All About Plankton

KINGDOM PROTISTA

HARMFUL ALGAL BLOOMS (HABs)

Often known as red tides, harmful algal blooms (HABs) may have severe impacts on human health, aquatic life and our economy. HABs are population explosions of algae in water. They require plenty of sunlight, slow moving water and nutrients such as phosphorous and nitrogen. Nutrient pollution is a result of human industrial waste and agricultural runoff into the ocean and often provides excess nutrients for the harmful algae. HABs occur when water conditions foster explosive growth of a toxic algal species. Harmful algal blooms can produce extremely dangerous toxins. These toxins bioaccumulate in the food web and can reach dangerous concentrations in the top predators. High levels of these toxins can sicken or kill people and/or animals. Domoic acid is a type of neurotoxin produced by HABs. Studies have shown how domoic acid can cause illness, seizures and death in humans and marine mammals, specifically in the California sea lion.

Dinoflagellates

The dinoflagellates are a large group of flagellate protists. Most are marine plankton, but they also occur in fresh water habitats. Their populations are distributed depending on temperature, salinity, or depth. Many dinoflagellates are known to be photosynthetic, but a large fraction of them are mixotrophic, combining photosynthesis with ingestion of prey (phagotrophy). Dinoflagellates form one of the largest groups of marine eukaryotes, although this group is substantially smaller than the diatoms. Some species are mutualistic symbionts (living together) of marine animals and play an important part in the biology of coral reefs. Other dinoflagellates are colorless predators on other protozoa, and a few are parasitic.

***Akashiwo** sanguinea*

This is a photosynthetic dinoflagellate. The word “akashiwo” comes from the Japanese for “red tide”. They are golden-brown color so a bloom can change the color of the water to appear a rusty-red. Although they are not known to produce toxins, a bloom of this species can be harmful to wildlife because they can produce surfactants that have been linked to seabird mortality. This species can cause harmful algal blooms (HABs).

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Alexandrium catenella

This photosynthetic dinoflagellate appears spherical with a distinct band (or girdle) around the middle. They can be solitary or they can form chains. This species is known to produce saxitoxin, a neurotoxin that can cause Paralytic Shellfish Poisoning (PSP). Paralytic shellfish poisoning is one of the four recognized syndromes of Shellfish Poisoning, which are primarily associated with bivalve mollusks (such as mussels, clams, oysters, and scallops). Shellfish are filter feeders and, therefore, accumulate the neurotoxins produced by these microscopic algae. This species can cause harmful algal blooms (HABs).

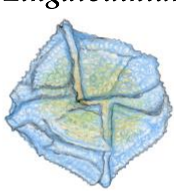
***Ceratium* spp.**

These dinoflagellates are found in both fresh and salt water and are easily identified thanks to their distinctive “horns”. In different species, these “horns” can be straight or curved. They are non-toxic and play an important part of the food web. The movements of the flagella cause the animal to rotate while moving forward. They are mixotrophic, meaning they are able to produce their own food through photosynthesis as well as engulfing prey or food particles.

***Dinophysis* spp.**

These photosynthetic dinoflagellates have a distinctive collar that make this species easy to identify. They are known to produce the toxin okadiac acid and dinophysis toxins that can cause Diarrhetic Shellfish Poisoning (DSP). Diarrhetic Shellfish Poisoning is one of the four recognized syndromes of shellfish poisoning, which are primarily associated with bivalve mollusks (such as mussels, clams, oysters, and scallops). Shellfish are filter feeders and, therefore, accumulate the neurotoxins produced by these microscopic algae. This species can cause harmful algal blooms (HABs).

Lingulodinium polyedra



This bioluminescent photosynthetic dinoflagellate is often a dark golden brown and are highly armored with a distinct groove around the equator. They can produce a toxin called Yessotoxin that can cause symptoms similar to Paralytic Shellfish Poisoning (PSP). Paralytic shellfish poisoning is one of the four recognized syndromes of Shellfish Poisoning, which are primarily associated with bivalve mollusks (such as mussels, clams, oysters, and scallops). Shellfish are filter feeders and, therefore, accumulate the neurotoxins produced by these microscopic algae. This species can cause harmful algal blooms (HABs).

