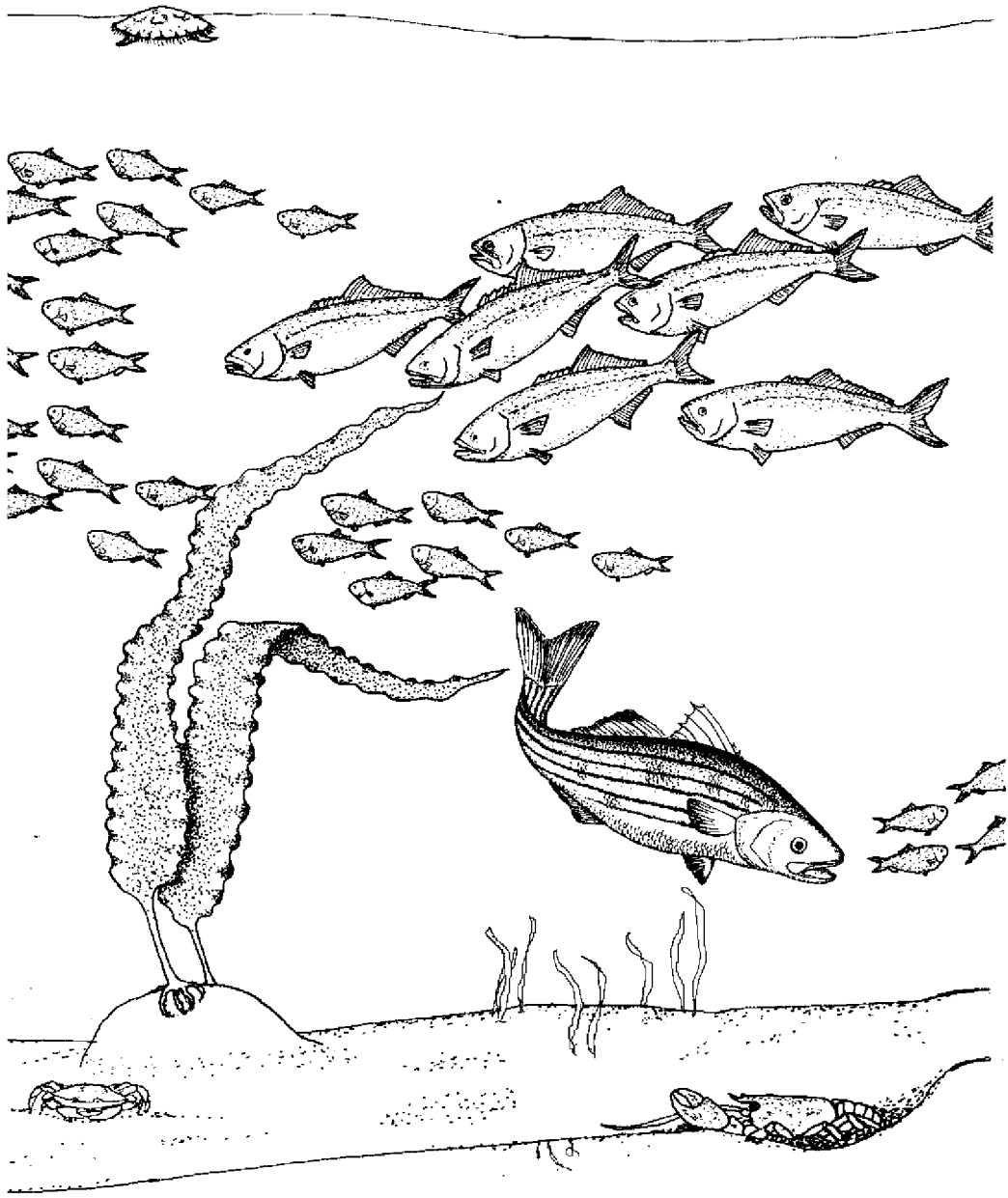
Living Treasures:

The Plants and Animals of Long Island Sound



Living Treasures:

The Plants and Animals of Long Island Sound

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Long Island Sound Study

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 Plan for Long Island Sound, and implementation of this plan is currently underway. For additional information, contact:

EPA Long Island Sound Office
CT (203) 977-1541
NY (631) 632-9216
www.epa.gov/region01/eco/lis

Connecticut Sea Grant College Program

The Connecticut Sea Grant College Program is a partnership between the NOAA National Sea Grant College Program and The University of Connecticut. It is one of a network of 30 university-based non-profit programs in the coastal and Great Lakes 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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Preface

More than ten years and 25,000 copies have come and gone since the initial publication of this booklet written by Lisa Wahle. While the text has been revised and updated, its original purpose has not changed–to raise awareness of the beauty and diversity of the flora and fauna with whom we share the Sound, and their relationship to it–and to us. During these past ten years, the Sound's ecosystem has both benefitted and suffered from human intervention.

During the past decade the Long Island Sound Study partnership began to implement its Comprehensive Conservation and Management Plan (CCMP) for Long Island Sound. The CCMP addresses seven priority areas: low dissolved oxygen, or hypoxia, toxic contamination, pathogen contamination, floatable debris, living resources and habitat management, land use and development, and public involvement and education. While positive progress is being made towards achieving interim and final goals outlined in the CCMP, other significant events remind us that we must continue to be vigilant in our efforts to wisely conserve and manage the Sound and all its resources.

In the late 1990's, the Sound's oysters succumbed to the oyster parasites, MSX and Dermo, and only recently have shown signs of recovery. In 1999, lobsters in the western portion of the Sound suffered a massive mortality event, recovery from which may take years. At the same time, lobsters in the eastern Sound and other parts of New England exhibited a greater occurrence of shell disease, a bacterial disease that causes dark spotting and pitting of the lobsters' shells. Non-point sources of pollution from the land and atmosphere continue to adversely affect the Sound's health. Human-related activities, from boating to fishing to harvesting to shellfish farming, compete with each other and with coastal development in general, putting additional stress on the Long Island Sound ecosystem. The Sound continues to need our attention.

Many thanks to Susan Stone for the beautiful line drawings of the Sound's living "treasures"; to Judy Ricketts-White for the booklet design, and to my cadre of reviewers – Carter Balcom, Penny Howell, Mark Parker, Rosemary Pastor, Diana Payne, Peg Van Patten, Lisa Wahle, and Kimberly Zimmer–for their fact checking and insightful comments. Any mistakes that remain are my own. Enjoy!

Nancy Balcom
Connecticut Sea Grant
May 2002

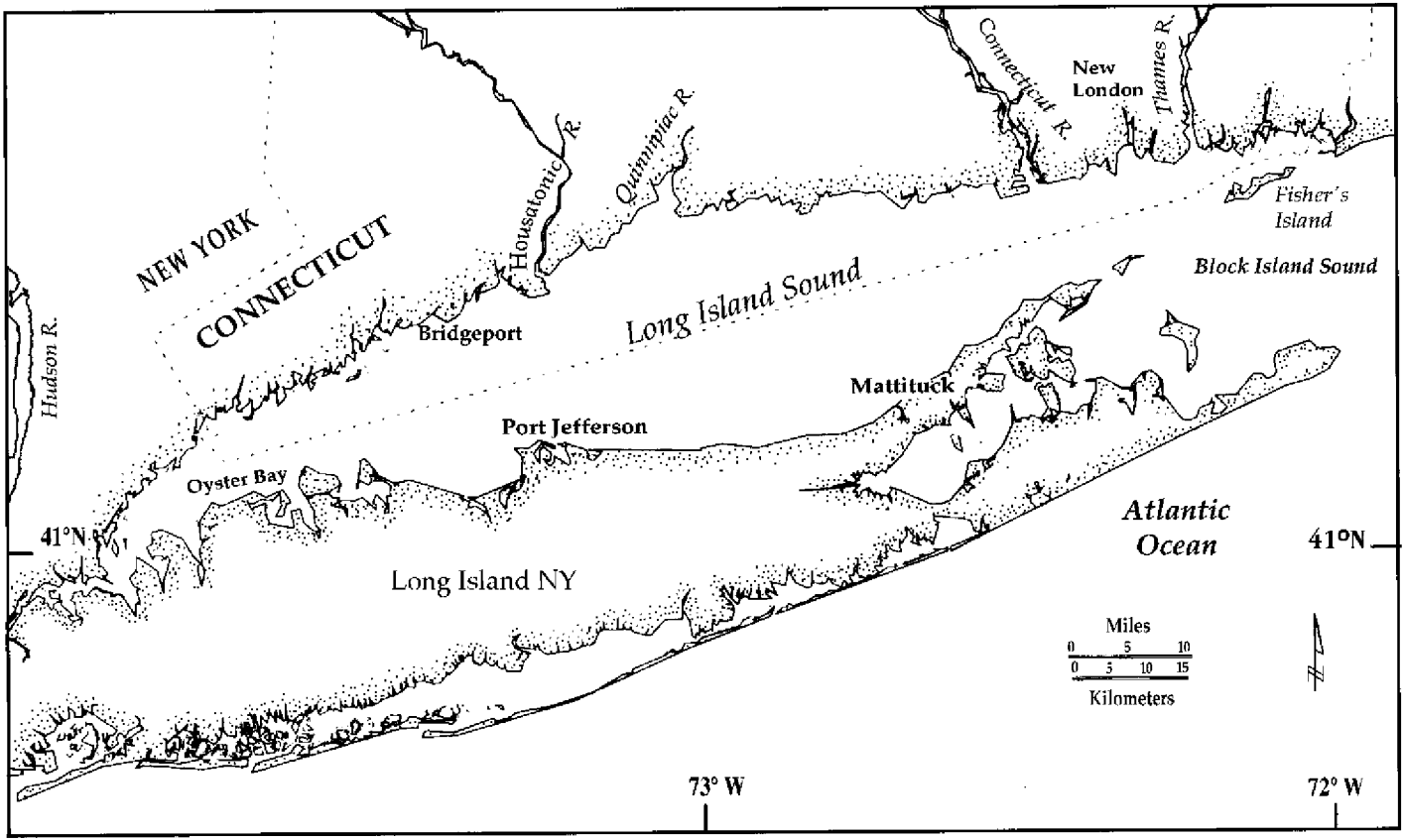
An Introduction to the "Urban Sea"

Often called the "Urban Sea", Long Island Sound is a water body of immense size and complexity, stretching from densely-populated New York City on the western end to the eastern tip of Long Island. Its northern shore comprises the entire southern boundary of the State of Connecticut; its southern shore is the northern boundary of Long Island, New York.

LONG ISLAND SOUND FACTS & FIGURES

- 110 miles long from end to end, from the East River to The Race
- 21 miles wide at its widest point, near the Connecticut River
- Ranges from 60 to 300 feet at its deepest points; average depth is 65 feet
- East-west orientation (most estuaries orient north-south)
- Covers 1,300 square miles
- Drainage basin is more than 16,800 square miles; 71% is Connecticut River drainage basin
- Watershed reaches into five states and part of Canada
- Two high and two low tides per day

Long Island Sound is an **estuary**, a place where fresh water from rivers mixes with salt water from the Atlantic Ocean. Like other estuaries, it is among the most productive ecosystems on Earth. The Sound abounds in plant life, finfish, shellfish, and waterfowl, and provides feeding, breeding, nesting, and nursery areas for many animals. Indeed, its "specialness" has led to national recognition. In 1987, Long Island Sound was designated an "Estuary of National Significance" by the National Estuary Program established by Congress.



