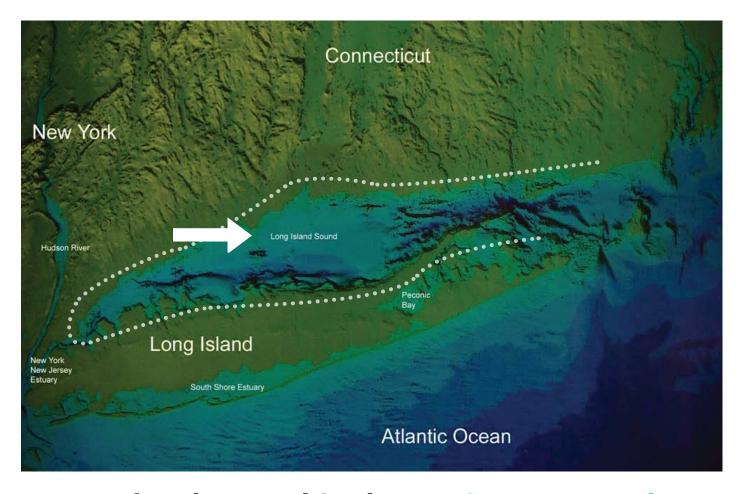


Long Island Sound is bordered on the south by Long Island, New York and on the north and west by the coasts of Connecticut and Westchester County, New York.





Long Island Sound is the nation's second largest estuary – a special place where fresh water from rivers and streams and salt water from the ocean meet and mix.



- Estuaries are among the most productive ecosystems in the world, providing feeding, breeding, nesting, and nursery areas for many animals.
- They are water bodies of constantly changing conditions, such as temperature and salinity.
- Plants and animals that live in estuaries are able to tolerate these changes; many have special adaptations that help them cope.
- More than 170 fish species and 1,200 invertebrate species live year-round or seasonally in Long Island Sound.





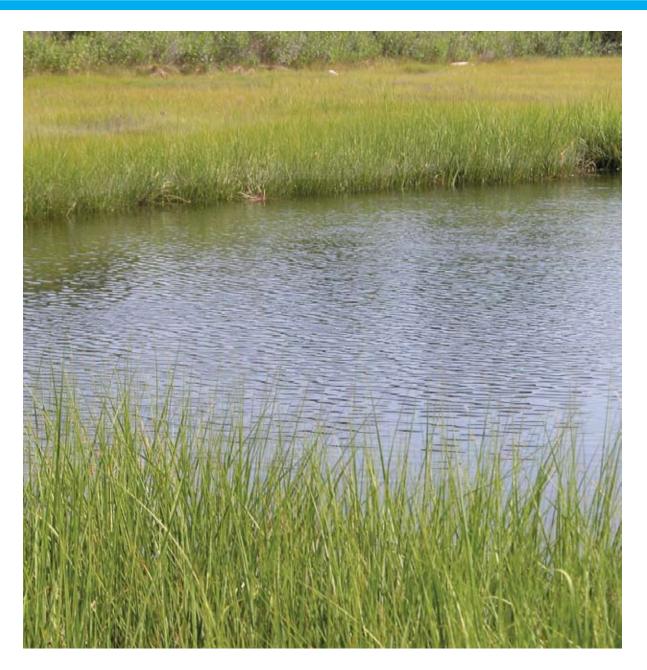
- Long Island Sound has a broad range of habitat types, which in turn support a wide variety (diversity) of plant and animal species.
- A habitat meets the primary needs of organisms, including food, water, air, and shelter.

## Primary habitat types in the Sound are:

- 1. Salt marshes
- 2. Sandy beaches
- 3. Tidal flats
- 4. Rocky intertidal
- 5. Submerged bottom
- 6. Open water





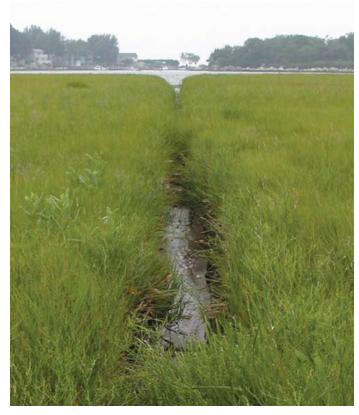


A salt marsh serves many important roles in the Sound's ecosystem:

- Nursery
- Filter
- Sponge
- Nutrient source







Mosquito ditches criss-cross the marsh; they were originally hand-dug to combat diseases carried by mosquitoes, which breed in pools of standing water.





Salt marshes have distinct zones of vegetation determined by elevation. **Tall saltmarsh cordgrass** grows along the water's edge in the low marsh, which is regularly flooded by the tides; this grass tolerates changing water level, salt concentration, and temperature.

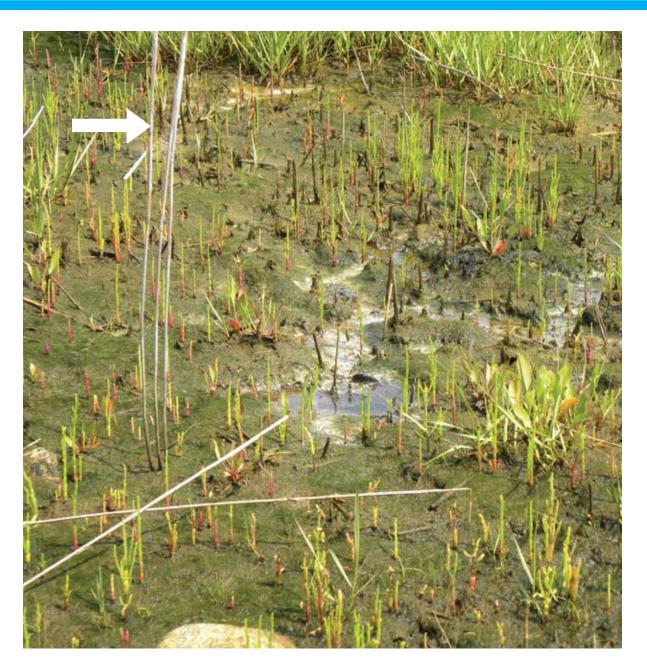






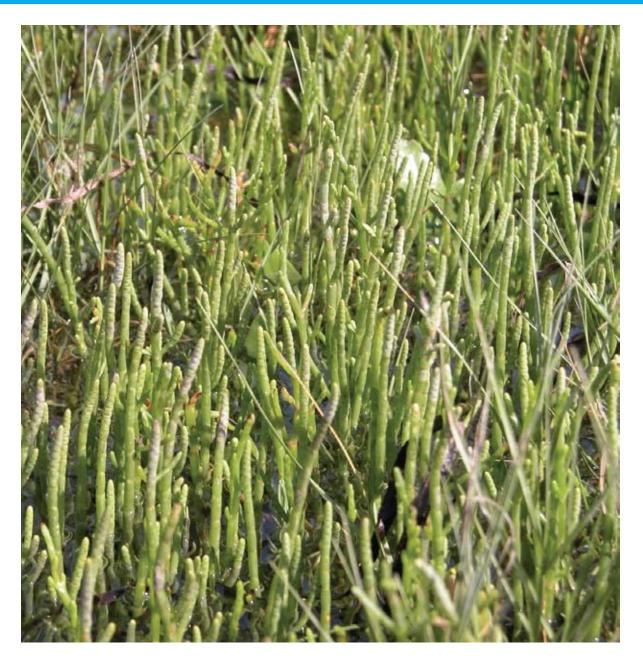
The high marsh is flooded only during storms or unusually high tides; saltmeadow cordgrass (I) and spikegrass (r) dominate this part of the marsh.





Salt pannes are small, "desert-like" depressions in the marsh, where soil salinity can reach levels that are almost twice that of full strength sea water.