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Noctiluca scintillans

This dinoflagellate is bioluminescent when disturbed in the water. They are not known to produce a toxin, but a bloom of this species may trigger other species of algae to produce toxins. They are heterotrophic, eating other dinoflagellates, diatoms, fish eggs and bacteria. It can engulf almost any planktonic animal up tp the size of a small crustacean (e.g. copepod larva). The tentacle is the active organ in feeding. As the tentacle swings, it comes in contact with food, which adheres to its sticky surface. They lack photosynthetic pigments; however, photosynthetic diatoms can be found at times living symbiotically within this species. This species can cause harmful algal blooms (HABs).

***Prorocentrum* spp.**

These photosynthetic dinoflagellates are tear-dropped shaped with a spine making them look almost like little leaves. They are usually golden-brown in color and are small to medium-sized (15-100 µm). All species are phototrophic with 1-2 chloroplasts. Some species form large blooms, discoloring the sea. Others produce toxins that can cause Paralytic Shellfish Poisoning (PSP). Paralytic shellfish poisoning is one of the four recognized syndromes of Shellfish Poisoning, which are primarily associated with bivalve mollusks (such as mussels, clams, oysters, and scallops). Shellfish are filter feeders and, therefore, accumulate the neurotoxins produced by these microscopic algae.

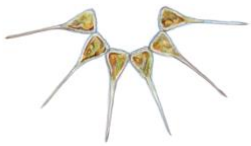
Diatoms

Diatoms are a major group of protists, and are among the most common types of phytoplankton. Most diatoms are unicellular, although they can exist as colonies (in chains) in the shape of filaments, ribbons, fans, zigzags, or stars. Diatoms are primary producers within the food chain (they are photosynthetic). A unique feature of diatom cells is that they are enclosed within a cell wall made of silica (hydrated silicon dioxide) called a frustule. These frustules show a wide diversity in form, but are usually almost bilaterally symmetrical, hence the group name. However, diatoms can have either radial or bilateral symmetry. Radial symmetrical species are called centric diatoms and bilateral symmetrical species are called pennate diatoms.

DIATOMACEOUS EARTH

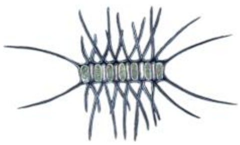
Diatomaceous Earth is a naturally occurring sedimentary rock that is made from fossilized silica remains of diatoms (single-celled plant-like plankton) that accumulate on the bottom of the ocean. It has many uses, but it is mostly commonly used as an aid in filtration (i.e. pool filters). Because it is a sedimentary rock, other fossils can often be found in layers of diatomaceous earth.

Asterionellopsis glacialis



This distinct diatom often forms spiraling chains. Individual cells have a triangular base with a long needle like spine and are usually 30 - 150 µm in length. They are photosynthetic and usually are yellow-brown in color. The chloroplasts are plate-like and are located in the base. This is a pennate diatom, which are bilaterally symmetrical. They are usually more abundant in spring and summer and are found worldwide.

***Chaetoceros* spp.**



This is the largest group of marine planktonic diatoms with approximately 400 species described. This group of photosynthetic diatoms can be easily distinguished from other diatoms as each cell has paired bristles or setae. Some form chains that are straight, others spiral. These are centric diatoms with very lightly silicified frustules. Each frustule possesses four long, thin spines, or setae. The setae link the frustules together to form colonies of several cells. They are commonly found in the ocean waters of California.

***Coscinodiscus* spp.**

Living cells of this group will have many spots of chloroplasts and are relatively large compared to other diatoms. Many species are cylindrical but when looking at them through a microscope, they often simply look like circles because you are only seeing the top valve of the cylinder. The cells are discoid, sometimes thin (like a coin), some are more barrel-shaped, occasionally with valve mantle deeper on one side. They are usually solitary diatoms that are common in our ocean waters.

