# Living The Plants and Animals of Long Island Sound Treasures:





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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 2015, the



LISS partners updated its Comprehensive Conservation and Management Plan for Long Island Sound and implementation of this plan is ongoing. For additional information, contact: EPA Long Island Sound Office, CT (203) 977-1541, longislandsoundstudy.net

## **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 34 university-based programs in the coastal and Great Lakes states and U.S. territories. 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

It's been 30 years and more than 100,000 copies since the initial publication of this booklet and while many things have changed, its purpose has not. With this book, we hope to raise awareness of the beauty and diversity of the plants and animals inhabiting Long Island Sound and emphasize the important role that everyone can play in being a steward of this unique body of water. The resources of the Sound, and the various commercial and recreational activities it supports, contribute nearly \$9 billion a year to the economy!

The Sound is being affected by the changing climate. Analyses of water temperature data indicate that the average spring and fall water temperatures increased by a couple of degrees over a three-decade period. While this may not seem significant, trends in state fisheries survey data indicate a shift from the presence of more cold-tolerant species in winter and spring and warm-adapted species in the summer and fall, to more of a single community of species adapting to warmer water temperatures. While some long familiar species are becoming less abundant and other newer ones more abundant, diversity in the Sound remains high.

In 2015, the **Long Island Sound Study** partnership revised its Comprehensive Conservation and Management Plan (CCMP) for Long Island Sound. The CCMP addresses four themes: Clean Waters and Healthy Watersheds, Thriving Habitats and Abundant Wildlife, Sustainable and Resilient Communities and Sound Science and Inclusive Management (**www.longislandsoundstudy.net**). Environmental indicators are measured and tracked to drive and document progress towards meeting the established long-term ecosystem goals. Progress is reported annually and reviewed in depth every five years.

There are many ways you can help protect and restore Long Island Sound. Join a beach cleanup or report tagged horseshoe crabs. Limit the amount of fertilizers, chemicals and pesticides used around your home and dispose of them properly. Use less water and maintain your septic system. And, as much as it is a popular activity, resist the temptation to feed those geese, ducks and swans. They tend to stick around, fouling beaches, lawns and swimming areas with their droppings.

Above all, enjoy the Sound - visit its beaches, swim in its waters, go fishing or crabbing, take pictures of sunsets, watch birds and seals and sail on its waters. It's our estuary of national significance!

#### **Nancy Balcom**

Associate Director Connecticut Sea Grant September 2020

## 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 boundary comprises the entire shoreline of the state of Connecticut; its southern boundary is the northern shoreline of Long Island, New York.

#### LONG ISLAND SOUND FACTS & FIGURES

- ► 110 miles (117 km) long from end to end, from the East River to The Race
- 21 miles (34 km) wide at its widest point, near the Connecticut River
- Ranges from 60 to 300 feet (18-92 m) at its deepest points; average depth is 63 feet (20 m)
- East-west orientation (most estuaries orient north-south)
- Covers 1,300 square miles (3,367 sq. km)
- Drainage basin is more than 16,800 square miles (43,512 sq. km); 71% is Connecticut River drainage basin
- Watershed begins in Quebec, Canada and includes sections of five states
- 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.

People are very much a part of the Sound. Currently, nearly nine million people live within its watershed, and four million within the bordering coastal communities. The Sound is heavily used by people for purposes that include marine industry, commercial and sport fishing, shellfish and aquaculture, boating, swimming and other types of recreation, transportation, military maneuvers and waste disposal. These uses



sometimes conflict or compete with each other or with the myriad living "treasures" that live in the Sound and along its shores.

Continued development of an already densely populated coastline keeps pressure on the Sound's ecosystem. However, progress continues to be made to arrest and even reverse the effects of stressors on the health and abundance of the Sound's biota (plant and animal life), including 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 shifted over time, the Sound still supports a multitude of creatures great and small year-round. Many more are linked to the Sound for parts of their life cycle. Together, 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 simple **food web** scenario. A bluefish served at a cookout was caught by a recreational angler as it chased and fed on a school of menhaden (bunker). The menhaden in turn had been consuming millions of microscopic algae 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 groundwater and 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, including 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**

Within estuaries like Long Island Sound, a range of habitat types support the wide variety (**diversity**) of individual organism types or **species** found in these productive waters. These **habitats** range from the Sound's open waters to salt marshes, tidal mud flats, rocky reefs and sandy beaches. 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 lives.

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. The process of photosynthesis 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** or seaweed and the **vascular** or true **plants**.