Glasswort, a succulent plant, grows in the salt pannes, looking like a field of tiny, spineless cacti.



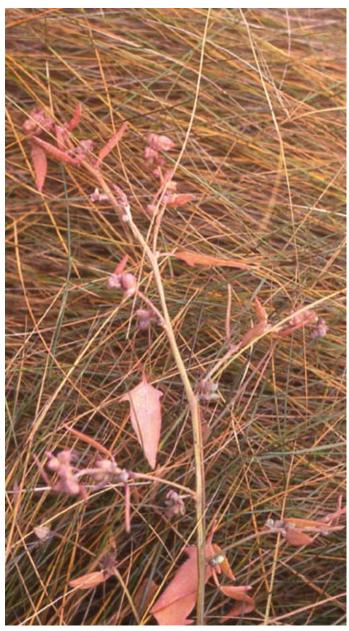




Sea lavender has delicate flowers and wiry stems, grows in salt pannes and low marsh.

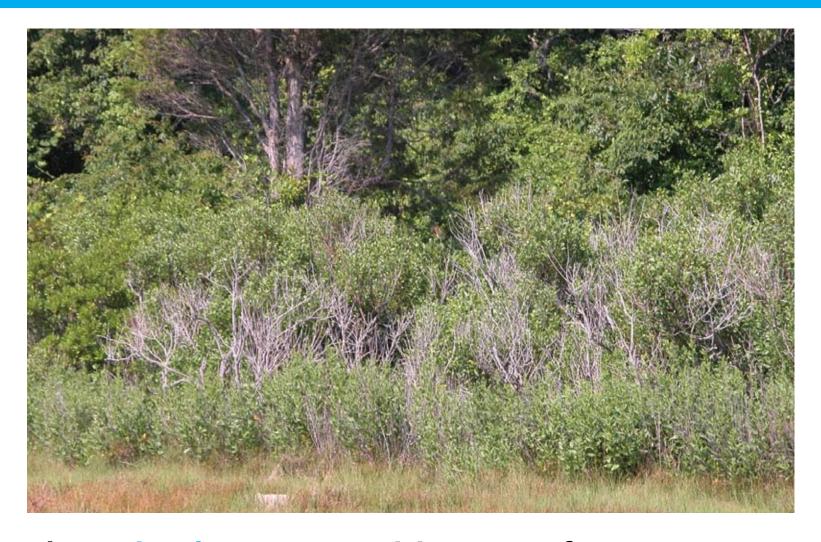






Salt-marsh asters (I) and orach (r) grow among the grasses in the high marsh, adding color in spring and fall.





The uplands are a transition zone from marsh to forest, and are home to many shrubs and broad-leaved plants.

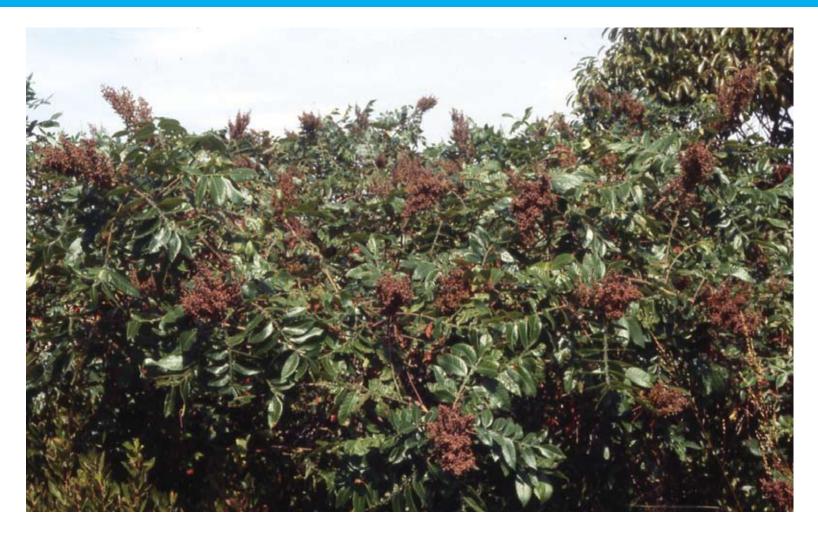






**Common reed** or Phragmites often grows in dense stands at the upland edge of disturbed marshes; the thick stems can reach 15 feet tall.





Sumac is a shrub that grows in the upland zone, providing food and shelter for birds.





Ribbed mussels grow along the edges of tidal creeks in salt marshes, providing food for terrestrial mammals and other organisms.





The longwrist hermit crab, carrying an empty snail shell on its back for protection, moves about in the shallows of the marsh and tidal flats.





## **Green crabs**

inhabit the Sound's marshes, rocky areas and tidal flats; voracious eaters of bivalve shellfish, they also eat seaweed and worms.





Tidal creeks and mosquito ditches winding through the salt marsh shelter small fish from most larger predators, while blue crabs forage for prey in these creeks.





Striped killifish and other minnows rely on camouflage coloration and swimming in schools to confuse their predators.







Two sparrow species of special concern, the seaside sparrow (I) and the saltmarsh sharptailed sparrow (r), rely on larger patches of salt marsh in Long Island Sound as key habitat; they build their nests in the marsh grasses.



Egrets and herons are common sights along the salt marsh edge and shore, where they stand quietly in shallows waiting to spear fish; most are colonial tree nesters like this great egret.





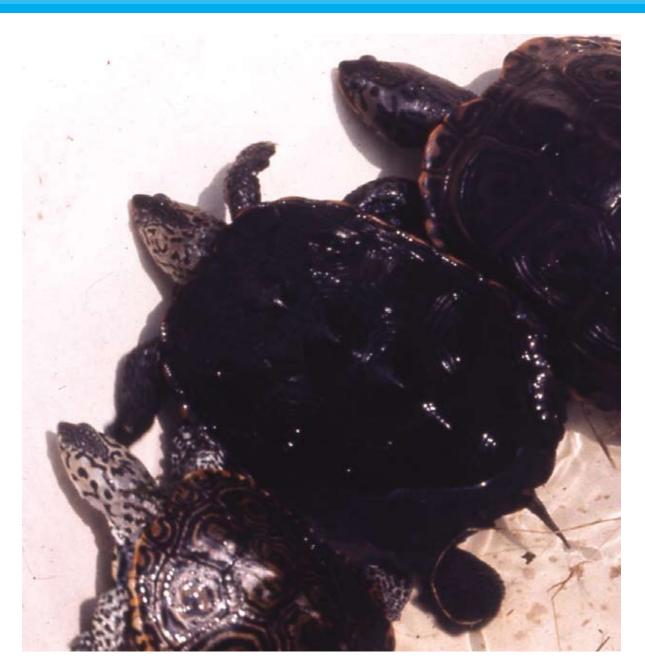
A green heron watches and waits patiently for prey.





Osprey, or fish hawks, are a common sight around Long Island Sound, especially in eastern regions; they arrive in March to nest, mostly on manmade platforms which keep their nests out of the reach of predators.

