When feeding, the mussel opens its shell and creates a current of water to bring small food particles and water in. When the tide is out, they close their shells tightly to prevent drying out. Mussels are a favorite food of sea stars, which often determine the lower extent of the mussels’ range.

Oysters generally are found in bays and sheltered waters, so they are not found along the Mendocino County coast.

Mollusca (continued)

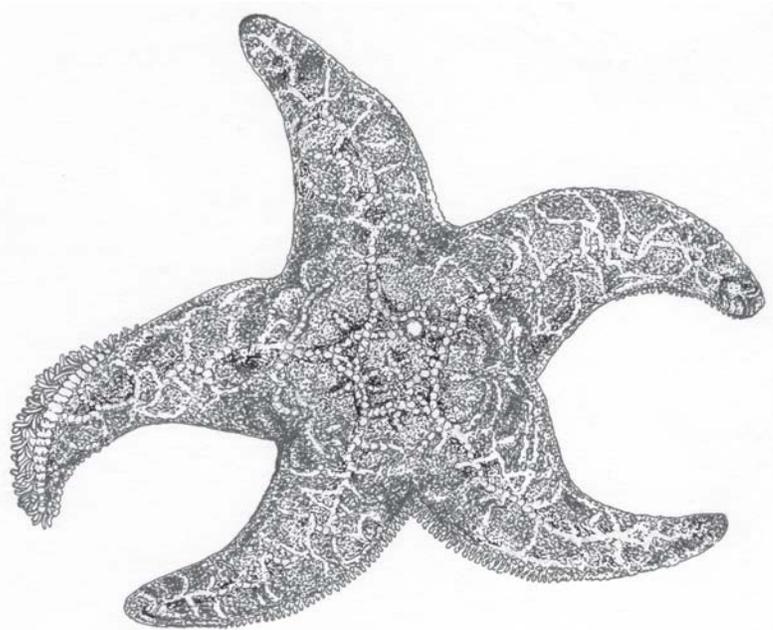
Class Cephalopoda

Another important group of molluscs is the class Cephalopoda. This group includes the octopus, squid, cuttlefish, and the beautiful chambered nautilus. Students may find octopi hiding in crevices in the rocks. They should be left alone. Squid don't normally enter the intertidal zone, but sometimes their eggs are washed into the tide pools and at that time they become a very important food source for the tide pool organisms.

Phylum Echinodermata - sea stars and their relatives

The phylum Echinodermata includes the "spiny skinned" organisms such as sea stars, sea urchins, and the sand dollar. Echinoderms have several unique characteristics such as tube feet and a "water vascular system." Sand dollars (*Dendraster*) aren't rocky intertidal organisms, but students may find their shells (tests) in the area or in sandy intertidal areas. As their name implies, sand dollars live in sandy areas.

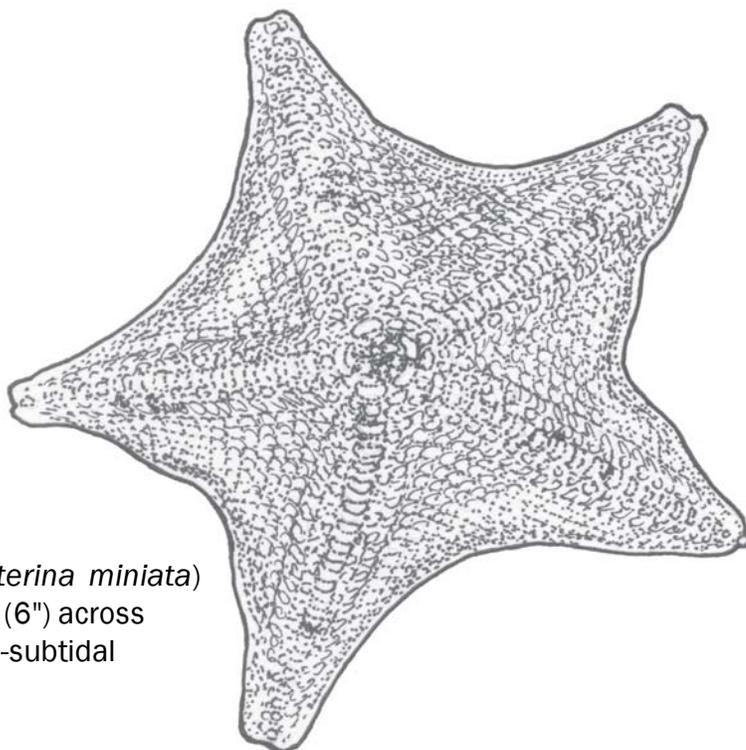
A common "starfish" is the ochre star, *Pisaster ochraceus*. It is very common in tide pools, and subtidally, along with several other types of sea stars (see below). It may be orange, purple, or brown in color. Sea stars have thousands of tiny "tube feet" that operate like suction cups to hold the animal on the rock or to grasp a mussel shell and pull it open. When feeding, it thrusts its stomach out of its body to digest its food outside of its body! On the back of the ochre star are tiny pincers called pedicellariae that remove algae, sand, or anything else that settles on the animal. Do not tug hard on a sea star to remove it from its perch. If it doesn't come off with a gentle tug, leave it alone, as pulling hard will rip off the tube feet that it needs to survive.