The fauna of Long Island Sound is also abundant and diverse, ranging from microscopic zooplankton to spider crabs, sea anemones

and osprey. 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, marine mammals and sea turtles may be year-round Long Island Sound 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. Animals 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**.



Great Blue Heron

## Habitats of Long Island Sound

The following pages describe the primary habitat types that are part of the Long Island Sound ecosystem, and some of the plants and animals associated with each. Keep in mind that many of the Sound's animals can be found in more than one habitat type and they can 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 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 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 immature stages of finfish and shellfish. Bacteria break down the vegetation further to release chemical nutrients into the water.

A salt marsh is commonly separated from upland tree and shrub vegetation by a narrow band of brackish water supporting tall feathery-headed reeds or freshwater reeds and cattails intolerant of salt water. Broad-leaved plants and shrubs such as bayberry and marsh elder dominate the salt marsh in this 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 higher salinity waters. The high marsh is dominated by salt-marsh hay and spike grass, among other grasses and sedges. An unusual succulent plant called glasswort can be found in **salt pannes**, small depressions in the marsh devoid of grass. Purple 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 saltwater cordgrass. This grass is very tolerant of the ever-changing water level, temperature and salt concentration.





Diamondback Terrapin

Rising sea level is impacting the salt marshes of the Sound. Marshes rely on sediment input and growth of marsh plants to keep up with sea level rise. Because climate change is causing an increased rate of sea level rise that some marshes may not be able to keep up with, tidal flooding may be more frequent and last longer. This could lead to changes in the species of plants typically found. Marshes also migrate landward over time. Many groups are working to conserve lands bordering marshes that are appropriate for this marsh migration.

In the tidal creeks and mosquito ditches that wind through the salt marsh, small fish such as mummichogs, killifishes, sticklebacks and Atlantic silversides congregate. Larger fish often move in during high tide to feed on these small fish. A turtle known as the diamondback terrapin may be found inhabiting brackish marsh waters. **Terrapins** eat crustaceans and molluscs such as blue crabs and mussels. Female diamondback terrapins lay eggs in shallow nests on sandy beaches in the spring. Threatened by habitat loss, nest predation and accidental capture, harvest of this species is prohibited.

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 about to lure a female into his burrow. Fiddler crabs feed on algae and decaying matter found among the marsh sediments. **Molluscs** such as the ribbed mussel and the salt marsh snail live primarily in salt marshes.

Terrestrial mammals live along the Sound's shores as well. The semiaquatic muskrat 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 wade in the tidal creeks in search of their next meal. One of the most thrilling harbingers of spring is the highpitched call of the fish-hunting osprey returning to nest. Platforms installed in some marshes mimic tall dead trees to attract nesting osprey. Breeding pairs can stay together for years, returning to the same nesting sites. Ospreys represent a well-known restoration success story their population levels recovered following the banning of the pesticide DDT after it was found to cause reproductive failure in both ospreys and bald eagles.



Red fox chasing vole



The osprey sits on a man-made nesting platform.



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

## **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 predatory 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.

Tidal flats are another habitat impacted by sea level rise. While some tidal flats may become completely covered by water, new tidal flats may develop along the changing shoreline.

**Gastropods** — molluscs with a single shell or "univalve" such as mud snails, moon snails and periwinkles — 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 tiny shrimp also inhabit the flats. **Bivalves** or molluscs with two hinged shells, such as 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 and scup are among the fish that move into the tidal flats to feed. Sandpipers, plovers, herons and egrets 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 fish bait.

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. 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.





## **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 ongoing to map existing eelgrass beds and restore former beds in the Sound.

## **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 area between high and low tides. Of all the Sound's habitats, this is probably the harshest environment and the organisms inhabiting this zone are well-adapted to their situation. To cope with intense wave action among the rocks, organisms such as barnacles, small snails and seasweed have special adaptations that enable them to attach securely to hard 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 deal 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 small periwinkle snails head for the underside of the rocks to stay moist during low tide. There is always intense **competition** for space on the rocks 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 molluscs 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 draw food particles into their mouths with featherlike appendages during high tide. During low



tide, they close tightly to retain moisture.

Long Island Sound is home to a number of creatures **endemic** (native) to other parts of the world that were introduced to the Sound's ecosystem accidentally or on purpose, survived and reproduced. Small periwinkle snails that cover the rocks by the thousands were introduced to the western Atlantic coastline by Europeans more than two hundred years ago. These snails, which feed by scraping algae from the rocks, have long dominated the rocky intertidal "scene".