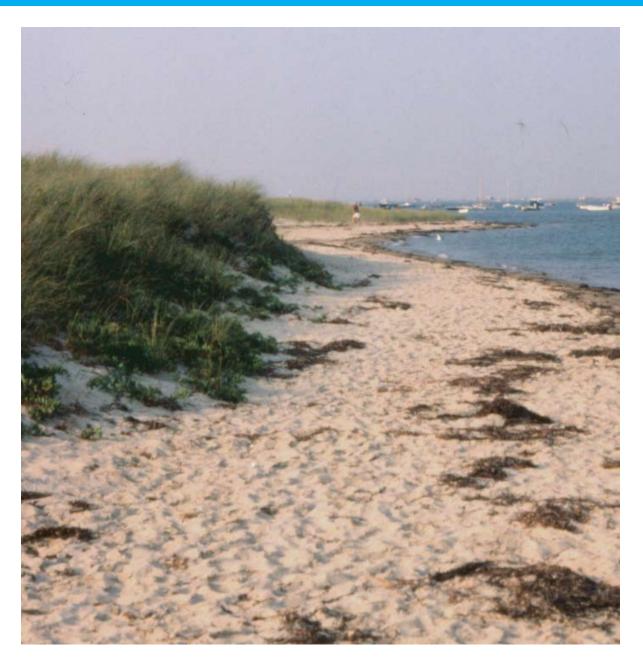




Diamondback terrapins live in the Sound's salt marshes, eating a mixture of plants and animals; locally, these reptiles were nearly hunted to extinction for their meat.







Sandy beaches are high-energy habitats that constantly change throughout the year, reflecting the effects of tides, winds, storms, and currents.







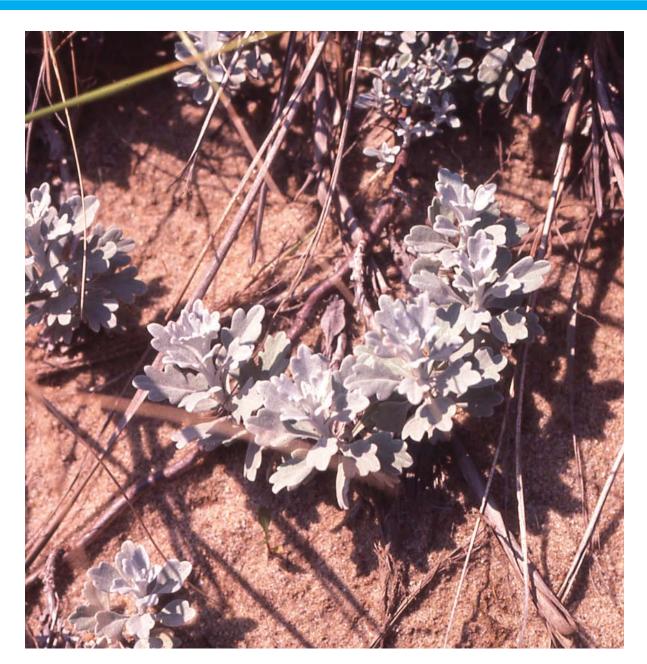
Beach sands may appear devoid of life, but many tiny animals live beneath and between grains of sand, or in the wrack line, the line of decaying seaweed and eelgrass that washes up along the high tide mark.





The upper side of each beach grass blade has 10-12 parallel ridges, alternating with grooves, that run from the base to the tip; this ribbed structure causes the leaves to roll up tightly when water is scarce, and to unroll when water is available.





**Dune grass and** plants, such as this dusty miller, help keep the sand in place; while the plants can withstand the harsh environment they live in, their root systems are fragile and they are easily damaged if walked on by humans.





Beach pea grows on the dunes, helping to stabilize the sand while providing a splash of color throughout the summer; its dark brown seed pods (peas) are eaten by birds and mice.







Seaside goldenrod (I) and cocklebur (r) are hardy plants that can call sandy or rocky beaches "home".







Salt-spray rose (I), with its pink or white flowers and prickly stems, is common to the upper reaches of the beach; the colorful fruit or rosehips (r) are high in Vitamin C and can be made into tea or jelly



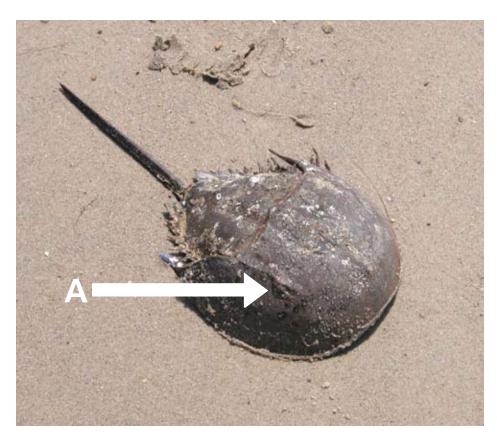


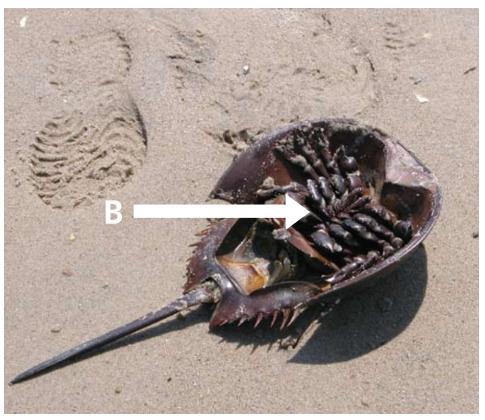


Bayberry bushes, with their waxy blue berries and sweet-smelling leaves, grow in the sandy soil of the upper beach among the dune grasses.









Horseshoe crabs are arthropods, more closely related to spiders than to crabs; they have two primitive compound eyes (A) and their mouth (B) is found in the center of their legs; bristles on the legs act as "teeth"





Piping plovers and sandpipers skitter up and down the beach at the water's edge, seeking small mollusks and crustaceans as the waves wash in and out.







Least terms are considered "threatened" and therefore are a protected species – during nesting season, beaches may be closed and the nests fenced off, for protection from predators and to keep the camouflaged nests from being stepped on.







A great black-backed gull sits on its nest; these large, aggressive gulls are common year-round.





Herring gulls are also very common year-round in Long Island Sound habitats; they nest in large colonies on islands from early May through July.

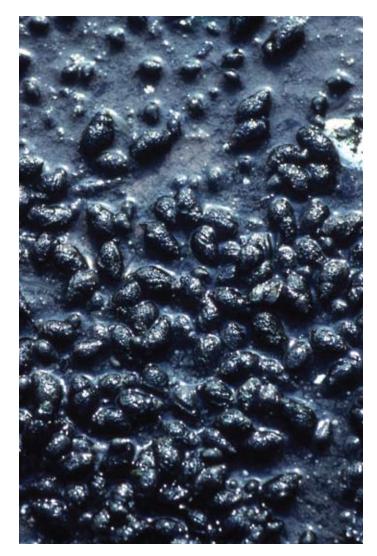






Water currents near tidal flats are quieter, allowing mud or sand to settle out; the fine sands, silts, and clay particles trap a lot of organic debris, which is then broken down by bacteria and fungi.







Mud snails feed on detritus (decaying material) and algae on the surface of tidal flats.



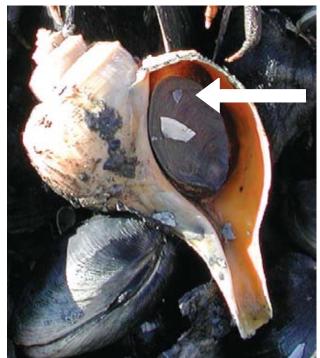


Moon snails construct gelatinous sand grain egg cases, which sometimes can be found on the beach resembling fragile sand "collars".





The carnivorous channeled whelk, laying its parchment egg case, is one of the largest snails inhabiting Long Island Sound; each disk will release several fully formed baby whelks.



The dark piece of shell, is the operculum, which acts as a door.







A hard clam feeds by drawing water in through one of its two siphons, straining plankton from the water, and discharging the water and its wastes through the other siphon.





Often, the only signs that bivalve mollusks are present in the tidal flats are their siphons extending from holes in the sand or mud as they filter microscopic plankton from the water.