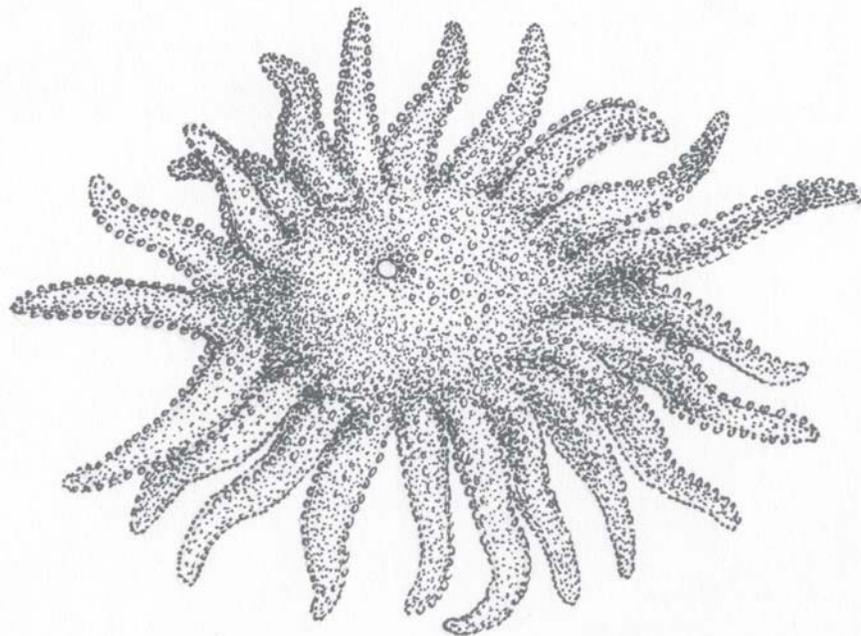
Ochre Star (*Pisaster ochraceus*)
to 35 cm (14") across
zone 3-subtidal

Echinodermata (continued)

Another common sea star is the bat star, *Asterina miniata*. It ranges in color from solid orange, yellow, and silver-gray to mottled combinations of these colors.



Bat Star (*Asterina miniata*)
to 15 cm (6") across
zone 4-subtidal

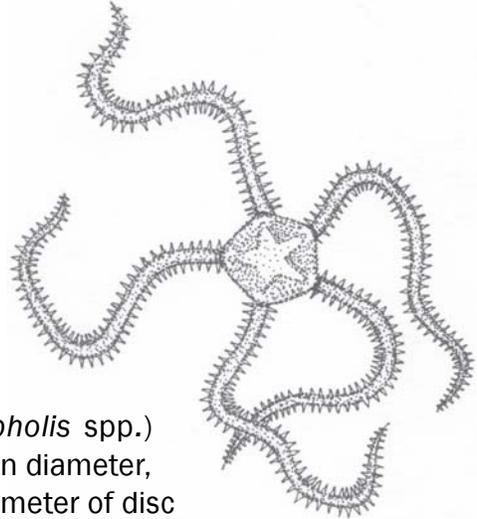


Sunflower Star (*Pycnopodia helianthoides*)
to 1 m (39") across, but usually smaller
zone 4 -subtidal

The sunflower star, *Pycnopodia helianthoides*, can grow to 100 cm (39 in.) in diameter and is a fast moving voracious feeder. Interestingly, it starts life with 6 arms, but develops up to 24 as it matures! These animals may be orange, purple, red, or grey-blue in color, and are soft and limp (and fragile!) when out of water. The arms break off easily. Look for them in the low tide zone.