Lauderia annulata

Often seen in chains, this diatom can have many spots of chlorophyll with each cylindrical cell. They are common but usually not abundant in the ocean waters of California. They are preyed on by a number of microorganisms and animal larvae.

***Pleurosigma* spp.**

This group of diatoms can have a gentle "s" shape. They are photosynthetic with spots of yellow-brown chlorophyll and can be seen moving slowly through the water. They are preyed on by a number of microorganisms and animal larvae.

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Pseudo-nitzschia **spp.**

This photosynthetic diatom often form long chains. Each cell is tapered at both ends and when seen in chains these ends overlap. Because of this, unless looking closely under high magnification, the chains can often appear like tiny sticks in the water. They are known to produce a neurotoxin called domoic acid which can cause Amnesic Shellfish Poisoning (ASP). Amnesic shellfish poisoning is one of the four recognized syndromes of Shellfish Poisoning, which are primarily associated with bivalve mollusks (such as mussels, clams, oysters, and scallops). Shellfish are filter feeders and, therefore, accumulate the neurotoxins produced by these microscopic algae. This species can cause harmful algal blooms (HABs).

PROTOZOA

Protozoa are a diverse group of unicellular eukaryotic organisms, many of which are motile. Historically, the protozoa were defined as unicellular protists with animal-like behavior, such as movement or motility. However, the term protozoan has become highly problematic due to the introduction of modern genetic techniques. Today, we know that protozoans are usually single-celled and heterotrophic eukaryotes containing non filamentous structures that belong to any of the major lineages of protists (they are not all descendants from a common ancestor). They are all, however, restricted to moist or aquatic habitats (i.e., they are obligate aquatic organisms). Many protozoan species are symbionts, some are parasites, and some are predators of soil bacteria and algae. There are an estimated 30,000 protozoan species. In this section we only cover ciliates (tintinnids) and actinopods (acantharians, radiolarians, and foraminiferans).

Ciliata

The ciliates are a group of protozoans characterized by the presence of hair-like organelles called cilia. Cilia are identical in structure to eukaryotic flagella, but typically shorter and are present in much larger numbers with a different undulating pattern. Cilia occur in all members of the group and are used in swimming, crawling, attachment, feeding, and sensation. In this section we only cover tintinnids.

TINTINNID
many species

Tintinnids are ciliated organisms that eat other photosynthetic algae and bacteria. Their vase-shaped shell and ring of cilia make them easily identifiable if you can catch a quick glimpse of them as they move through the water. The shells are called loricae and are mostly protein but may incorporate minute pieces of minerals. Many species have wide distributions while others are restricted to certain areas, such as arctic waters or coastal seas. Like other members of the microzooplankton (such as ciliates, dinoflagellates, radiolarians, etc.), tintinnids are a vital link

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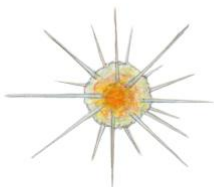
in aquatic food chains as they are the herbivores of the plankton. They feed on phytoplankton (algae and cyanobacteria) and in turn act as food for larger organisms such as copepods (small crustaceans) and larval fish.

Actinopoda

Actinopods are amoeboids with pseudopods (temporary projections of eukaryotic cells membranes). They are single-celled organisms characterized by an irregular shape. Most references to "amoebas" or "amoebae" are to amoeboids in general rather than to the specific genus *Amoeba*. The amoeboids in general derive their name from the ancient Greek word for change. In this section we only cover acantharians, radiolarians, and foraminiferans.