Softshell clams, also known as steamers or long-necks, live in deep burrows in the flats and shallows; when disturbed, they shoot up a spurt of water.





**Razor clams** burrow in the mud or sand straight up and down; they are fast and deep





Small, translucent sand shrimp burrow in the soft bottom sediments and are important food for other animals.

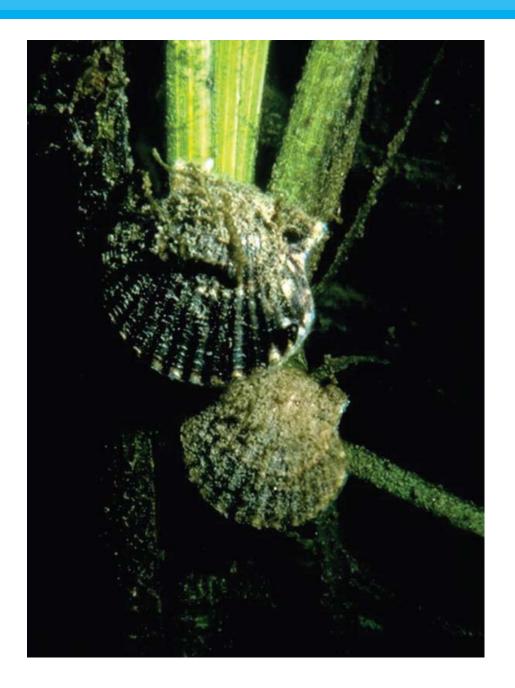






**Eelgrass** grows in shallow waters where sunlight can reach deep enough to support the plant's growth; the roots help stabilize soft bottom sediments from being eroded by tidal currents; many eelgrass beds in the Sound have disappeared due to disease, predation, or poor water quality.





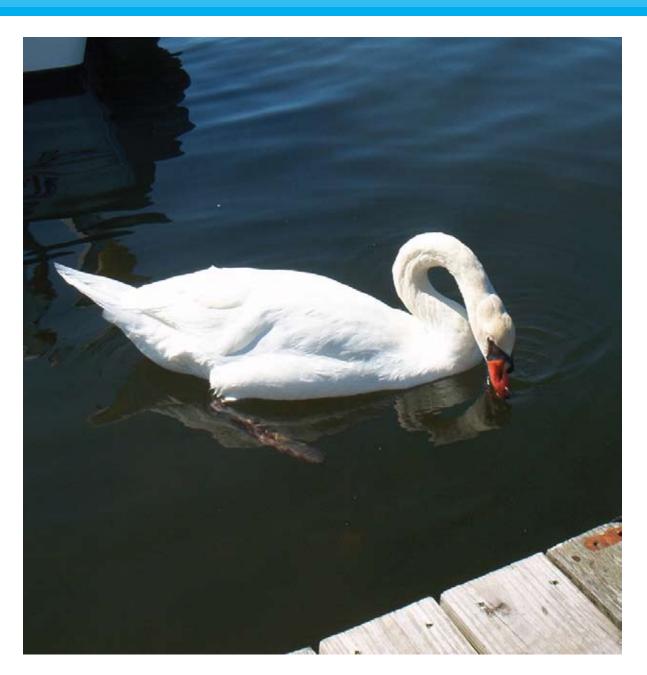
Eelgrass beds provide young fish and bay scallops with shelter from predators; juvenile bay scallops attach to the eelgrass blades during their first few weeks, which may help them avoid predation from crabs.





Translucent grass shrimp are common shallow-water inhabitants, finding shelter among aquatic vegetation such as eelgrass.





## **Mute swans**

dine heavily on eelgrass and the green seaweed, sea lettuce; their long necks enable them to reach down and pull the eelgrass out by its roots, destroying the beds.

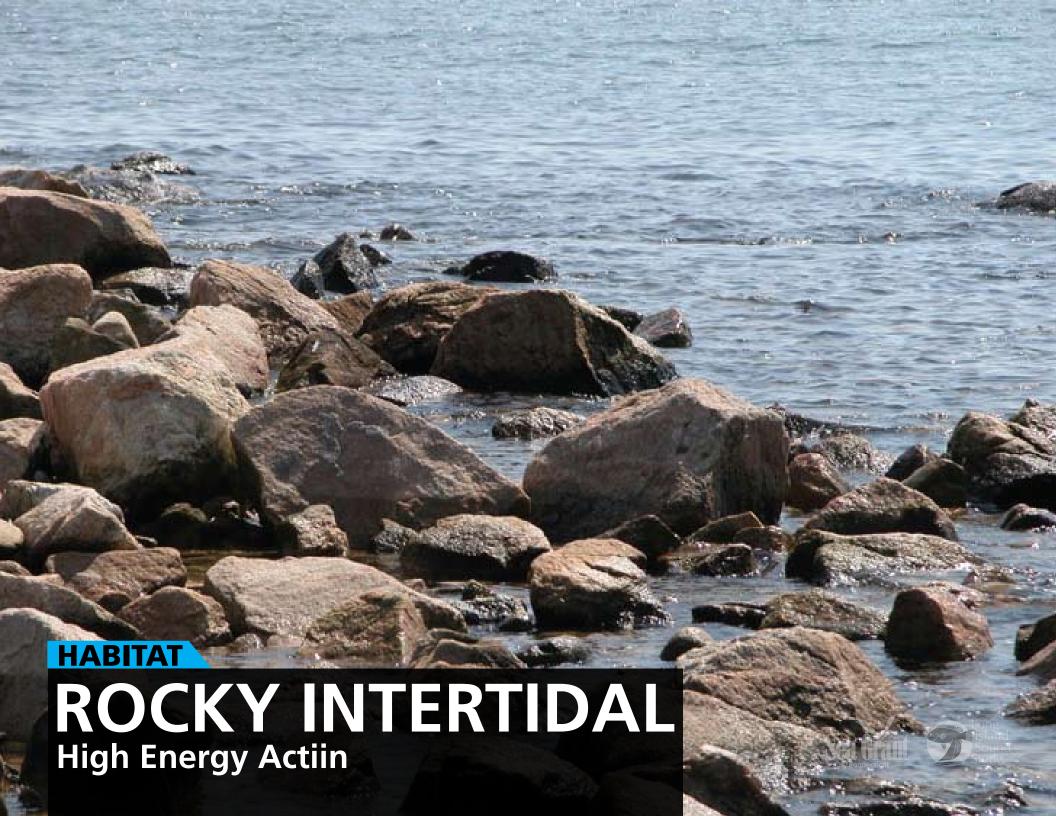






Canada geese also feed on aquatic vegetation and seaweed; they often concentrate in large flocks, and their wastes can cause local water quality problems.

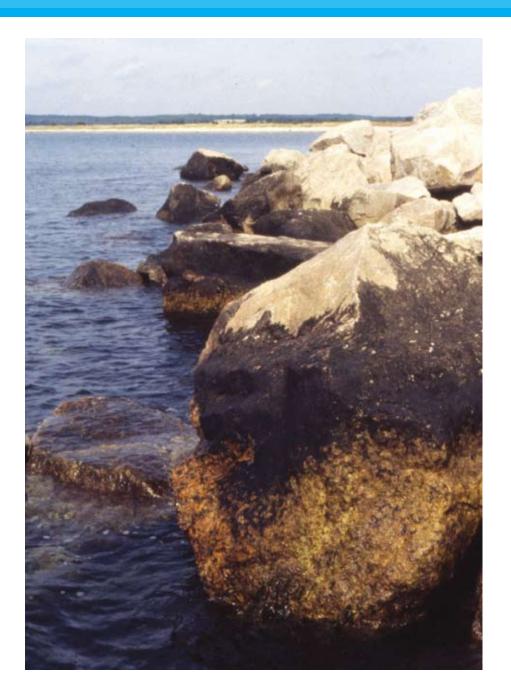






Intense wave action among the rocks, exposure to drying air during daily low tides, freezing winter and extreme summer temperatures, freshwater rainfall, and predation create harsh conditions for organisms living in the rocky intertidal zone.