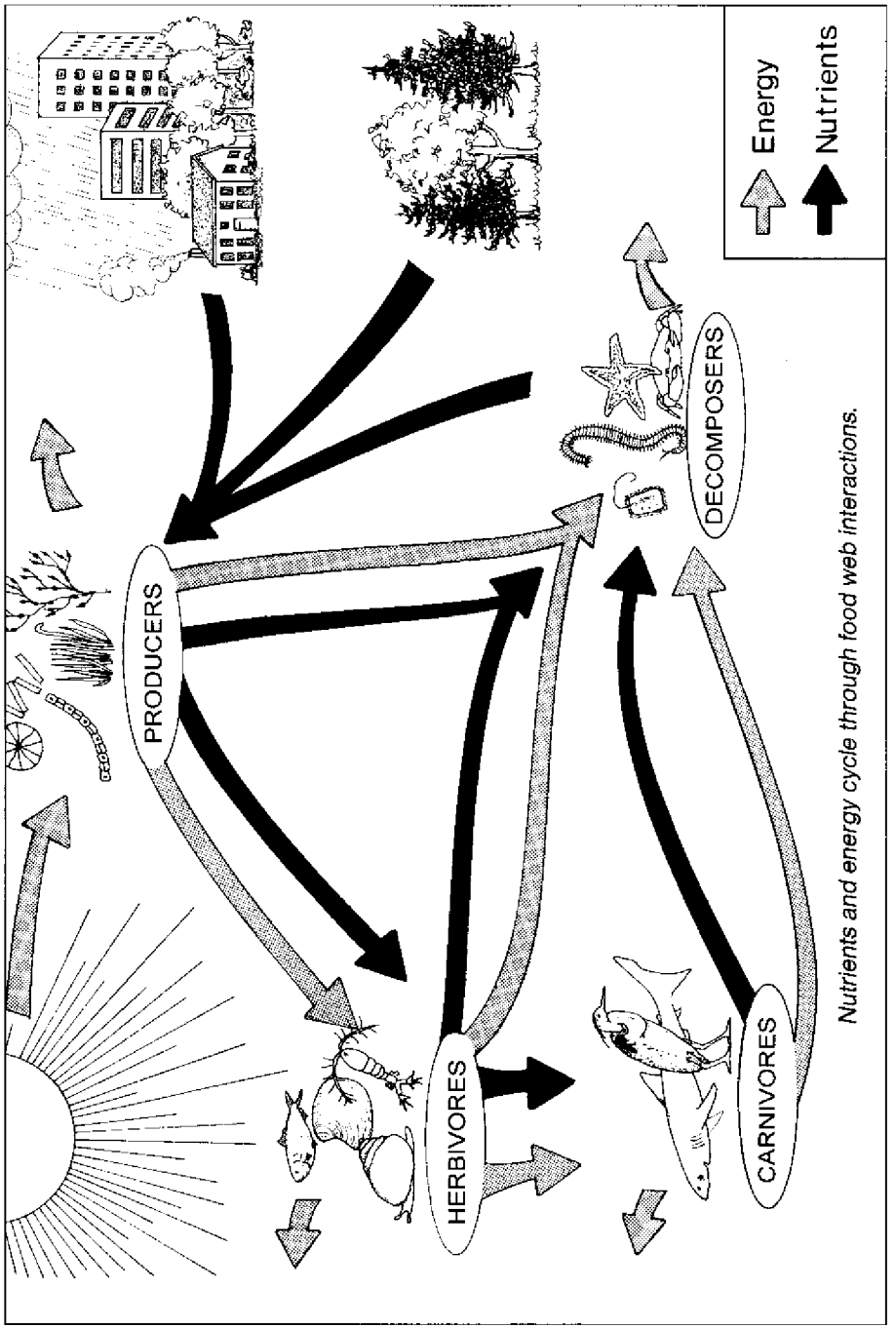
Long Island Sound, "The Urban Sea," an estuary of immense size and complexity.

People are very much a part of the Sound. Currently, more than eight million people live within its watershed, and more than 21 million live within a 50-mile radius of the Sound. Following the national trend, both Connecticut and New York are experiencing a shift in their population towards the coast along the New York to Boston corridor, increasing pressure on the Sound and its resources. The Sound is heavily used by people for a variety of purposes: marine industry, commercial and sport fishing, aquaculture, boating, swimming and other types of recreation, transportation, military maneuvers, and waste disposal. These uses sometimes conflict or compete with each other and with the myriad living "treasures" that live in the Sound and along its shores.

Continued development of an already densely-populated coastline has kept pressure on the Sound's ecosystem. However, progress has been made in arresting, and even reversing, the effects of some stresses on the health and abundance of the Sound's biota, such as reductions in nitrogen and toxic contaminant discharges into the Sound's waters. The outlook is far from dismal and is largely in our control. By donning environmental stewardship caps and remaining vigilant about weighing the effects of human activities on the ecosystem, concerned citizens can succeed in preserving the integrity of this vast water body.

The Sound's Living Treasures

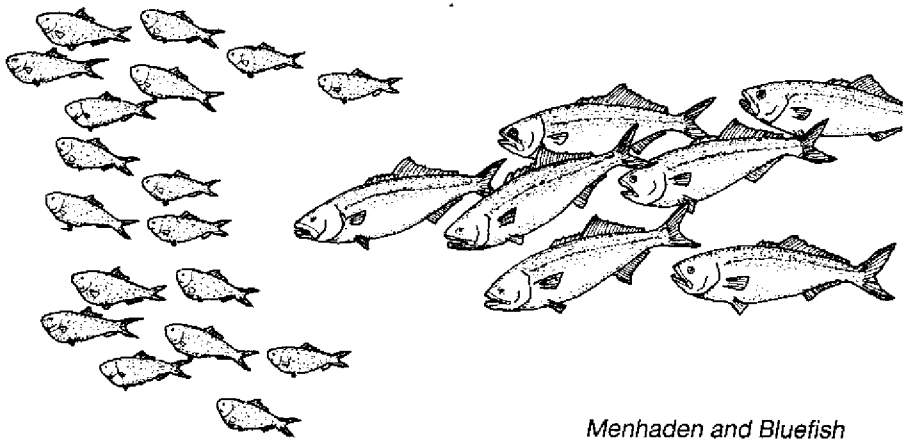
From microscopic bacteria and phytoplankton to striped bass and harbor seals, Long Island Sound is alive! There are more than 1,200 species of invertebrates and 170 species of fish associated with the Sound. This body of water is a major spawning ground for many species of finfish and shellfish, and an essential food and rest stop for dozens of species of migratory birds. Although the abundance and variety of organisms have changed over time, the Sound still supports a multitude of creatures great and small year-round. Many more are linked to the Sound for part of their life cycle. Together,



Nutrients and energy cycle through food web interactions.

these plants (**flora**) and animals (**fauna**) are valuable living marine resources. While not all species are commercially important, they are all interesting and of great ecological importance to the balance of life in the Sound.

Plants and animals interact with each other, their environment, and people in the Long Island Sound **ecosystem** in complex and interesting ways. Consider the following **food web** scenario. The last meal eaten by a lobster served at a restaurant was the remains of a bluefish filleted and tossed overboard by an angler. The bluefish had



Menhaden and Bluefish

been chasing and feeding on a school of menhaden (bunker) when hooked by the angler. The bunker had in turn been consuming tiny **zooplankton**. Earlier, the zooplankton had in turn fed on microscopic algae (**phytoplankton**), that use the sun's energy to turn water, carbon dioxide, and chemical nutrients, such as nitrates and phosphates, into living tissue and oxygen through the process of **photosynthesis**.

Energy and nutrients are cycled through the Sound's living marine resources by these types of food web interactions. Organisms obtain energy and nutrients by consuming other organisms or, in the case of seaweed, phytoplankton, and green plants, by converting sunlight, water, and chemicals into living tissue.

Long Island Sound's Environment for Life

Long Island Sound is a dynamic estuarine system encompassing diverse habitats where plants and animals live. Fresh water from several large rivers (Connecticut, Thames, Housatonic, and East) and numerous small ones dilute sea water coming in from the Atlantic Ocean; waters in the eastern Sound near the open ocean are more **saline** (saltier) than those of the western Sound. In turn, each river mouth is itself a sub-estuary of the larger Long Island Sound estuary where fresh water from upstream mixes with the more saline waters of the Sound.

Estuaries are water bodies of constantly varying conditions. Thus, the plants and animals in Long Island Sound must be able to tolerate wide ranges in salinity (salt content). Year-round residents must also withstand tremendous changes in temperature. Organisms that live in the **intertidal zone** must tolerate being alternately submerged in water and exposed to air, as well as withstand the baking sun or frigid winter weather.

Estuarine organisms have special adaptations to cope with a constantly changing environment. Animals that move between fresh and salt water, like striped bass and American shad, for example, have special mechanisms to balance the salt level inside their bodies relative to the level in the water. In response to cold temperatures, some animals, such as bluefish, migrate out of the area. Others, like fiddler crabs, go into an inactive state during the winter months. To avoid drying out, barnacles, mussels, and snails close up tight when exposed to air during low tide.

Diverse Habitats = Diverse Species

Estuaries like Long Island Sound provide a broad range of habitat types that in turn contribute to a wide variety (**diversity**) of individual organism types or **species** these productive waters can support. These **habitats** range from salt marshes to tidal mud flats, rocky reefs to sandy beaches, and the open waters in between. From the coastal forests and grasslands to the submerged bottom, the environmental conditions change in well-defined patterns. Estuaries are very important to marine life in general. Research suggests that more than three-quarters of the finfish and shellfish species landed by anglers and commercial fishermen along the Atlantic coast inhabit an estuary during some period of their life.

Plants are crucial to the survival of all that live in Long Island Sound because they alone can use water, carbon dioxide, chemical nutrients, and the sun's energy to make living tissue and to release oxygen. In fact, it is this process of photosynthesis that permits most life forms to exist on earth. In the Long Island Sound ecosystem, there are three broad categories of plants: **microalgae** or phytoplankton, **macroalgae** (seaweeds), and the **vascular** or true **plants**.

The fauna of Long Island Sound is abundant and diverse, ranging from microscopic zooplankton to spider crabs, sea anemones, and great blue herons. **Invertebrates** (animals without backbones) include crabs, snails, jellyfish, sea stars, and worms. Animals with backbones are **vertebrates**, and include fish, reptiles, birds, and mammals. Finfish in Long

Great Blue Heron

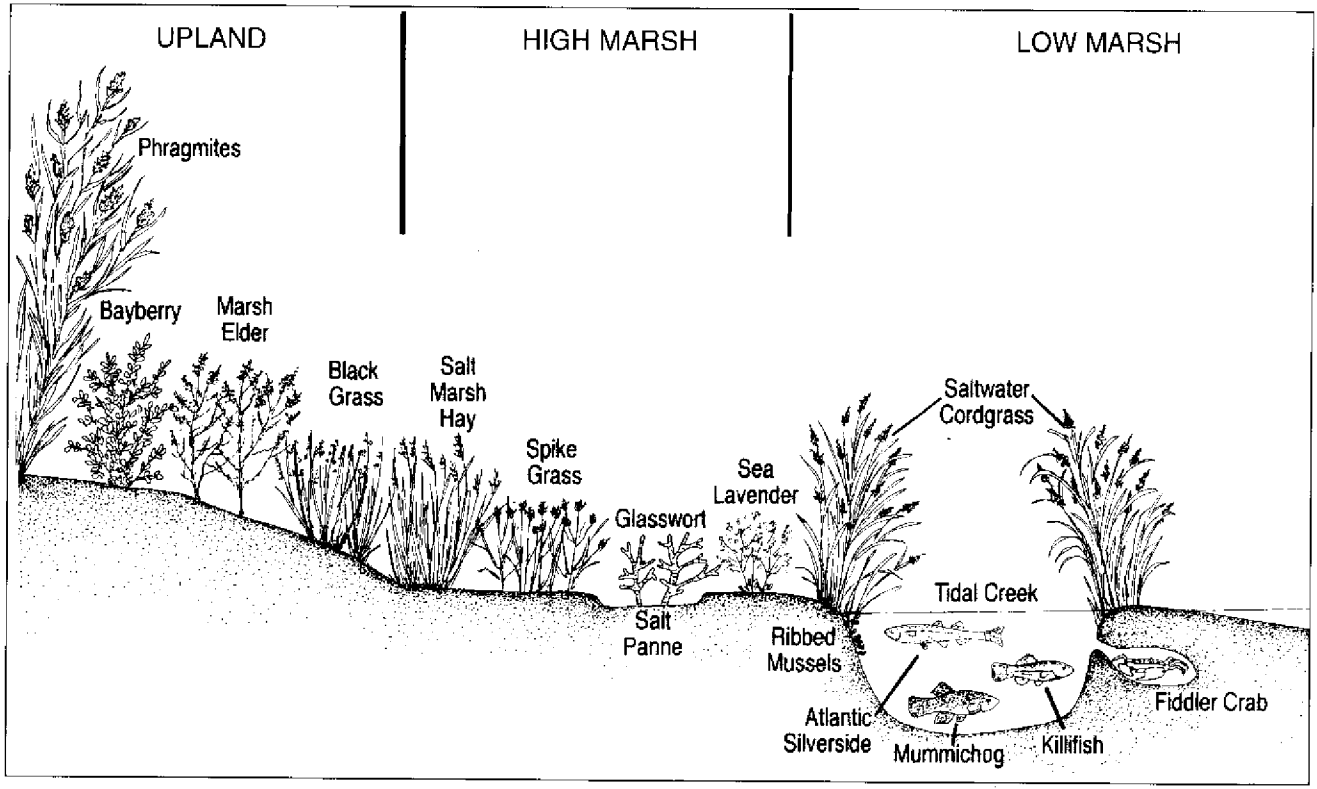
Island Sound may be year-round residents, regular visitors that migrate in and out of the Sound at predictable times, or "accidental tourists" from the open ocean. Populations of many fish species vary dramatically from season to season. All animals must eat food to obtain nutrients necessary for survival. Those that eat algae or plants are called **herbivores**, those that eat other animals are called **carnivores**, and those that eat both plants and animals are **omnivores**.

Habitats of Long Island Sound

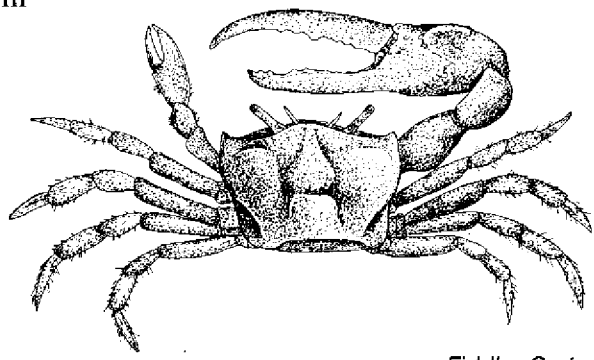
The following pages describe a number of habitat types that are part of the Long Island Sound ecosystem, and some of the plants and animals that can be found in them. Keep in mind that many of the Sound's animals can be found in more than one habitat type, and they may move between these habitats daily or seasonally, or shift from one habitat to another as they grow and mature, and their food and shelter needs change.

