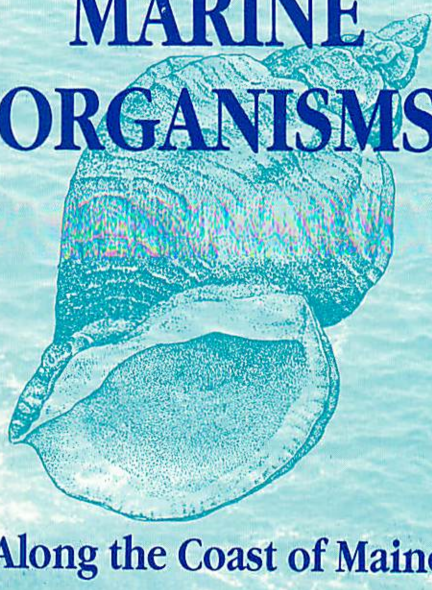
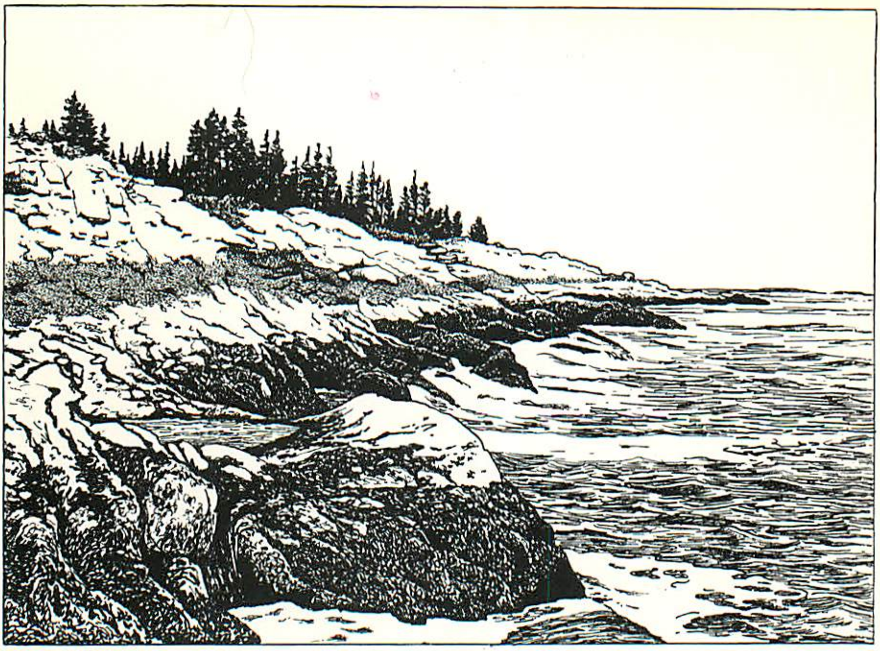
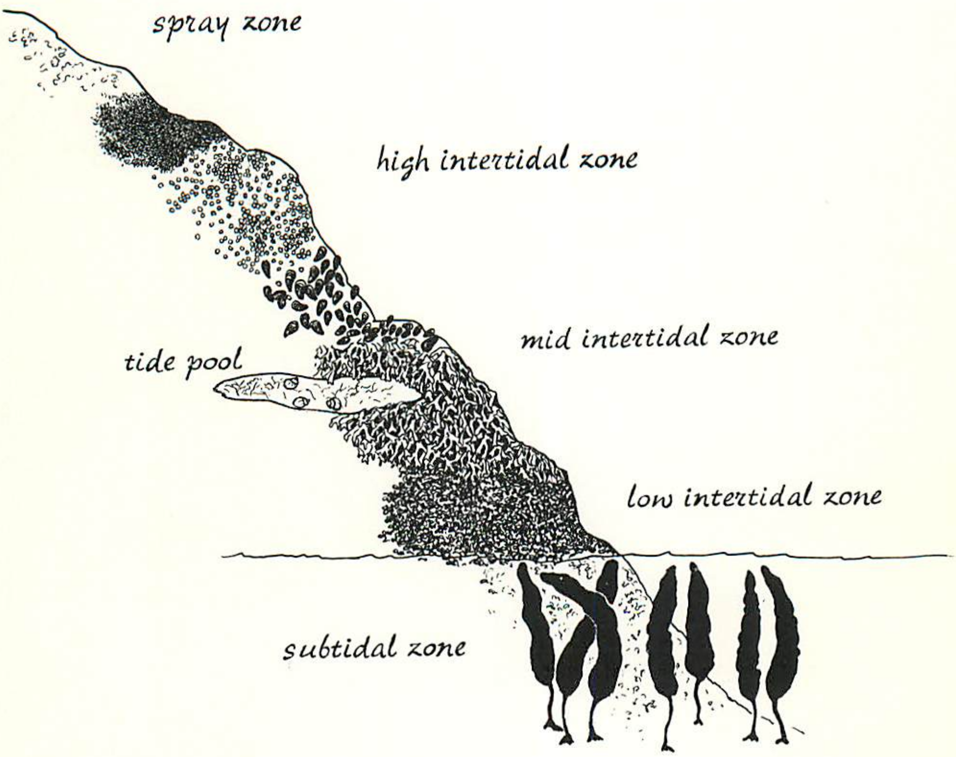
A Guide to COMMON MARINE ORGANISMS



Along the Coast of Maine




spray zone
high intertidal zone
mid intertidal zone
tide pool
low intertidal zone
subtidal zone

A Guide to

COMMON MARINE ORGANISMS ALONG THE COAST OF MAINE

Dedicated to the

Volunteer Environmental Monitors

on the Coast of Maine

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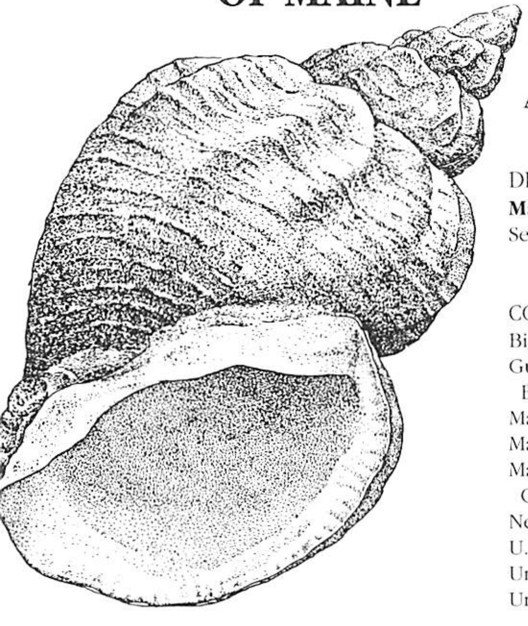

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Finally, we are indebted to the volunteer environmental monitoring community in Maine who gave us the idea for the guide in the first place.

HOW TO USE THIS GUIDE

While most of the guide concentrates on macroscopic algae and animals, one section is devoted to microscopic phytoplankton. In describing an organism, the Latin-based scientific name is in italics, with the genus name first and the species name second, followed by its common name. Scientific names are placed first since common names vary from region to region. The abbreviation "sp." is the singular for species while "spp." is the plural form for species whose identities are unknown.

The metric system has been used throughout the guide since it is the accepted measurement used by academic and scientific communities. See the conversion chart below to determine approximate U.S. equivalents.

We hope you enjoy reading this guide and that it will help you discover and appreciate the wide array of fascinating marine life along the coast of Maine.

METRIC SYSTEM

Unit	Abbreviation	No. of Meters	Approx. U.S. Equivalents
meter	m	1	39.37 in.
decimeter	dm	0.1	3.94 in.
centimeter	cm	0.01	0.39 in.
millimeter	mm	0.001	0.039 in.
micrometer	μm	0.000001	0.000039 in.

INTRODUCTION

Maine is known for its nearly 5000 miles of rugged coastline with over 4600 islands scattered along its shores. Throughout the years, Maine's estuaries, harbors, bays, and offshore waters have played a vital role in the state's history, culture, economy, and livelihood of its people.

Today, almost half of all Maine's residents live in coastal communities. In 1990, there were 125 persons per square mile living in coastal communities compared to 21 persons per square mile living in inland communities. Tourism is also increasing dramatically, with the majority of 8 million annual visitors to the state spending most of their time on the coast.

The coastal area is clearly under intense pressure from expanding coastal development and tourism. This, in turn, is creating many environmental problems. Coastal lands, waters, and wetlands are becoming increasingly contaminated by wastes from people, businesses, and boats. Crowded harbors and bays have become polluted, clam flats have been closed to digging, and other fisheries and marine life have been harmed by human-caused contamination.

In Maine, a group of citizens dedicated to protecting the marine environment began monitoring coastal waters in 1988. Today, Maine has one of the most active coastal networks in the country, with over 1000 adult and student volunteers representing 26 monitoring groups from Kittery to Calais. These groups are studying estuaries and coastal waters by monitoring water quality, phytoplankton, and intertidal habitat.

Volunteer citizen monitors have provided valuable data to local and state policy-makers to help solve pollution problems and restore clam flats. In addition, students involved in monitoring groups have gone on to study environmental science at universities, and hundreds of citizens have become active in environmental education and conservation efforts. The volunteer monitoring program has spawned a dedicated cadre of citizen stewards of the Maine coast.

The *Guide to Common Marine Organisms Along the Coast of Maine* was developed to recognize the achievements of the volunteer monitoring groups and to support their ongoing efforts. This guide was also designed to be used by community volunteers, teachers, and students involved in the Marine Phytoplankton Project—a joint effort of Maine Department of Marine Resources and University of Maine Cooperative Extension (UMCE)—and in UMCE's Marine Habitat Program. Lastly, this guide was written for everyone who is fascinated by the many plants and animals that inhabit the coastal and marine environment and would like to identify the organisms they see.

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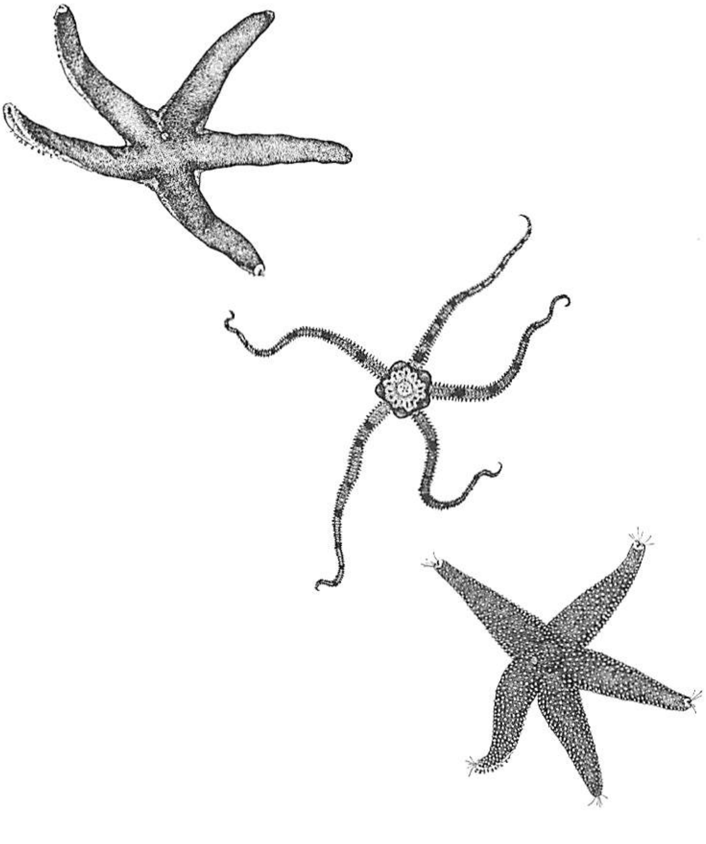
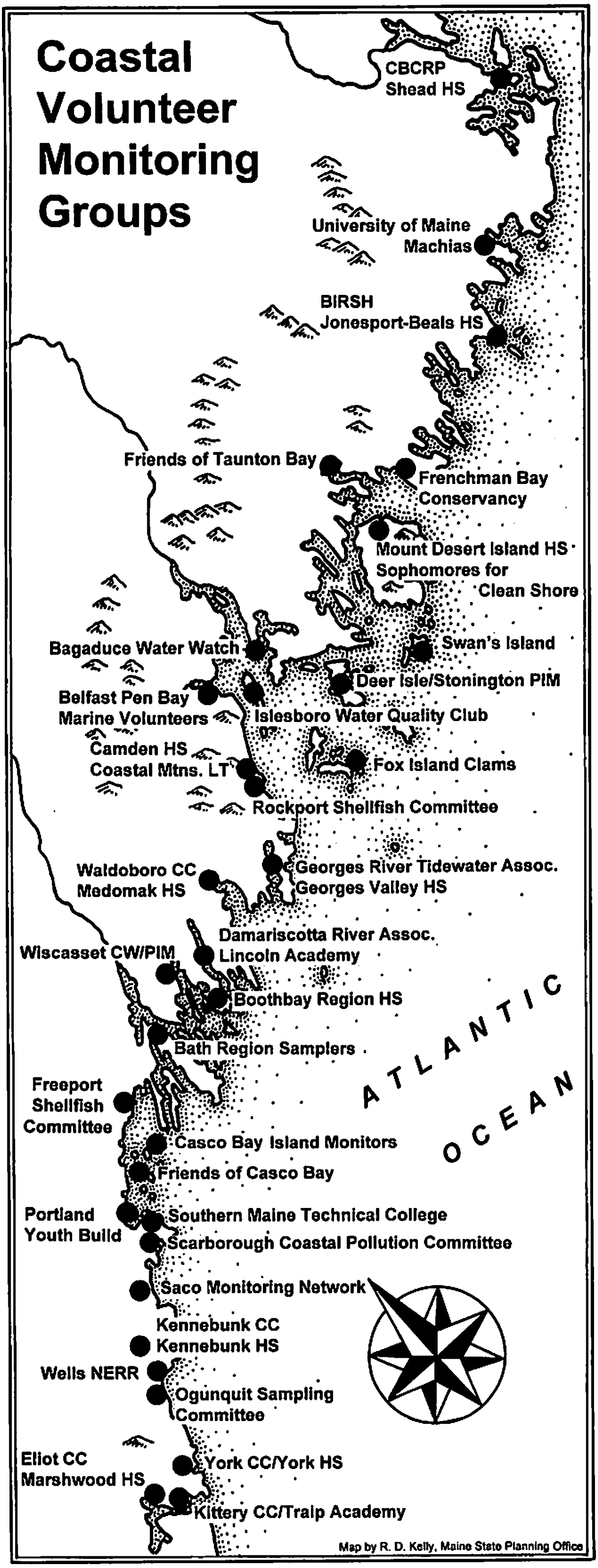


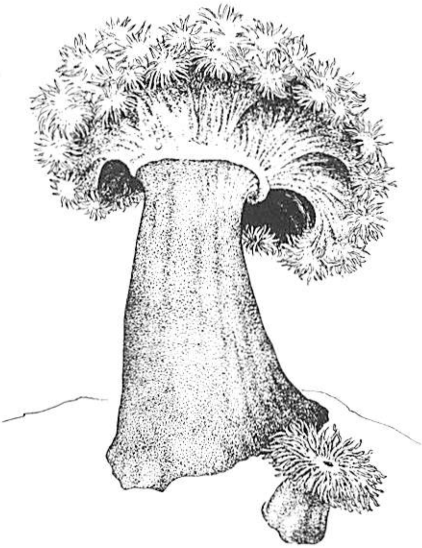


Coastal Volunteer Monitoring Groups
CBCRP
Shead HS
University of Maine Machias
BIRSH
Jonesport-Beals HS
Friends of Taunton Bay
Frenchman Bay Conservancy
Mount Desert Island HS
Sophomores for Clean Shore
Swan's Island
Bagaduce Water Watch
Deer Isle/Stonington PIM
Belfast Pen Bay Marine Volunteers
Islesboro Water Quality Club
Camden HS
Coastal Mtns. LT
Fox Island Clams
Rockport Shellfish Committee
Waldoboro CC
Medomak HS
Georges River Tidewater Assoc.
Georges Valley HS
Damariscotta River Assoc.
Lincoln Academy
Wiscasset CW/PIM
Boothbay Region HS
Bath Region Samplers
ATLANTIC OCEAN
Freeport Shellfish Committee
Casco Bay Island Monitors
Friends of Casco Bay
Portland Youth Build
Southern Maine Technical College
Scarborough Coastal Pollution Committee
Saco Monitoring Network
Kennebunk CC
Kennebunk HS
Wells NERR
Ogunquit Sampling Committee
Eliot CC
Marshwood HS
York CC/York HS
Kittery CC/Traip Academy
Map by R. D. Kelly, Maine State Planning Office

chapter 1
COMMON MARINE ORGANISMS

Written by Les Watling, University of Maine

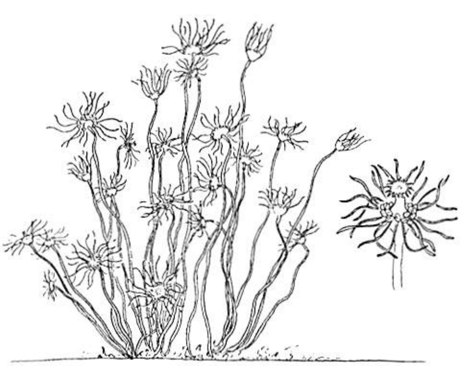
Anemones and their relatives belong to the phylum Coelenterata (which means "bag body"), also called the Cnidaria, due to the peculiar small, specialized stinging cells (*cnidae*) located in their tentacles. Cnidarians may exist as polyps attached to the sea bottom, as jellyfish floating freely in the sea, or have life cycles that include both stages. Anemones are found only as polyps; large jellyfish may have small, inconspicuous polyps; and in hydroids, both stages are often important.