Green crabs inhabit rocky areas, mudflats and marshes in the Sound. Originally from Europe, they feed voraciously on bivalve molluscs and are sold as bait. Introduced more than 150 years ago and once very common in the Sound, the green crab has been dramatically outnumbered by another non-native crustacean in recent years. The



Japanese (Asian) Shore Crab

Japanese (Asian) shore crab was introduced into the Sound in the early 1990s and rapidly became the dominant crustacean in the rocky intertidal zone, which is similar to its native habitat. The small shore crabs have distinctive striped legs and square-shaped **carapaces** (shells) and can easily be found at low tide by turning over rocks near the water's edge. Over a 10 to12 year period, this crab spread up and down much of the Atlantic coast. Both the green crab and shore crab are omnivores, feeding on small shellfish, other crabs and seaweed.

The lower intertidal area is nearly always under water and typically abounds with seaweed, sea stars and other spiny-skinned **echinoderms** and anemones, all of which are sensitive to changes in salinity and the drying effects of air.



Seals, a marine mammal, are also attracted to the Sound's rocky habitat. Harbor seals are the most dominant species and can be spotted overwintering on offshore rocky islands after journeying to the Sound from northern New England. They "haul out" onto rocky ledges or beaches to rest. Gray, harp, hooded and ringed seals are uncommon visitors to Long Island Sound, but sightings of these more northern species of marine mammals do occur occasionally. Whales including humpbacks, dolphins and porpoises are also rare visitors to the Sound, likely in pursuit of schools of small fish.

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

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 grow closest to shore, browns grow in the shallow to mid-depths and reds in deeper waters furthest from shore.

Seaweeds generally attach to rocks or other hard surfaces, providing habitat, food and shelter for aquatic organisms and thus are 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 Irish moss is commonly used in toothpaste, ice cream and many other smooth and creamy products. **Alginate** from kelp and rockweed is used in syrups and as coatings for paper, film, medications and fabric.



Although a sandy beach seems barren at first glance, this constantly shifting environment supports many species of plants and animals.

## Sandy Beaches

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.

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 windswept beaches, protected from human disturbance and straying house pets, the threatened piping plover and least tern make their nests.

Атртро



## Subtidal Zone

The **subtidal zone** is constantly submerged, supporting 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 such as 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. A new aquaculture industry in the Sound grows native sugar kelp on longlines during the winter, which is then harvested in late spring for human consumption, fertilizer and other uses.

## **Benthic Zone**

Organisms that live on or in the seafloor are collectively known as the **benthos**. They are further categorized by where they live: on (**epifauna**) or in (**infauna**) 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. Boring sponges drill into the shells of oysters and other molluscs, 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 muds. It may be surprising that the Sound supports star coral, another cnidarian, which grows 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 specialized for reproduction. **Tunicates**, commonly known as sea squirts, are found attached to rocks, shells, piers, seaweed 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 species transported from other parts of the world that have become nuisances by fouling moorings, lines and other boating gear. Their tough outer skin, called tunics, range in appearance from brown and leathery to opaque or bright orange gelatinous material.

Mollusc species are common members of the benthic community. Bivalve molluscs include clams, oysters and mussels, while the gastropod molluscs include channeled whelks, oyster drills and other snails. Both oysters and hard clams are commercially important and are farmed on the bottom or in raised gear on designated plots leased by shellfish farmers. To grow successfully, young oysters or **spat** need to attach to a clean hard substrate (preferably old oyster shell). Because of the tremendous commercial importance of the oyster aquaculture industry, clean oyster shells (**cultch**) are sometimes spread on oyster beds to encourage the settling and growth of new oysters.

Most molluscs feed on phytoplankton, 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 are predators. Oyster drills and moon snails drill holes in the shells of their bivalve prey.





Large channeled and knobbed whelks (sea snails) 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 **desiccation**.

The most unusual and graceful gastropod molluscs inhabiting the Sound are nudibranchs. Also known as sea slugs — they have no shell at all. Colorful with striking patterns, their upper surfaces often have gills or club-shaped structures for breathing along with one or more pairs of tentacles.

American lobsters, bottom-dwelling crustaceans with 10 legs, inhabit rock crevasses and mud burrows. Omnivores, they feed at night on crabs, molluscs, sea stars, sea urchins, worms and algae. Lobsters are easily identified by their two specialized front legs—the large "crushing" claw and the narrower "ripping and tearing" claw.