Salt Marshes

Fringing the shore, **salt marshes** and tidal wetlands provide sheltered nursery areas for many species of fish and are home to abundant prey organisms for crabs and shrimp, fish, birds, reptiles, and mammals. Salt marshes also serve as traps for contaminants, sediments, and nutrients. The dense roots and peat of the salt marsh grasses act as a sponge to absorb water during storms, protecting the higher marsh and reducing the impact of flooding on shoreline areas. Interestingly, most salt marsh vegetation is as important to the Long Island Sound ecosystem dead as it is alive. Dead leaves and stems provide food for fiddler crabs, worms, snails, and the immature stages of finfish and shellfish. Bacteria break down the vegetation further to release chemical nutrients into the water.



Salt marshes provide food and shelter for a myriad of birds, fish, crustaceans, mollusks, reptiles, and mammals. They are also the nursery grounds for many estuarine species.



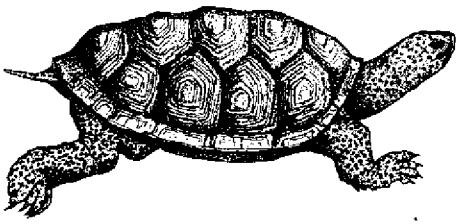
Fiddler Crab

The vegetation in a salt marsh is distributed in belt-like patterns, based on elevation. Salt marshes that have been disturbed are often colonized by the invasive common reed (*Phragmites*). Broad-leaved plants and shrubs such as bayberry and marsh elder dominate the salt marsh plant community in the upland zone. The landward region of the marsh, known as the **high marsh**, is unflooded most of the time except during **spring tides** (very high and extra low tides that occur twice a month at the time of the full and new moons). Salt marsh plants are especially tolerant of salinity. The high marsh is dominated by salt-marsh hay and spike grass, among other grasses and sedges. An unusual succulent plant called glasswort may be found in **salt pannes**, small depressions in the marsh devoid of grass. Sea lavender grows here as well.

The seaward region of the marsh is the **low marsh**, which is regularly flooded by the tides. This part of the marsh, particularly along the water line, is almost exclusively vegetated by tall saltwater cordgrass. This grass is very tolerant of the ever-changing water level, temperature, and salt concentration.

In the tidal creeks and mosquito ditches that wind through the salt marsh, small fish such as mummichogs, killifishes, sticklebacks, and Atlantic silversides congregate during low tide. Larger fish often move in during high tide to feed on these small fish. The only reptile that lives exclusively in coastal salt marshes is the diamondback terrapin. **Terrapins** eat crustaceans, mollusks, dead fish, and some plant material. Locally, they were nearly hunted to extinction in the early 1900's for their tasty meat, but populations have since recovered in many areas.

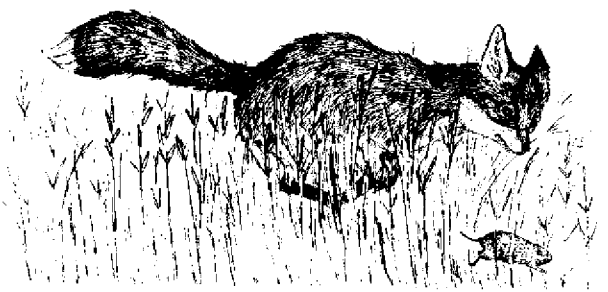
Fiddler crabs, a **crustacean**, are found almost exclusively in salt marshes where their burrows line the banks of tidal creeks and mosquito ditches. The enlarged front claw of the male is waved around to lure a female into his burrow. Fiddler crabs feed on algae and decaying matter found among the marsh sediments. Some **mollusks**, such as the ribbed mussel and the salt marsh snail, are found almost exclusively in salt marshes.



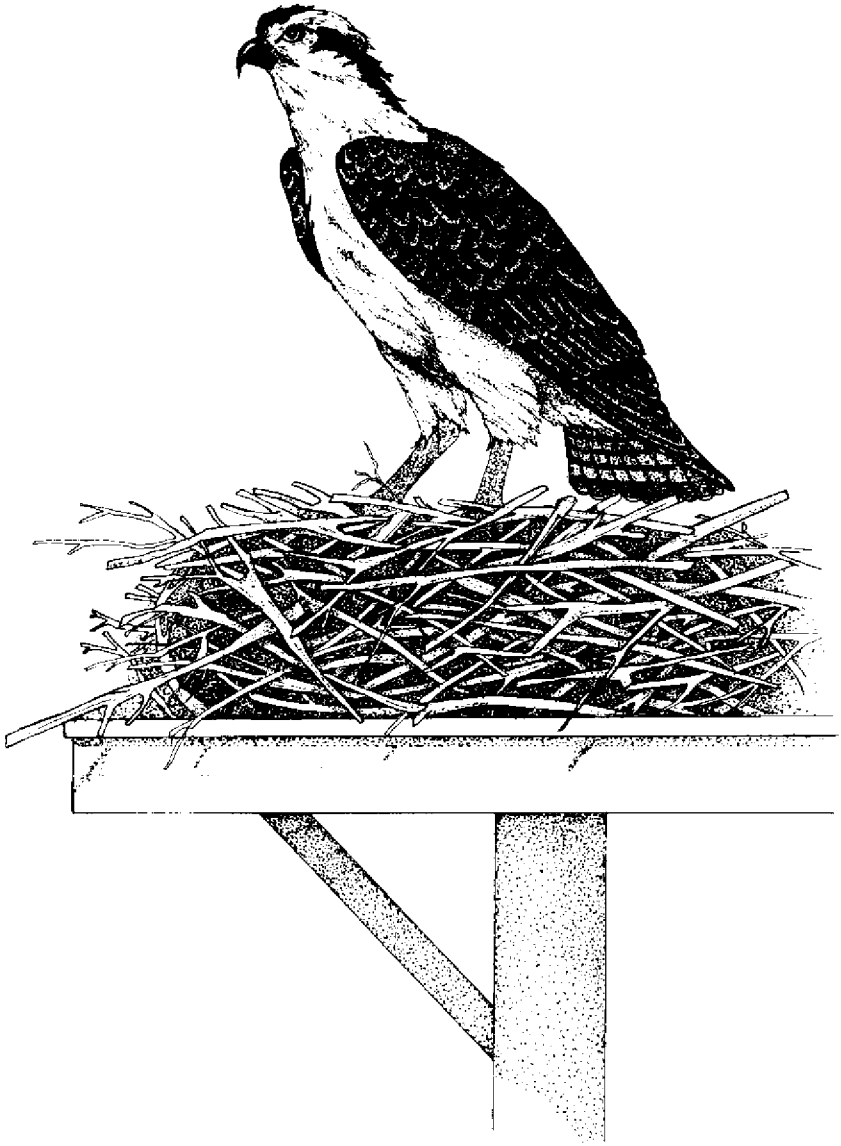
Diamondback Terrapin

Among the **terrestrial** mammals that can be found along the coast is the muskrat, which may be the most representative mammal of the coastal region. Raccoons, red fox, and weasels also use coastal habitats as hunting grounds. Meadow voles tunnel through marsh grasses feeding on plant matter, insects, and other invertebrates. These small mammals in turn provide food for other mammals and predatory birds.

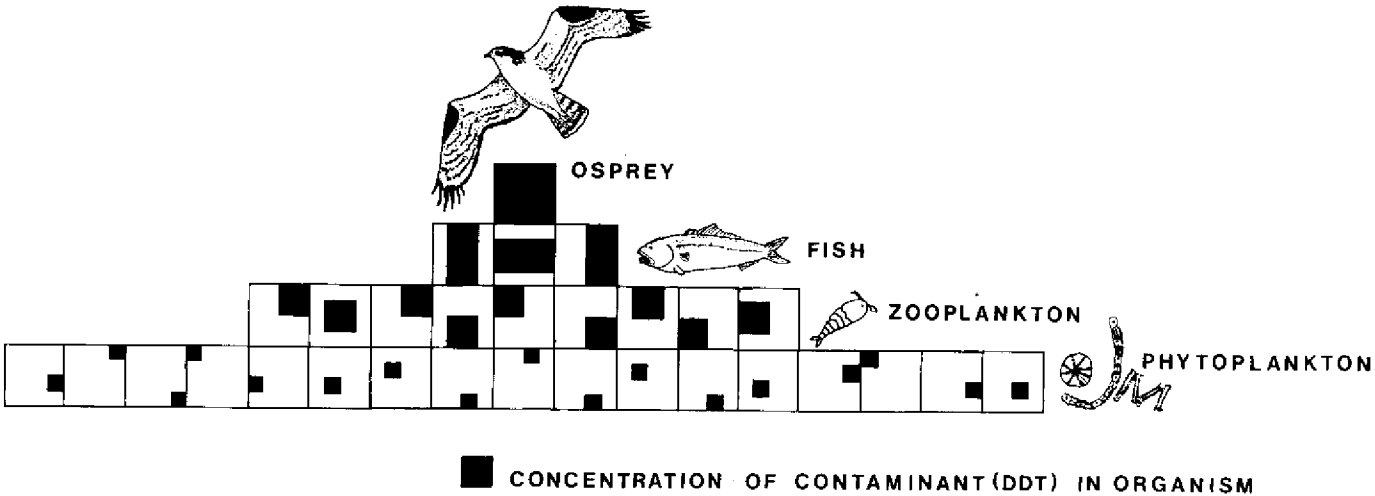
Herons, egrets, and ibis are among the bird species commonly spotted in salt marshes, as they make their way along the tidal creeks in search of their next meal. Sometimes tall nesting platforms are installed in marshes to attract osprey. One of the most thrilling harbingers of spring is the high-pitched call of the fish-hunting osprey returning to nest. The osprey represents a well-known restoration success story. The banning of the



Red fox chasing vole



The osprey sits on a man-made nesting platform.

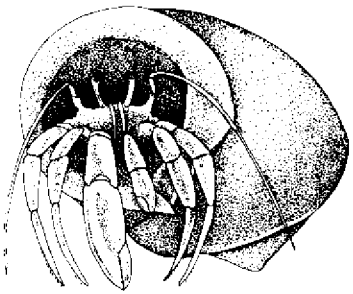


Certain contaminants, such as DDT, are not water soluble. Instead of being flushed out with body wastes, DDT accumulates in fatty tissue. When one organism eats several others, DDT from the prey concentrates in the predator.

pesticide DDT, which had caused osprey (and bald eagle) reproductive failure, and the construction of these nesting platforms have enabled the Sound's osprey population to return to levels not seen for decades.

Tidal Flats

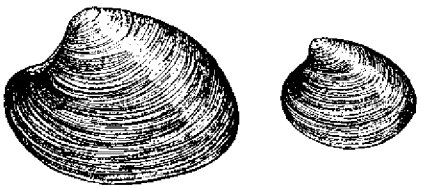
Tidal flats are lower energy sandy or muddy areas in the estuary. As with all **intertidal** areas (situated between the limits of low and high tide), they are subject to daily periods of exposure to air followed by complete inundation by water. Flats support communities of snails, worms, burrowing clams, and the higher organisms that feed on them. Tidal flats are often bordered by salt marshes, eelgrass beds, or deep channels. Water currents in these areas are quieter, allowing sand or mud to settle out and remain. The fine sands, silts, and clay particles of these flats trap a lot of organic debris, which is broken down by bacteria and fungi.