Zonation is evident in the rocky intertidal zone - lighter bands of barnacles higher on the rocks give way to darker bands of periwinkle snails, blue mussels, and various seaweeds lower on the rocks.







Rockweeds are brown seaweeds that inhabit the rocky intertidal zone, attaching to the rocks and providing food and shelter for many organisms.





Green sea lettuce grows abundantly in nutrientrich waters, and is grazed upon by snails, crabs, some fish, and waterfowl.









Deadman's fingers, or green fleece, is a spongy, thick green algae (seaweed) that grows subtidally.





Irish moss is a red algae that grows in dense clumps at the low tide line; it serves as food and habitat for many other species.

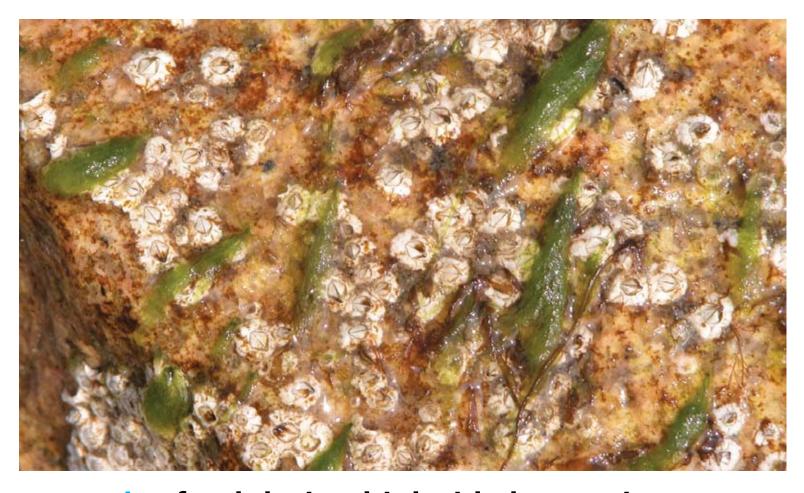






Grateloupia, another red algae, is a relative newcomer to Long Island Sound, growing in shallow subtidal waters; scientists are studying it to determine its impact on the Sound's ecosystem.

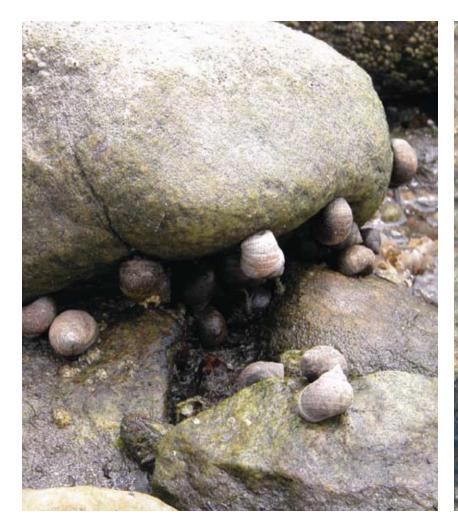




Barnacles feed during high tide by waving feathery appendages through the water, sweeping plankton into their mouths; as the tide recedes, the valves at the top close up tightly.









Periwinkles are snails that live in huge numbers in the rocky intertidal area, scraping algae off the rocks with their radula.









Atlantic slippersnails (I) are also gastropods; they are often found in "stacks" or clumps attached to rocks or other shells. Unlike a snail shell (r), the shell of this gastropod is not coiled.





Blue mussels grow in large clumps in the intertidal zone, attaching to the rocks and each other with strong, elastic threads called byssus.





Translucent white anemones, up to 1.5" tall, attach to hard surfaces such as rocks or shells, or the underside of floating docks; the tentacles capture and direct food particles to the mouth in the center.







Echinoderms are spiny-skinned animals with five-part symmetry, like sea stars and sea urchins. Sea stars feed on shellfish, other invertebrates, and even fish, dead or alive.







These two crustaceans, the Asian shore crab (top) and the green crab (bottom), are non-native invasive species; the Asian shore crab is the most dominant crab in the intertidal zone, easily found under rocks at low tide.







A number of tunicate species (or sea squirts) inhabit the Sound; some are solitary and others are colonial— made up of many individuals.



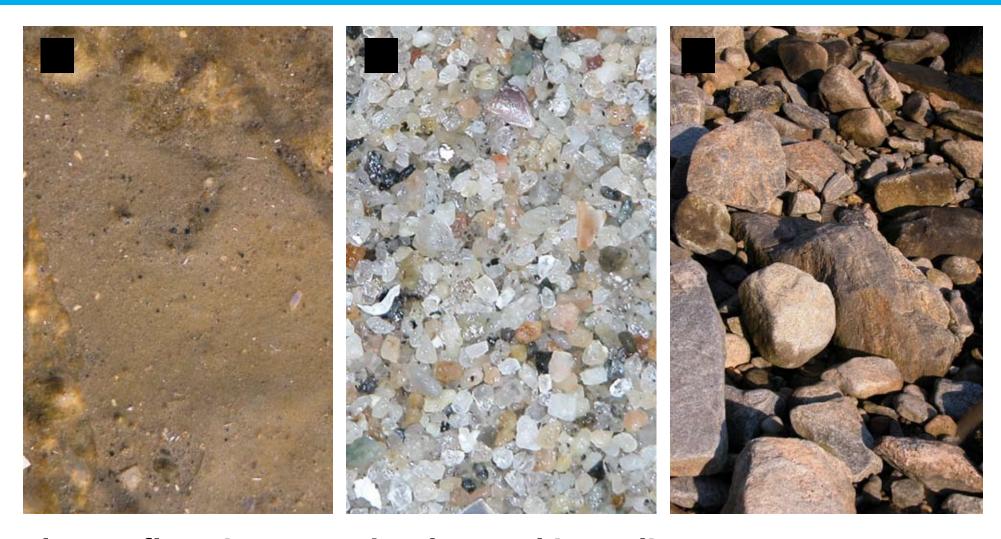




Clusters of sea grapes are commonly found on pilings, floats, and docks; solitary tunicates, they have two siphons used to filter water and food and excrete wastes.







The seafloor in Long Island Sound is as diverse as the habitats along the shore, varying from mud and silt (1), to sand(2), to cobble and boulders (3).



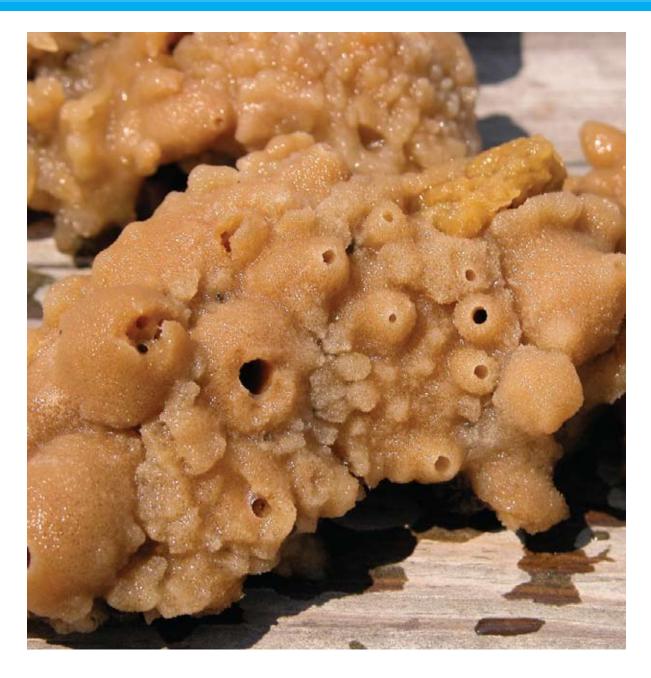






Brown kelp, a seaweed, grows in subtidal beds or "forests," attaching to hard surfaces on the bottom with a holdfast. Kelp holdfasts and blades provide food and shelter for many benthic and pelagic species.