Metridium senile **(Anemone)**

Metridium senile is the most common **anemone** found on Maine's shores. It lives from the lower intertidal zone to about 30 meters deep and may be green, white, orange, or various shades of brown. Intertidally, it can be found clinging to the underside of rocks where the humidity remains high at low tide. When disturbed, the anemone pulls its numerous fine tentacles into its mouth and looks rather like a fleshy lump on the rock. Anemones feed on small organisms which they catch using the stinging cells in their tentacles.

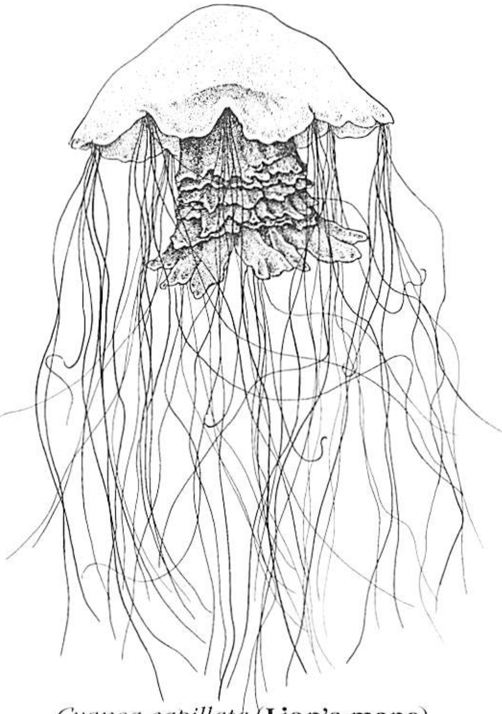
An abundant species attached to floating docks along the Maine coast is the pink **hydroid** *Tubularia* spp. Hydroids are colonial animals; that is, several individuals live together attached by a common, root-like system that enables them to share



Tubularia spp. **(Hydroid)**

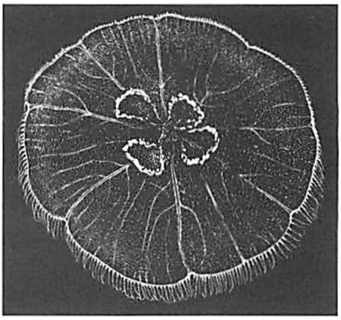
digested food materials. Each individual consists of a long stalk, at the end of which is a "head," bearing the food-gathering tentacles, a mouth, and a collection of reproductive structures.

Two species of true **jellyfish** are commonly found in Maine waters. The largest is the burgundy-colored *Cyanea capillata*, a species native to the colder waters of the Atlantic Ocean. Along the margin of the bell (the thick, disc-like part) are a series of robust tentacles. These bear numerous stinging cells and are used to capture food. Prey items subdued by the tentacles are transferred to the mouth which is located at the bottom of a long, ruffled tube hanging down from the center of the bell. Some people have a strong reaction to the toxin in the stinging cells of this jellyfish, so it should be handled cautiously.



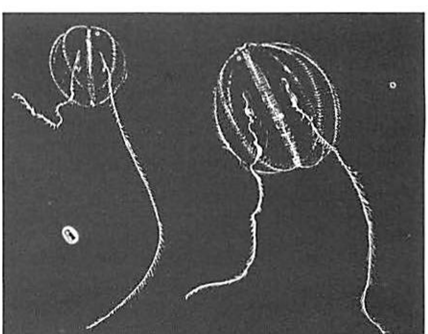
Cyanea capillata **(Lion's mane)**

The other local jellyfish is the moon jellyfish, *Aurelia aurita*. It is nearly all white or slightly transparent except for the four, horseshoe-shaped, light pinkish gonads located in the bell. This species has numerous short tentacles arranged along the edge of the bell. The stinging cells of the moon jellyfish are not toxic to humans, so this species can be handled easily.



Aurelia aurita **(Moon jellyfish)**

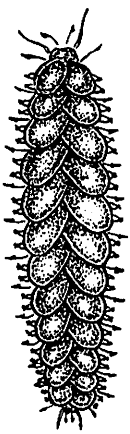
A relative of the cnidarians is the sea gooseberry, *Pleurobrachia pileus*, a member of a group called **ctenophores.** By holding a ctenophore up to the light, the *ctenes*, or comb rows (which give the group its name), can be seen by their iridescence. Ctenophores are a major consumer of smaller zooplankton,



Pleurobrachia pileus
(Sea gooseberry)

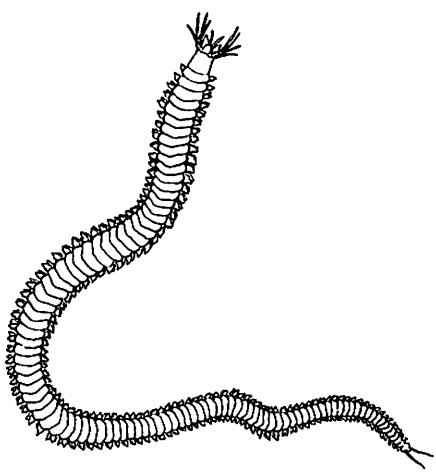
especially copepods, fish eggs, and larvae. Prey are captured by adhesive, rather than stinging, cells located on the two long tentacles which can be retracted into pockets in the body.

Worms may be a variety of shapes and sizes. In the sea, the true worms are called polychaetes (after the numerous *chaetae* or bristles seen along the sides of the body), but other worm groups include the flatworms and ribbon worms. Flatworms are unsegmented and very flat. Although ribbon worms are also usually flat, they are generally quite long relative to their width.



Lepidonotus squamatus **(Scale worm)**

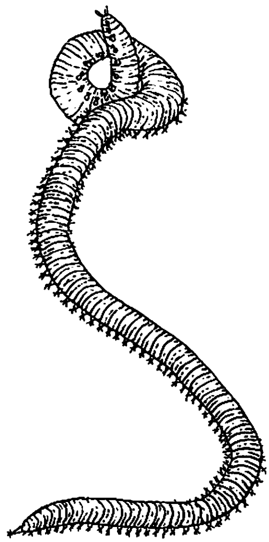
Scale worms, a group of polychaetes vaguely reminiscent of large insect larvae, are so-called because their entire upper surface is covered with pairs of overlapping scales. *Lepidonotus squamatus* has 12 to 13 pairs of scales, whereas several other Gulf of Maine species have 15 pairs, at least as adults. *L. squamatus* commonly can be found in old mussel shells, under debris, etc. in the lower intertidal zone—from the rocky shore to mussel reefs at the lower end of tidal flats.



Nereis spp. **(Clam worm)**

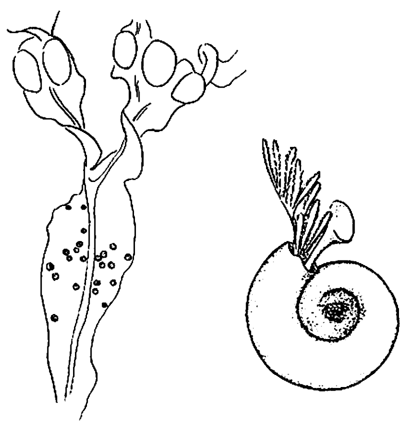
The most commonly encountered worms in Maine waters, clam worms and blood worms, form the basis of the baitworm industry. Clam worms are members of the genus *Nereis*. Five species are found in Maine, the most typical being *N. virens* and *N. diversicolor*. All have complex heads bearing fleshy lobes (palps) on either side of the mouth, four pairs of finger-like appendages (cirri), one pair of antennae at the front, and four eyes. Clam worms are predators, capturing their prey with a proboscis turned inside out through the mouth, and armed with strong jaws. They are also quite beautiful with iridescent green and blue bodies.

The other major baitworm species is the blood worm, *Glycera dibranchiata*. Blood worms are easily distinguished from clam worms by their uniform red color and pointed heads. A blood worm has no eyes or cirri on its head, which is often difficult to distinguish from the posterior end. However, if you handle a live blood worm, you will soon know which end bears the head, as the worm will evert its long proboscis with little provocation. The proboscis bears a pair of sharp, black jaws capable of piercing your skin. Bloodworms use a neurotoxin to subdue their prey which is injected under the prey's skin through small pores in the bloodworm's jaws.



Glycera dibranchiata
(Blood worm)

When looking closely at rockweeds, you will often see small white spirals attached to the surface of the plant. These are the tubes of the small serpulid polychaete, usually one of the species of the genus *Spirorbis*. These worms have very small, sticky tentacles which they use to catch minute food particles suspended in the passing water. One of the tentacles is modified to form a plug which can be used to close off the entrance to the tube, after the animal has withdrawn into it. While it can be difficult to tell the various species apart, the most common species, *S. borealis*, coils to the left and has a smooth tube.



Spirorbis borealis
(Hard tube worm)
Enlarged view (on right)

Molluscs are unsegmented animals, with bodies generally covered by shells. Typical molluscs are clams, snails, tooth shells, and chitons. Some molluscs—such as squids, octopuses, and nudibranchs—have no shells.

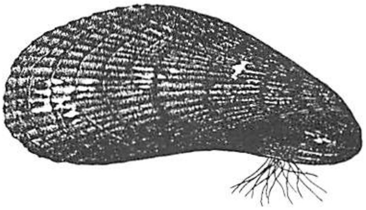
Bivalves are molluscs with two shells, usually symmetrical left to right. Since the shells typically close tightly when the animal is disturbed, special structures, called siphons, are used to pump water from outside onto the gills. Bivalves are designed efficiently; their gills can be used for respiration, as well as for food collection.

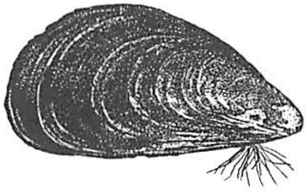
MUSSELS: Three species of mussels are commonly found in the Gulf of Maine: the ribbed mussel, *Modiolus demissus*; the blue mussel, *Mytilus edulis*; and the horse mussel, *Modiolus modiolus*. All occur in the intertidal zone and feed on tiny, suspended particles.

The ribbed mussel, so-called because of the delicate lines running the length of the shell, is usually found living partially buried in the mud near salt-marsh grasses. It is a southern species, with Maine being near the northern edge of its range.

Blue mussels occur intertidally from the bays to the outer coast, but are most commonly seen attached just below the waterline of floats or other man-made structures in the water. On the outer coast, blue mussels are usually quite small and form a conspicuous band on the rocks just between the barnacle and rockweed zones.

The horse mussel is the largest of the mussels. It often has a shaggy appearance, due to producing an excessive amount of the brown,



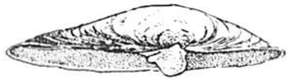


Modiolus demissus
(**Ribbed mussel**), top

Mytilus edulis
(**Blue mussel**), middle

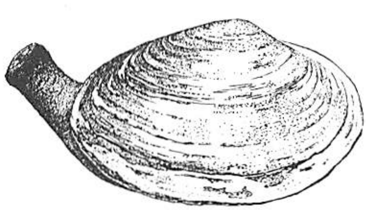
Modiolus modiolus
(**Horse mussel**), bottom

papery outer shell layer, called the periostracum. Horse mussels love cold water and are found from the low intertidal of the outer coast to about 30 meters deep. Near the entrance to the Bay of Fundy, there are large "reefs" made up entirely of horse mussels.



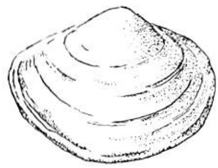
CLAMS: Several species of clams inhabit the Maine coast, but only a few are abundant in the shallow, intertidal waters.

Of course, the most notable clam species is the soft-shell clam, *Mya arenaria*, which is found on all mud flats from the Gulf of St. Lawrence to Delaware. Its ovoid shape, relatively soft shell, and united siphons covered with a brown "skin" distinguish it from other local species. While soft-shell clams live entirely under the surface of the mud, they use their siphons to obtain food and oxygen from the overlying waters when the tide is in.



Mya arenaria (**Soft-shell clam**)

The clam, *Macoma balthica*, is also found on tidal flats, usually living in exactly the same habitat as *Mya arenaria*. An easy way to identify the *Macoma* clam is by its siphons, which are long and slender and not united. In fact, if you look closely at the surface of a mud flat, the *Macoma* siphons can often be seen moving like little white worms in a circle, picking up bits of mud to ingest.



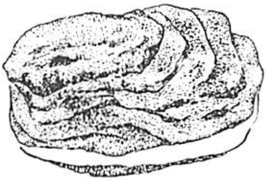
Macoma balthica (**Macoma clam**)

The razor clam, *Ensis directus*, is an inhabitant of sandy flats and lower edges of quiet sand beaches. This clam can be identified easily by its very elongate form and amber color. A razor clam is often difficult to catch because it maintains a burrow in the sand into which it can retreat by rapid contraction of its

Ensis directus (**Razor clam**)

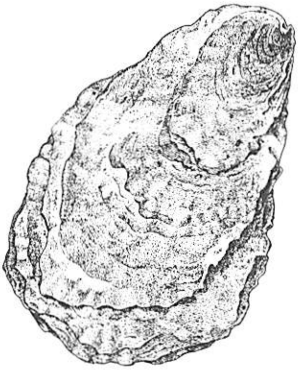
foot. Contrary to popular belief, razor clams do not rapidly burrow into the sand when disturbed; their burrows are already there.

Another small clam that is often overlooked in Maine is the Arctic rock borer, *Hiatella arctica*. It is often irregular in shape, due to its habit of living wedged under rocks, in crevices, under kelp holdfasts, and in other small spaces in the lower part of the rocky intertidal zone. This clam attaches itself by means of byssal threads and, if dislodged, cannot reattach itself since it does not readily make new byssal threads. Very young specimens are occasionally mistaken for young soft-shell clams.

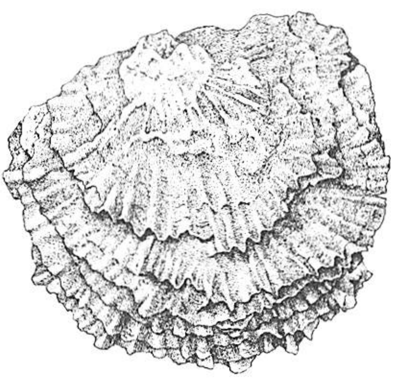


Hiatella arctica
(**Arctic rock borer**)

OYSTERS: Two species of oysters are likely to be found in Maine, the native American oyster, *Crassostrea virginica*, and the introduced European oyster, *Ostrea edulis*. The American oyster is more elongate in outline, whereas the European oyster, especially when cultured, is more circular when viewed from above. American oysters can be found in isolated pockets in the upper parts of the estuaries in the southern part of Maine. European oysters, on the other hand, were brought to Maine to foster a fledgling aquaculture industry. Although scientists have thought that Maine water temperatures were too cool in the summer for this species to reproduce, they have found occasional individuals in unusual places which suggests that some limited reproduction and survival may have occurred.



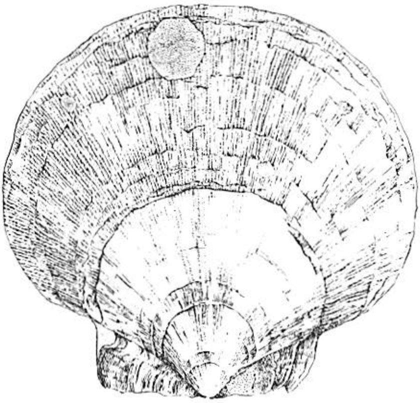
Crassostrea virginica
(**American oyster**)



Ostrea edulis
(**European oyster**)

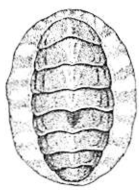
SCALLOPS: The scallop shell is a familiar symbol of ocean life. In Maine, two scallop species are caught commercially. The smallest of the two is the bay scallop, *Aequipecten irradians*, distinguished by its heavy ribs which extend from the hinged side to open edge. On the other hand, the ocean scallop, *Placopecten magellanica*, is quite large and the shell is sculptured with numerous fine lines. Due to Maine's deep and cool bay waters, both species are likely to be found nearshore.

Aequipecten irradians (**Bay scallop**)



Placopecten magellanica (**Ocean scallop**)

Another group of molluscs are the **chitons**, represented locally by the red chiton, *Ischnochiton ruber*. A chiton has a broad muscular foot which it uses to hold its body tight against the surface of the rock. Its back is protected by eight calcareous plates which are firmly embedded in a leathery mantle. While a chiton may not move while being observed, most are quite mobile and glide over the rock surface at a slow pace while rasping the rock with their teeth, known as radulae. Chitons usually eat single-celled or very small plants.



Ischnochiton ruber (**Red chiton**)

Gastropods are sometimes called univalves because of their single shell. Some snails, like nudibranchs, have lost their shells; in others, including bubble shells, the shell is reduced and covered with fleshy tissue. Whether they have a shell or not, all snails have a flattened foot on which they glide over the bottom. They also have radulae which can protrude from the mouth and be used to feed on everything—from other animals, to plants and small microscopic particles.