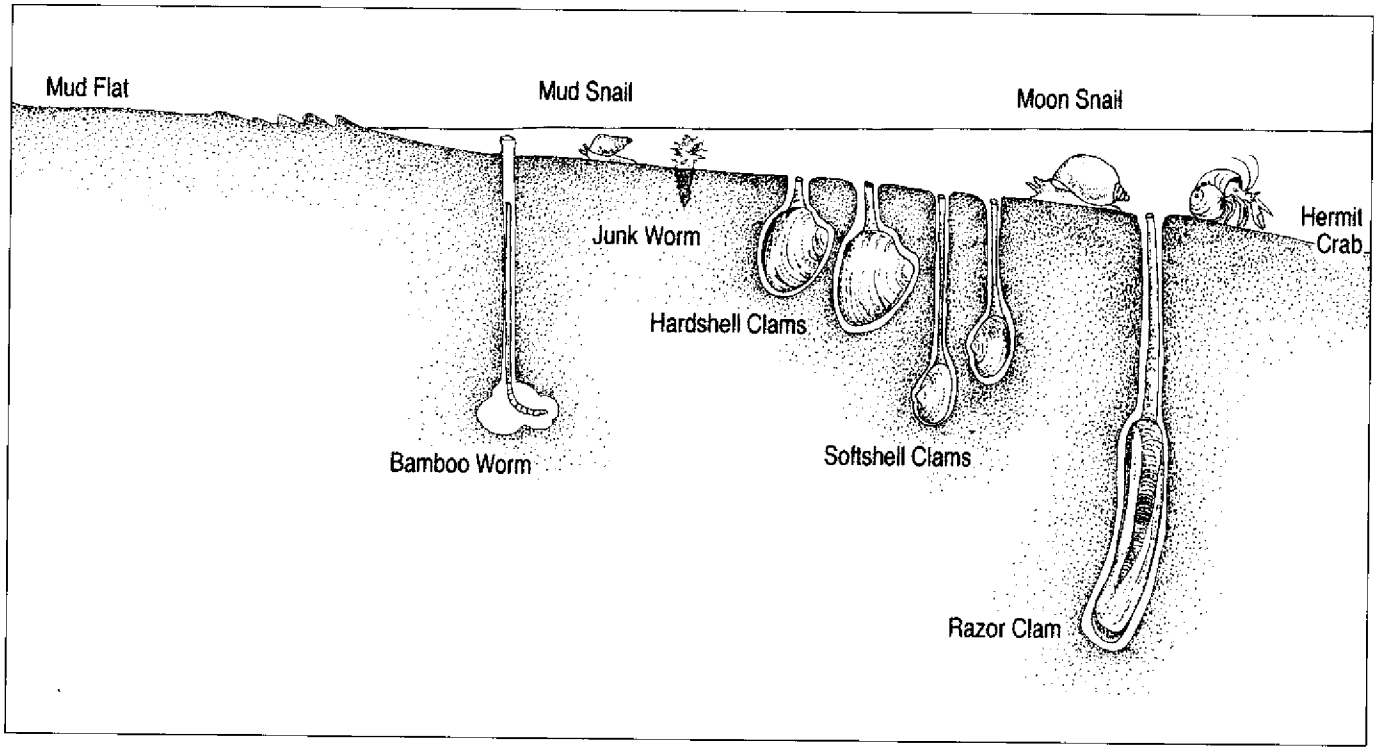
Hermit Crab

Gastropods–mollusks with a single shell or "valve" such as mud snails, moon snails, and periwinkles–can leave obvious trails on the mud flats at low tide. Small crabs including hermit crabs (which inhabit abandoned snail shells to protect their soft tail parts) and shrimp also inhabit the flats.

Bivalve mollusks like hard clams (quahogs), soft-shell clams (steamers), and razor clams can be found by digging in the softer sediments of these flats. During high tide, flatfish, skates, scup, and tomcod are among the fish that



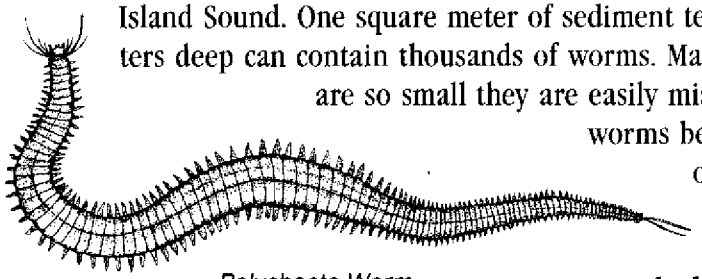
Hard Clams



Tidal or mud flats may look rather barren at first glance, but they are home to many species of polychaete worms, snails, bivalves, and crabs, which in turn, are prey for fish and birds.

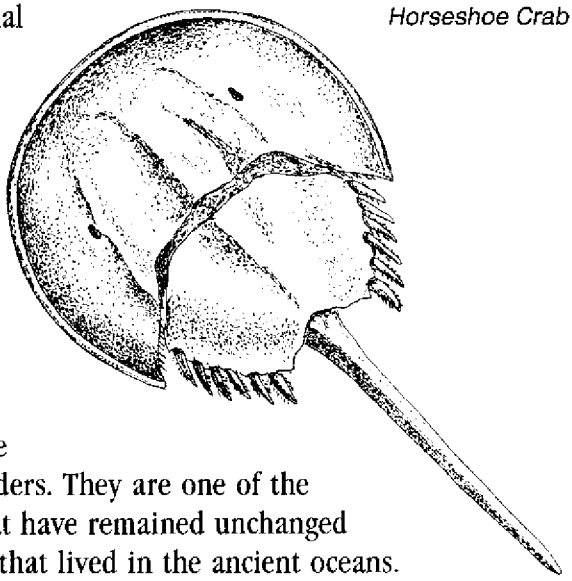
move into the tidal flats to feed. Sandpipers, plovers, herons, and egrets are some of the birds that can often be seen feeding at the water's edge or wading over tidal flats.

Dig into the mud of a tidal flat and look closely for wiggly **annelids**, also known as worms! Many people are unaware of the huge number of worms that inhabit the sediments of Long Island Sound. One square meter of sediment ten centimeters deep can contain thousands of worms. Many of these are so small they are easily missed. Most worms belong to one of two major groups, **polychaetes** (many-bristled) and **oligochaetes** (few-bristled). The worms work the sediments, bringing nutrients to the mud or sand surface layer and allowing oxygen to penetrate deeper into the mud or sand. Worms feed on decaying matter, algae, and bacteria. They themselves are prey for larger animals, such as crabs. Large marine sand worms are sold as bait for fish.



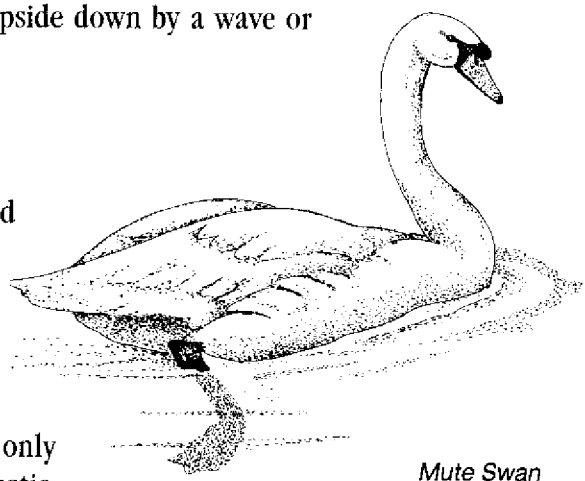
Polychaete Worm

One unusual animal that can be found plowing through the soft sediments of shallow waters, foraging on worms and soft-shell clams, is the horseshoe crab. Horseshoe crabs are not true crabs, but distant relatives more closely related to spiders. They are one of the few sea creatures that have remained unchanged from their ancestors that lived in the ancient oceans.



Horseshoe Crab

Their helmet-like shell provides protection for the bristly mouth found in the center of the legs underneath, while the pointed tail aids the animal in righting itself if it gets turned upside down by a wave or curious child.

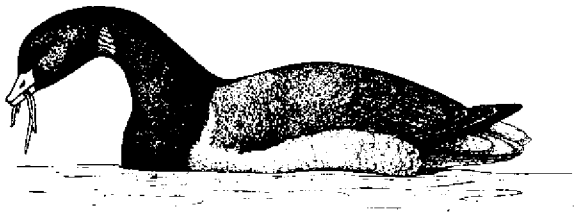


Mute Swan

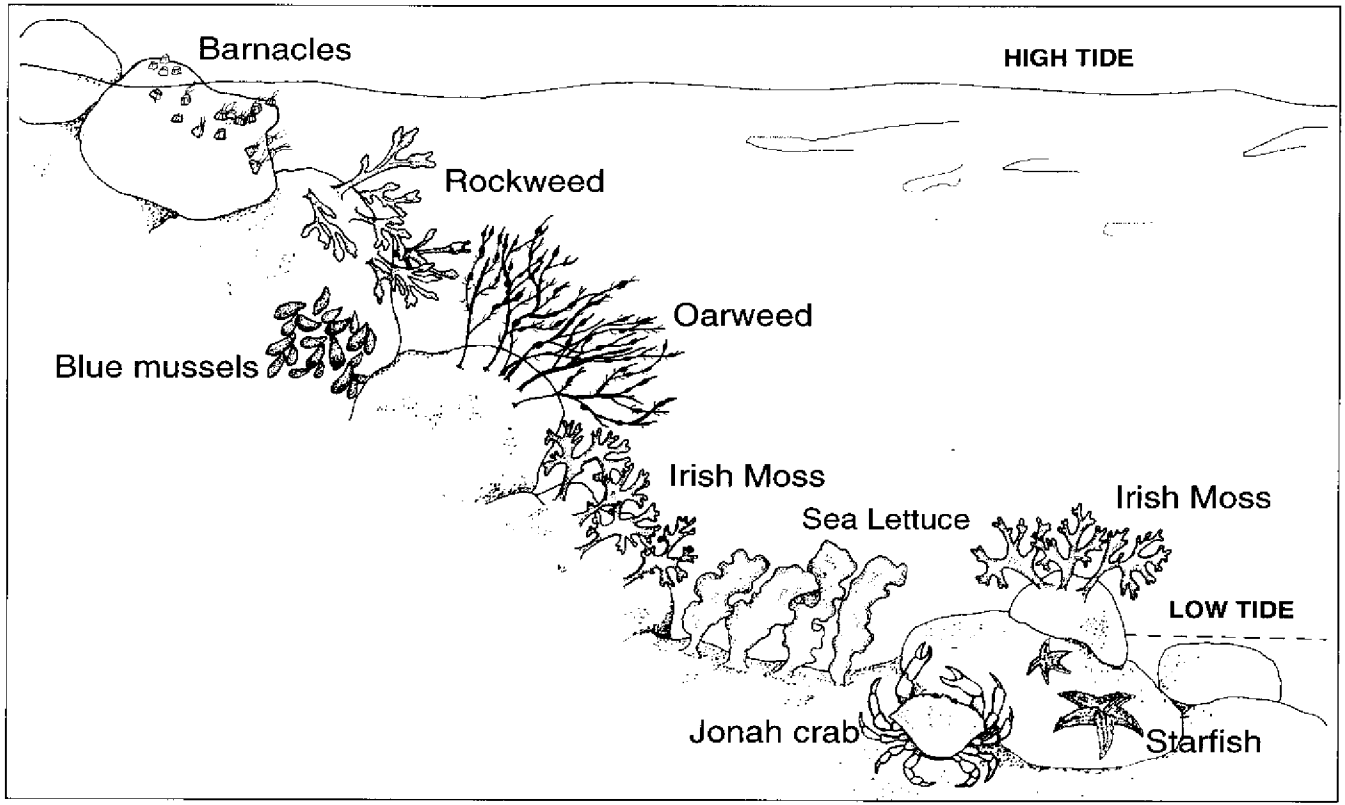
Eelgrass Beds

In shallow shoreward areas where the water is relatively clear, light penetrates deep enough to support the growth of eelgrass, the only vascular submerged aquatic plant in the Sound. The grasses help stabilize the bottom against the eroding effects of tidal currents, while providing young fish and juvenile bay scallops with refuge or shelter from predators. Bay scallops can attach to the blades of eelgrass during their first few weeks of life, which may help them avoid predators like crabs.

Many eelgrass beds in Long Island Sound have disappeared due to problems with water quality, disease, or **predation** by mute swans, Canada geese, and brant, close relatives of Canada geese. These birds dine heavily on eelgrass and sea lettuce. Efforts are continuing in Connecticut and New York to map existing eelgrass beds and to restore former beds in the Sound.



Brant



The rocky intertidal zone, a habitat that undergoes alternate submergence and dessication.

Rocky Intertidal Zone

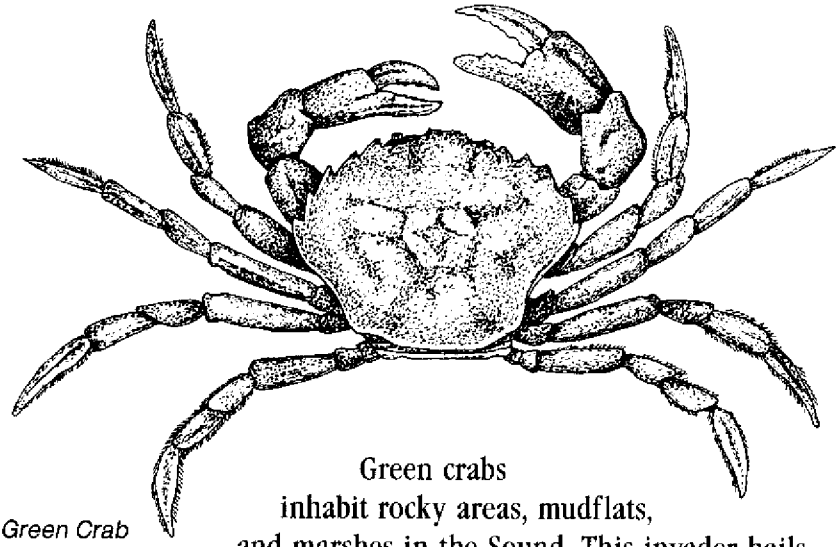
While the zonation patterns in some of the Sound's habitats are quite subtle, they are obvious to even the most casual observer in the **rocky intertidal zone**, the area between the reaches of the high and low tides. This is probably the harshest environment of all the Sound's habitats, and the organisms that inhabit this area are well-adapted to their situation. Inhabitants must cope with intense wave action, thus many organisms that live there, such as barnacles and seaweeds, have special adaptations to allow them to attach securely to the rock surfaces. In addition to hanging on, these organisms must also survive exposure to drying air during low tide, extreme heat during the summer and freezing temperatures in the winter, rainfall and freshwater runoff, and predation by land animals.