Echinodermata (continued)

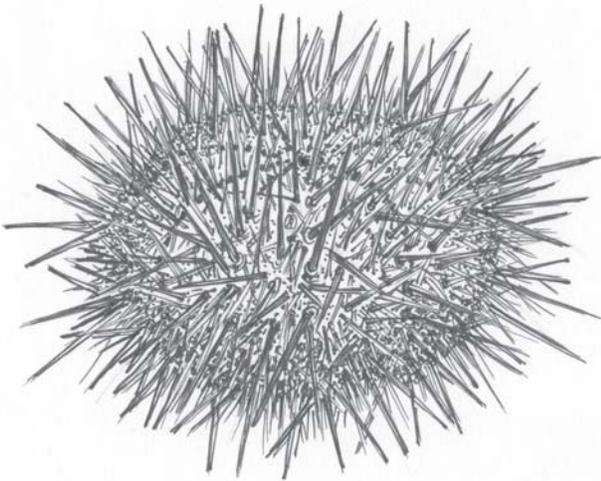
Brittle stars, which are in a different class from the “sea stars,” can sometimes be found under rocks. The central body “disc” is about 2-5 cm across (approximately 1/4”), with long thin, flexible legs that can easily break off, giving the brittle star its common name. They are generally found in the low tide zone.



Brittle Star (*Amphipholis* spp.)
disc to 5 mm (1/4”) in diameter,
with legs 3-4 times diameter of disc
various zones, depending on species

Other common sea stars are the leather star, sun star, six-rayed star, and knobby star.

If you were to take a 5-rayed sea star’s arms, narrow the aboral (back) part, and curl them up underneath to form a flattened ball, you would have the body plan for a sea urchin. If you were to flatten the “ball” a bit more, you would have a “sea biscuit” body plan. Flatten it still more to make a sand dollar. If you were to stretch the arms out rather than flattening them, you would have the body plan for a sea cucumber.



Purple Sea Urchin
(*Strongylocentrotus purpuratus*)
test (“shell”) to 12 cm (5”) wide
spines to 2.5 cm (1”) long
zone 4-subtidal

The purple sea urchin, *Strongylocentrotus purpuratus*, is one of the most familiar tide pool animals in the Mendocino area. Its test (“shell”) is covered with hundreds of movable spines, between which are its tube feet. The urchin uses its tube feet and spines to capture bits of food from the water. It also feeds by grazing on algae. If they overpopulate an area, they can eat so much algae that problems can ensue. Sometimes sea urchins form rounded burrows in soft sandstone by scraping the rock with their spines. After a while, the urchin may become trapped in its burrow because it has grown larger than the opening. Purple urchins can get to be 5” in diameter. They are most common in the low tide zones. Both the purple and red sea urchins are harvested commercially for their eggs.

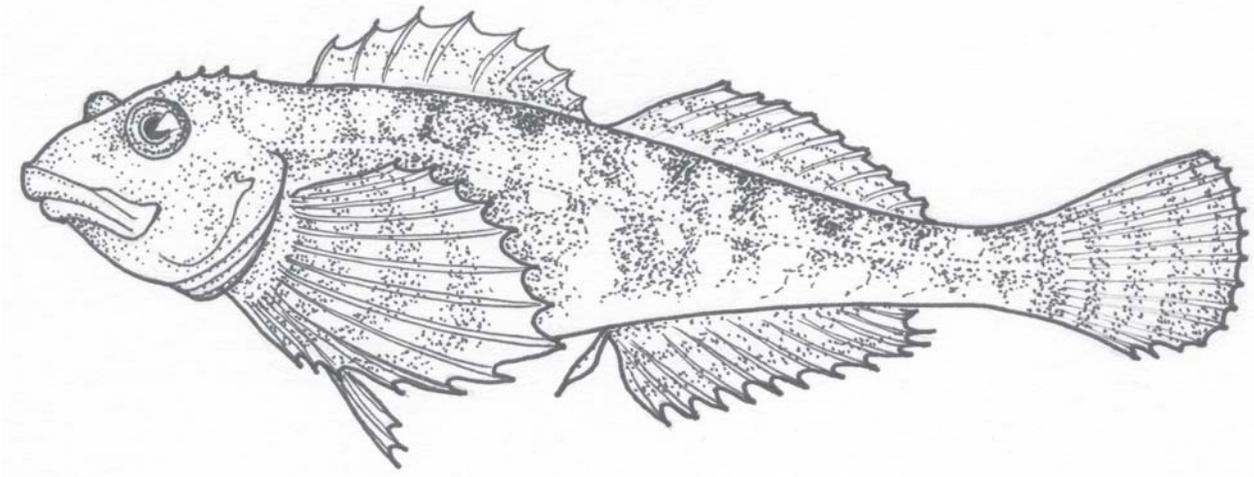
Phylum Chordata

The chordates include the “higher” groups of animals, including fish, reptiles, amphibians, birds, and mammals. Chordates are characterized by having, some time in their lives, a notochord, dorsal hollow nerve cord, and gill slits. Most chordates have “backbones,” or vertebrae developing around the notochords, and are classified as vertebrates. Others, like the tunicates or “sea squirts” are primitive chordates that resemble sponges.