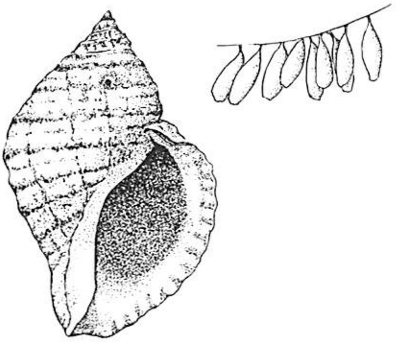
The predatory snails include the dog whelk, *Nucella lapillus*; the waved whelk, *Buccinum undatum*; and the moon snail, *Lunatia heros*.

The dog whelk is most frequently encountered on the outer shore. It occurs in a variety of color patterns, ranging from black and white to orange. In some years, there are so many of this species that it seems the whole shore is covered with snails, while in other years, dog whelks can be difficult to find.

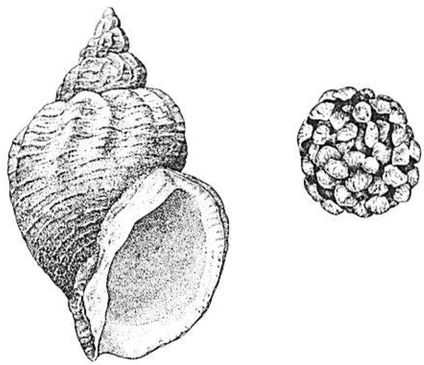
The waved whelk is a larger, heavier snail that is usually taken in subtidal samples, or from lobster traps where it feeds as a scavenger on lobster bait. It is decidedly less colorful than the other snails and is easily distinguished by the strong ridges running from the apex of the shell to the body opening.

Moon snails are predators that live on sandy flats or shallow, sandy mud bottoms where they feed primarily on bivalves. The northern moon snail, *Lunatia heros*, may look more like an old piece of gristle that has been thrown overboard, as the body of the snail may obscure most of the shell. Like dog whelks, moon snails obtain their food by boring holes through their victims' shells and using their radulae to tear off pieces of meat until the prey is consumed.

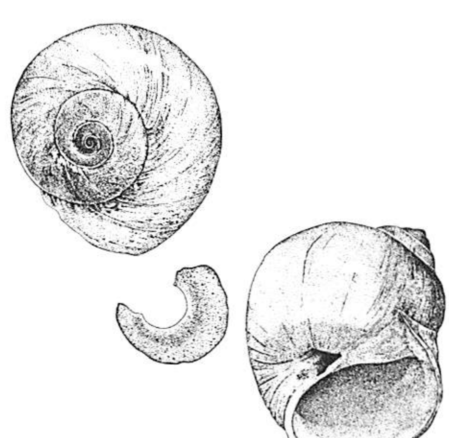
Many snail species are herbivores, feeding on the abundant algae of exposed and protected rocky shores. The most prominent are the littorines: *Littorina littorea*, *L. obtusata*, and *L. saxatilis*, known as the common periwinkle, smooth periwinkle, and rough periwinkle,



Nucella lapillus (**Dog whelk**)
Egg cases (on right)

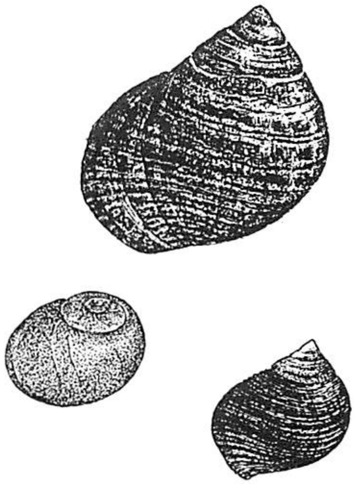


Buccinum undatum (**Waved whelk**)
Egg case (on right)



Lunatia heros (**Moon snail**)
Egg collar (in middle)

respectively. *L. littorea* has a thick, smooth, purplish-brown shell and occupies the middle to lower levels of the intertidal zone. It is thought that *L. littorea* was introduced from Europe in the 1840s, and it occurs in such large numbers that it can easily control the algal growth in the areas where it occurs. *L. obtusata* is a smaller species, orange to yellow in color, and is usually found living on rockweed or knotted wrack, on which it feeds. *L. saxatilis*, on the other hand, is an inhabitant of the upper shore and usually occurs in protected areas (such as under rocks) or in the more protected reaches of coastal bays. Unlike the other two littorines, *L. saxatilis* produces young directly, skipping the normal free-living larval stages.



Littorina littorea
(**Common periwinkle**), top

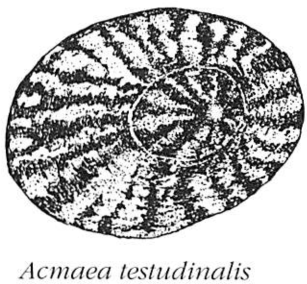
L. obtusata
(**Smooth periwinkle**), middle

L. saxatilis
(**Rough periwinkle**), bottom

An herbivore of the lower shore, *Lacuna vincta*, has a littorine-like look, but is small and has a very thin shell which may be decorated with a delicate reddish-brown banding. Also, near the opening of the shell, there is a small slit-like hole (umbilicus) which gives the snail its common name, chink shell. *L. vincta* is commonly found on kelp and seagrass on which it probably feeds.

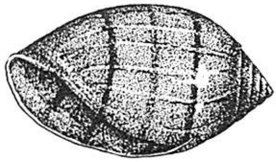
Lacuna vincta (**Chink shell**)
Egg mass on kelp (on right)

Another common grazer of the rocky shore is the tortoiseshell limpet, *Acmaea testudinalis*. Its shell has no signs of coiling, typical of snails, and the foot is very large. Limpets have especially strong teeth in their radulae which they use to graze the coralline algae lining the bottom and sides of many rock pools in the lower intertidal zone. In fact, coralline algae need to have their outer layer of cells scraped off by limpets to be able to grow and reproduce.

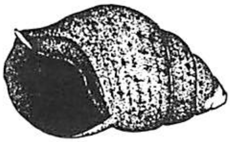


Acmaea testudinalis
(**Tortoiseshell limpet**)

Two snails of our estuarine waters specialize in grazing on small detrital particles, most likely gaining their nutrition from the resident bacteria and fungi. Animals that feed in this way are called "microphages." *Melampus bidentatus* is a microphage with a stout, multi-banded shell and is most commonly found on the stems of salt-marsh grasses. In contrast, *Nassarius obsoletus* (sometimes called *Ilyanassa obsoletus*), has a dull, dark shell and is primarily found on muddy surfaces where it grazes on diatoms and other microalgae living among the sediment grains.

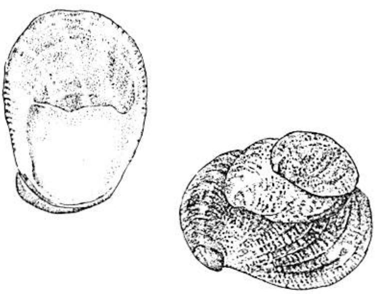


Melampus bidentatus
(Salt-marsh snail)



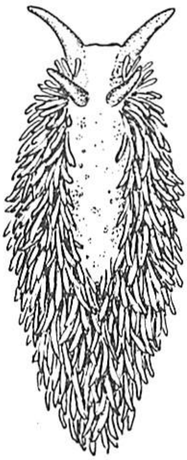
Nassarius obsoletus
(Mud dog whelk)

Not all snails eat material that sits on, or is attached to, the bottom. The slipper shell, *Crepidula fornicata*, obtains its food directly from the water. As in bivalves, it takes advantage of the fact that water passing over the gill for respiration usually contains a lot of small food particles. In many species, these particles would simply clog the gill and inhibit its functioning. The slipper limpet has evolved a mechanism for collecting those particles and transferring them to its mouth. Slipper limpets are almost always found in groups, piled one on top of the other. Since their food is obtained directly from the water, they do not have to go anywhere. The animals on the bottom of the pile are always females, those on the top are males, and the ones in the middle have both sets of sex organs, and are hermaphrodites.



Crepidula fornicata **(Slipper shell)**

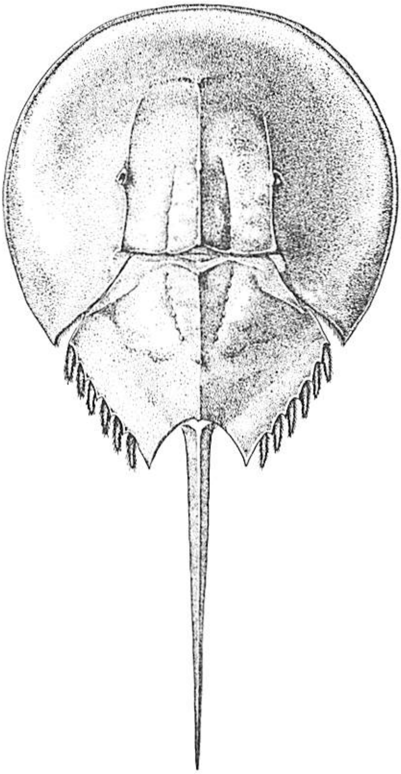
An unusual, although visually striking, group of "snails" are the nudibranchs. These gastropods have no shells to protect them, but instead use other methods of defense. *Aeolidia papillosa* is an example that is found in crevices, tidal pools, or low on pilings. It is usually a dull grey or orange color with brown flecks. Along its side are several hundred finger-like "cerata." These store large numbers of stinging cells obtained from the hydroids or anemones on which it has fed. Somehow the stinging cells are moved from the gut of the nudibranch to the cerata without discharging, allowing them to then be used in the nudibranch's defense.



Aeolidia papillosa
(Maned nudibranch or sea slug)

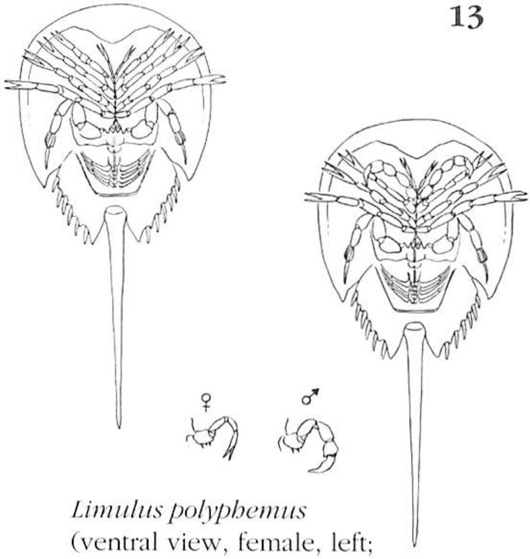
Arthropods are animals that are covered in chitinous exoskeletons. (Note the spelling of chitinous, differentiating this substance from chiton, the mollusc). Since the exoskeleton is hard, it must be shed, or moulted, in order for the animal to grow. In many species, the exoskeleton is impregnated with minerals or "tanned" with proteins, making it hard and resistant to abrasion. When it is shed, it may resist breakdown, explaining the occasional query about the "millions of dead crabs" that can be found washed up on local beaches during moulting season.

There are a large number of arthropod groups, each defined by peculiarities in the design of their legs. **Chelicerates**, for example, have a pair of "chelicerae" (pincers) as the first appendages on their heads near their mouths, and their bodies are divided into two parts. The best known chelicerates are spiders, but there is one common species that lives in the sea—the misnamed horseshoe "crab," *Limulus polyphemus*. This animal is very



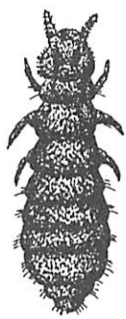
Limulus polyphemus (dorsal view)
(Horseshoe crab)

ancient, having ancestors that lived 350 million years ago. The horseshoe crab's body is composed of a broad shield-like prosoma, a region comprising two-thirds of the body on the "head" end, bearing the chelicerae and five pairs of legs on the underside; and the opisthosoma, which bears the gills. At the end of the body is the long tail spike which the animal can use for righting itself if turned onto its back.



Limulus polyphemus (ventral view, female, left; male, right) (**Horseshoe crab**)

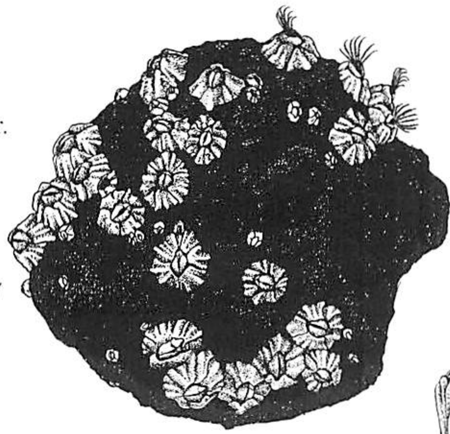
Insects have bodies divided into three parts, with the middle part, or thorax, having three pairs of legs, and usually one pair of antennae at the front of the head. While present in the sea, insects are generally not common and are usually omitted from most field guides. However, one species of springtail, *Anurida maritima*, can be quite abundant. They belong to a group of wingless insects, the Collembola, and look like adults when they hatch. These insects are most often seen as large, floating aggregations of small, blue specks on the surface of protected tide pools in the more marine part of New England estuaries. *A. maritima* has an exoskeleton designed to make it "unwettable," which is why it floats so easily.



Anurida maritima (**Common springtail,** as seen under microscope)

Crustaceans are the most common Arthropods found in the sea and are typified by shrimp, crabs, and lobsters. Crustacean body designs can be very diverse, but all have jaws near the mouth and two pairs of antennae at the front of the head, at least at some time during their life.

While not obviously a crustacean, the common barnacle of the shore has all the typical crustacean features when it is in its larval stage. *Semibalanus balanoides* is the most abundant of all the local barnacles, occurring in a broad zone on the upper parts of rocky shores. The shell of this species is quite variable and, in fact, changes during the year. In the spring when it is newly settled, the shell looks like that of a typical acorn barnacle. As the summer progresses, the barnacles continue to grow and they gradually fill in all the space among themselves. Then they have to grow upward. By early winter, all the individuals are very elongate and can be quite readily swept from the rocks by waves or people walking on the shore. Barnacles are unusual in that they have glued their "heads" to the rock and so have to feed with their "feet."

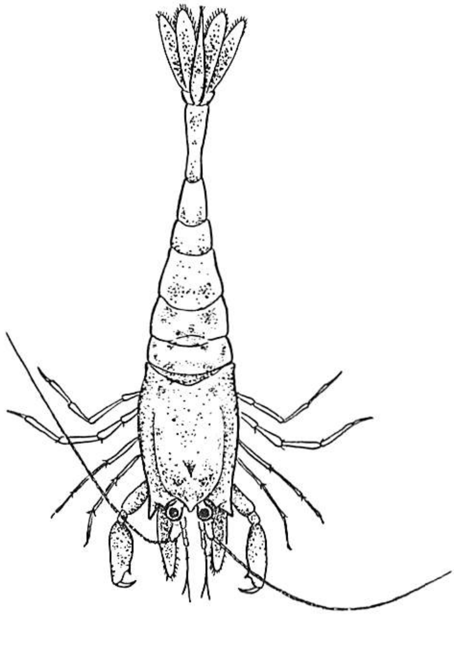


Semibalanus balanoides
(**Common barnacle**)

Elongated form

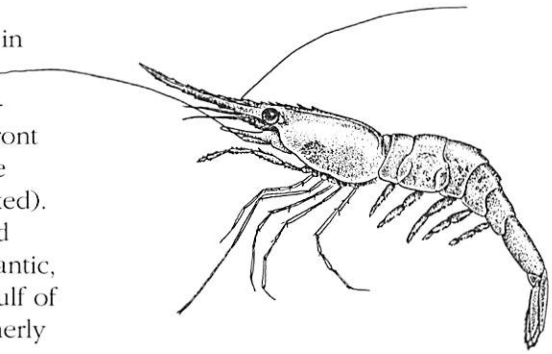
A major group of crustaceans is the **decapods**, so-called because they have ten walking legs. In some cases, the legs may be modified to help in capturing food. Decapods are often grouped into either shrimp or crabs, with lobsters and hermit crabs falling between the two.

The most common estuarine shrimp is *Crangon septemspinosum*. It is easily distinguished from all other shrimp by its front pair of legs which possess "subchelae," or claws, that are flattened and have the moveable finger folded back against the base. *C. septemspinosum* is also colored so that it blends into the background provided by the sand or mud on which it generally lives. This shrimp is very abundant in estuaries and bays on both sides of the Atlantic, especially in Europe where it forms the basis of a commercial fishery.



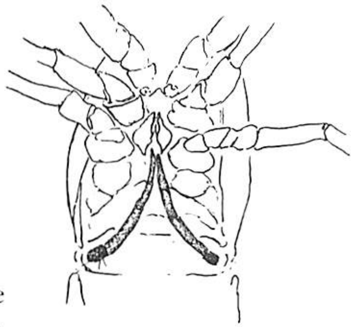
Crangon septemspinosum
(**"Estuarine" shrimp**)

The commercial shrimp species in the Gulf of Maine is *Pandalus borealis*. It has a very long, saw-toothed rostrum (spike on the front of the head) and is usually some shade of red (before being cooked). This species is widely distributed throughout the Arctic, North Atlantic, and North Pacific. In fact, the Gulf of Maine represents the most southerly occurrence of this species in the Atlantic. As a result, most individuals are restricted to the deeper, colder waters of the Gulf until winter when the surface water cools. Then, the females move inshore where they release their larvae—if they haven't already been removed from the sea by a shrimp trawler or trapper.