To cope with these trying and varying conditions, the organisms rely on sturdy holdfasts, flexible stems, or strong threads called **byssus** to anchor them to the rocks, and thick walls or shells to prevent drying and loss of water during low tide. Blue mussels and barnacles shut their shells tightly to conserve water, while the smaller snails head for the underside of the rocks to stay moist during low tide. There is intense **competition** for space on the rocks at all times, and threats from predatory sea stars, snails, and fish during high water periods.

The upper intertidal zone is nearly terrestrial, and is affected primarily by splashing water and spring tides. The middle intertidal zone is inundated daily by the tides, and is home to barnacles, macroalgae (seaweeds), and mollusks such as periwinkle snails, slipper shells, and blue mussels. Barnacles are crustaceans with a sedentary lifestyle in which they cement their shells to rocky surfaces, and simply wave food particles into their mouths with feather-like appendages during high tide. During low tide, they close up tight to remain moist.

Long Island Sound is home to a number of alien invaders...creatures from other parts of the world that were introduced to the

Sound's ecosystem accidentally or on purpose and then stayed. The small periwinkle snails that cover the rocks by the millions were introduced to the western Atlantic coastline by Europeans about two hundred years ago. These snails, which feed by scraping algae from the rocks, have long dominated the rocky intertidal "scene".

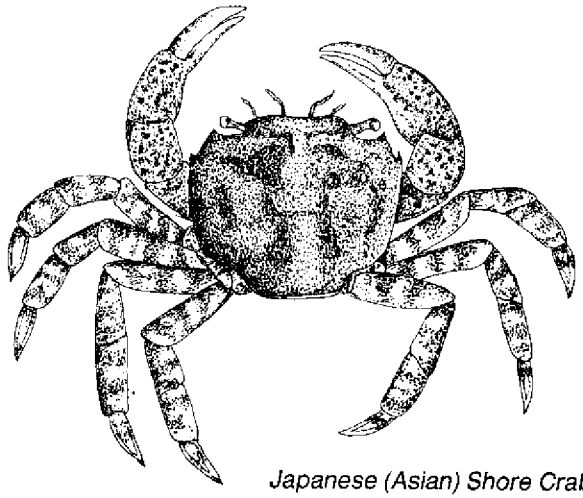


Green Crab

Green crabs inhabit rocky areas, mudflats, and marshes in the Sound. This invader hails from Europe originally, feeds voraciously on bivalves, and is sold as bait for blackfish. Introduced more than 100 years ago, and once very common in the Sound, the green crab has been dramatically outnumbered by another invader in recent years. The Japanese shore crab (Asian shore crab) invaded the Sound in the early 1990s and has rapidly become the dominant crustacean in the rocky intertidal zone, a habitat similar to its native habitat in Japan. The shore crab has distinctive striped legs and a square-shaped carapace. Over a period of 10-12 years, this crab spread up and down much of the Atlantic coast. By far the dominant crab species in the intertidal zone, it has earned the moniker of "invasive species". Both the green crab and shore crab are omnivores, feeding on small shellfish, other crabs, and seaweeds.

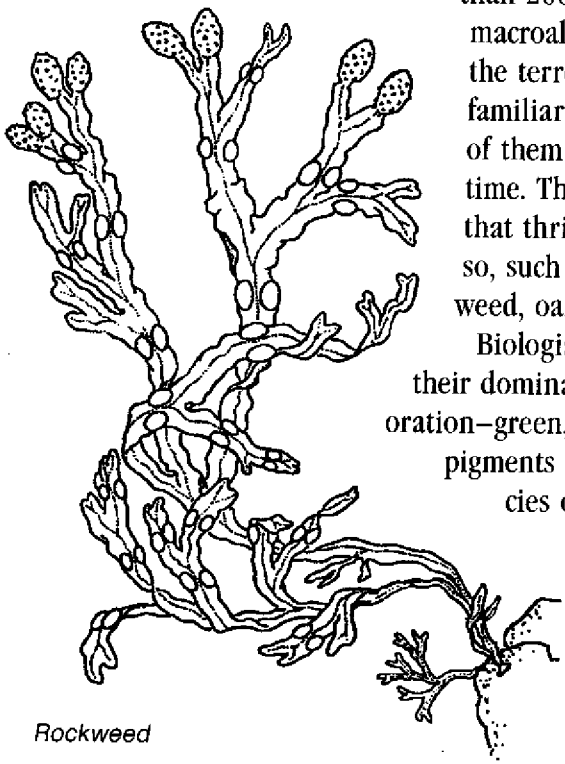
The lower intertidal area is nearly always inundated, and usually abounds with seaweeds, sea stars and other spiny-skinned

echinoderms, and anemones, all of which are sensitive to changes in salinity and the drying effects of air.



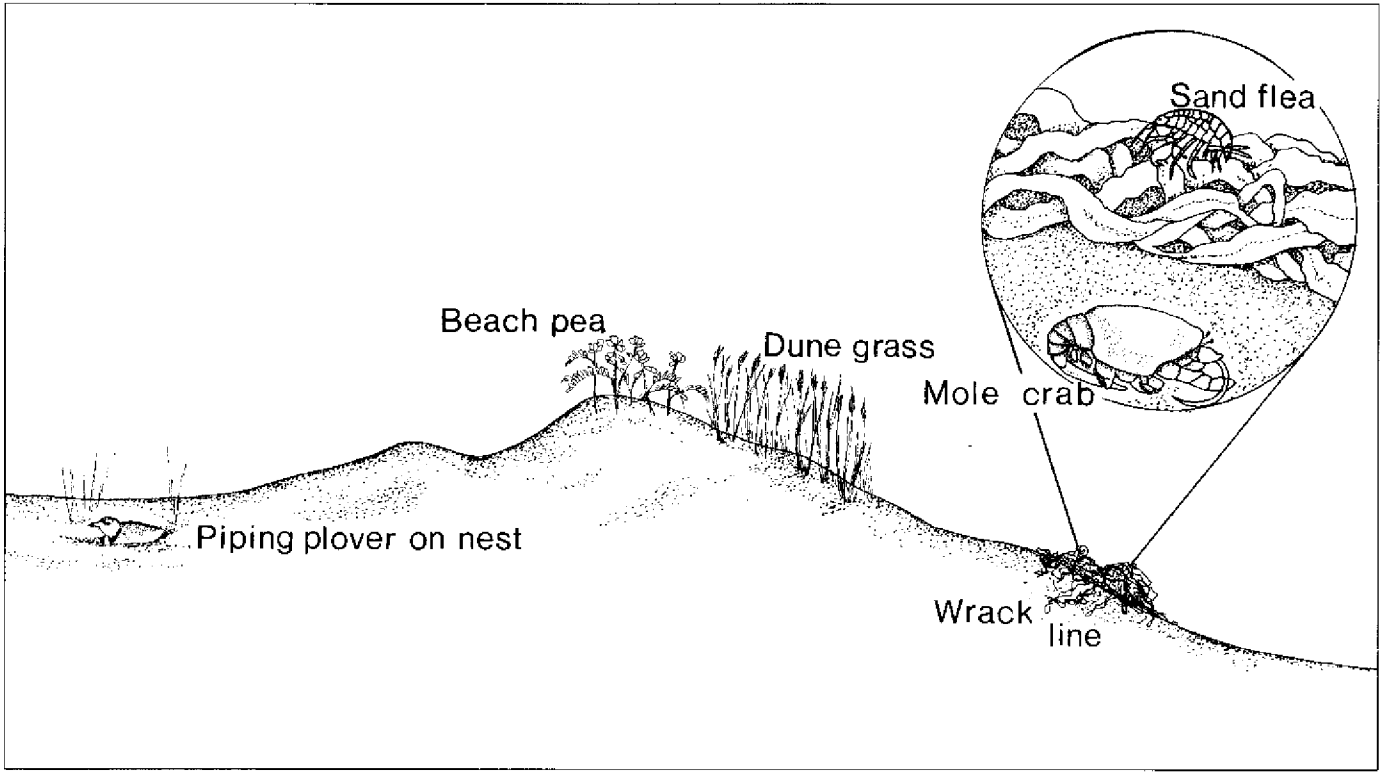
Japanese (Asian) Shore Crab

Because of its abundant nutrients, temperature range, and its sheltered geographic location, Long Island Sound supports a rich algal flora, better known to most as seaweed. In fact, there are more than 200 species of seaweed, or macroalgae, in the Sound. Like the terrestrial plants more familiar to many people, not all of them bloom at the same time. There are some, however, that thrive year-round or nearly so, such as kelp, dulse, rockweed, oarweed, and Irish moss.



Rockweed

Biologists group seaweeds by their dominant pigments or coloration–green, red, or brown. These pigments absorb various frequencies of light, and the limited light available in coastal waters determines the depth at which the algae can grow. In general, green seaweeds are

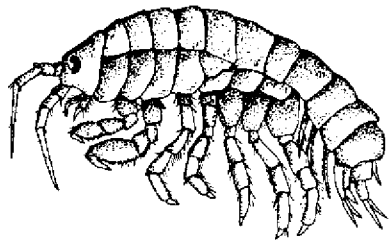


Sandy Beach: although seemingly barren at first glance, this constantly shifting environment supports many species of plants and animals.

closest to shore, browns in the shallow to mid-depths, and reds further down and farthest from shore.

Seaweed, which generally attaches to rocks or other hard surfaces, provides habitat, food, and shelter for a number of aquatic organisms and thus is very important to the ecology of Long Island Sound. The diversity in form and beauty of these algae is astonishing, and so is the variety of uses humans have found for them. **Carrageenan** extracted from red seaweeds is commonly used to make toothpaste, ice cream, and many other products smooth and creamy. **Alginate** from kelp and rockweed is used in syrups, and as coatings for paper, film, medications, and fabric.

Sandy Beaches



Amphipod

Another high energy shoreline habitat is the **sandy beach**. Although a beach may seem barren at first glance, numerous tiny animals live beneath and between the grains of sand, escaping the scorching heat of the sun. This constantly shifting environment is also home to tiny mole crabs, dune grass, and several species of shore birds.

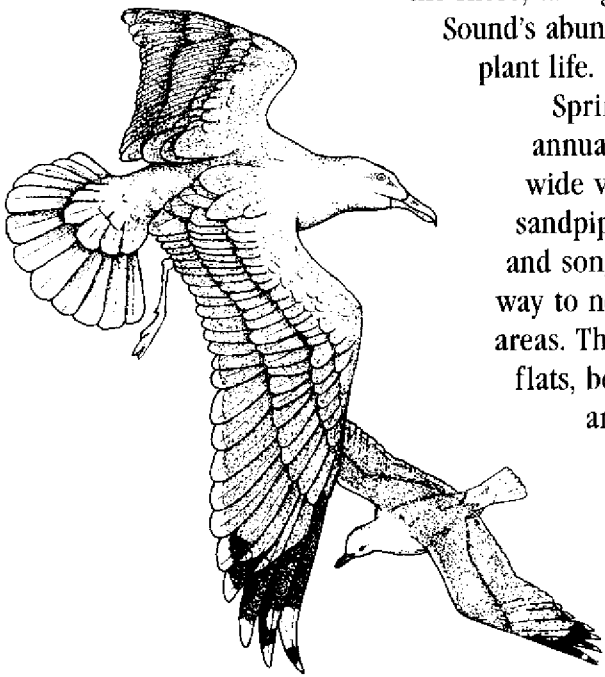
Sandy beaches are ever-changing, reflecting the effects of the tides, weather, storms, and currents. Typically they erode during the winter and are replenished during the summer. A few species of vascular plants inhabit the sandy shores of Long Island Sound. Dune grasses help stabilize shifting sands. Hardy plants like Jimson weed, beach pea, seaside goldenrod, and dusty miller are also found on beach dunes.

Most permanent residents of sandy beaches live under the surface of the sand. Mole crabs burrow along the surf line of the beach, while beach hoppers, isopods, and amphipods, all crustaceans,

inhabit the **wrack line** (line of washed up debris that marks the furthest reach of high tide on the beach) and the beach proper. The nocturnal ghost crab lives on the upper beach but returns periodically to the water to wet its gills.

The lower beach houses polychaete worms, clams, cockles, and amphipods. Larger predators such as fish and crabs come into the tidal flats and sandy beaches with the high tide to feed. At low tide, shore birds feed heavily along the waterline.

No trip to the beach would be complete without hearing the raucous call of gulls overhead or seeing them eye your picnic lunch. While gulls may be the most obvious coastal birds, numerous other species are found along the shore, taking advantage of the Sound's abundant animal and plant life.



Herring Gulls

Spring brings the annual migration of a wide variety of plovers, sandpipers, waterfowl, and songbirds on their way to northern breeding areas. The marshes, mudflats, beaches, and rocky areas of the Sound's shore serve as important stopover areas for many bird species along their migration routes. On a few wind-swept beaches, protected from human disturbance and straying house pets, the threatened piping plover and least tern make their nests.