A "berried" lobster is a female lobster carrying tens of thousands of eggs in a mass attached to the underside of its tail. After hatching, larval lobsters temporarily join the **zooplankton** community in the water column. After four **molts** (shedding of the **exoskeleton** or outer shell during growth), lobsters settle to the bottom where molting continues at an increasingly slower rate throughout their lives. Lobsters molt 20-25 times over five to eight years before reaching maturity. They can then reproduce and have attained the minimum size for legal harvest.

Long Island Sound long supported a significant American lobster fishery. The lobster population in the Sound suffered a catastrophic dieoff in 1999 due to disease and environmental stressors such as extended warmer-than-average water temperatures. To date, the abundance of lobsters remains relatively low. As a result, the commercial fishery in Long Island Sound is greatly reduced in terms of pounds of lobsters landed and the number of fishermen harvesting them. American lobster in Long Island Sound is a cold-water species at the southernmost end of



its inshore range; it may no longer be able to thrive in the Sound due to increasing average water temperatures caused by the changing climate.

Many different species of crabs live in Long Island Sound. The large blue crab is a voracious predator of small shellfish and finfish. The last pair of its legs is paddle-shaped, specially adapted for swimming. The Latin name for blue crab means "beautiful swimmers". The quick pincer movements that serve the crab in hunting prey can also inflict pain on incautious crabbers. Red crab species include the rock and Jonah crabs. These crabs feed on small benthic animals and are themselves a favorite food of lobsters. Both species are edible; the Jonah crab has become commercially important in recent years.

Other common crab species inhabiting the Sound include the green crab as well as scavenging spider crabs with their small, bumpy, oval bodies and long radiating legs. Lady crabs (calico crabs) swim through the water at night and burrow during the day. A lady crab is distinguishable by its purple mottled carapace, paddle-shaped last pair of legs and sharp pincers. Other crustaceans include shrimp, mostly tiny species found inshore and offshore that are an extremely important source of food for other organisms.

Among the Sound's benthic echinoderms are predatory sea stars, prickly sea urchins and sand dollars. While some species of 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 feed on algae and detritus attached to hard surfaces. The species most commonly found in Long





Island Sound is the Atlantic purple sea urchin. Sand dollars are rare in Long Island Sound, found occasionally in the easternmost regions.

Warmer waters are leading to some changes in the species of fish commonly and uncommonly found in Long Island Sound. State fisheries survey data indicate a shift over time from the expected presence of more cold-tolerant species in winter and spring and warm-adapted species in the summer and fall, to more of a single community of species adapting to warmer water temperatures. The number of different species overall has not changed significantly, but the abundance of some familiar species, such as winter flounder, little skate and windowpane flounder has declined while other species like scup, weakfish, black sea bass and summer flounder have become more common.

A number of fish species inhabit the bottom either seasonally or yearround, including winter flounder, summer flounder (fluke) 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.



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. All flounders have a chameleon-like ability to change their color to blend with surrounding sediments. This adaptation serves them well against most predators.

Other bottom-dwelling or reef-hugging fish species include sculpin, cunner, sand lance, whiting, windowpane flounder and sea robins. Cunner, blackfish (tautog), scup, and sea ravens inhabit subtidal rocky habitats, as well as near pilings and piers. Cunner and blackfish are year-round residents. During warmer months, they feed on molluscs and barnacles in nearshore rocky areas. During the 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 (cnidarians) and squid (**cephalopod** molluscs with a greatly altered internal shell or "pen"). 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 multicellular colonial algae. Phytoplankton are important food for many herbivores, as well as producers of oxygen for other life forms in the Sound.

However, a general overabundance of phytoplankton, or an excess of certain species, can have serious ecological consequences. Certain phytoplankton called **dinoflagellates** form masses or algal "blooms" and



the pigments inside of them can turn the water green, red or brown. In some instances, the dinoflagellates also produce toxins during a bloom, creating a harmful algal bloom. The toxins can accumulate in filter feeding organisms such as bivalve shellfish, posing a health threat to human consumers. Algal blooms are monitored for the presence of these toxins so that fishing activity can be suspended until the bloom breaks up.

Algae blooms that are not toxic can still have a negative effect on the Sound. Scientists have determined that algae blooms fuel low oxygen level events (hypoxia) that typically occur in late summer. Using excess nutrients in the form of nitrogen entering Long Island Sound from runoff, treated sewage and failing septic systems, the algae multiply, form huge blooms and then die. 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. One of the ways the amount of nitrogen in the Sound has been reduced is through the implemen-



Copepod



Diatoms

tation of tertiary treatment by sewage treatment plants, which removes excess nutrients from the treated effluent prior to its discharge. Proper maintenance of individual septic tanks is also important to reducing excess nitrogen in the Sound.