The simplest multi-cellular animals are sponges, which feed by filtering plankton and particulates out of the water.





Benthic rocky communities support attached organisms such as this frilled anemone, which, in turn, provide food and shelter for other organisms.





Corals are living colonies of individual cnidarians set within calcium carbonate shells; this northern star coral is found on rocky reefs in the Sound.







Sea urchins, armored with spines, have five hard pointed teeth at the center of their underside which allows them to scrape algae or attached animals and detritus off rocks and other substrates.





Eastern oysters are an important commercial shellfish; they are farmed on the bottom of the Sound, a practice known as aquaculture.







Nudibranchs (I) are mollusks with no shells; this species feeds on "sea strawberries" (colonial hydroids, r), incorporating the hydroids' stinging cells into its gill tips for protection.





The front appendages of the burrowing mantis shrimp are similar to those of the praying mantis, an insect; barbs on these legs are used to quickly spear and crush prey.







Spider crabs are well camouflaged—the one on the right has a colonial tunicate growing on its shell (carapace); primarily scavengers, they cluster together in groups to molt(shed their exoskeletons) and mate.





Rock crabs are the favorite food of lobsters; they feed on worms, mollusks and other invertebrates.





The most commerciallyimportant crustacean in Long Island Sound is the American lobster. Crustaceans are included in the phylum Arthropoda, which also includes spiders and insects; all arthropods have jointed appendages.







The benthic infauna is largely composed of segmented bristled worms, which work the sand and mud, helping to bring oxygen down into the sediments, and are food for other animals; clam worms make good fish bait, especially for winter flounder.







**Didemnum** is a colonial invasive tunicate that is found in both shallow and deeper parts of the eastern Sound; it forms mats in the summer that cover the bottom.





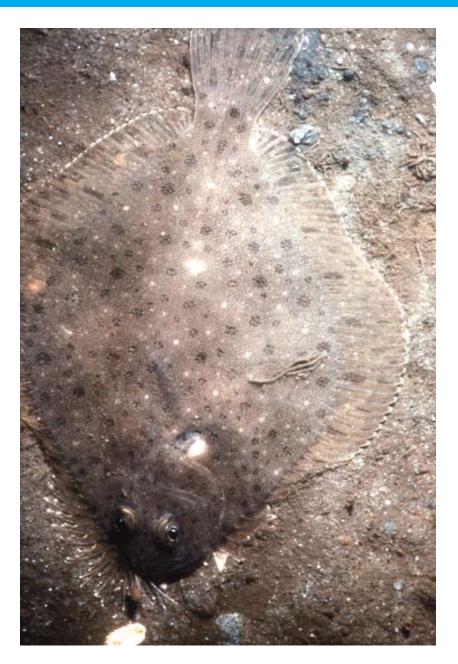
Little skates are common benthic fish in the Sound; relatives of sharks and rays, they possess skeletons entirely made of cartilage.





Winter flounder are year-round residents of Long Island Sound; "right-eyed" flatfish, they swim along the bottom feeding on soft-bodied animals in the sediments.





Windowpane, or sand dabs, are also year-round flatfish residents of the Sound; "left-eyed" flatfish, they have larger mouths than winter flounder, and will leave the bottom to ingest swimming prey.





Searobins lie quietly on the bottom, blending in with their surroundings; the first 3 rays of the fish's pectoral fins are separate, adapted to rout prey from the sediments.





Sea ravens and their relatives, sculpins, have large spiny heads and wide mouths; sea ravens possess fleshy tabs on their heads and ragged dorsal fins; they inhabit rocky or hard bottoms where they eat both invertebrates and finfish.

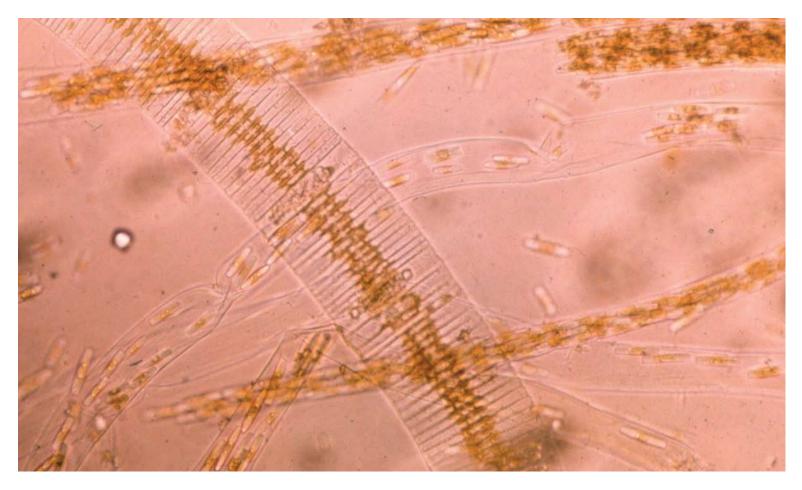






The water column, or pelagic zone, of Long Island Sound is home to many finfish and other interesting organisms, such as squid, jellyfish, and marine mammals.





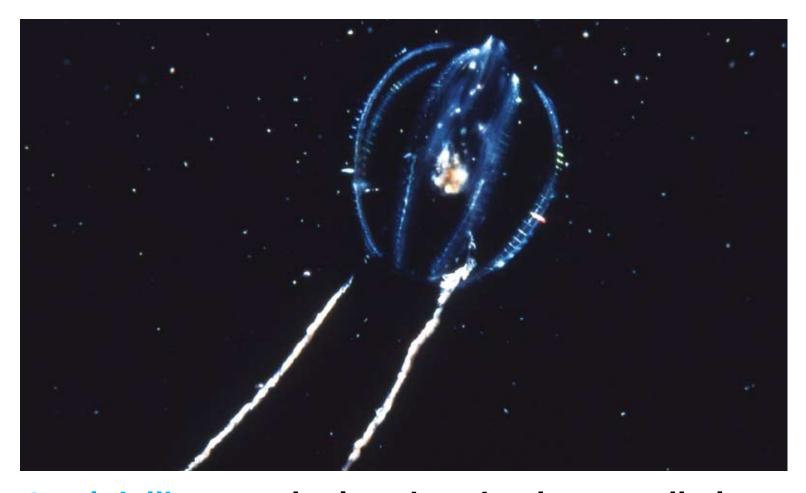
Drifting microalgae or phytoplankton form the base of the food web in estuaries; here are a variety of microscopic marine diatoms common to Long Island Sound waters.





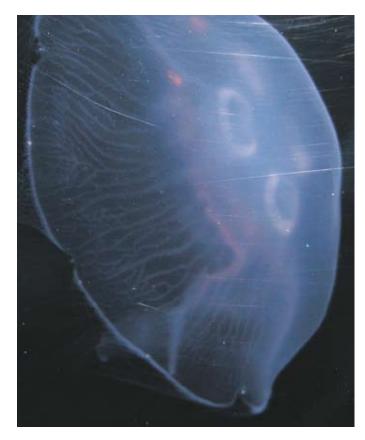
Zooplankton are drifting or weakly swimming organisms, ranging in size from this tiny (2-3mm) copepod to large jellyfish; most animals in the Sound begin life as part of the zooplankton community, e.g., clams, crabs, lobsters, flounder.