ACANTHARIAN
***Acanthometra* spp.**

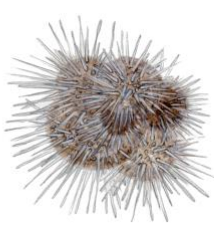


Acantharia are planktonic, free living, exclusively marine protozoa, ranging in size from 0.05-5 mm in diameter. The skeletons of acantharians are made from strontium sulfate (which distinguish them from radiolarians). However, both look like spiky round balls. The spines of this genus of acantharia are thin and abundant. No fossil evidence of the origin or geologic history of the Acantharia exists because their skeletons do not preserve in sediments.

RADIOLARIAN
many species

Radiolarians are marine plankton that have a siliceous (opaline) skeletons and are exclusively marine. The siliceous is extremely resistant to chemical degradation and high hydrostatic pressure. These organisms get their name from the radial symmetrical shape and spines that their skeletons form. Radiolarians are very diverse in form, but all have a central capsule and a siliceous skeleton. The endoplasm is within the capsule.

FORAMINIFERAN
***Globigerina* spp.**



Foraminifera (for-a-min-IF-era) Mostly microscopic, some can reach almost 20 cm in size. There are over 50,000 species, both living and extinct. They live as mostly benthic organisms, although there are many planktonic species. Forams (as they are commonly called) make mostly calcium carbonate shells, the same material that clams and snails use to make their shells. Some make their shells out of silicon dioxide, which is very similar to glass. These shells, also called "tests" constantly rain down and collect on the ocean floor as these organisms die. Some scientists estimate that about half the ocean floor is compose of this

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"Globigerina Ooze" as it is called, named from a genus of foram, *Globigerina*. A cubic meter of marine sediment may contain four million foram shells! This is important as it means that they are well represented in the fossil record. They have become what are known as "index fossils". Different species of extinct forams lived at specific periods of time, so that sediment layers can be easily dated, helping us understand better the geologic record. Geologists can even use this information to help determine the probability of finding oil and/or gas in rock formations.

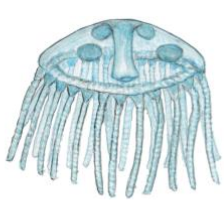
KINGDOM ANIMALIA

Cnidaria

MOON JELLY (ADULT MEDUSA and EPHYRA LARVA)
Aurelia aurita

Jellies have no backbone, no brain, no heart, and are 95% water. Out of the water, they are shapeless, gelatinous blobs often found on the beach after a rough storm. Most use their tentacles to capture a meal, and then slowly pass the food toward their bell (or saucer-shaped body). If food is scarce, some jellies have the unusual ability to shrink in size, requiring less food. When food is abundant, they can grow in size. Out of approximately 2,000 jelly species, only about 70 are known to be harmful to humans. Because adult moon jellies are at the mercy of ocean currents, they are also plankton. However, like most scyphozoan jellies, moon jellies start life as a sessile polyp that looks like a tiny sea anemone. These polyps undergo something called strobilation where the polyp becomes segmented and one by one starts to bud off into ephyra. The ephyra then eventually develops into the adult medusa.

OBELIA (ADULT MEDUSA)
***Obelia* spp.**



This cnidarian is a colonial marine invertebrate (at one stage of its life cycle) that is closely related to sea jellies and sea anemones. The life cycle begins as a colonial hydroid that resembles a tiny sea anemone. The hydroids are commonly found attached to submerged objects, including plants and other animals, in the quiet waters of coasts and bays. The colony is composed of two types of polyps, the nutritive polyp, and the reproductive polyp (asexual). As the hydroid grows, tiny medusa will emerge from the reproductive polyp and become planktonic umbrella-shaped medusae that are sexually reproductive (the stage pictured here). The medusa have four radial canals and a mouth that hangs down from the inside of the center of the bell.