Subtidal Zone

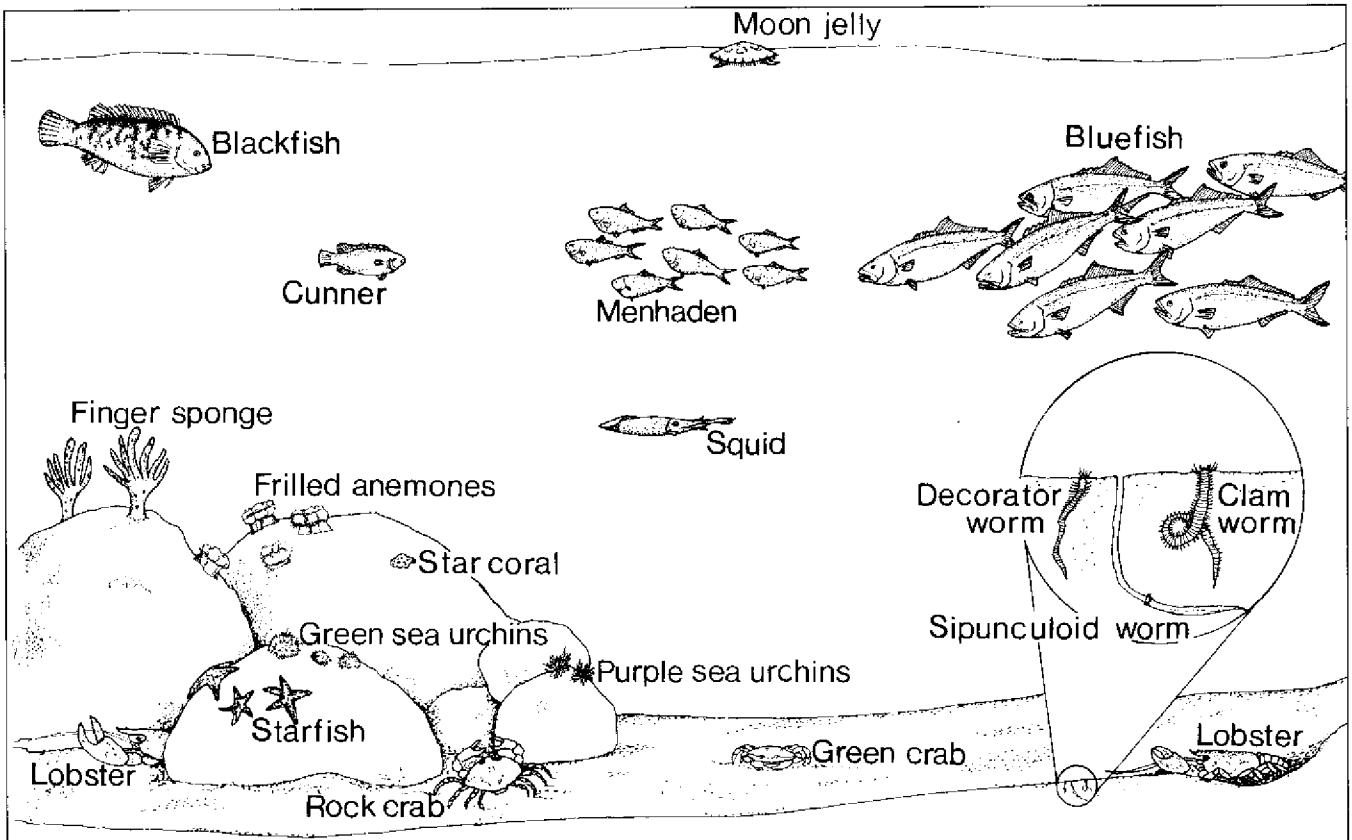
The **subtidal zone** is constantly submerged and supports both **benthic** (sea floor) and **pelagic** (open water) communities. Benthic substrates vary in the Sound from rocky reefs to fine organic silts. Rocky reef communities have many attached organisms, such as anemones and seaweed, which provide food and shelter for mobile organisms, like fish and crabs. On mud and sand substrates, benthic communities are largely composed of invertebrates, microscopic organisms, and some finfish. Another subtidal community is the kelp bed or forest. The long thick blades of this brown seaweed provide food and shelter for many benthic and pelagic species.

Benthic Zone

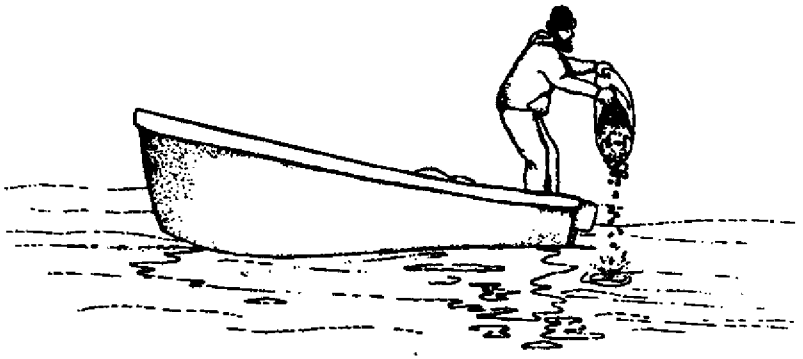
Organisms that live on or in the sea floor are collectively known as the **benthos**. They are further categorized by where they live: on (**epibenthos**) or in (**infauna** and **inflora**) the sediments. Benthic organisms range in size from microscopic bacteria to large lobsters and flounder.

Some animals live attached to the bottom or other hard surfaces. Sponges are primitive animals that pass water through their bodies to filter out food particles. They provide cover for juvenile lobsters and crabs, and food for certain sea stars. Some sponges, known as boring sponges, drill into the shells of oysters and other mollusks, leaving a lace-like pattern of holes. **Cnidarians** such as sea anemones with their crown of stinging tentacles can be found attached to rock surfaces, pilings, and even shellfish in Long Island Sound. Other species burrow in offshore mud. It may come as a surprise to some that the Sound supports coral, another cnidarian. The star corals of Long Island Sound grow abundantly on rocky reefs.

Closely related to sea anemones are the colonial **hydroids**, often mistaken for seaweed on rocks and pilings. Within the branching hydroid colony are individuals specialized for feeding and others



Subtidal zone supports both pelagic and benthic communities.

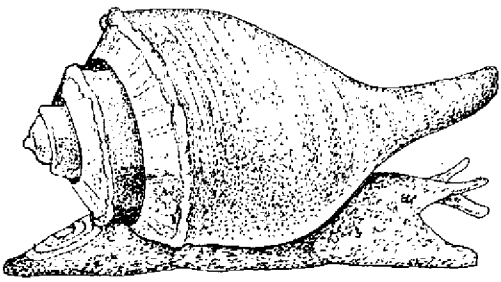


Oysterman spreading cultch

specialized for reproduction. **Tunicates**, commonly known as sea squirts, are found attached to rocks, shells, piers, seaweeds, or almost any submerged object, particularly in the more eastern parts of the Sound. Many of the tunicate species present in Long Island Sound are non-native invasive species that have become a nuisance, fouling moorings, lines, and other boating gear. Their tough outer tunics can range in appearance from brown and leathery to opaque or bright orange gelatinous material.

Mollusk species are common members of the benthic community, typically classified by their shell type. Mollusks having two hinged shells (valves) are called bivalves (clams, oysters and mussels are examples), while those with one continuous shell are known as univalves or gastropods (snails). Both oysters and hard clams are commercially important, and are farmed on the bottom on designated plots leased out to shellfish farmers. Young oysters or **spat** require a clean hard substrate (preferably old oyster shell) for attachment. Because of the

Oyster drill on oyster

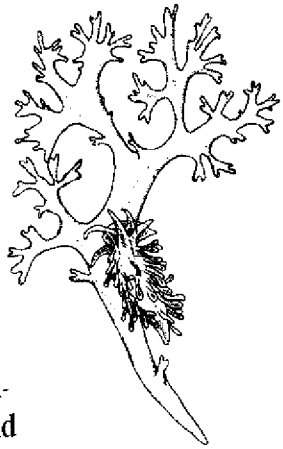


Channeled Whelk

tremendous commercial importance of the oyster aquaculture industry, this substrate is often provided through the spreading of **cultch** (clean oyster shells).

Most mollusks feed on algae or decaying matter either by scraping the substrate surface (e.g. snails) or by filtering food particles out of the water (e.g. bivalves). Some snail species, however, are predators. Oyster drills and moon snails drill holes in the shells of their bivalve prey. Large channeled and knobbed whelks can pry open the shells of razor clams and other bivalves using the edge of their shells. A small flat piece of shell on the bottom of their soft foot, called an **operculum**, enables the snails to close their soft bodies inside the shells to avoid predators and **dessication**.

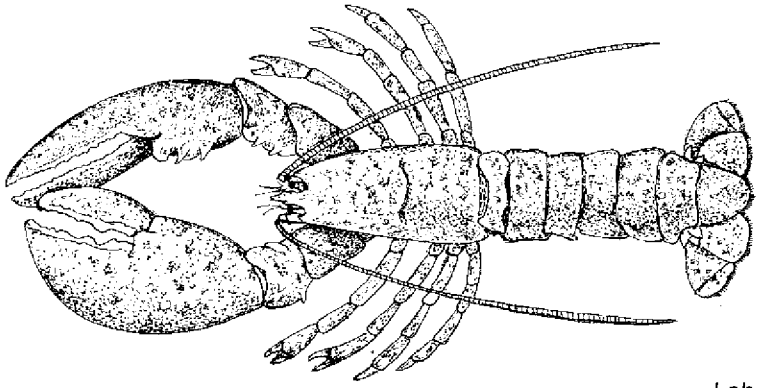
One unusual and beautiful mollusk that makes its home in the Sound is the nudibranch. Unlike most mollusks, nudibranchs–also known as sea slugs–have no shell at all.



Nudibranch

American lobsters are by far the most commercially important crustaceans in Long Island Sound. They utilize a variety of substrates from rock crevasses to mud burrows, and they primarily consume other animals. A lobster can be easily identified by its two specialized front claws–the large "crushing" claw and the narrower "ripping and tearing" claw.

"Berried" lobsters are female lobsters that are carrying an egg mass attached to their underside. After hatching, larval lobsters become part of the zooplankton community in the water column.

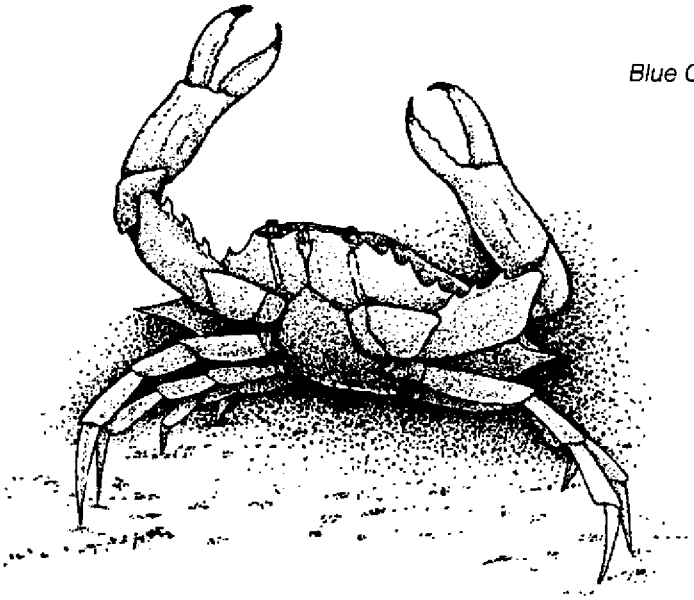


Lobster

After four **molts** (shedding of the **exoskeleton** or outer shell) during growth, lobsters settle to the bottom where growth and molting continue at an increasingly slower rate throughout their lives. A $1\,^1/_2$ to 2 pound lobster is approximately 5 to 7 years old, and has undergone as many as two dozen molts.

Long Island Sound has traditionally supported the third largest lobster fishery in the U.S., following Maine and Massachusetts. Commercial catch data from Connecticut and New York show that the greatest density of lobsters historically has been in western Long Island Sound. The lobster population in the Sound, and most particularly in the western Sound, suffered a catastrophic die-off in 1999. While lobster abundance in eastern Long Island Sound is stable, abundance in western Long Island Sound remains at low levels and complete recovery of the lobster population and commercial fishery may be years away.