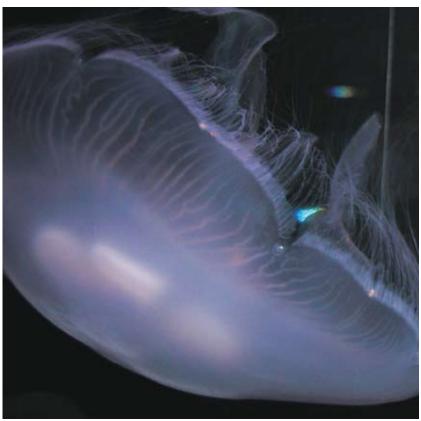




Comb jellies are planktonic animals, propelled through the water by cilia comprising the luminescent bands running along their bodies; unlike true jellyfish, they have no stinging cells.







The moon jelly is one of the larger members of the zooplankton community, with a nearly flat, pale pink, orange, or milky-white bell, and a fringe of short tentacles. They are commonly found in the Sound's waters during late spring.





The lion's mane jellyfish, with stripes of red or purple radiating from the center of the umbrella and reddish-brown tentacles, are common in the **Sound during the** summer and early fall.





The colorful scup (porgies) feed on both invertebrates and small fish; they are popular with sport anglers for their vigorous fight on the line and are also harvested commercially.





American shad (top) and Atlantic salmon (bottom) are anadromous fish, spending their adult lives at sea, and returning to fresh rivers to spawn.





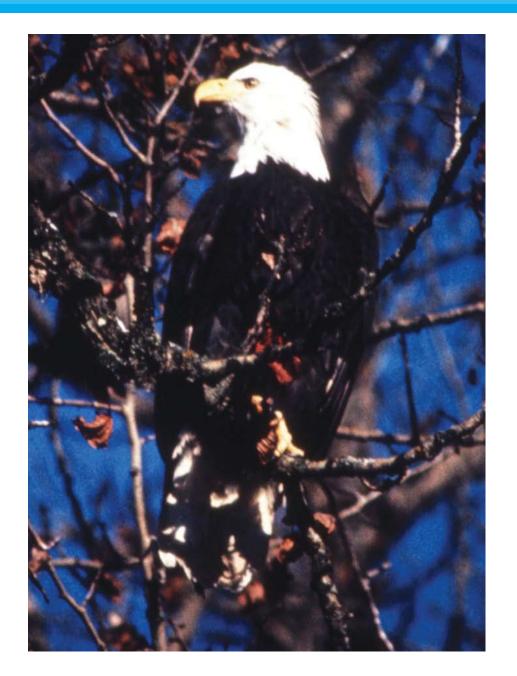
Striped bass are also anadromous but do not spawn in Long Island Sound tributaries; they are popular sport fish which occur in the Sound in the summer, feeding on squid and finfish.





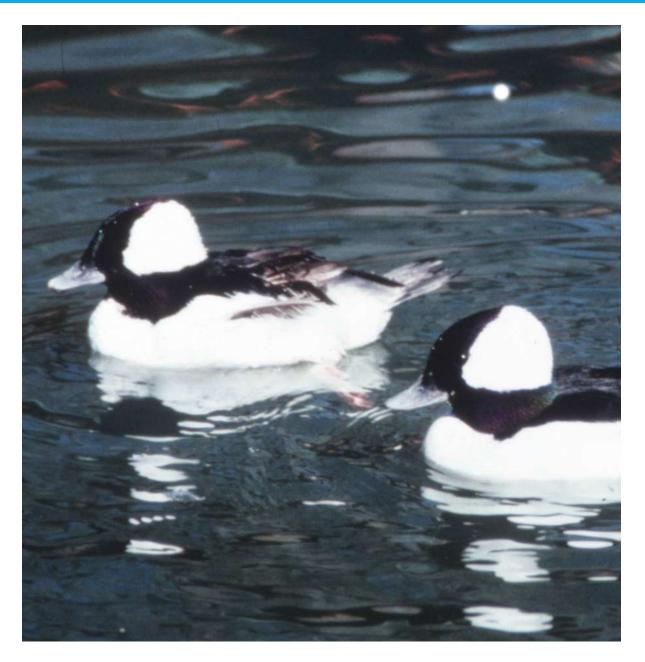
American eels are catadromous, meaning they have the reverse migration pattern of anadromous fish. Adult American eels migrate from freshwater streams or nearshore habitats to the Sargasso Sea, south of Bermuda, to spawn; the adults die there, but the young return to the streams and shore areas.





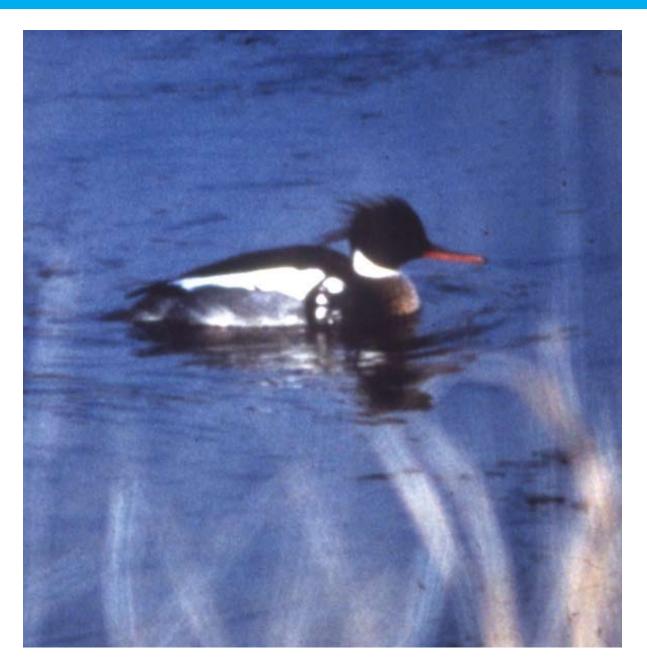
Endangered bald eagles are spectacular winter residents along the Connecticut and Housatonic Rivers. They sit in trees or on ice flows at the water's edge to hunt for fish; eagles will also steal fish from their relative, the osprey.





**Buffleheads** (males pictured) are small diving ducks that winter along the coast of Long Island Sound, feeding on benthic invertebrates and small fish; they breed in central Canada.





mergansers are common wintering waterfowl in Long Island Sound; these birds dive to capture fish.







**Double-crested cormorants** occur here year-round; but they are more numerous in summer when they breed on rocky islands. **Cormorants are primitive** fish-eating birds that are master divers and swimmers; they must occasionally dry their wings in the air because their feathers lack the oil that serves as a water repellent in other waterfowl.