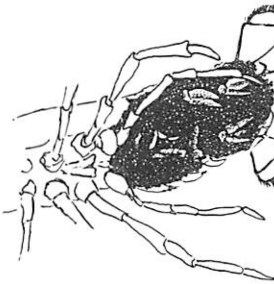


Pandalus borealis
("Commercial" shrimp)

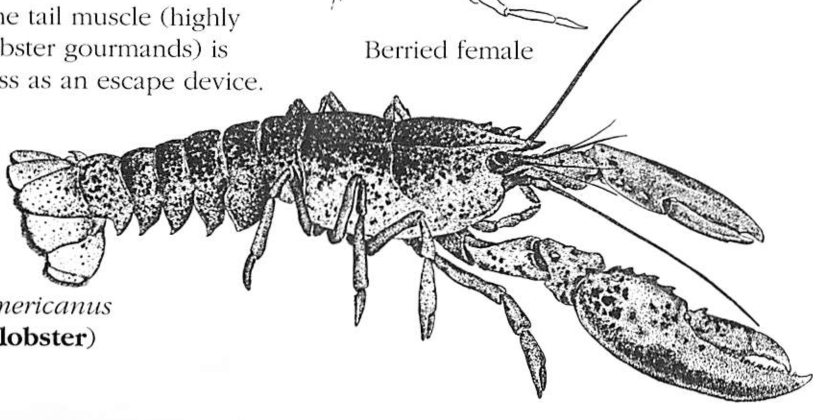
Of course, the largest and best known crustacean in Maine is the American lobster, *Homarus americanus*. It has two large chelate claws which are the source of much gastronomic attention. Lobsters, like shrimp, have an elongated abdomen bearing the swimmerets, small appendages under the abdomen (or tail) used for locomotion which, in females, are also used to carry the eggs until the larvae hatch. The abdomen of the lobster contains a large muscle which it uses to rapidly flex, or flap, the tail to escape predators. In the case of human predators, the tail muscle (highly prized by lobster gourmands) is nearly useless as an escape device.



Male lobster

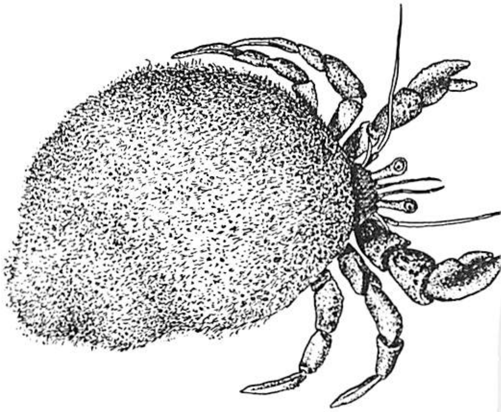


Berried female

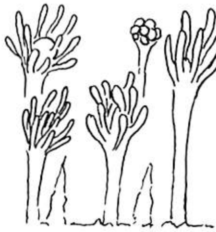


Homarus americanus
(American lobster)

Hermit crabs are more closely related to lobsters than to the true crabs. All hermit crabs in our colder waters inhabit gastropod shells, which they use to protect their soft abdomens. Five species of hermit crabs can be found in the Gulf of Maine but two are particularly common. Details of the major and minor claws are often used to tell the hermit crabs apart. *Pagurus acadianus* is a northern species whose claws are covered with low bumps. Its major claw has a prominent orange stripe and is about one-third larger than the minor claw. In *Pagurus longicarpus*, on the other hand, the major claw is much longer than the minor, is nearly smooth, and has a brown or gray stripe. The shells inhabited by hermit crabs are often partly overgrown by a bright pink, furry carpet which is a colonial hydroid of the genus *Hydractinia*. Each hermit crab species carries its own *Hydractinia* species with it.

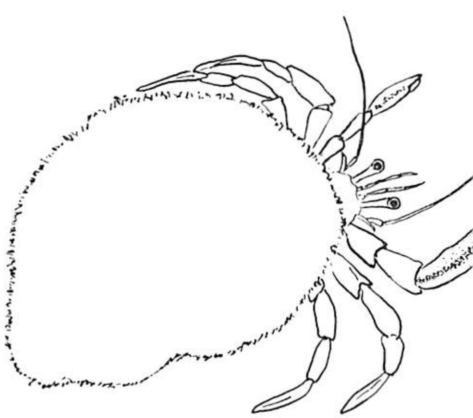


Pagurus acadianus
(**Hermit crab**)



Hydractinia spp.
(**Snail fur,** enlarged view)

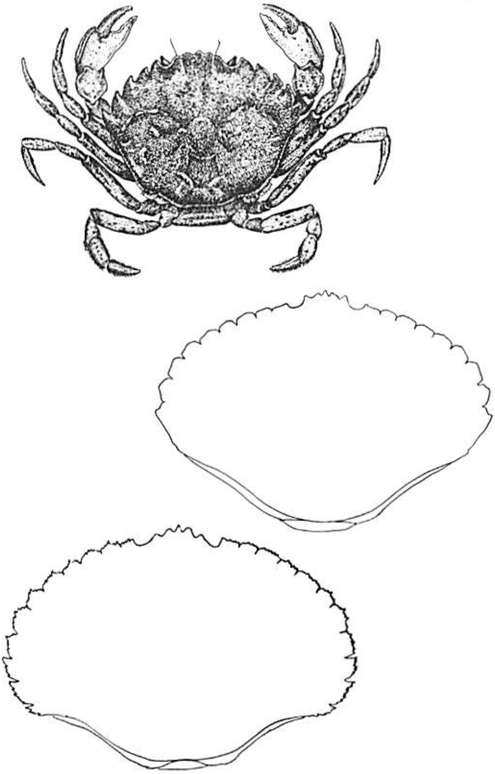
A true crab has a box-like design, with an abdomen reduced in size and tucked under the front part of the body. The ten legs originate from the side of the body which often gives crabs their odd sideways mode of walking. Crabs breathe by means of gills tucked safely under their carapaces. Water pumped through the gill chamber enters at the base of the legs and exits in front of the mouth, producing the odd bubbling of water when crabs are kept alive in shallow water.



Pagurus longicarpus
(**Long-clawed hermit crab**)

The most common crab of the shore is the green crab, *Carcinus maenas*. It is a member of the swimming crab family Portunidae; however, its last pair of legs are merely flattened instead of having fully developed paddles. As the name implies, green crabs are generally greenish in color, but may also have tinges of yellow, especially on the undersides.

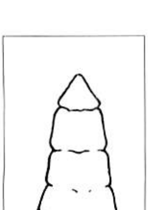
The two commercially fished crab species are the rock and Jonah crabs, *Cancer irroratus* and *Cancer borealis*, respectively. The rock crab carapace is slightly yellowish with reddish flecks, and is broadly oval with nine smooth or slightly granular teeth on each side of the front margin. The Jonah crab, on the other hand, is more reddish and the front margin teeth have what seem to be little teeth on them. If not taken in traps, rock and Jonah crabs may occasionally be found among algae on rocky shores. All individuals of both species molt within a few days of each other, which often results in large numbers of crab shells being washed up on the beach.



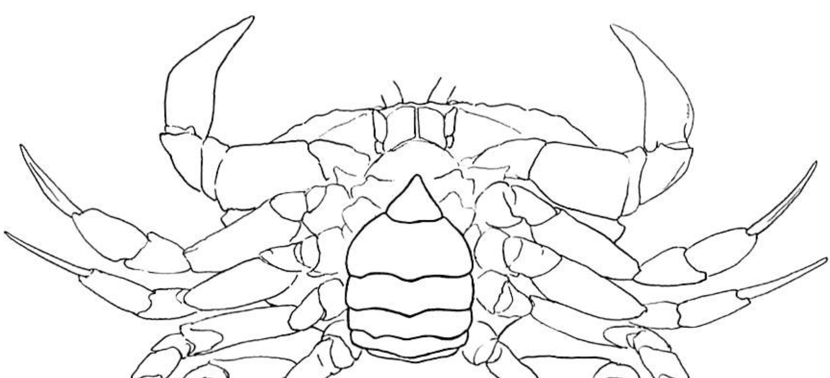
Carcinus maenas
(**Green crab**), top

Cancer irroratus
(**Rock crab**), middle

Cancer borealis
(**Jonah crab**), bottom

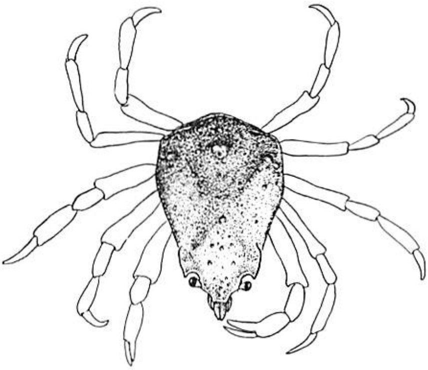


Male crab



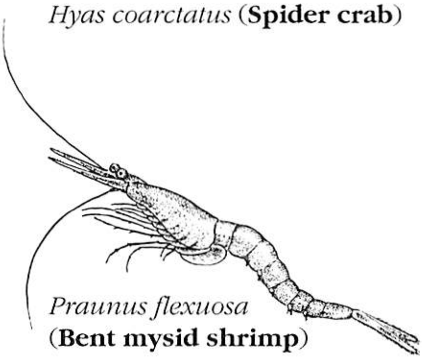
Female crab

Hyas coarctatus is a member of the spider crab family. It has a triangular carapace which is usually covered with a dense growth of algae, sponges, hydroids, or other species that can find a home among the hairs and spines on the crab's back. Spider crabs are slow-moving herbivores who use camouflage as their primary defense. As a result, their claws are relatively harmless to humans.



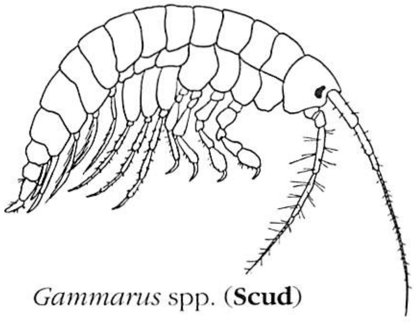
Hyas coarctatus (**Spider crab**)

Mysids are shrimp-like crustaceans, but differ from true shrimp in having seven pairs of walking legs and carapaces that are not attached to the backs of their bodies. Common inhabitants of shallow estuarine bottoms, mysids usually hover just over the sediment and feed on small animals and detritus. One of the largest mysids is the introduced European species, *Praunus flexuosa*. As with most mysids, it is nearly transparent when alive.

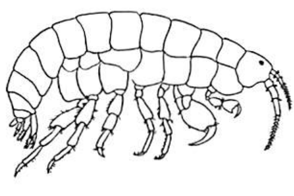


Praunus flexuosa
(**Bent mysid shrimp**)

Amphipods are one of the most diverse groups of crustaceans on our shores. They have seven pairs of walking legs arranged in three groups on the main part of their bodies and their abdomens are divided into two sections. Members of the genus *Gammarus* are the most easily seen amphipods on algal-covered shores. They are generally greenish in color and have a dark, kidney-shaped eye. Most *Gammarus* species are omnivores, eating plant material most of the time but feeding on dead or dying animals when the opportunity arises. *Hyale nilssoni* is a small amphipod of the rocky shore, yellowish in color, and it is usually seen hopping



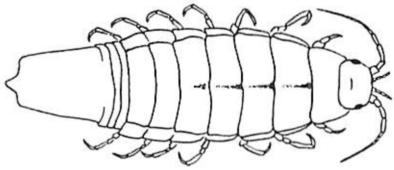
Gammarus spp. (**Scud**)



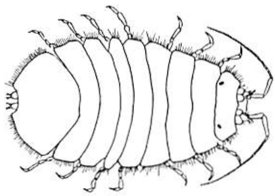
Hyale nilssoni (**Beach flea**)

about like a large flea from one place to another.

Isopods, like amphipods, have seven pairs of walking legs but, in this case, the walking legs all look alike. Also, isopods have abdomens that are not subdivided and appendages that are flattened and used as gills. There are two common species on the rocky shore: the larger, reddish purple *Idotea baltica*; and the very small, ovoid, dark grey *Jaera marina*. *I. baltica* is always found living in algae, whereas *J. marina* can be seen most easily by looking on the undersides of rocks immersed in tidal pools. In the estuaries, *I. baltica* can also be found living on eelgrass, where it is usually greenish in color.

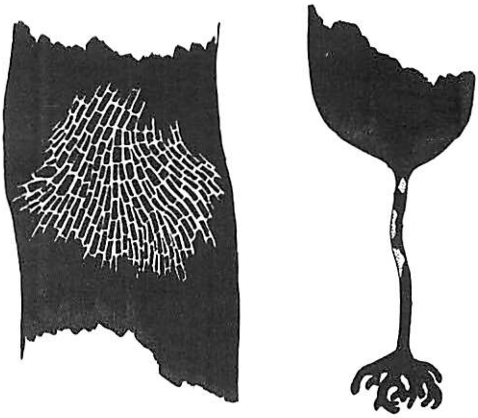


Idotea baltica (**Isopod**)



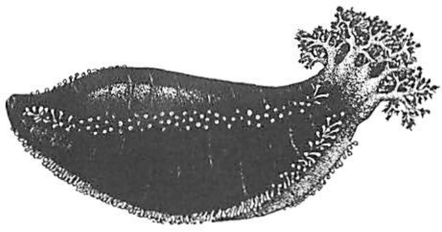
Jaera marina (**Little shore isopod**)

Bryozoans are another group of colonial animals. Each individual makes its own box-like shelter, which is joined together with others in a complex pattern. Each individual is also the descendant of an individual next to it, and all individuals are connected by a small strand of tissue extending through the walls of the box. Bryozoans, typified by species of *Membranipora*, feed by means of water currents generated by cilia on their tentacles. Very small particles are carried into the vicinity of the tentacles and caught by sticky substances. Because it is not efficient for the whole colony to feed at one time, cooperating individuals set up feeding zones.



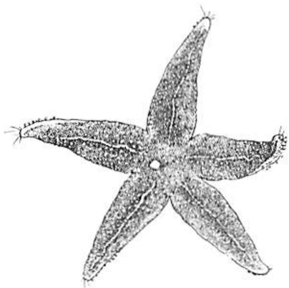
Membranipora spp. (**Lacy crusts**)
Microscopic view (on left)

A truly unusual group of invertebrates are the **Echinoderms**. They have a five-part symmetry to their bodies and do not have a brain comparable to that seen in worms, molluscs, or crustaceans. Most echinoderms also have bodies completely covered in small calcareous plates through which tube feet, used for locomotion, protrude. There are four common groups of echinoderms that can be found in Maine waters: the starfish, brittle stars, sea cucumbers, and sea urchins and sand dollars.

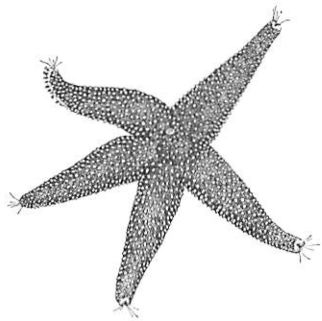


Cucumaria frondosa
(**Sea cucumber**)

Starfish are typical echinoderms. They usually, but not always, have five arms, each of which has four rows of tube feet lining the undersides. The upper side of the body is covered with a dense set of calcareous plates set so closely together that it appears the animal has a continuous coat of armor. On the upper surface is a small button-like structure, called the "madreporite," used by the animal to take in water which helps the tube feet move. *Asterias vulgaris* has a pale yellow madreporite whereas the one on *Asterias forbesi* is bright orange. Otherwise, the two species are very difficult to tell apart.

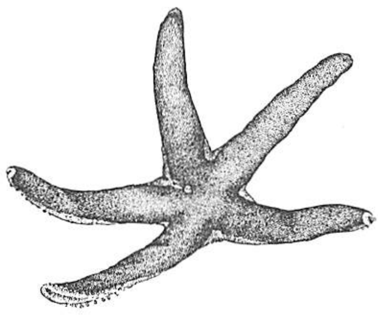


Asterias vulgaris (**Sea star**)



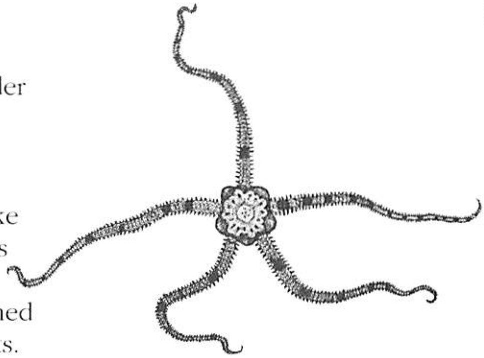
Asterias forbesi (**Sea star**)

Henricia spp., on the other hand, have only two rows of tube feet along the undersides of their arms. The upper part of the body of this group of starfish is also generally quite smooth.



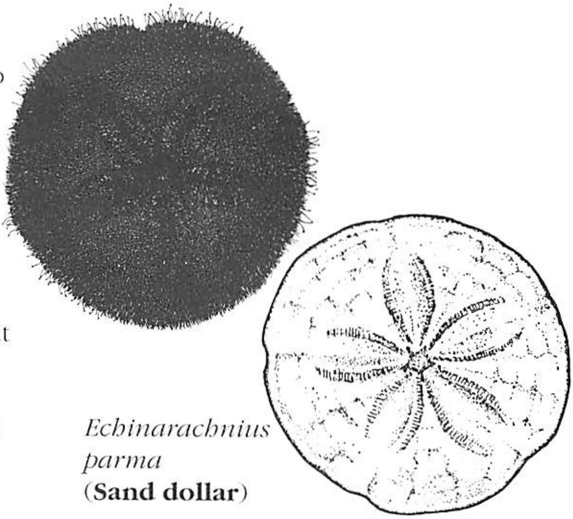
Henricia sp. (**Blood star**)

Brittle stars are completely different from true starfish. They have arms and bodies distinct from each other, and the calcareous plates lining their arms have several different designs. Brittle stars are so-called because their arms generally break away from their bodies relatively easily. The most accessible local brittle star is the daisy brittle star, *Ophiopholis* *aculeata*, which can be found under rocks and sponges low in the intertidal zone.