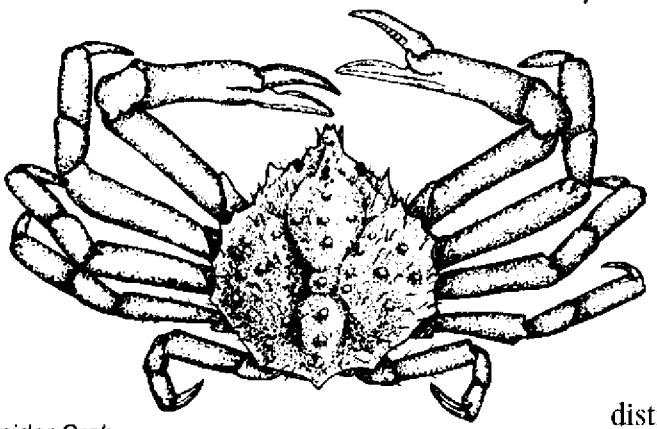
Crabs of Long Island Sound come in many colors and shapes, and live in different habitats. Blue crabs, considered a delicacy, are voracious predators of small shellfish and finfish. The last pair of legs is paddle-shaped, specially adapted for swimming. The Latin name for blue crab means "beautiful swimmer". The quick pincer movements that serve the crab in hunting can also inflict pain on incautious crabbers. Red crabs include the rock and Jonah crabs. These crabs feed on small benthic animals and are themselves a



Blue Crab

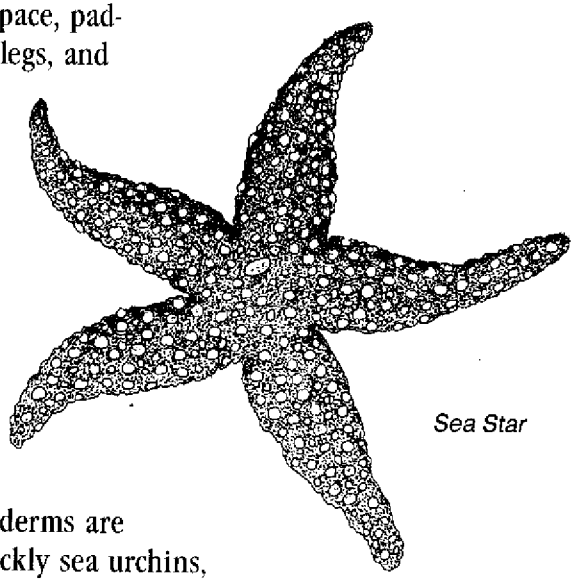
favorite food of lobsters. Both red crab species are edible although not commercially important in Long Island Sound at this time.

Other common crabs in the Sound are the scavenging spider crabs with small, bumpy, oval bodies and long, radiating legs, and lady crabs (calico crabs) that swim through the water at night and burrow during the day. A lady crab is distinguishable by



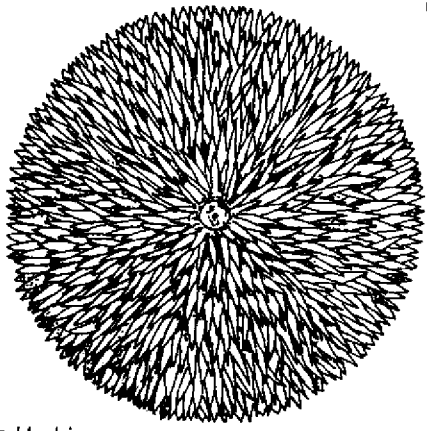
Spider Crab

its purple mottled carapace, paddle-shaped last pair of legs, and sharp pincers. Other crustaceans include shrimp, extremely important prey organisms that are mostly tiny species found inshore and offshore.



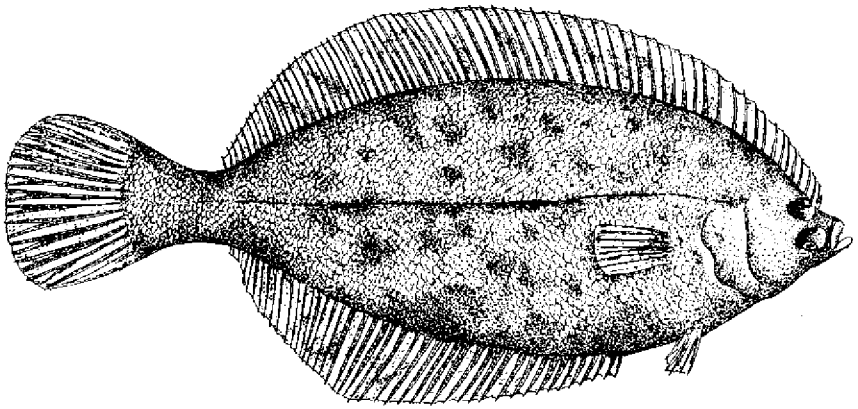
Sea Star

Among the Sound's benthic echinoderms are predatory sea stars, prickly sea urchins, and sand dollars. Sea stars are the scourge of shellfish farmers and can devastate commercial shellfish grounds. While many sea stars consume clams and oysters, other species dine exclusively on sponges, and still others on decaying matter. Sea urchins have a specially developed scraping apparatus that allows them to obtain algae and detritus from substrate surfaces. The species most commonly found in Long Island Sound is the Atlantic purple sea urchin. Sand dollars are rare in Long Island Sound, occurring occasionally in the easternmost regions.



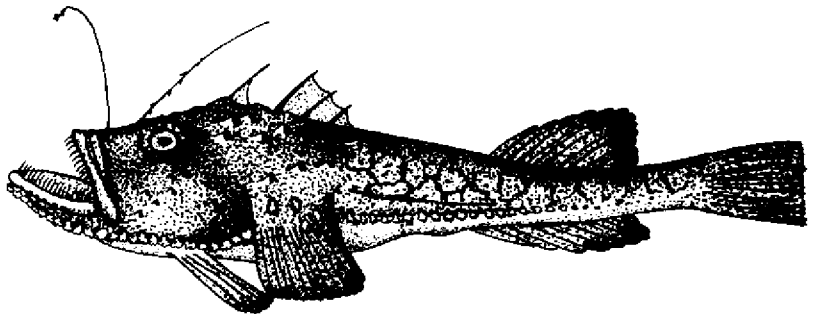
Sea Urchin

A number of fish species inhabit the bottom either seasonally or year-round, including winter flounder, summer flounder (fluke),



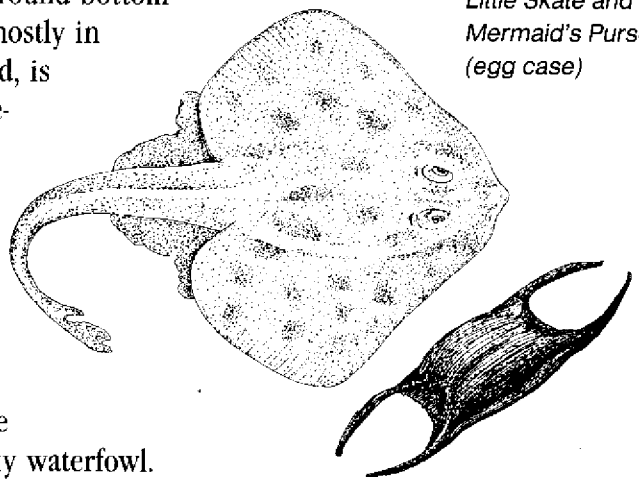
Winter Flounder

and several skate species. Winter flounder are year-round residents of the Sound, migrating only between offshore and inshore waters on a seasonal basis. In summer, they move to cool deep water, returning to the shallows to spawn when water temperatures fall. When a winter flounder is very young, its left eye migrates to the right side of its head. This "right-eyed" flatfish spends the rest of its life swimming along the bottom on its side, right side and two eyes up, feeding primarily on benthic worms and invertebrates. Winter flounder, like all flounders and fluke, have a chameleon-like ability to change their color to blend with surrounding sediments. This adaptation serves them well against most predators.



Monkfish

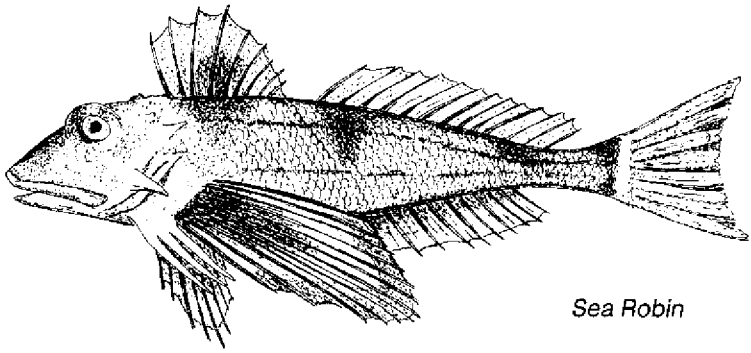
Another year-round bottom resident, found mostly in the eastern Sound, is the bizarre goose- or monkfish. The enormous mouth of this animal is capable of grasping large fish, crustaceans, and even, on rare occasions, unlucky waterfowl.



Little Skate and Mermaid's Purse (egg case)

Little skates and sea robins are among the most abundant fish found in Long Island Sound. The "left-eyed" summer flounder, popular with both commercial and recreational fishermen, migrate into the Sound about June and leave to spawn offshore in November. While their numbers have been very depleted, they show some signs of coming back.

Other bottom-dwelling or reef-hugging fish species include sculpin, cunner, sand lance, whiting, tomcod, windowpane flounder, and sea ravens. Cunner, blackfish, scup, and sea raven inhabit subtidal rocky habitats, as well as near pilings and piers. Like cunner, blackfish are year-round residents. During warmer months, they feed on mollusks and barnacles in nearshore rocky areas. During the



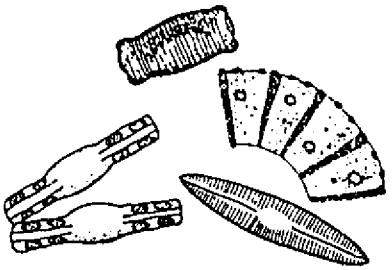
Sea Robin

cold months they move into rocky crevasses in deeper waters, and begin an inactive or "quiescent" phase.

Pelagic Zone

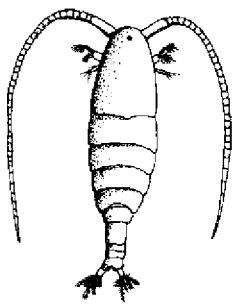
Many finfish species are found in open pelagic waters, along with other interesting organisms such as jellyfish, related to sea anemones, and squid, which are mollusks with a greatly altered shell or "pen", related to snails and clams. The upper waters of the pelagic zone are also home to the many plankton species that drive the nutrient and energy cycles in Long Island Sound.

Microscopic phytoplankton are usually free-floating single-cell algae, the most common type being diatoms. They may also occur as multi-cellular colonial algae. Phytoplankton are important food for many herbivores, as well as producers of oxygen for other life forms in the Sound.



Diatoms

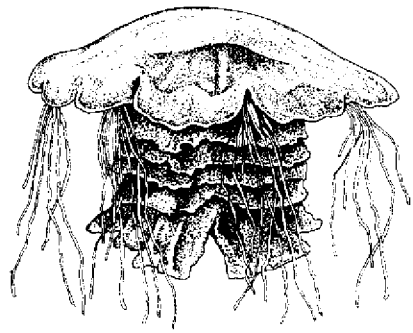
However, a general over-abundance of phytoplankton, or an excess of certain species, can have serious ecological consequences. For instance, certain phytoplankton, dinoflagellates, can cause harmful algal blooms such as "red tides" which may be toxic to marine life. Dinoflagellate toxins can, on rare occasions, accumulate in filter feeders such as clams, posing a health threat to human consumers.



Copepod

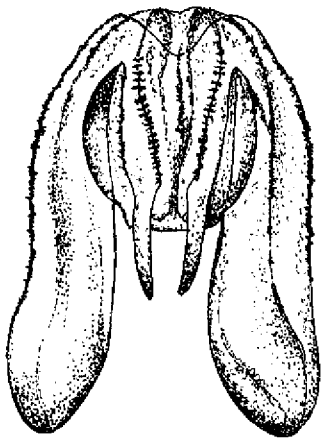
Even algae blooms that are not toxic can have a negative effect on the Sound. For example, scientists believe that non-toxic algae blooms fuel low oxygen level events (**hypoxia**) that typically occur in late summer. The algae blooms result from

excess nutrients in the form of nitrogen discharged to Long Island Sound primarily from treated sewage. The algae multiply, form huge blooms, and then die. The dead and dying algae use up tremendous amounts of oxygen in the decaying process, causing oxygen levels to drop to levels that are dangerously low or lethal to other organisms. The Long Island Sound Study has addressed this problem by requiring many sewage treatment plants to implement tertiary treatment, which removes excess nutrients from the treated effluent prior to its discharge.



Lion's Mane Jellyfish

There are also many microscopic animals in the Sound. These zooplankton are generally small drifting or weakly swimming animals that feed on bacteria, phytoplankton, and other zooplankton. Copepods, amphipods, and other shrimp-like creatures spend their entire lives as zooplankton, while larval (immature) forms of barnacles, crabs, worms, mollusks, and finfish are temporary members of the zooplankton community. All zooplankton are extremely important prey for other organisms. Some zooplankton may be quite large such as the stinging (lion's mane) jellyfish, the moon jellyfish and the non-stinging comb jellies or **ctenophores**.