Fish

While some open water fish may enter the intertidal zone to breed, the most common tide pool fish are the various species of blenny “eels” and sculpins. Both of these fish are well **camouflaged** and can even change colors to match their background.

The tide pool sculpin, or Tide Pool Johnny, *Oligocottus* may be seen darting out from cover to grab a bit of food, but you have to look carefully, because they are very fast and well camouflaged. Sometimes they will remain exposed, but will use their large pectoral (“arm”) fins to remain stable and are quite difficult to spot.



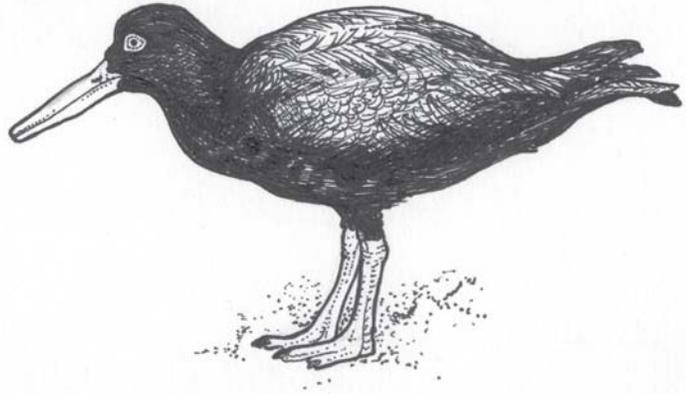
Tide Pool Sculpin (*Oligocottus* spp.)
to about 9 cm (3.5") long

Chordata (continued)

Birds

While many different kinds of birds may be seen at or near the tide pools, the most common ones that students will see in the intertidal zone are various kinds of gulls, which scavenge for whatever they can find, and the black oystercatcher. They may also see brown pelicans and cormorants flying by, or even a great blue heron.

The black oystercatcher, *Haematopus bachmani*, is a large (44 cm [17"]) black shorebird with stout body and a long, strong, red bill and light colored eyes. It inhabits rocky coasts where it uses its bill to detach limpets or open mussels.



Black Oystercatcher (*Haematopus bachmani*)
length to 44 cm (17")



Brandt's Cormorant
(*Phalacrocorax pennicelatus*)
length (height) to 89 cm (35")

Several species of cormorant may be seen at the coast. One of the most common is the Brandt's Cormorant, *Phalacrocorax pennicelatus*. It can be almost a meter (89 cm [35"]) tall and is an iridescent black color. Cormorants nest in rocky areas along the shore and on islands. They will sometimes gather in flocks and fly to breeding grounds in long straggling lines. Sometimes they will dive together, forming a living "net" that confuses and entraps fish.

Chordata (continued)

Mammals

While no mammals inhabit the tide pools, several may be seen while on a trip to intertidal areas.

Seals, as opposed to sea lions, lack external ear flaps, and also are unable to bring their hind legs (“flippers”) alongside of the body. The most common seal in California is the harbor seal, *Phoca vitulina*, which forms permanent colonies in Mendocino County. In some areas, one might see the elephant seal, *Mirounga angustirostris*, which is making a comeback from near extinction.

There are two species of sea lions found in California. Sea lions have external ear flaps, and they can bring their hind legs up alongside of their bodies. The circus “seal” is actually a California Sea Lion, *Zalophus californianus*.

The southern sea otter, *Enhydra lutris*, like the northern elephant seal, was nearly extinct until not very many years ago. It was once numerous along the west coast from southern California to Canada, but is not now found along the Mendocino coast. In fact, the desire for the sea otter’s beautiful, soft, warm pelt was one of the major causes of the exploration and settlement of northern California by Europeans, primarily the Russians. Sea otters may sometimes enter tide pools, but healthy sea otters rarely come ashore in California. (The northern sea otter, found in Alaska, has different habits and often comes ashore.) River otters, *Lutra canadensis*, may sometimes be seen feeding near shore and intertidally along the Mendocino coast.

The whale that students are most likely to see is the California Gray Whale, *Eschrichtius robustus*. These whales generally spend their lives near shore, migrating from arctic waters in winter to the lagoons of Baja California, and returning in the spring.