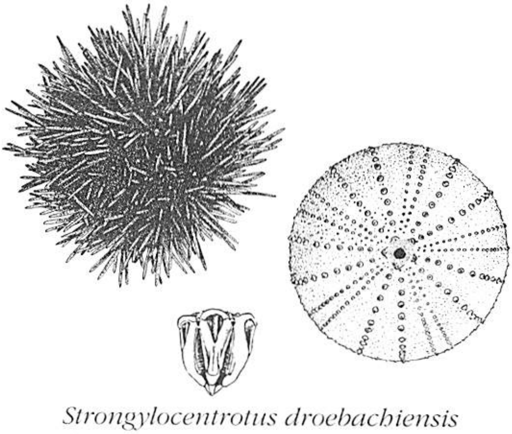
Ophiopholis aculeata
(Daisy brittle star)

Sea urchins and sand dollars, unlike all other echinoderms, have bodies that are apparently completely encased in calcareous plates attached to each other without flexible joints. While it appears that the hard plates are on the "outside" of the animals' bodies, there is actually a thin layer of skin covering the plates. Both have calcareous spines connected to the hard plates, but those of the sand dollar, *Echinarachnius parma*, are shorter than those of the sea urchin, *Strongylocentrotus droebachiensis*. Sand dollars, as the name implies, live on open sandy bottoms of bays and offshore banks and feed on small plant particles that they catch from the water passing over their bodies. Sea urchins live near rocky surfaces where they feed on the larger algae which are present.



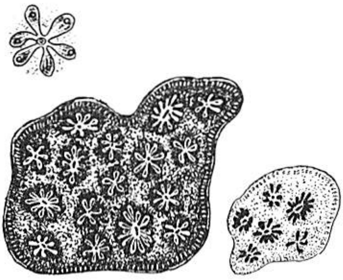
Echinarachnius parma
(Sand dollar)

Tunicates are sessile organisms that live either solitarily or in colonies. They are related to fish and other vertebrates, due to their tadpole-like larvae. Tunicates get their name from the tough, often leathery, outer tunics in which they live. Whether solitary or colonial, all tunicates have an elaborate filter basket which is used to extract very small food particles from the water. There are several tunicate species in Maine, three of which might be commonly encountered.



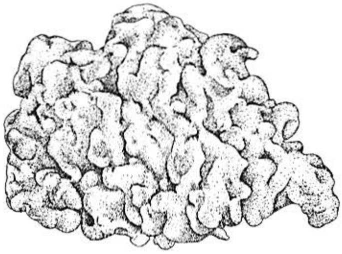
Strongylocentrotus droebachiensis
(Green sea urchin)

Botryllus schlosseri is a small, dark-colored colonial tunicate whose individuals have distinct white regions and are arranged in a multi-pointed star shape. There is a related species, *Botrylloides leachi*, that is very similar in appearance except the individuals are not in a star-like arrangement.



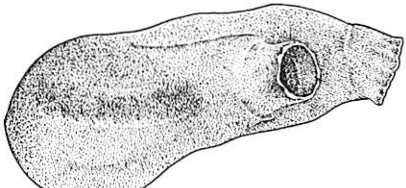
Botryllus schlosseri
(Golden star tunicate)

Another common colonial tunicate is *Lissoclinum aureum*. It forms large, sponge-like colonies that are found on pilings, eelgrass, or any hard substratum to which they can attach. The colonies may be white, purple, or orange.



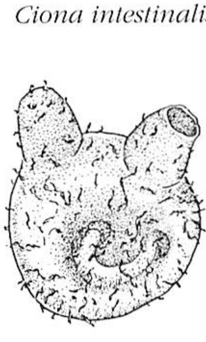
Lissoclinum aureum
(Orange tunicate)

Among the solitary tunicates, the vase-like, nearly transparent *Ciona intestinalis* is especially striking. As with all tunicates, each individual has two large openings, one for pumping water into the filter basket area and the other through which the water can exit. This species can be found most easily by looking around pilings or in floating lobster pens.



Ciona intestinalis **(Sea vase)**

There are also several other solitary tunicates that are usually small, brown, and nearly globular. These are members of the genus *Molgula*, commonly called sea grapes. Identifying the species in this genus is difficult because they differ from one another only in small details, such as the pattern on the outside of the filter basket, and the length and direction of the loop in the intestine. Molgulas are quite common in the brackish parts of Maine's bays and can be found growing on pilings, sea grasses, rocks, or any other moderately solid surface.



Molgula spp. **(Sea grapes)**

The **rock gunnel**, *Pholis gunnellus*, is the only vertebrate listed in this guide. You will often find gunnels living under rocks or in tide pools in the lower intertidal zone. They have an eel-like appearance and a long dorsal fin. Rock gunnels are 10 to 25 centimeters long and are generally brownish to olive green. Feel free to pick one up for a closer look, but be sure to put it back under the rock or in the pool where you found it. Rock gunnels have rather small mouths for their size and consequently feed only on very small crustaceans, in particular, copepods and young amphipods that live on algae or on the bottom of rock pools.

Pholis gunnellus (**Rock gunnel**)

NOTES

chapter 2
COMMON MARINE MACROALGAE (SEAWEEDS)

Written by Wendy Norden, University of Maine Cooperative Extension
Reviewed by Ian Davison, University of Maine

Introduction

Marine macroalgae are beautiful and complex, and the Maine coast is an ideal place to discover the great diversity of these interesting and important organisms. To the casual observer walking along the intertidal zone, seaweeds may seem like terrestrial plants that have adapted to life along the shore. However, marine macroalgae are not **true** plants and differ from them in several ways.

Like terrestrial plants, seaweeds rely on sunlight for photosynthesis. However, seaweeds belong to a more primitive group called algae, that includes both unicellular microscopic forms (phytoplankton) and multicellular forms, such as seaweeds and certain freshwater algae. Unlike higher plants, seaweed reproduction does not involve flowers or seeds, but may involve sexual or asexual spores. Many seaweeds have a complex life history with two or three stages that may physically be very different. Seaweeds come in many diverse forms, ranging from simple species, made of filaments or resembling crusts, to those that are highly complex, such as kelp which possess specialized tissues and cell types.

As you look at seaweeds along the shore, you will notice they are found in three basic colors— red, brown, and green. All algae possess chlorophyll, but it is frequently masked by other accessory pigments. These colors are used to divide seaweeds into three major groups. Green algae are in the class *Chlorophyta*, red algae are called *Rhodophyta*, and brown are *Phaeophyta*. It is important to note that some algae, like the reds, don't always appear red and have several color variations which resemble brown algae.

If you examine a complex seaweed such as a kelp, you will notice that it has three major parts: *holdfast*, *stipe*, and *blade*. The entire alga is referred to as the *thallus*.

The holdfast acts as an anchor for the seaweed. Despite its resemblance to a root, the holdfast is not used for nutrient uptake. Instead, nutrients are absorbed from the seawater over the entire thallus. The holdfast provides homes to many invertebrates along the intertidal and subtidal zones. It's interesting to explore the holdfast to see what you can find.

The seaweed's stipe connects the blade to the holdfast. It is generally rubbery to the touch and is extremely flexible, to allow algae to move easily as the tide goes in and out and as waves crash on the intertidal zone.

The blade is the major region of

the thallus for photosynthesis, nutrient uptake and, in some kelp, is also responsible for spore production. Kelp possess several distinct types of cells, including sieve tubes, that transport nutrients and food from the blade to the major growing region, located between the stipe and the blade. This enables kelp blades in Maine to grow up to 20 centimeters per month during the early spring, the height of their growing season. Blades also create refuge for many intertidal invertebrates. As you explore marine macroalgae, look under the blades to find what organisms use them as habitat.

It is important to note that not all macroalgae exhibit a prominent holdfast, stipe, and blade like kelp do. Although other species do not have obvious blades, the entire plant is still called a thallus.

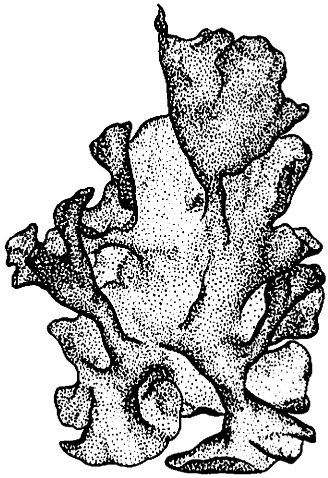
Seaweed species dominate different zones, or tide heights, forming distinct bands in the intertidal area. Since species compete for space, light, and nutrients, they settle in the zone which best meets their biological requirements and where they will not be outcompeted by other species. In addition, wave action, ice scour, desiccation, and predation help determine where seaweeds can survive. Snails, in particular, prey on certain seaweeds in the intertidal zone and help shape their settlement and growth patterns.

When you visit the intertidal zone, you will notice that, at the upper edge closest to land, there is a yellow growth that covers the rocks. This is a not an alga but a marine **lichen** (a plant comprised of one or more species of unicellular algae and a fungus) called *Xanthoria* sp. This lichen indicates the upper limit of the intertidal zone, where salt spray reaches during high tides and storm events.

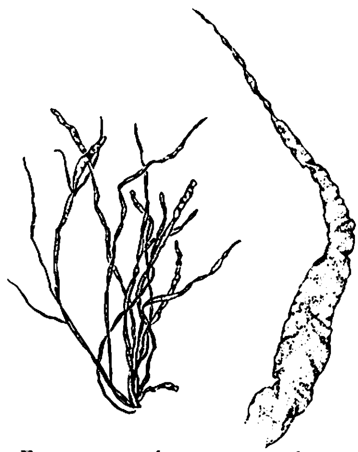
Blue-green algae are also commonly seen on rocks throughout the intertidal zone. They are black (resembling tar spots), cover a large area, and are very slippery to walk on when wet. Blue-green algae are in the division *Cyanophyta*. These algae have existed for billions of years, and form colonies that are surrounded by a jelly-like substance that holds them together and keeps them from drying out. It would be a good idea to use a hand lens or to scrape some of these algae from the rocks to examine under a microscope.

GREEN ALGAE (Chlorophyta)
Green algae need a lot of sunlight and are often associated with high nutrient areas. You may find them in the lower intertidal and subtidal areas. As long as they receive enough sunlight, these marine plants will thrive. Green algae come in a variety of shapes and sizes; some resemble sheets, while others form long, hollow tubes. Many types of green algae are found in fresh water, but we will focus only on the marine species. Green algae are more closely related to terrestrial plants than any other algae.

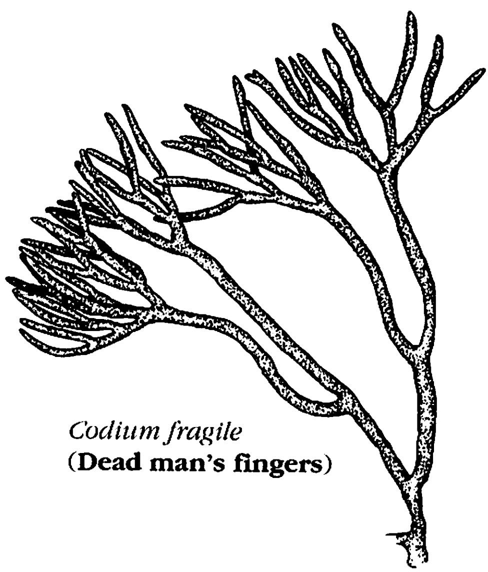
***Ulva lactuca* (Sea lettuce)**
This alga resembles a thin piece of lettuce, is usually bright green, and is found in the lower intertidal zone. Often you may see it washed up in the high intertidal zone, bleached by the sun, so it appears almost white. *Ulva lactuca* is two cells thick, and looks like another type of alga called *Monostroma* sp. which is one cell thick. Since mono means "one," you can easily remember that *Monostroma* is one cell thick. *Monostroma* is often found growing on a species of red algae, *Chondrus crispus*. One way to tell the difference between *Monostroma* and *Ulva lactuca* is by touching them; *Monostroma* feels like tissue paper.


Ulva lactuca **(Sea lettuce)**

***Enteromorpha* spp.**
(Hollow green weed)
More than one species of *Enteromorpha* grows along the coast of Maine. Illustrated here is *E. intestinalis,* which resembles hollow, green tubes. Often you will find it in large masses on the lower intertidal zone or in tide pools. The color of this alga ranges from bright green to darker olive-green; it gets darker as it ages. This alga is sometimes found in areas with high nutrients and may act as an indicator for nutrient enrichment.

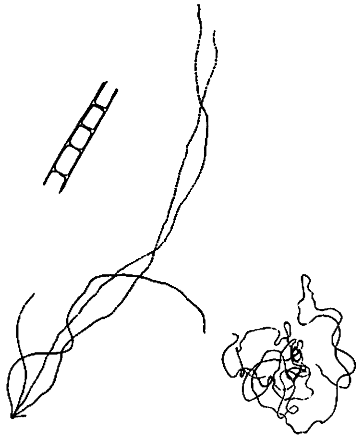

Enteromorpha intestinalis
(Hollow green weed)

Codium fragile
(Dead man's fingers)
This alga is dark green and has a spongy texture. You can find it low in the intertidal zone, subtidally, or washed up on shore. This alga was introduced into Maine waters from Europe, making it an exotic species, and has now begun to take over a wide range of habitat in the subtidal zone. Another common name for it


Codium fragile
(Dead man's fingers)

is "green fleece" due to its fleece-like appearance.

***Chaetomorpha* spp.**
There are two types of *Chaetomorpha* illustrated. One resembles bright green fishing line and generally tangles into a small ball on the intertidal zone. The other species looks like a string of tiny pearls and is dark green. These marine plants are found very low in the intertidal zone near the water, or in some tide pools.



Chaetomorpha melagonium (on left) and *C. linum*
Microscopic view of *C. melagonium* (top left)

***Spongomorpha* sp.**
This bright to dark green alga is seen in the lower intertidal zone. It grows in mats or clumps, and is sometimes hard to distinguish from other green algae at first glance. Look closely at this species by pulling apart clumps. It has filaments and small, hook-like branches.

Spongomorpha sp.

BROWN ALGAE (Phaeophyta)

Brown algae are generally easy to locate because of their large size and abundance over a wide area of the intertidal zone. These algae are usually seen in the middle intertidal area and subtidally. Brown algae provide suitable habitat for many intertidal invertebrates and are extremely important to these organisms' survival.

The Fucoids

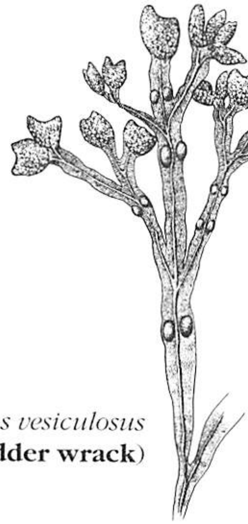
Most fucoids contain air bladders, known as vesicles, which help them float above the bottom so they can use the sun's rays for photosynthesis. They also contain receptacles, inflated bumpy structures which hold eggs and/or sperm for reproduction. In *Fucus*, receptacles are at the ends of their branches; in *Ascophyllum*, receptacles are distributed along the thallus. The fucoids, ranging from yellow brown to olive or dark brown, dominate the middle intertidal zone. *Fucus* spp. and *Ascophyllum nodosum* are the dominant intertidal fucoids in Maine.

***Fucus* spp. (Bladder wrack)**

There are several species of *Fucus* in the intertidal zone and in tide pools along the coast of Maine. *Fucus* species generally branch at their ends, forming a "Y" shape. The most common species is *F. vesiculosus*. You can distinguish this species by looking at its midrib. *F. vesiculosus* is the only species of *Fucus* which has two vesicles paired along this section. However, on wave-swept shores, the vesicles are often absent. You may want to open the receptacle to see if the alga is male, female, or both. *F. vesiculosus* individuals will be either male or female, while other *Fucus* species contain both egg and sperm in the same receptacle.

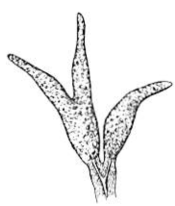
Another species, *F. spiralis* , may be found in low energy environments. This species has a distinct ridge that surrounds the receptacle which, generally, is bloated. *F. Spiralis* is smaller than *F. vesiculosus*, lacks paired vesicles, and grows higher on the intertidal zone.

Another common species of *Fucus* is *Fucus distichus* ssp.(sub species) *edentatus*. This fucoid has elongated, spear-shaped receptacles and grows lower on the shore than *F. vesiculosus*. A related species in Maine is *F. distichus* ssp. *distichus* which is smaller than *F. distichus* spp. *edentatus*; it is found only in high tide pools.