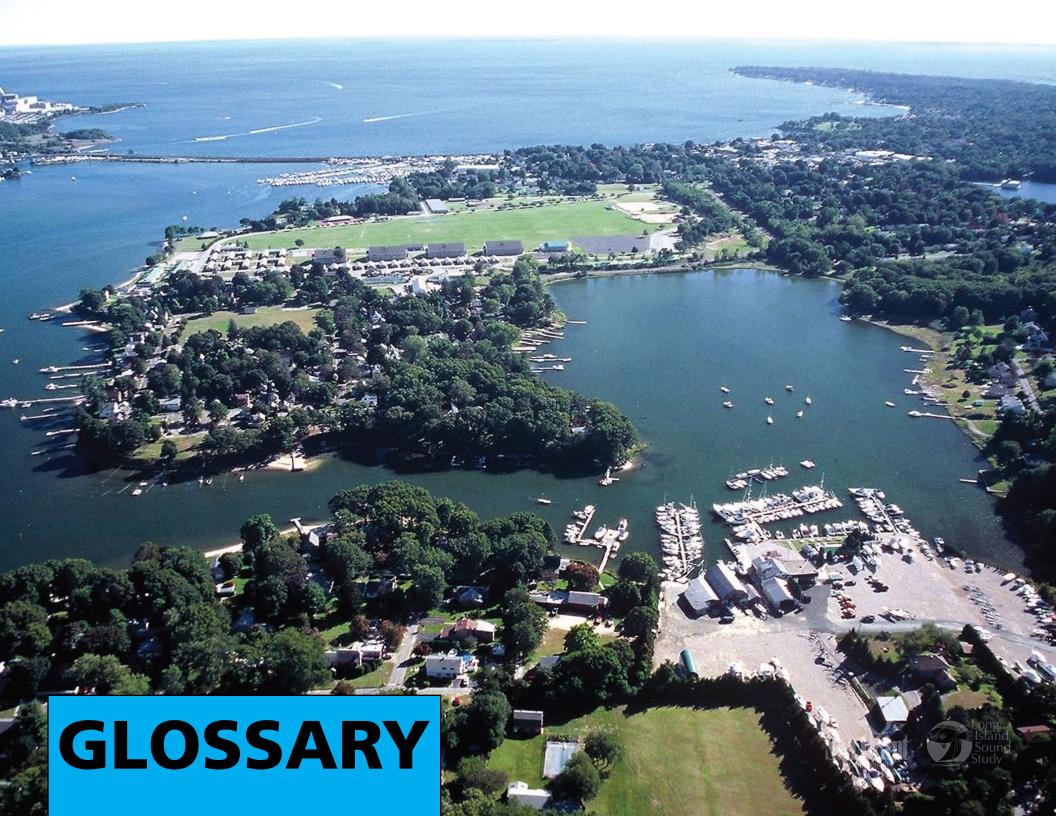


The only true marine mammals that inhabit the Sound regularly are harbor seals (spots) and gray seals (top); they migrate from northern pupping grounds to winter in the Sound, hauling out to rest on rocky outcrops along the coast.





Long Island Sound is a tremendous resource of fascinating, ecologically and economically-important organisms. By far, humans have the greatest impact on the Sound's health and viability, so we must all be aware that pollution and mismanagement can and has degraded the Sound in some areas. It is up to ALL of us to protect Long Island Sound, a living treasure.



# alginate

gelatinous substance derived from certain seaweeds, used as a thickener

#### anadromous

ocean-living species that must migrate into fresh water to spawn

## aquaculture

farming of crops in water, including fish and shellfish

# arthropods

invertebrates belonging to phylum Arthropoda, including crustaceans

#### benthic

animals or plants that live or feed on or near the sea floor

# byssus

strong elastic threads produced and used by mussels to attach to hard surfaces

# camouflage

ability to blend with one's surroundings

#### carapace

hard shell covering head and thorax of a crustacean

#### carrageenan

substance derived from seaweed, used to make products creamy and smooth

#### catadromous

lives in fresh water streams but migrates to salt water to spawn

#### cilia

microscopic hairlike processes extending from cell, often capable of rhythmic motion

#### cnidarian

invertebrate animals belonging to phylum Cnidaria, including jellyfish, sea anemones and corals

#### crustacean

lobsters, crabs, shrimp, and barnacles; arthropods belonging to Class Crustacea

#### cultch

clean shell, placed on shellfish beds to encourage settling of oyster larvae

#### detritivore

organism that consumes dead and decaying material

#### echinoderm

radially symmetrical invertebrates belonging to phylum Echinodermata, including sea stars, sea urchins, and sea cucumbers

#### ecosystem

an ecological community and its environment

# epifauna

organisms that live on the surface of sediments

## estuary

a body of water where fresh water and salt water meet and mix

#### exoskeleton

external protective/supporting structure of many invertebrates, an outer shell

# flagellum

whiplike organ of locomotion of a dinoflagellate

#### food web

a complex of interrelated food chains in an ecological community

# gastropod

a mollusk that has a single, usually coiled shell, including snails and limpets

#### herbivore

an organism that consumes plants

# hermaphrodite

animal with both male and female reproductive organs

# high marsh

part of the marsh that floods during storm events and bi-monthly spring tides

#### holdfast

structure by which seaweeds attach to hard surfaces

# hydroids

a colonial organism that has a polyp as its dominant life stage

#### infauna

organisms that live within the sediments

#### intertidal zone

the region between the extremes of high and low tide

#### invasive

an organism, often non-native, that spreads rapidly and becomes dominant

#### invertebrate

animal without a backbone

#### low marsh

part of the marsh that is regularly flooded by tides

#### **luminesce**

emits light produced by a chemical or biochemical reaction

# macroalgae

large algae or seaweeds

# madreporite

sieve plate on top of sea star through which water enters

#### mollusks

invertebrates belonging to the phylum Mollusca, including snails, bivalves and nudibranchs

#### molt

process of crustacean growth during which the outer exoskeleton is shed and replaced by a new, larger exoskeleton

### nematocysts

tiny stinging cells in various cnidarians, like jellyfish, that chemically paralyzes its victim

# nitrogen fixer

plants in the legume family that have bacteria associated with their root systems; the bacteria convert or "fix" nitrogen from the air and use it for growth

#### notochord

primitive backbone

#### omnivore

animal that consumes both plants and animals

## operculum

small piece of shell that seals the opening of snail shells

# palps

elongated sensory organ, usually near the mouth, of mollusks and crustaceans

## pelagic

relating to, or living in, open water

# phytoplankton

microscopic, floating plants; photosynthetic organisms

### predators

an animal that feeds on other organisms

#### prey

an organism hunted or caught for food

#### radula

a tongue-like organ in snails, with rows of teeth, used for scraping algae

## salt panne

depression in salt marsh where water collects and evaporates, leaving soil with high salinity concentration

# spring tide

higher than average tides twice a month with the full and new moons

#### telson

the tail of a horseshoe crab

#### tunicate

a chordate marine animal of the subphylum Urochordata, having cylindrical bodies enclosed in a tough outer "tunic", includes the sea squirts and salps

# uplands

the portion of a salt marsh that transitions from the high marsh to the forest

#### wrack line

the line of dead and decaying matter or vegetation (usually seaweed and eelgrass) found along the high tide line on a beach

# zooplankton

small, often microscopic animals that drift in currents as part of the plankton



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www.lisrc.uconn.edu (Long Island Sound Resource Center, Connecticut Department of Environmental Protection and the University of Connecticut)

www.seagrant.uconn.edu (Connecticut Sea Grant, University of Connecticut)

www.seagrant.sunysb.edu (New York Sea Grant Institute)

www.longislandsoundstudy.net (EPA Long Island Sound Study)

www.mysound.uconn.edu (University of Connecticut Dept. of Marine Sciences)

The Long Island Sound Study (LISS) is a partnership of federal, state, and local government agencies, private organizations, and educational institutions working together to restore and protect Long Island Sound. This research, management, and education project began in 1985 as part of the National Estuary Program under the federal Clean Water Act. In 1994, the LISS partners completed development of a Comprehensive Conservation and Management Plant for Long Island Sound, and implementation of this plan is on-going.

The Connecticut Sea Grant College Program is a partnership between the NOAA National Sea Grant College Program and The University of Connecticut. Along with New York Sea Grant, it is one of a network of 32 university-based non-profit programs in the coastal and Great Lake states. Established by Congress in 1966, Sea Grant fosters the conservation and wise use of our coastal and marine resources by supporting research, providing extension and technology transfer services, and raising public awareness of coastal and marine environments through educational programs.







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