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Annelida

PLANKTONIC POLYCHETE WORM
Tomopteris elegans

This pelagic polychaete worm is a very important source of food out in the open ocean. They are normally transparent, but can also bioluminescence, which may be used to confuse their predators. They eat other planktonic organisms such as larval fish using their eversible proboscis, a feeding appendage that can quickly be pushed out to capture prey. Along the sides of their bodies they have modified broad, finlike structures, called parapodia, that is used for swimming.
Check out this website for some interesting pictures and a video of *Tomopteris* spp. underwater:
http://www.thefeaturedcreature.com/2013/01/this-deep-sea-alien-worm-tomopteris-is-utterly-captivating.html

SCALE WORM (ADULT and LARVA)
***Halosydna* spp.**

Scale worms are polychaete worms that are short, flat and have paired, overlapping scales on their backs. They can be found in the low intertidal around rocky shores and bays, and are often found hiding inside the holdfast of seaweed. They prey on other worms with an eversible proboscis and are in turn eaten by fish, crabs, birds and sea stars. The scales that give them their common name help to facilitate water flow and gas exchange through the thin areas in the body wall. Most species of scale worms will spawn which means males and females release sperm and eggs into the water column, but in some species the female will brood the embryos. Their larval stage is a planktonic trochophore larvae. They have long bristles called setae (found on both larvae and adult worms) and are used for defense against predators. The early-stage trochophore larvae are pear-shaped and later stages become more worm-like, and eventually settle to the bottom (majority of adult polychaete worms are benthic, living on the bottom).

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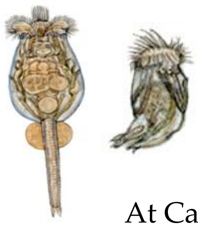
Rotifera

ROTIFERS
many species

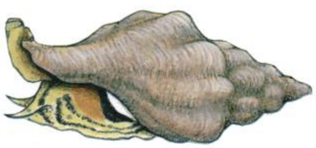


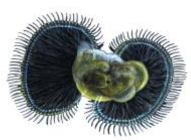
These are small planktonic animals that are classified in the phylum Rotifera. The name comes from the crown of cilia that is located at the mouth. When these cilia move, the rotifer tends to spiral through the water. They have a very unique reproductive process. Some females produce daughters from unfertilized eggs while other females become males that will fertilize the eggs. At Cabrillo Marine Aquarium, we raise rotifers in our Aquatic Nursery to feed many of our larval and juvenile fishes.

Mollusca

Gastropoda

KELLET'S WHELK (ADULT and VELIGER LARVA)
Kelletia kelletii





Kellek's whelks are large snails found from Monterey Bay to Isla Asuncion off Baja California. They frequent kelp beds, rocky reefs and soft bottoms from the low intertidal where they are rare down to about 230 feet. Their white or gray shells are heavy and strongly sculptured. The shell may reach lengths of 7 inches, making them one of the larger snails in our waters. A 3 inch long animal may be 7 to 8 years old and they are reported to live a long time. The shell may be covered with encrusting algae and invertebrates. Kellet's whelks lay clusters of white, pumpkin-seed shaped capsules onto hard substrates like rocks or empty snail shells. The larvae that hatches out of the egg is a trochophore larvae and is planktonic. The second larval stage in the development of many gastropods (snails) is called the veliger larvae, following the earlier trochophore stage. Veligers move quickly through the water as their cilia beat to collect food particles. Torsion (rotation of visceral mass, mantle, and shell 180˚ with respect to the head) characteristic of many gastropods (snails) occurs during the veliger stage. This sudden rotation of bodily organs may take from 3 minutes to 10 days, depending on the species.

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Arthropods

Crustacea

BRINE SHRIMP (FEMALE and MALE)
***Artemia* spp.**

These small planktonic crustaceans have a high-salinity tolerance. They can tolerate varying levels of salinity from 25‰ to 250‰, with an optimal range of 60‰ to 100‰ (the ocean ranges from 32‰ to 35‰). They occupy an ecological niche that can protect them from predators. When conditions are not favorable, their eggs remain dormant as a cyst for long periods of time until the conditions are right. Males differ from females by having enlarged second antennae, and modified into clasping organs used in mating (looks like large hooks: illustration on the right). At Cabrillo Marine Aquarium, we raise brine shrimp in our Aquatic Nursery to feed many of our animals (such as sea jellies, sea anemones, and juvenile fishes). Brine shrimp are very easy to raise, so they can also be used as fish food in home aquariums and in scientific school experiments. Look for “Sea Monkeys” on the packaging.