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, molluscs 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



Lion's Mane Jellyfish

mane jellyfish, the moon jellyfish and the non-stinging comb jellies or **ctenophores**.

The pelagic zone is home to many schools of fish. Most fish species inhabit Long Island Sound waters either 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. Young bluefish, called "snappers", appear in the Sound from spring through fall. Other finfish that occur during summer in abundance are scup, butterfish, weakfish, black sea bass and dogfish.

Long Island Sound has several species of finfish whose migration routes take them from salty ocean to the freshwater 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, the state fish of Connecticut, are large herring that return to spawn in the streams where they were born after four to five years at sea. Pollution and dams have reduced their spawning effort in the Sound to one major 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 include the endangered Atlantic sturgeon, alewives, blueback herring and 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 river dams, industrial pollution and overfishing 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 have been removed and fish ladders or passages constructed as part of ongoing 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 freshwater streams and travel tremendous distances to spawn





American eel migration route

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 navigate is still unknown.

Four true marine turtles—the loggerhead, Kemp's ridley, leatherback and green—are regular summer visitors to Long Island Sound, although unfortunately few of us ever see them. If these coldblooded creatures linger in the Sound for too long in the fall, they can become "cold-stunned", wash up on shore and need to be rescued by experts.

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 spawning grounds in Mexico to reach Long Island Sound.

Sea turtle species have different food preferences. For example, loggerheads and Kemp's ridleys eat molluscs and crustaceans. Green turtles are herbivores while leatherbacks feed ex-

clusively on jellyfish. Leatherbacks can mistakenly ingest marine debris like plastic bags and balloons, which can cause their deaths.

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 diving water birds 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 feeding their young. Colonies of cormorants, gulls, terns, herons, ibis and egrets can be found on islands along the coast. Egrets and ibises nest in trees.

Autumn once again brings masses of migrating birds. Hawk watching 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 heading south.

Birds associated with the Sound take advantage of the abundant fish, invertebrates and plant life. Scaup and scoter feed primarily on molluscs while mergansers, cormorants, loons, herons, ospreys and terns feed mostly on fish. Canada geese, brant and mute swans graze on eelgrass and seaweed.

The Long Island Sound ecosystem is made up of a spectacular complex of flora and fauna. They provide hours of enjoyable observation and photo opportunities. 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, we can reasonably 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 live 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.



**Red-Breasted Mergansers** 

## 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 three years
- ► Leave grass clippings on the lawn to recycle the nutrients. Start a compost pile.
- 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. Contact your city or town for instructions.
- Refuse, reduce, reuse or recycle. Dispose of trash properly, so it doesn't get washed into the Sound or litter its beaches. Reduce your use of single-use plastics and plastic bags. Participate in #DontTrashLISound https://longislandsoundstudy.net/category/ media-center/dont-trash-li-sound/
- ► Be a responsible boater and use pump out facilities to properly dispose of wastes from port-a-potties and Type III (holding tank) marine sanitation devices.

- Resist the urge to feed waterfowl. Feeding encourages them to gather in flocks and stay in the area. Their droppings contain bacteria and nitrogen that can contaminate swimming areas and shellfish beds.
- Organize or participate in beach cleanup efforts. For opportunities near you, visit the American Littoral Society's website (https://www.littoralsociety.org/coastal-cleanup.html) or Save the Sound's website (https://www.ctenvironment.org/whatwe-do/saving-sound-rivers/stopping-pollution/coastal-cleanup/)



People are part of the Long Island Sound ecosystem too.

# For More Information

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

#### Connecticut Sea Grant resources (www.seagrant.uconn.edu)

A Guide to the Larval and Juvenile Stages of Common Long Island Sound Ascidians and Bryozoans http://media.ct seagrant.uconn.edu/publica tions/marineed/ascidian-guide.pdf

*Aquatic Invasive Species of Long Island Sound Poster* https://seagrant. uconn.edu/2001/01/01/aquatic-invasive-species-of-long-island-soundposter/ or call (860) 405-9128

A Student's Guide to Common Phytoplankton of Long Island Sound http://media.ctseagrant.uconn.edu/publications/marineed/phyto plankton/phytoplankton.pdf