Fucus vesiculosus
(Bladder wrack)

Receptacles of *F. spiralis*

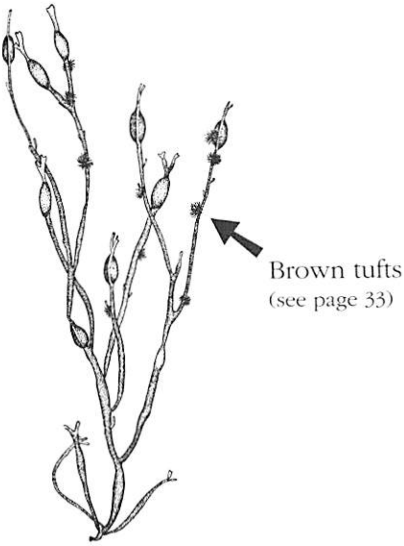


Receptacles of *F. distichus* ssp. *edentatus*

Note: Information on the fucoids is taken from Martine Villalard-Bohnsack's *Illustrated Key to the Seaweeds of New England*, 1995. The Rhode Island Natural History Survey, Kingston, RI and from James R. Sears' *NEAS Keys to the Benthic Marine Algae of the Northeastern Coast of North America from Long Island Sound to the Strait of Belle Isle*. 1998. University of Massachusetts, Dartmouth.

***Ascophyllum nodosum* (Knotted wrack)**

This species is olive green and yellow and is found in the mid-intertidal zone. If you look closely, you will often find a yellow snail crawling on *Ascophyllum*, which resembles its air bladder. This is the smooth periwinkle, *Littorina obtusata,* which likes to graze on unicellular algae that grow on the blades of *A. nodosum*. Like *Fucus* spp., *A. nodosum* has air bladders and receptacles. If you count the number of air bladders, starting at the holdfast and going to the end of the alga, you can get a rough estimate of its minimum age; it grows a new air bladder every year. You can also see what years were better for growth than others by measuring the distance between the bladders.



Ascophyllum nodosum
(Knotted wrack)

The Kelps

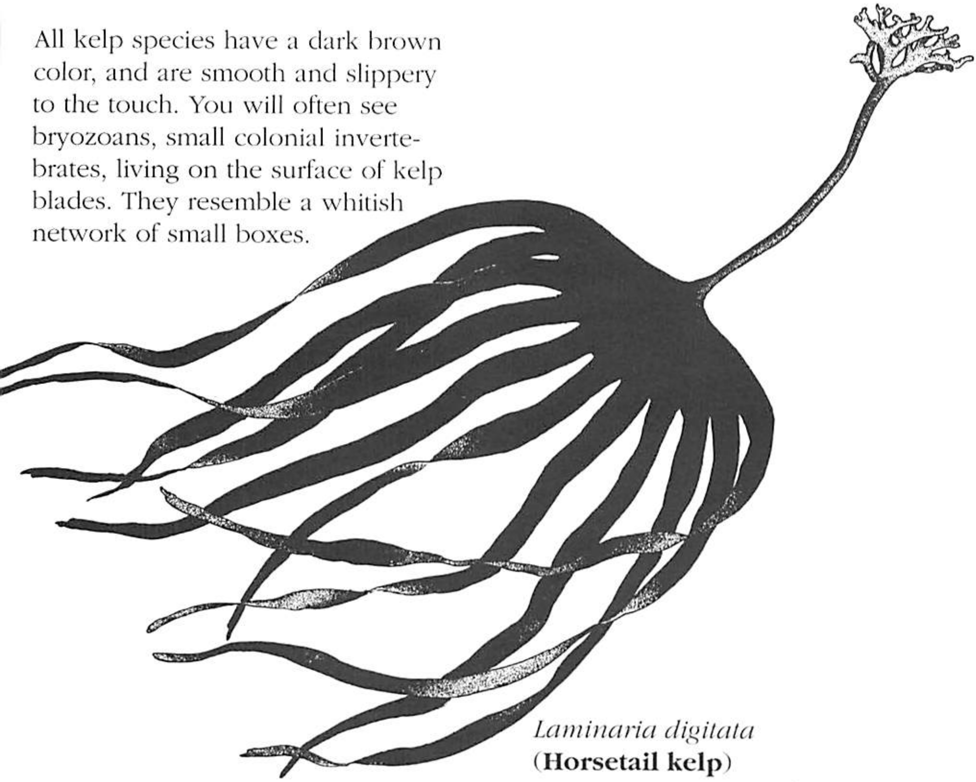
Kelps are the dominant seaweed species in the lower intertidal and subtidal zones and are common in rock pools. In recent years, kelp has become increasingly abundant in Maine, partly due to commercial sea urchin harvesting which removes the most active predator of kelp. The preferred food of the sea urchin is kelp in the genus *Laminaria*.

***Laminaria saccharina* (Sugar kelp)**

This species is very common below the low tide watermark and in subtidal zones. Kelp is easily identified; it is extremely long, has a large holdfast, and a long stipe. These are fast-growing marine plants, occasionally reaching over 4 meters in length.

Laminaria saccharina
(Sugar kelp)

All kelp species have a dark brown color, and are smooth and slippery to the touch. You will often see bryozoans, small colonial invertebrates, living on the surface of kelp blades. They resemble a whitish network of small boxes.



Laminaria digitata
(Horsetail kelp)

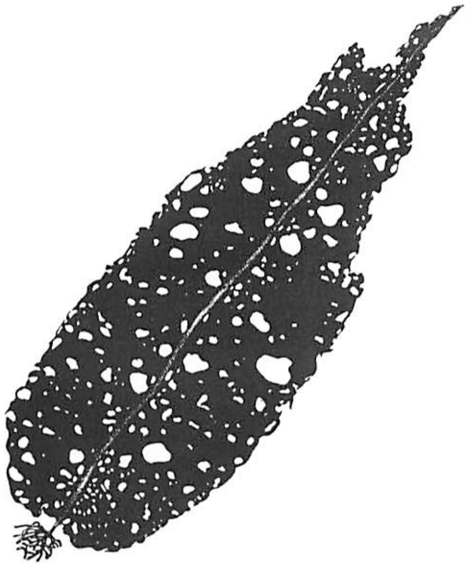
Laminaria digitata
(Horsetail kelp)
This kelp species is easily identified by the many tail-like sections that make up the plant—thus its common name— and it has no apparent midrib. You can find *L. digitata* on high energy coastlines, like Pemaquid Point in Maine, in the low intertidal and subtidal zones.

Alaria esculenta **(Edible kelp)**
Alaria is a narrow kelp that may be fringed at the top of the plant, making it appear that it was beaten by the waves. It also has a distinct midrib. At the base of the stipe near the holdfast, it possesses leaf-like "sporophylls" that extend from the stipe. The sporophylls are the reproductive structure of this alga. *Alaria* is commonly found in wave-swept, high energy environments,

Alaria esculenta **(Edible kelp)**

attached to rocks below the mean low tide mark.

Agarum clathratum
(Sea colander kelp)
Agarum resembles a colander, or swiss cheese, with its many small holes along the blade. It is also found in the low intertidal zone, and looks as if it has been eaten by an herbivore. The holes are part of the blade and should not be confused with damaged pieces of *Laminaria* spp. Unlike *A. esculenta* and *L. digitata*, this species likes to grow in low energy areas.



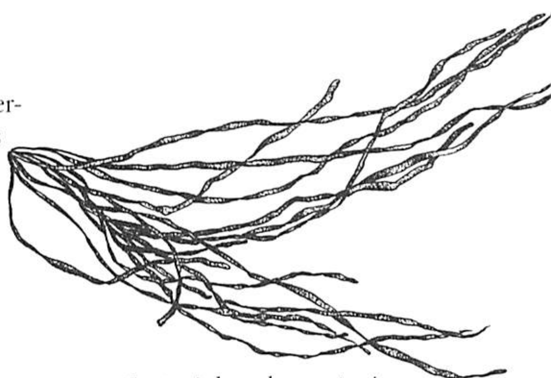
Agarum clathratum
(Sea colander kelp)

Other Browns

Leathesia difformis **(Sea potato)**
This is an interesting little alga that is light brown and rests on top of other algae species in the mid to low tidal zone. On Pemaquid Point, Maine, you can find it commonly on *Chondrus crispus*. When you first encounter *Leathesia*, it looks like a growth on the algae, but if you remove it, you will see that it is a hollow sack. Some people confuse it with an egg sack of an invertebrate.

Leathesia difformis **(Sea potato)**

Scytosiphon lomentaria
(Sausage weed)
This is a light brown alga that appears in the middle to low intertidal zone as thin hollow ribbons about 40 centimeters long. The hollow brown tubes resemble linked sausage, due to their segmentation.



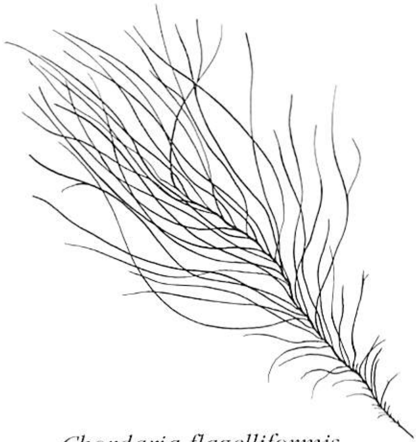
Scytosiphon lomentaria
(Sausage weed)

Chorda tomentosa
(Smooth cord weed)
This alga is easy to distinguish with its fine, long, whip-like thallus. It usually possesses fine brown hairs resembling fur along its blade. You may find it attached to pilings in the late spring and throughout the summer in Maine.

Chorda tomentosa
(Smooth cord weed)

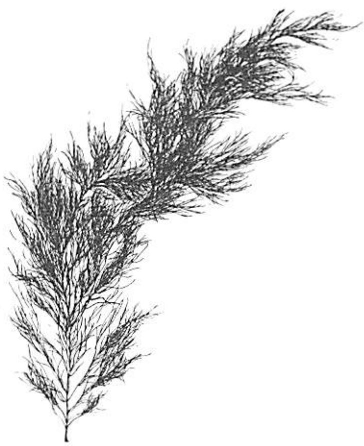
Ectocarpus confervoides
(Brown tufts)
This small, brown, fur-like alga can be found attached to other algae species along the intertidal zone. It is an epiphyte, a plant that derives moisture and nutrients from the air and rain and grows on another plant. Generally, you will find *Ectocarpus* in small tufts attached to other brown algae such as *Fucus* spp., or *Ascophyllum nodosum*. To identify it, dip it into the water and let it fan into its tuft, its distinguishing characteristic. (See page 30)

Chordaria flagelliformis
This brown alga has a leathery look to it, is smooth to the touch, and branches out slightly from the main blade. You can find it on the middle to lower intertidal zone.

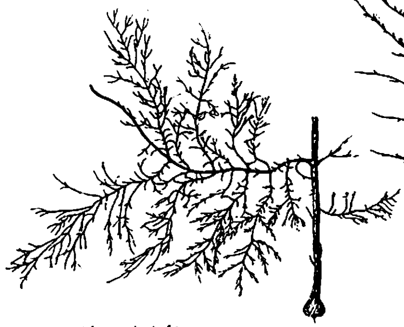


Chordaria flagelliformis

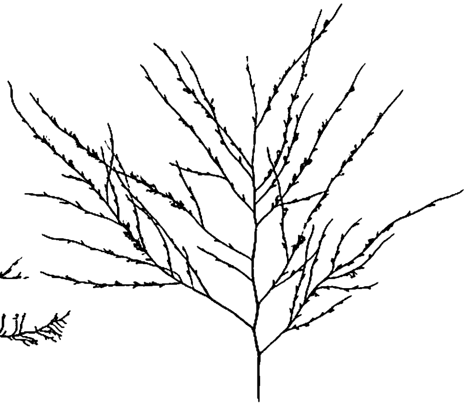
Desmarestia viridis **(Sour weed)**
This alga is light to dark brown, and looks soft and flowing when it is in the water. It has several branches extending from its main axis, and can grow to be three-quarters of a meter long. As its name suggests, this alga has a very sour odor. If you decide to collect it, make sure you keep it separate from other seaweeds. *Desmarestia viridis* contains sulfuric acid that can be released if it is damaged, killing it and any other seaweeds in the same bucket.



Desmarestia viridis **(Sour weed)**



Desmarestia viridis
(Soft sour weed)

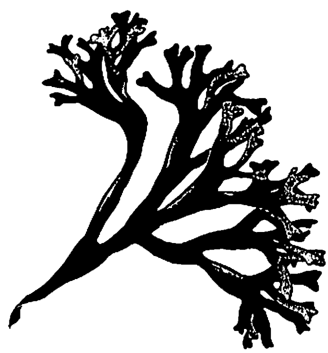


Desmarestia aculeata
(Spiny sour weed)

Fleshy Brown Crusts
Some brown algae grow as crusts, forming a layer over the rock surface in the intertidal zone and in tide pools. *Ralfsia fungiformis* is a light to dark brown fleshy crust which grows in a circular pattern, somewhat like fungus. (No figure shown)

RED ALGAE (Rhodophyta)
Red algae are the most numerous of the marine macroalgae. They can be found lower in the intertidal zone, and do not require as much sunlight as the green algae. Red algae are often used as food additives because of substances, such as agar and carrageenan, found in their cell walls. Carrageenan is odorless, tasteless, and has no color, which makes it perfect to use in recipes as a thickening agent.

***Chondrus crispus* (Irish moss)**
This alga is dark reddish brown to purple and is found low on the intertidal zone. Irish moss has a bushy appearance and grows in low clumps that cover rocks. This alga is the one commonly harvested for its carageenan.

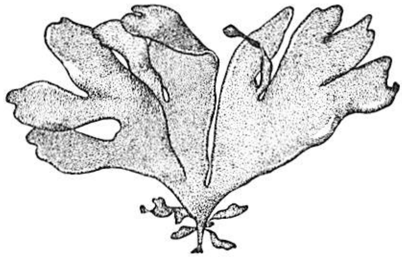


Chondrus crispus **(Irish moss)**

Mastocarpus stellatus
(Red weed)
This alga can be found where you find *Chondrus crispus* and looks very similar to Irish moss. The major difference between the two species is that red weed has small bumps on the underside of the blade that are absent in Irish moss.

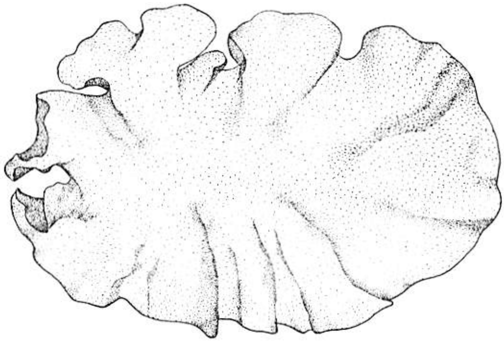
Mastocarpus stellatus
(Red weed)

Palmaria palmata (Dulse)
Dulse has a beautiful red color and is thin and rubbery to the touch. It is found in the middle to lower intertidal zone. Dulse can be eaten right on shore as you walk along the intertidal zone, or you can bring a piece home and dry it out before eating it.



Palmaria palmata **(Dulse)**

Porphyra sp. (Nori or laver)
You may recognize the name of this alga from Japanese cuisine. It is another edible red alga that is popular in Japan where it is used as a wrapping for sushi, a roll made of pressed rice garnished with fish and vegetables. Nori is transparent, papery thin, and has a washed-out red color that resembles a bleached version of *Monostroma* sp. This seaweed is found in the intertidal and subtidal zones.



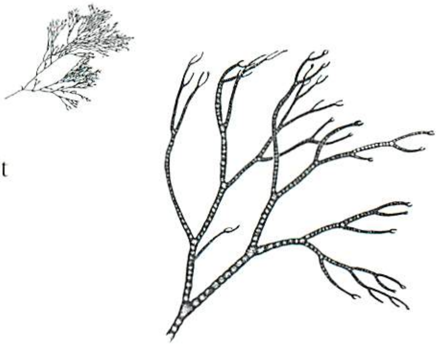
Porphyra sp. **(Nori or laver)**

Polysiphonia lanosa
(Tubed red weed)
This red alga grows as an epiphyte, attached to the brown alga, *Ascophyllum nodosum*. It does not harm its host brown alga, but uses it as an anchor. Other species of algae attach themselves to rocks or pilings. To fully appreciate the beauty of this alga, put it in a bucket of water and let it float and spread out so you can see its individual filaments.

Polysiphonia lanosa
(Tubed red weed)

Ceramium rubrum

This is a very common red alga along the shore in Maine, usually found in the lower intertidal area. The distinguishing characteristic of this species is that each blade has two hooks at the end which makes it easy to identify.

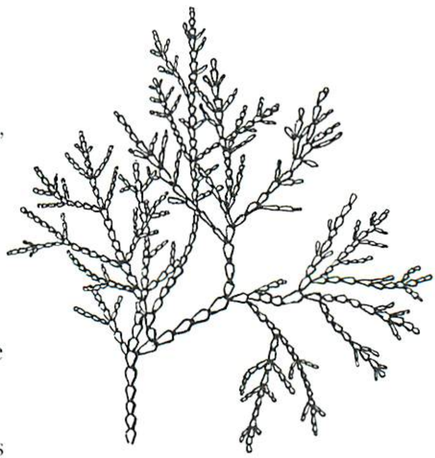


Ceramium rubrum

Calcareous Red Algae

Calcium carbonate extracted from seawater creates the structure of these red seaweeds and allows them to harden. They are very beautiful and diverse. Some grow as crusts, covering rocks and mussel shells, while others are found upright along the intertidal zone. One species found upright is *Corallina officinalis* which has hard, pinkish-red branches with whitish tips.