ACORN BARNACLE (ADULT and NAUPLIUS LARVA and CYPRID LARVA)
***Balanus* spp.**

Acorn barnacles are filter-feeding crustaceans that live attached to hard surfaces of rocks in the intertidal zone. They are small, about 1-2 cm in diameter, and are whitish to gray in color. During the winter and spring, they brood fertilized eggs within their shells. Depending on the size of the parent, 1,000 to 30,000 nauplius larvae are produced per brood. Barnacle nauplii look similar to copepod nauplii but barnacle nauplii have two spines (or “horns”) on their head. The last planktonic stage before a barnacle reaches adulthood is the cyprid larval stage. This is when they find a suitable place to settle. During the spring and summer, planktonic cyprid larvae settle onto a rock. They then “glue” their heads to the hard rocky surface. Cement glands within the antennae produce the brown glue that fastens the barnacle to the surface.

COPEPOD (ADULT and NAUPLIUS LARVA)

These small planktonic crustaceans have a two pair of antennae and one eye. Copepods eat, and are eaten. Tiny copepods (the smallest look like specks of dust) live most everywhere in the ocean in numbers too vast to count. They are a key link in ocean food webs and are considered primary consumers. They eat diatoms and other phytoplankton (primary producers) and are eaten in turn by larger drifters, larval fishes and filter feeders. Copepods may be the most abundant single species of animal on

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Earth. Copepods are an example of holoplankton as they remain planktonic for their entire lifecycle. During the larval stage of a copepod they are called nauplii.

KRILL

Thysanoessa spinifera

Krill is a type of crustacean that lives in the open ocean. Not a true shrimp, krill are a type of euphausiid. There are many species of krill, but they all commonly occur in extremely dense concentrations. This species of krill occurs from southeast Alaska to northern Baja California mostly in waters less than 300 feet (90 meters) deep. The body is elongated and shrimp-like. Adults reach 3 cm in length. Krill feed primarily on phytoplankton, mostly diatoms. Some species of krill are omnivorous, although a few species are carnivorous, preying on small zooplankton and fish larvae. Many species are filter feeders, using their appendages to form very fine combs with which they use to filter the food from the water. Females carry several thousand eggs, which may account for as much as one third of the animal's body mass. Krill can have multiple broods in one season. Krill are eaten by whales, seals, penguins, squid and fish. Blue whales feed almost exclusively on krill and can eat over 4 tons a day.

CRAB ZOEA LARVA and CRAB MEGALOPS LARVA

Many species of crab hatch from an egg as a zoae larva (illustration on the left). At this point in their metamorphosis, they are planktonic and must undergo a series of molts before they settle. A zoea can be identified by the large spine protruding from the head, one of many spines found all over the body which help to keep it from sinking.

After the crab molts and metamorphosizes from the zoea stage, they enter the megalops stage where they look more like the adult crab except with the tail extended (illustration on the right). Depending on the species of crab, the large spines are either retained or lost. The megalops is a relatively good swimmer and remains around the ocean surface for about a month while it is undergoing considerable internal and external changes eventually sinking to the bottom. Listed below are three examples of local species of crabs that have zoea larva and megalops larva.