*Connecticut River Tidal Marshes* (CD-ROM) https://seagrant.uconn. edu/2009/01/01/connecticut-river-tidal-marshes-cd-rom/ or call (860) 405-9128

*Harmful Algae: An Executive Summary* https://seagrant.uconn.edu/ wp-content/uploads/sites/1985/2017/08/algae-summary-web.pdf

Keys to the Larvae of Common Decapod Crustaceans in Long Island Sound https://seagrant.uconn.edu/wp-content/uploads/ sites/1985/2017/08/Weiss-Decapod-Crustacean-larvae-book\_Web.pdf

*Living Treasures: Plants and Animals of Long Island Sound* https://longislandsoundstudy.net/wp-content/uploads/2010/05/ LivingTreasuresBlue\_Full\_Lores.pdf

*Long Island Sound Curricular Resource Guide* (CD-ROM) https://sea grant.uconn.edu/2009/01/01/long-island-sound-educational-resourcescd-rom/ or call (860) 405-9128

Responding to a Resource Disaster: American Lobsters in Long Island Sound 1999-2004 http://media.ctseagrant.uconn.edu/publications/ fisheries/lobsterpid.pdf Salt Marsh Plants of Long Island Sound https://seagrant.uconn. edu/2009/01/01/salt-marsh-plants-of-long-island-sound-2/ or call (860) 405-9128

*Seaweeds of Long Island Sound* https://seagrant.uconn.edu/2009/01/01/ seaweeds-of-long-island-sound-new-second-edition/ or call (860) 405-9128

Sound facts: Fun Facts about Long Island Sound https://seagrant.uconn. edu/wp-content/uploads/sites/1985/2020/09/SoundFactsFinal.2009.pdf or call (860) 405-9128

*Visual Guide to Long Island Sound Marine Invasive Species* https://sea grant.uconn.edu/2001/01/01/visual-guide-to-long-island-soundmarine-invasive-species/ or call (860) 405-9128

**Connecticut Department of Energy and Environmental Protection Resources** (https://portal.ct.gov/DEEP)

*Long Island Sound Blue Plan* https://portal.ct.gov/DEEP/Coastal-Resources/LIS-Blue-Plan/Long-Island-Sound-Blue-Plan-Home

East River Crew Resources (http://www.eastrivercrew.org/)

*East River Estuary Guide* https://longislandsoundstudy.net/wp-content/uploads/2010/02/Estuary\_guide-FINAL\_sm4.pdf

Long Island Sound Study Resources (https://longislandsoundstudy.net/)

*By the Shore or in the Classroom* https://longislandsoundstudy.net/get-involved/educational-resources/getting-out-and-on-the-sound/

*Frequency of Hypoxia* https://longislandsoundstudy.net/2020/01/ frequency-of-hypoxia-2/

Long Island Sound Habitat Mapping: Home (https://lismap.uconn.edu/)

Long Island Sound Research https://longislandsoundstudy.net/wp-content/uploads/2019/04/research-factshee9-22-May.pdf

Nitrogen Pollution in Long Island Sound https://seagrant.uconn.edu/ wp-content/uploads/sites/1985/2019/06/Healthy-Sound\_NitrogenEpdf *Restoring Migratory Fish Passage* https://longislandsoundstudy.net/ wp-content/uploads/2020/04/rivermile-factsheet-8April20.pdf

*Restoring the Sound's Coastal Habitats* https://longislandsoundstudy. net/wp-content/uploads/2020/04/habitat-factsheetx12-8-April-20.pdf

*Sound Update Archives* (newsletters) https://longislandsoundstudy.net/ category/media-center/newsletters/sound-update/

*The Kraken2* ROV Explores Eastern Long Island Sound Story Map https://connecticut.maps.arcgis.com/apps/MapTour/index.html? appid=4aaf8908dd00497a9d0c282b5352e35b

New York Sea Grant Resources (https://seagrant.sunysb.edu/)

*Brown Tides in Long Island Bays* https://seagrant.sunysb.edu/btide/ pdfs/BTideinLIBays.pdf

*ColorYourCatch* https://seagrant.sunysb.edu/marinefish/pdfs/ ColorYourCatch.pdf

*Lobster Life Cycle and Habitat* https://seagrant.sunysb.edu/lobster/pdfs/LHN-Fall03sup.pdf

*Long Island Bays and Inlets poster* https://seagrant.sunysb.edu/articles/t/long-island-bays-and-inlets-poster-publications-posters or call (631) 632-9124

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