Calcareous red algae that grow as crusts cover intertidal rocks in pink and reddish films. In some instances, they resemble bubble gum. Growth patterns of these algae range from a very fine coating to a thick, gravelly cover. Use a hand lens to get a close look at the details of these species.



Corallina officinalis (**Coral weed**)

Crustose Corallines

***Lithothamnion* spp.**

To identify this species, look for a light pink alga that produces a thick cover over rocks and mussel shells. It has a bumpy, knobby, rough texture and may cover an entire mussel shell.

Lithothamnion spp.
(**Crustose coralline**)

***Phymatolithon* spp.**

This species can be found under *Fucus* spp. To identify, look for white spots among purple swirls covering the rocks. This species has rougher edges than the *Clathromorphum* spp. (No figure shown)

***Clathromorphum* spp.**
This species is the smoothest of the corallines and can be tan or orangish yellow.

Fleshy Red Crusts

Some red algae are not considered corallines, but also form a fleshy crust on intertdal rocks. These species will be referred to as "Fleshy Crusts." Two intertidal species exist along the Maine coast. One is a brown alga, *Ralfsia fungiformis*, and the other is red, *Hildenbrandia rubra*. Other species of this crust exist in Maine but are found subtidally in deeper water. *H. rubra* is a fleshy red crust that clings to rocks very tightly. It is smooth, slimy to the touch, and is slippery to walk on when wet. (No figure shown)

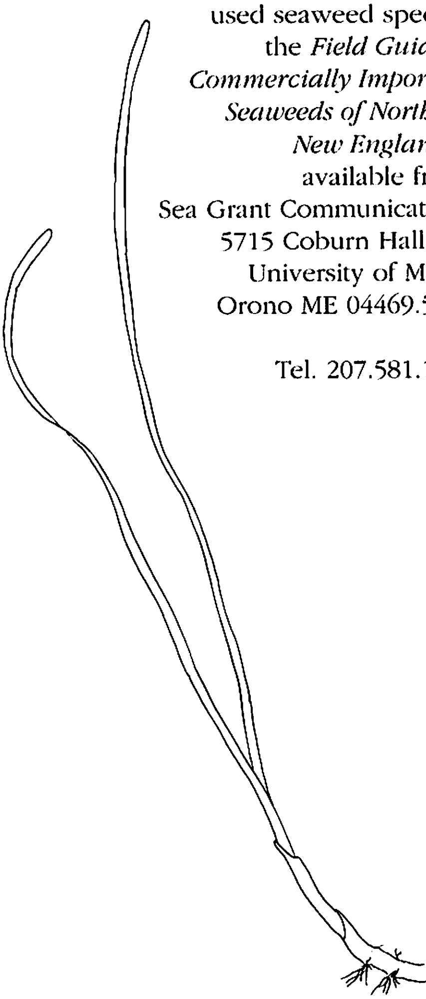
Marine Flowering Plants

A very few species of higher plants have managed to colonize the ocean. In Maine, the most important of these is eelgrass, *Zostera marina*, which is common in shallow sand and mud flats, and may be seen either at very low tide or washed up on the beach. As the name suggests, eelgrass resembles wide blades of lawn grass and can be 30 centimeters or more in length. It is an important plant to many forms of marine life, providing habitat to juvenile fish and marine invertebrates. Many human activities, including dock building and dredging, threaten eelgrass beds.

NOTE: If you are going to collect algae to press or eat, make sure you take only what you need. Cut the plant off, instead of ripping it out by its holdfast.

For suggestions on foraging, preparation, and recipes for some of the more commonly used seaweed species, the *Field Guide to Commercially Important Seaweeds of Northern New England* is available from:
Sea Grant Communications
5715 Coburn Hall #21
University of Maine
Orono ME 04469.5715

Tel. 207.581.1440



Zostera marina (**Eelgrass**)

NOTES

chapter 3

COMMON PHYTOPLANKTON

Written by Chuck Gregory, Southern Maine Technical College
Reviewed by Steve Morton, Bigelow Laboratory for Ocean Sciences

Introduction

The word "plankton" evolved from the Greek word *planktos* that means "wandering." In aquatic ecosystems, plankton refers to the drifting plants (phytoplankton) and animals (zooplankton) found suspended in the water column. We usually associate plankton with microscopic organisms but some, like certain seaweeds and jellyfish, can grow to be quite large. Most plankton can move throughout the water column, either by swimming or creeping, but there are a few non-mobile types that must rely on water currents to travel.

Ecologically, phytoplankton are the "grasses" of the sea. They obtain their energy from the sun and, through the process of photosynthesis, convert this energy into more phytoplankton and oxygen. Phytoplankton form the base of the trophic pyramid, or food chain, and are the food source for zooplankton. The zooplankton are, in turn, eaten by larger organisms, and so on up the pyramid.

Plankton can be collected in various ways, but a plankton net works best since it concentrates plankton into a jar-sized sample. Once you have obtained your sample, make a simple wet-mount microscope slide with two or three drops of the sample. Place the slide on your microscope stage at low magnification and enjoy the microscopic water world. After focusing on some plankton at low magnification, you can increase your magnification for detailed observations.

The following pages describe only a few of the hundreds of phytoplankton species commonly found in Gulf of Maine waters. Use the figures, along with the written descriptions, to accurately identify the organisms. Occasionally, you will be able to identify both the genus **and** species for a particular organism, but do not get discouraged if you are only able to identify the genus. Many of these organisms look alike and identifying just the genus is often adequate and useful.

Diatoms

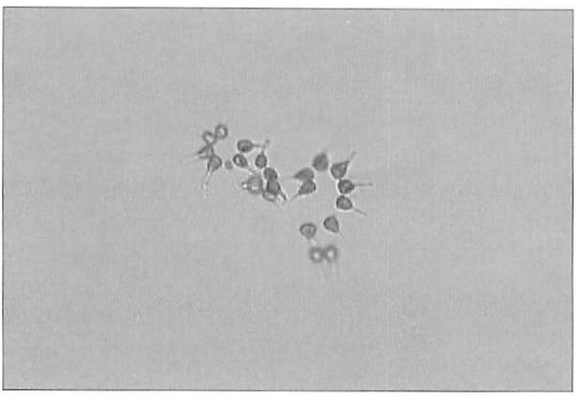
Diatoms are among the most common phytoplankton found in Maine's coastal waters. They usually occur as single cells or in chains. Chains may be only a few cells long or they may be dozens of cells, attached end to end. Each diatom cell wall is made of silica, often sculpted in beautiful patterns. This ornamentation, along with the diatom's shape and size, is useful information for identifying a particular diatom.

In general, diatoms are not toxic to other organisms. However, one genus, *Pseudonitzschia*, produces a substance that causes amnesiac shellfish poisoning (ASP) in humans. Other diatom species are known to cause fish kills by producing mucus that clogs fish gills or by irritating fish gills with their spines.

The following is a description of some of the most common diatoms found in net samples. While their sizes vary, their shapes are generally species specific. As you view your diatom sample, try to match your specimen with the figures provided in this guide. Once you have narrowed your list of choices, read the description accompanying each example. In many cases, the description should provide you with the specifics needed for an accurate identification.

Asterionellopsis spp.

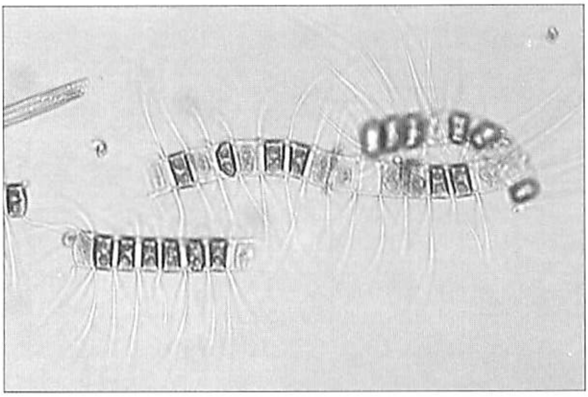
One genus of diatom that is easy to identify is *Asterionellopsis*. Cells in this genus are arranged in either star-shaped, zigzag, or spiral chains. Individual cells are much longer (30 to 150 µm) than they are wide (about 5 µm) and are joined to each other at an enlarged, triangular end. The figure below will help greatly when attempting to identify members of this genus. Note that colonies of *Thalassionema nitzschioides*, another common Gulf of Maine diatom, appear similar to *Asterionellopsis* but lack the enlarged, triangular ends.



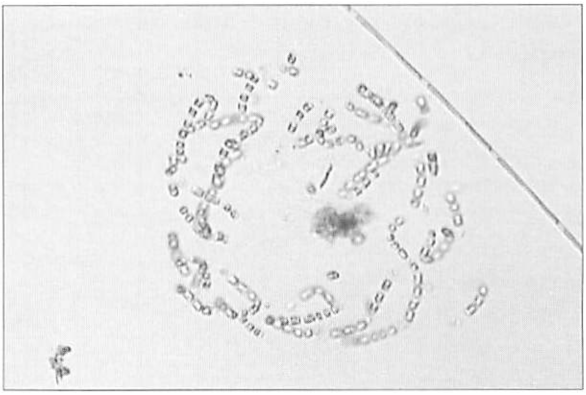
***Asterionellopsis* sp.**

Chaetoceros spp.

Over a dozen species in the genus *Chaetoceros* have been observed in coastal Maine waters. This genus often produces "bloom" conditions. *Chaetoceros* cells usually occur in chains that can be several cells long, although *C. danicum*, *C. gracile*, and C. *simplex* cells are usually solitary. Chains can be straight, spirally twisted, irregularly bent or, as with *C. sociale*, the chains are short, curved, and arranged in bunches or "colonies." Each square or rectangular *Chaetoceros* cell typically has four long, fine "hairs," or setae, extending outward. The cells of this genus range in size from 6 to 80 µm in diameter. When you are attempting to identify a member of this genus, determine whether the cells are arranged in chains, and if there are four, fine setae extending from each cell. In general, *Chaetoceros* resembles the shape seen in the top figure. The bottom figure is *C. sociale*.

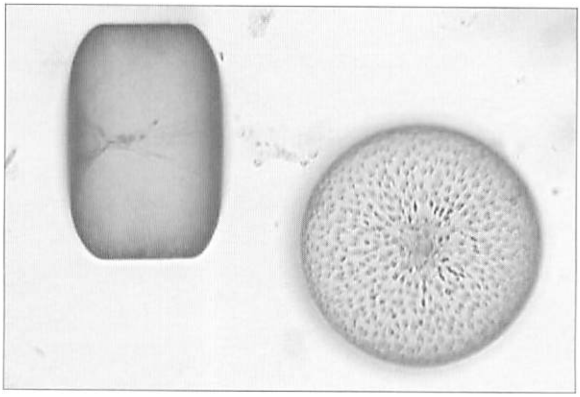


Chaetoceros spp.



Coscinodiscus spp.

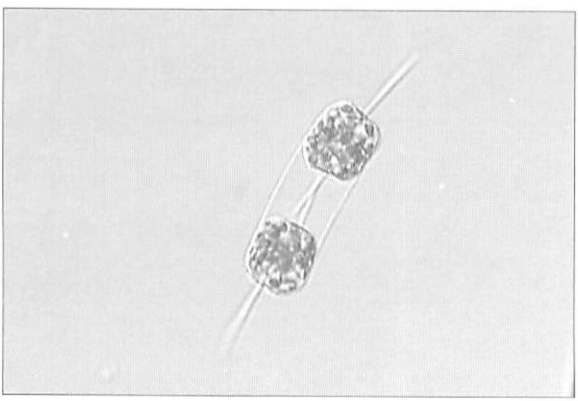
Unlike *Chaetoceros* spp., members of the genus *Coscinodiscus* exist as large (25 to 500 µm in diameter) single cells. These cells are shaped like a drum or cylinder, and you usually view them as if you are looking down on the end of the cylinder. Because of their size and shape, members of the genus *Coscinodiscus* are easy to identify. Though not as common as *Chaetoceros*, a few *Coscinodiscus* cells are often seen in each phytoplankton net sample. If you think you have a member of this genus, check to see if your organism is relatively large in comparison to the other phytoplankton in your sample, and that its shape matches the figure below. *Coscinodiscus* blooms have been linked to fish kills because these diatoms can produce mucus that will clog fish gills.



***Coscinodiscus* sp.**

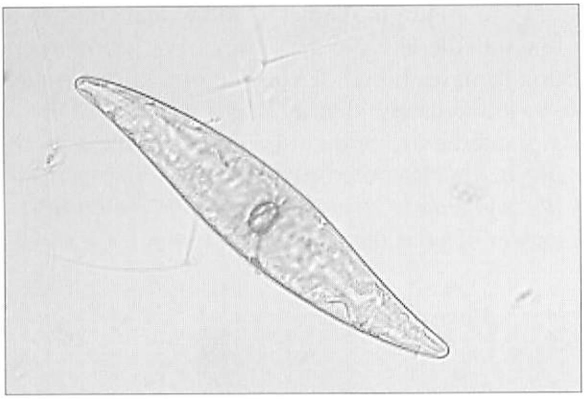
Ditylum brightwellii

D.brightwellii is the only species of the genus *Ditylum* found in Maine waters. This diatom usually occurs as a single, large cell shaped like a long cylinder with one straight, long spine at each end. Cells are usually three to eight times as long as they are wide. Diameters of these cells range from 15 to 90 µm, and their total lengths can reach 250 µm. The unique shape of this diatom makes it easy to identify. Make sure you can see the long spines at both ends of the long, cylindrical body. The figure below will help you positively identify *D. brightwellii*.



Ditylum brightwellii

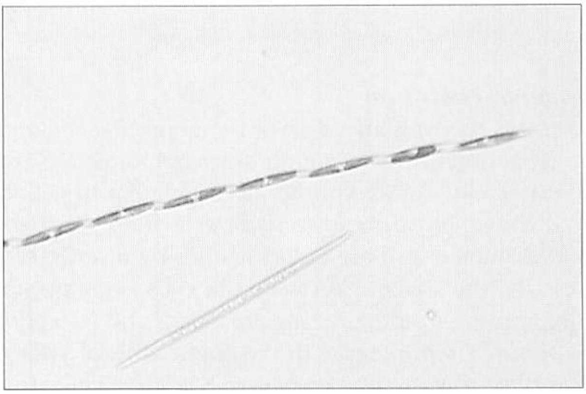
***Gyrosigma* spp. and *Pleurosigma* spp.**
Since members of both *Gyrosigma* and *Pleurosigma* genera are similar in appearance, both are described here. They occur as single cells, and are shaped like a rectangle, a canoe, or with their ends curved in opposite directions like an elongated "S." The figure of *Pleurosigma* below will be useful when identifying either of these organisms, whose cells range from 100 to 500 µm in length and are typically 15 to 65 µm wide. Both *Gyrosigma* and *Pleurosigma* organisms live on the sea floor, but they often are swept up into the water column by tidal currents and storm mixing.



***Pleurosigma* sp.**

***Nitzschia* spp.** and ***Navicula* spp.**
Two of the most difficult diatoms to distinguish are *Nitzschia* and *Navicula*. Both are long and thin and are usually solitary with either tapered or hair-like ends. Detailed knowledge of cell structure is required to differentiate them. Their lengths range from 25 to170 µm and only 2 to10 µm wide. Both genera are easily and often confused. (No figure shown)

***Pseudonitzschia* sp.**

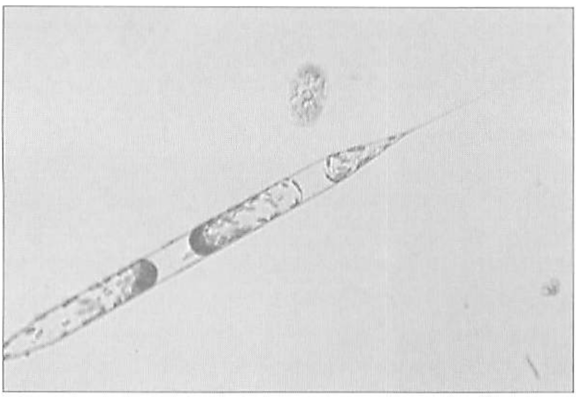


***Pseudonitzschia* spp.**
This is a relatively new diatom genus. Prior to 1992, its members were included with the genus *Nitzschia*, but scanning electron microscope studies revealed the structural differences that justified placing them into their own

genus. Thus, most of the chain-forming species of *Nitzschia* were moved into *Pseudonitzschia*. *Pseudonitzschia* cells, resembling toothpicks since they are 70 to 170 µm long and 2 to 8 µm wide, are arranged into stiff chains with the tips of each cell overlapping its neighbor. The importance of separating *Pseudonitzschia* from *Nitzschia* was heightened when, in 1988, *Pseudonitzschia* was found to produce domoic acid, a substance that causes ASP in humans.

***Rhizosolenia* spp.**

Rhizosolenia cells are usually arranged in lengthy chains, with long (up to 1.5 mm or 1,500 µm) and thin (4 to 70 µm in diameter) individual cells. Both ends are usually tapered to a fine, needle-like point, or they have rounded ends with a small spine emerging from each end. If you see one of the long, thin cells, you should be able to immediately identify it as a member of the *Rhizosolenia* genus by its pointed ends. Spines should be visible at both ends, as can be seen in the figure below. If you suspect you are looking at the round-ended species of *Rhizosolenia* (*R. fragilissima* and *R. delicatula*), increase the magnifying power of your microscope and look for a small spine on the end of the cell.