NORTHERN KELP CRAB

Pugettia producta

Kelp crabs are crustaceans, with a hard exoskeleton protecting their soft bodies. They can be found in tidepools, but mostly in the kelp canopy of kelp forests, camouflaging with the kelp. This particular family of crab has a unique, elongated carapace, looking like an upside down shovel with the handle end towards its mouth. It has four pairs of slender walking legs and a pair of modified legs, called chelipeds. Their abdomen has seven

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segments. The color of the crab is food-dependent, meaning that the color greatly depends on the type of algae they consume in their surrounding environment. This particular adaptation gives it a natural camouflage. Mostly, the color is dark brown or olive green, but sometimes there is a mixture of the two colors. They use their long, spindly legs to hang onto the seaweed against waves and currents that may sometimes be quite strong. Kelp crabs have long, sharp pinchers that they use to tear off pieces of seaweed and bring towards their mouth where they have paired mandibles to chew. They sometimes even stick a piece of seaweed onto their rostrum (the extension of their shell in front of their eyes) to perhaps eat later on.

PACIFIC ROCK CRAB
Romaleon antennarius

This crab has a fan-shaped carapace with eleven teeth to either side of the eyestalks. The chelipeds (claws) are stout with the black tips that are bent downward. The antennae are long and prominent, referring to the species name. The dorsal surfaces of adults are uniformly red, but the ventral surface is spotted. This species is easily confused with the larger red rock crab, *Cancer productus*. They can be distinguished by the less prominent antennae, less robust claws, and lack of ventral spots. This species used to be considered in the genus *Cancer,* but with additional research is was moved into the genus *Romaleon*.

STRIPED SHORE CRAB
Pachygrapsus crassipes

The striped shore crab has a purplish black carapace with green stripes. Its carapace is square and can reach 4 to 5 cm in size. The claws are usually red with a mottled pattern on the upper surface, and white on the lower surface, while its legs are purple and green with a similar mottled appearance. These crabs are found in crevices, tidepools, and mussel beds, and sometimes on muddy shores of bays and estuaries. The striped shore crab feeds on films of algae and diatoms growing on the rocks in tidepools and crevices, which the crab scrapes off with its claws. They also scavenge on dead animals and at times they eat living prey, such as limpets, snails, other crabs, and even the unwary fly: a quick lunge can result in a successful catch. In turn, these crabs are eaten by gulls, octopus, rats, raccoons, and even man.

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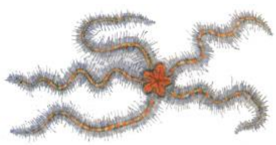
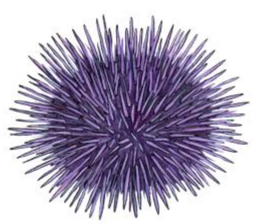
Echinodermata

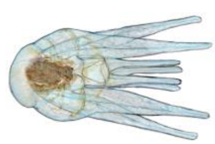
SPINY BRITTLE STAR (ADULT and PLUTEUS LARVA)
Ophiothrix spiculata



Those aren't worms, they're brittle stars. They leave an arm or two free to catch bits of food, but sometimes their wave can hail a hungry fish. Fortunately, a star can't be tugged out by the arm. If an arm snaps off, a new one grows from the stump. At night they stretch out to catch food particles, passing the bits down to the central mouth. These marine invertebrates move very slowly along the sea bed. There are over 2,000 different species of brittle stars worldwide. Most brittle stars are less than 1 inch in diameter. They have a hard endoskeleton and vary in color. Brittle stars occur in incredible numbers on the sandy seafloor, and millions of them can carpet the ocean floor, in layers up to an inch thick. Sometimes these sea stars can be found taking refuge inside the holdfast of seaweed. Male and female brittle stars will broadcast their sperm and eggs into the water column where they fertilize. When a brittle star embryo hatches out, they are referred to as pluteus larva (illustration on the right).