Ctenophore

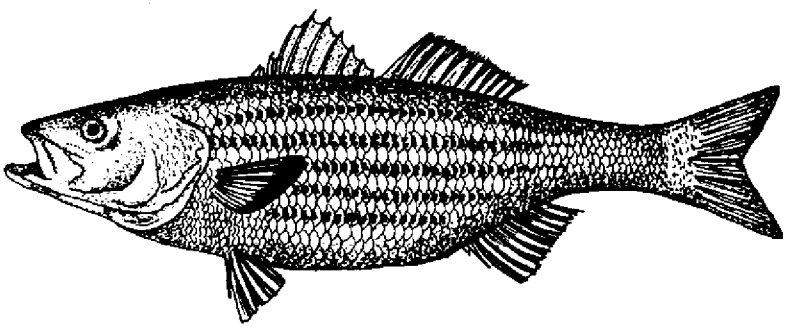
The pelagic zone is home to many schools of fish. Most fish species inhabit Long Island Sound waters seasonally or undergo seasonal changes in abundance. Spring

heralds the arrival of adult bluefish after spawning offshore, appearing in greatest numbers in July and August. They remain until the fall, providing tremendous fishing opportunities for anglers. Voracious schools of blues have been known to chase prey species such as menhaden (bunker) far up into shallow coves causing mass fish kills. The bunker become so frenzied and concentrated that they use up all available oxygen in the water and suffocate.

Young bluefish, called "snappers", appear in the Sound from spring through fall. Snapper blues and adult bluefish combined are the most common fish caught by recreational anglers. Other finfish that occur during summer in abundance are scup, butterfish, weakfish, menhaden, and dogfish.

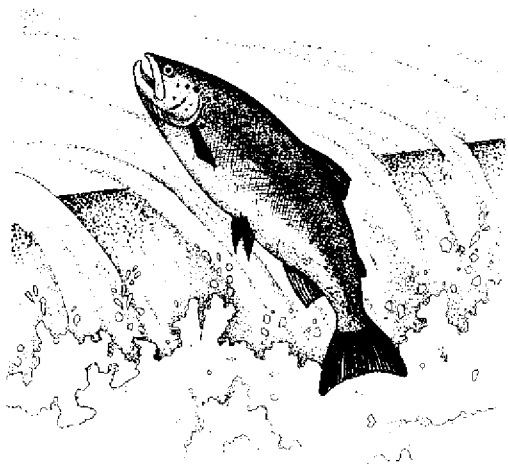
Long Island Sound has several species of finfish whose migration routes take them from salty ocean to the fresh water streams where they spawn. The most notable of these **anadromous** fish is the striped bass. The predatory striped bass arrive in the Sound in early spring, feed in shallow nearshore waters during the summer and depart by fall. A small population of striped bass overwinters in the Sound, but most of these fish migrate south. Spawning occurs primarily in tributaries of the Chesapeake Bay, the Roanoke River of North Carolina, and the Hudson River of New York.

American shad are large herring that return to spawn in the streams where they were born after 4-5 years at sea. Pollution and dams have reduced their spawning effort in the Sound to one major



Striped Bass

run in the Connecticut River, and smaller runs in the Thames, Housatonic, and Quinnipiac Rivers. They arrive in April, and after spawning, the adults move out of the rivers and Sound. Young shad follow in October and November. Other anadromous fish that pass through the Sound on their way to these rivers include alewives, blueback herring, and Atlantic salmon.



Atlantic Salmon

Atlantic salmon spend their first few years in fresh water before migrating to the sea. They return two years later to their birthplace to spawn. The construction of impassable dams on rivers, industrial pollution, and over-fishing caused the local extinction of this species by the mid 1800's. Attempts to restore the Atlantic salmon to the Connecticut River began as early as 1893 with the construction of a fish ladder at the Holyoke Dam. While some dams are being removed and fish ladders or passages constructed as part of continuing restoration efforts, salmon have yet to achieve their target population levels.

American eels are **catadromous**, meaning they have a migration pattern that is opposite to striped bass and shad. Mature adult eels migrate out of fresh water streams and travel tremendous distances to spawn in the Sargasso Sea south of Bermuda. Young eels eventually migrate back to the streams that their parents once occupied. The mechanism by which they are able to navigate is still unknown.

Four true marine turtles, the loggerhead, Kemp's ridley, leatherback, and green, are regular summer visitors to Long Island

American eel migration route

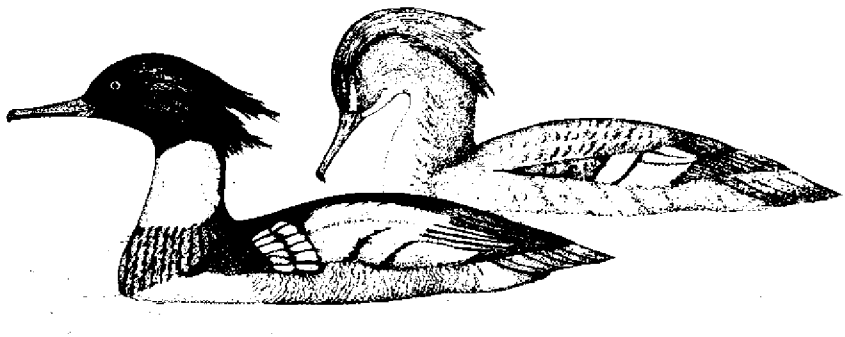
Sound, although few of us ever see them unfortunately. If these cold-blooded creatures linger in the Sound for too long in the fall, they can become "cold-stunned" and wash up on shore.

Except for laying eggs on more southern shores, a healthy sea turtle spends its entire life at sea. Kemp's ridleys travel 2,000 miles from their only spawning grounds in Mexico to reach Long Island Sound.

Different kinds of sea turtles eat different things. For example, loggerheads and Kemp's ridleys eat mollusks and crustaceans. Green turtles are vegetarians, while leatherbacks feed exclusively on jellyfish. (A leatherback may ingest marine debris like plastic bags and balloons, mistaking them for jellyfish, which can lead to the death of the turtle.)

Bird populations in and near Long Island Sound vary seasonally. In winter, birders delight at large concentrations of waterfowl and other water birds. Mergansers, buffleheads, goldeneyes, scaup, scoter, canvasbacks, mallards, black ducks, brant, and Canada geese are among the types of waterfowl commonly seen along the coast in winter. Loons and grebes are distant relatives of waterfowl that also winter along the shores of the Sound. Probably our most spectacular winter resident is the American bald eagle along the Connecticut and Housatonic Rivers.

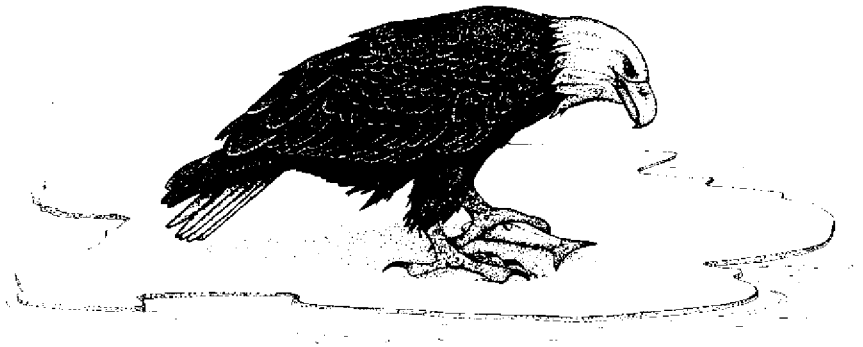
During summer, some offshore islands are frantic with the comings and goings of birds tending their nests and young. Colonies of cormorants, gulls, terns, herons, ibis, and egrets can be found on islands along the coast.



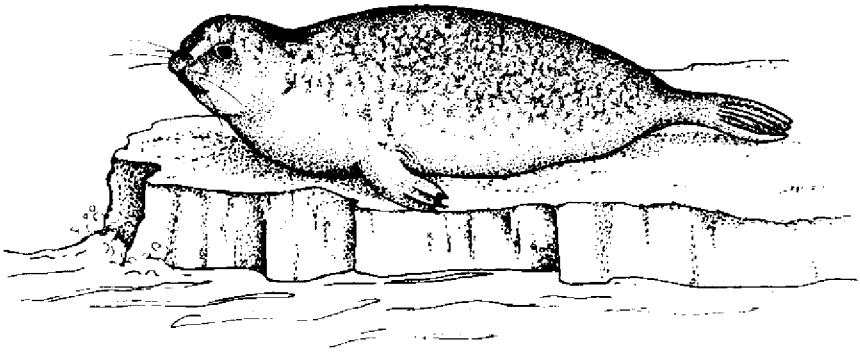
Red-Breasted Mergansers

Fall, once again, brings masses of migrating birds. Hawk watching at this time is optimal as thousands of birds of prey migrate along the coast to southern wintering grounds. Great flocks of waterfowl begin to arrive, and shorebirds move through again, this time heading South.

Birds associated with the Sound take advantage of the abundant fish, invertebrates and plant life. Scaup and scoters feed primarily on mollusks, while mergansers, cormorants, loons, herons, ospreys,



Bald Eagle



Harbor Seal

and terns feed mostly on finfish. Canada geese, brant, and mute swans are grazers of eelgrass and seaweeds.

Marine mammals are also attracted to the Sound's rocky habitat. Harbor seals are the most dominant species, and can be spotted throughout the winter on offshore rocky islands. Their numbers have increased dramatically over the past 5-10 years. Gray, harp, and hooded seals are relatively uncommon visitors to Long Island Sound, but sightings of these more northern species of marine mammals have also increased in recent years. Whales and dolphins are rare visitors, though harbor porpoises once were observed regularly.

The Long Island Sound ecosystem is made up of a spectacular complex of flora and fauna. While some species are harvested, farmed, hunted, or trapped, they all provide hours of enjoyable observation and photography. Some coastal wildlife species also serve as **biological indicators** of the environmental health of Long Island Sound.

Because living marine resources in Long Island Sound are all interrelated at some level, it is reasonable to assume that a change in the status of one will somehow affect the well-being of others...including ourselves. People are part of the Long Island Sound ecosystem, affecting and being affected by all that lives there.

As ultimate users and beneficiaries of the Sound's living marine resources, people have the responsibility to protect and promote the health of the ecosystem.

People are part of the LIS ecosystem, too.

What Can YOU Do to Help Protect the Sound?

Here are some suggestions to help you, a resident of the Long Island Sound watershed, become an environmental steward of the Sound.

- Minimize the use of chemicals, pesticides, and fertilizers around your home, and explore safe, non-toxic alternatives for cleaning and for controlling pests.
- Conserve water use to help reduce the amount of wastewater that must be treated by sewage treatment plants.
- Maintain your septic system by having it pumped out every 3 to 5 years.
- Leave grass clippings on the lawn to recycle the nutrients. Start a compost pile to reduce the amount of waste put into the garbage can.
- Dispose of used motor oil and other auto fluids properly. (It's illegal to pour them down a storm drain or dispose of them in the garbage.)
- Dispose of trash properly, so it can't get washed into the Sound or litter its beaches.
- Be a responsible boater and use pumpout facilities to properly dispose of wastes from port-a-potties and Type III (holding tank) marine sanitation devices.
- Never feed water birds. This encourages them to stay through the winter and gather in flocks. Their droppings, which contain bacteria and nitrogen, can contaminate swimming areas and shellfish beds.

Additional Resources

In addition to the numerous field guides available that describe the flora and fauna of the Atlantic coast, check out these resources:

Adams, S. and T. Crago. 2000. *Marine Science Careers.* University of New Hampshire Sea Grant Program and Woods Hole Oceanographic Institution Sea Grant Program. 33pp. (www.marinecareers.net)

Auster, P.J. and S. Schaub. 2001. *An Underwater Tour of Long Island Sound* (CD-ROM). Pew Charitable Trusts and National Undersea Research Center for North Atlantic and Great Lakes. University of Connecticut, Groton.

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Carlton, J.T. 1992. "Blue Immigrants: The Marine Biology of Maritime History". *The Log of Mystic Seaport.* 44(2):31-36.

Crawford, Heather. 1999. *Long Island Sound in a Jar: Activities for Youth.* Connecticut Sea Grant College Program, University of Connecticut, Groton. 90pp.

Dreyer, G.D. and W.A. Niering (eds). 1995. *Tidal Marshes of Long Island Sound: Ecology, History and Restoration.* Bulletin No. 34. The Connecticut College Arboretum, New London.

Kelly, W.J. 1992. "Invasion of the Aquatic Aliens". *Undercurrents*: The Mystic Marinelife Aquarium Quarterly. Spring issue: 2-5, 9.

Long Island Sound Fact Pack Collector Cards. 2001. Peabody's Toys That Teach, Novelty, OH. (Connecticut Sea Grant College Program, University of Connecticut, Groton.)

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McArdle, D. K. Conway and L. Norwitz. 1992. *Project Soundwise: A Curriculum and Teacher's Guide to Long Island Sound for Grades K-4.* Schooner, Inc., New Haven.

Patton, P.C. and J.M. Kent. 1992. *A Moveable Shore: The Fate of the Connecticut Coast.* Duke University Press, Durham.

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Van Patten, M., M. Moore, and E. O'Muin. 1997. *Sound facts: fun facts about Long Island Sound.* Connecticut Sea Grant College Program, University of Connecticut, Groton.

Van Patten, P. 1992. "Aliens Among Us". *Nor'Easter.* Fall/Winter issue: 8-13. Connecticut Sea Grant College Program, University of Connecticut, Groton.

Weiss, H.M. 1995. *Marine Animals of Southern New England and New York.* Connecticut Department of Environmental Protection, Hartford.

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