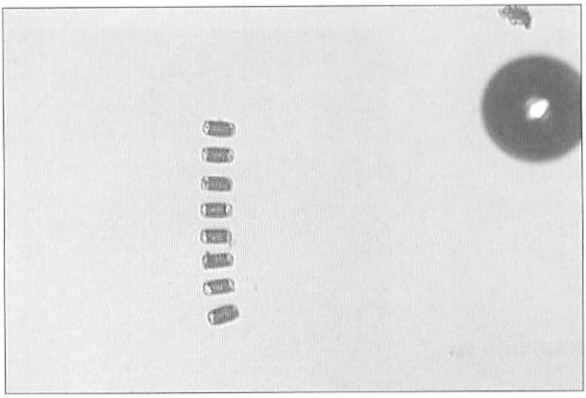
***Rhizosolenia* sp.**

Skeletonema costatum

S. costatum is the only member of the genus *Skeletonema* found in Maine waters. This organism commonly forms blooms in New England's coastal waters, especially during spring. Its rectangular to cylindrical cells occur in straight chains that can be dozens of cells long. Individual cells are only 6 to 20 µm in diameter, and are held together by a series of many fine spines. Occasionally, the spacing between the cells is greater than the actual cell size. When attempting to identify this organism, you should first observe the long, straight chain. Then increase the magnification of your microscope to high power and try to view one or two of the small cells. In addition, while using high magnification, concentrate on the many fine spines that attach one cell to the next. (No figure shown)

***Thalassiosira* spp.**

Thalassiosira is another common genus of diatoms found in coastal Gulf of Maine waters. The cells of this genus are similar in shape to *Coscinodiscus*, but are typically smaller (12 to 70 µm in diameter). Unlike *Coscinodiscus*, *Thalassiosira* cells are connected into long chains by one or several thin threads. Identifying this genus is easy if you concentrate on the shape of the overall chain of cells, and if you observe those thin threads holding one cell to the next. Most species in this genus have one thread connecting adjoining cells, except *T. polychorda* which has many thin threads. These threads probably will not be visible at low magnification, so you will have to set your microscope to high power. One species, *T. nordenskioldii*, has distinctive spines extending from each corner of its octagonal-shaped cells.



***Thalassiosira* sp.**

Dinoflagellates

Dinoflagellates are so named because of their two flagella, or hair-like structures, that are primarily used for moving the organism in the water column. One of these flagella wraps around the middle of the cell; the other flagellum extends lengthwise and has the appearance of a tail. Neither of these flagella are visible unless high-power magnification is used. Though they can move, most dinoflagellates are not fast swimmers. As a result, they can be identified by their relatively slow, rotating swimming pattern.

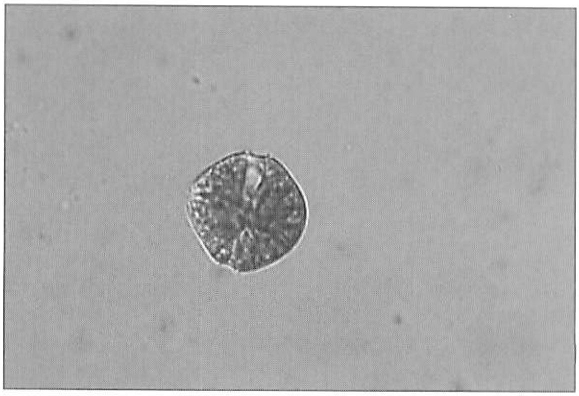
Some dinoflagellate cells are covered with plates or "armor" composed of cellulose. These plates help cells maintain their rigid appearance. Examples of armored dinoflagellates in this guide include *Alexandrium*, *Ceratium*, *Dinophysis*, *Prorocentrum*, and *Protoperidinium*. Other dinoflagellates do not have these plates and are termed "naked" or unarmored. Examples of this type are *Gymnodinium* and *Gyrodinium*.

A few dinoflagellate species produce substances that are toxic to humans. In the Gulf of Maine, there are two types of human poisonings that result from dinoflagellate toxins—paralytic shellfish poisoning (PSP) and diarrhetic shellfish poisoning (DSP). The toxins causing PSP originate from members of the genus *Alexandrium* while those causing DSP come from members of the genera *Dinophysis* and *Prorocentrum*.

***Alexandrium* spp.**

The genus *Alexandrium* has undergone taxonomic revision over the last 10 years, with the genus *Protogonyaulax* and some members of *Gonyaulax* now being placed in *Alexandrium*. One of Maine's most famous dinoflagellates is *Alexandrium tamarenses* that causes PSP in humans. *A. tamarenses* is one of the key organisms sought when monitoring Maine's waters for toxic phytoplankton.

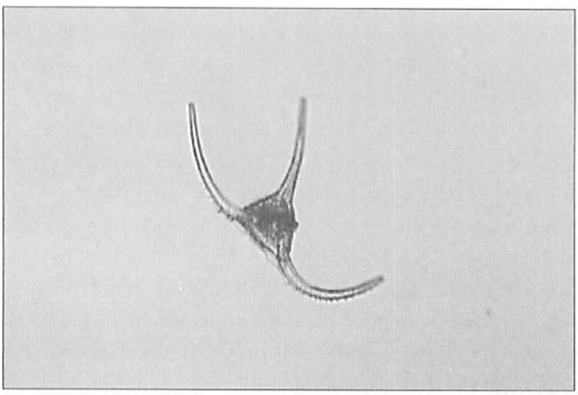
Alexandrium cells are usually irregularly shaped and are slightly longer (20 to 50 µm) than wide (20 to 45 µm). *A. tamarenses* cells occur either singularly or in pairs. It is very difficult to identify this genus to the species level, and members of *Alexandrium* are easily confused with many other genera. An expert should be consulted if you are concerned about identifying the species of your organism. The figure below might be helpful.



***Alexandrium* sp.**

***Ceratium* spp.**

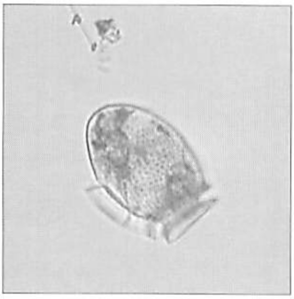
Ceratium is one dinoflagellate genus that often appears in phytoplankton net samples. This genus is easily recognized, but species identification can be difficult. Its cells usually possess three distinct horns; one extending from the top of the cell and two protruding from the sides or base. Because of these horns, *Ceratium* cells vary in size. They may reach 600 µm long and only 15 µm wide. Use the figure below to help you identify *Ceratium* species.

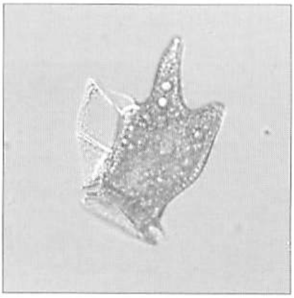


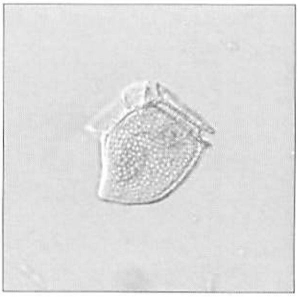
***Ceratium* sp.**

Dinophysis spp.

Like many other dinoflagellates, members of the genus *Dinophysis* are relatively easy to identify because of the size and oval shape of their cells. They exist as single cells, ranging in size from 35 to100 µm long and 20 to 60 µm wide. Examine the figures below and note the unique cellular shape, with a lateral "wing" supported by three "ribs." Some species of *Dinophysis* (such as *D. acuminata*, *D. tripos*, and *D. norvegica*, left to right below) have been known to cause DSP in humans.







Dinophysis spp.

Gymnodinium spp. and _Gyrodinium_ spp.

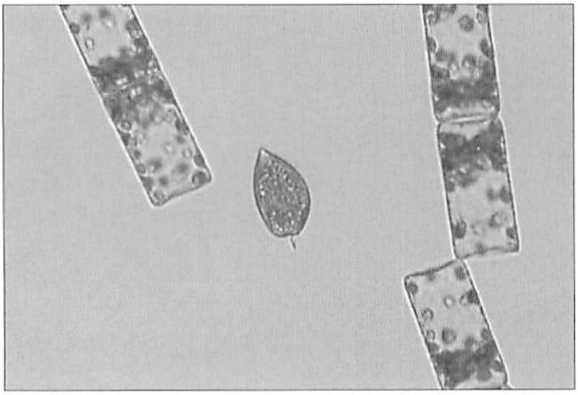
As mentioned before, members of these two genera do not have any supporting plates. As a result, *Gymnodinium* and *Gyrodinium* cells do not always retain their shape. If you examine a fresh plankton sample, you will have a better chance of seeing cells of either genus; however, the cells do not survive for long. Usually these dinoflagellates are rapid swimmers. A positive identification of either genus is difficult. The figure below of *Gymnodinium* may provide some assistance, but an authority should be consulted if a definite identification is needed.

Cells of both genera range from 20 to 60 µm wide and 20 to 80 µm long, with one species, *Gyrodinium spirale*, reaching 200 µm in length. These cells usually occur singularly but the species *Gymnodinium catenatum* can form chains of up to 30 cells.

Gymnodinium sp.

Prorocentrum spp.

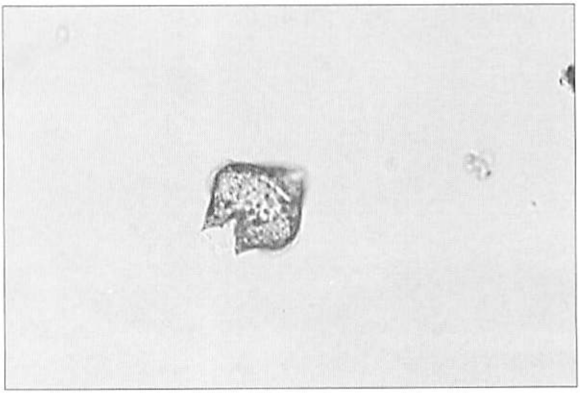
The most common bloom-forming dinoflagellate in the Gulf of Maine comes from the genus *Prorocentrum*. A few species of *Prorocentrum* can be identified based on the cell shape, size, and the presence or absence of a distinct short spine at one end of the cell. *Prorocentrum* cells are teardrop-shaped, with one end rounded and the opposite end tapered. The spine, if present, can be found at the rounded end of the cell. Note the spine on the *Prorocentrum* cell in the middle of the figure below. The cells range in size from 10 to 70 µm long, and 10 to 50 µm wide. One species, *P. lima*, is known to produce DSP and is toxic to humans.



***Prorocentrum* sp.**

Protoperidinium spp.

Members of the genus *Protoperidinium* are common dinoflagellates found in the Gulf of Maine and are usually slightly pinkish in color. They have been observed to feed on small diatoms and other dinoflagellates. One end of each cell generally tapers to a single point or "horn" while the opposite side is divided into two horns. Cells are covered in plates, giving them a rigid, defined shape. Cell sizes are variable and can range from 20 to 250 µm long and 20 to 150 µm in diameter.



***Protoperidinium* sp.**

Ciliates

Ciliates commonly are found in most phytoplankton samples. They are frequently seen as a blur, swimming or "jumping" relatively fast, and often disrupt your otherwise serene view. The dozens of tiny hairs that help the organism move and feed are *cilia*— the Latin word for "eyelashes." Ciliates vary greatly in size and shape. *Mesodinium rubrum* is an example of a naked ciliate that jumps throughout your sample, while the tintinnids are a diverse group of slower-moving ciliates that live inside a hard, protective structure called a "lorica."

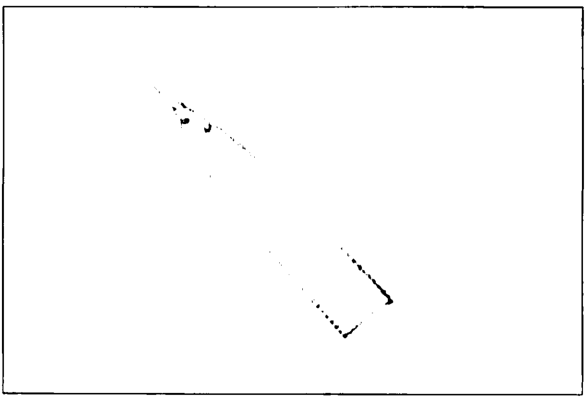
***Mesodinium rubrum* (or *Myrionecta rubra*)**

Mesodinium rubrum is also known in the literature as *Myrionecta rubra.* Its cells are solitary and range in size from 15 to 70 µm. Some scientists believe that there are two varieties of *M. rubrum*; a smaller cell in the 15 µm range, and a much larger cell measuring near 70 µm.

It will be difficult for you to identify cells of *M. rubrum.* These organisms are rapid movers, and can appear to jump about your field of view. The best way to view these ciliated organisms is to examine a sample that has been preserved in Lugol's iodine, for example.

M. rubrum has been reported to form blooms producing "red water" conditions. However, this is a non-toxic condition and should not be confused with the toxicity typically associated with red tides. (No figure shown)

Tintinnids



Tintinnids

Tintinnid is a common name for a group of organisms that form coverings called "loricae" around themselves. These coverings are stiff, made from seawater minerals or tiny pieces of sediment, and are shaped like a vase or barrel. Tintinnids are free-living, single-celled organisms. Some researchers have estimated that tintinnids may consume as much as 90 percent of the planktonic bacteria and algae in certain environments.

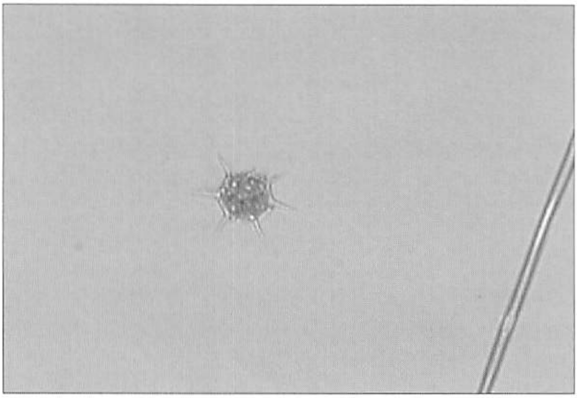
Examine the figure above to better understand the shape of tintinnids. The organism is housed inside its lorica, and its cilia are located next to the lorica's open end. Tintinnids are diverse in their size and shape, extending from 300 μm long to 30 μm wide. If you suspect you are seeing a tintinnid, chances are it is either moving in your sample or you are viewing the empty lorica without an organism inside.

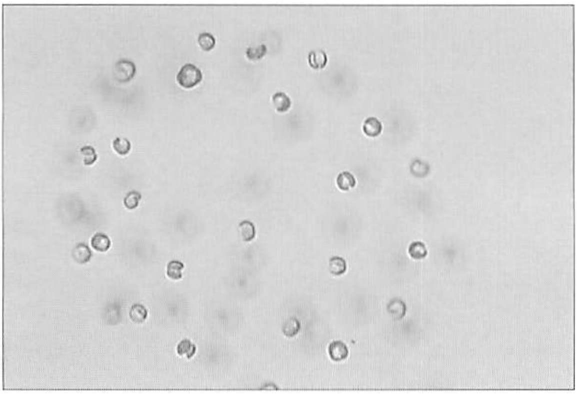
Other Common Phytoplankters

Silicoflagellates

Dictyocha fibula and *D. speculum* are two common members of the silicoflagellate group characterized by a skeleton made of silica. Though the living organism of these two species possesses a single flagellum, its identifying characteristic is a star-shaped skeleton, bearing four to six spines. This unique shape makes identification relatively easy, even when the organism is not living. Silicoflagellates range from 10 to 45 μm in diameter.

Silicoflagellates





Phaeocystis pouchetii

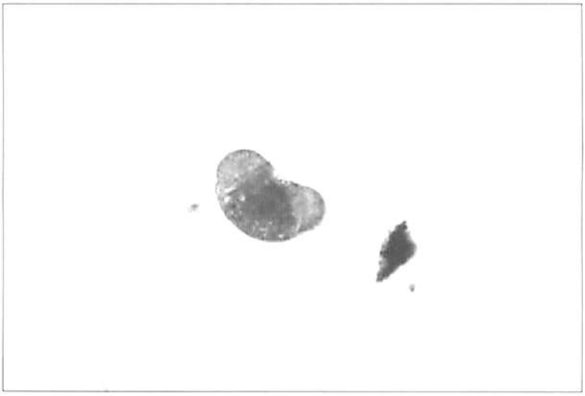
Phaeocystis pouchetii

P. pouchetii has been known to form extensive blooms in coastal waters during spring. While these blooms are non-toxic, scientists report that these "slimy" organisms may clog the gills of some bivalves and interfere with their respiratory processes.

P. pouchetii cells are typically seen in brown colonies as large as 1.5 to 2 mm (1,500 to 2,000 µm) in diameter. These colonies are made up of many small flagellated cells that are 5 µm in size. The cells are held together by an extracellular matrix similar to mucus, causing the colonies to be slimy. Because of their numerous flagella, the colonies can move slightly. For the nonscientist, individual *P. pouchetii* cells are nearly impossible to identify. Note the colony in the figure on page 50.

Pine pollen

An interesting structure that often appears in many Maine phytoplankton samples is pine pollen. These structures, in the shape of "Mickey Mouse hats" (see figure below), are produced from evergreen trees within the genus *Pinus*. Pine pollen are easily dispersed by wind and are buoyant on water. Their dimensions are approximately 50 µm in height and 150 µm across.



Pine pollen

Helpful Literature

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