PURPLE SEA URCHIN (ADULT and PLUTEUS LARVA)
Strongylocentroutus purpuratus





The purple sea urchin is a spiny, hard-shelled organism that lives along the rocky shore. It lives from the intertidal zone down to depths of about 33 feet. When in high numbers, sea urchins can graze away all seaweeds except the hard-textured coralline algae. To survive the pounding surf in the intertidal, the purple sea urchin often lives in shallow depressions in rocks. These "foxholes" are dug by the urchins as they hold on with their suction cup tube feet and scrape the rock with their teeth and spines. They have tiny jaw-like pedicellariae among the spines that keep the body surface free of settling organisms and may also deter predators. Rocky shore organisms are at risk from coastal development and pollution, including waste oil and agricultural runoff. Some areas are also in danger of being "loved to death" by visitors. Tread lightly as you explore the rocky intertidal to avoid crushing algae and animals, and never take organisms from their habitat. Male and female sea urchins will broadcast their sperm and eggs into the water column where they fertilize. A sea urchin larva is referred to as a pluteus (illustration on the right).

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OCHRE STAR (ADULT and BRACHIOLARIA LARVA)
Pisaster ochraceous


Distinguished by the dense, weblike pattern formed by its small white spines, the ochre sea star grows to lengths of 6-12 inches and is usually brown, orange, or purple. Adult ochre sea stars appear to have few enemies, but some are eaten by sea otters and sea gulls. Capable of clinging to rocks in the intertidal to depths of 300 feet from Alaska to Baja, California, they feed on attached or slow-moving prey like mussels, barnacles, snails, limpets and chitons. Feeding is accomplished by utilizing tube feet to pry mussel shells slightly apart and inserting its muscular stomach into slits as narrow as 0.1 mm. Digestion actually occurs inside the shells. Ochre sea stars may live for more than 20 years. Sea stars start life as planktonic organisms in the larval stages of their lifecycle. During the brachiolaria larval stage they have a bilateral symmetry unlike the pentaradial symmetry of adult sea stars.

CHORDATA

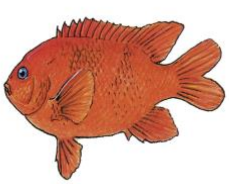
Urochordata

TUNICATE (ADULT and LARVA)
many species


Closely resembling tadpoles, the early stage of a tunicate is planktonic (illustration on the right). Tunicates are in the larval stage for a short period of time before settling down onto a hard substrate and metamorphing into the adult form (illustration on the left). As adults, they are also referred to as “sea squirts.” What is interesting about the tunicate is that even though they are considered an invertebrate, they do have a notochord as larvae which makes them more closely related to vertebrates (hence why they are in the Phylum Chordata).

Vertebrata

GARIBALDI (ADULT and LARVA)
Hypsypops rubicundus




The Garibaldi, a damselfish, is one of the most colorful fish in Southern California waters and is our California State marine fish. A spectacular bright orange, it is easily visible as it "sculls" in and around the holes and crevices of the kelp forest floor where it is usually found. It is in an almost constant state of activity as it defends its territory against potential "land grabbers" or as it searches for the small, sessile sponges and bryozoans that make up a good portion of its diet.

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During the springtime, the activity level climbs even higher as the male begins the all-important task of nest building. Carefully, he clears everything but the most stubborn calcareous material and a small, elliptical patch of red algae. Once the nest is completed, the amorous male begins searching for one or more females. Rushing about his territory, he charges and challenges any of his kind. Challenges consist of loud, thumping noises made by the grinding together of teeth far back in his throat called pharyngeal teeth. Eventually, a female will dart past him as he charges her and will hover above the nest. In an increasingly high state of excitement, he will join her to fertilize the 15,000 - 80,000 eggs she lays. Her job is done and he drives her off to guard the nest during the two to three week period it takes the yellowish, capsule-like eggs to develop. Just like the Garibaldi, many fish begin life as planktonic larva when they first hatch out of their eggs as their fins and muscles haven't developed yet. It is incredibly difficult to identify what species of fish you may be seeing in your plankton tow when they are still in their larval stage because of their small size and underdeveloped anatomy.

For more information on plankton, algae and other marine life, be sure to visit our the "Marine Life" page of CMA's website: http://www.cabrillomarineaquarium.org/exhibits/marine-life.asp

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