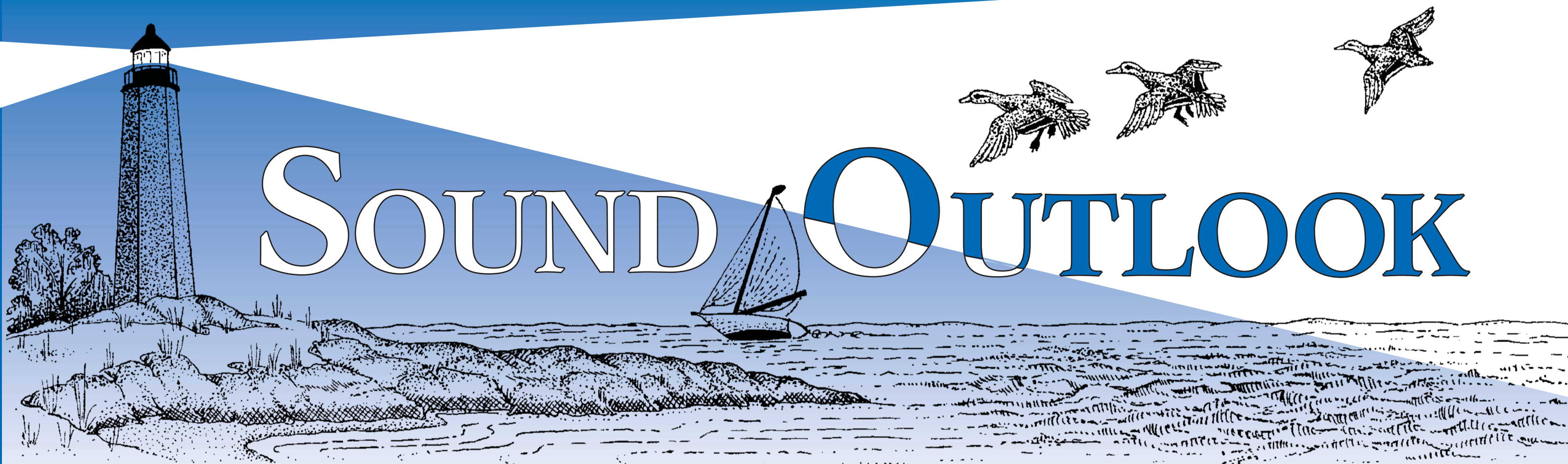


SOUND OUTLOOK

A NEWSLETTER OF THE CONNECTICUT DEPARTMENT OF ENVIRONMENTAL PROTECTION
EXPLORING LONG ISLAND SOUND – ISSUES AND OPPORTUNITIES

This issue of *Sound Outlook* describes how
Little Things Make a Big Difference in Long Island Sound.

In the articles that follow, you will find discussions of resources that are generally invisible to the naked eye: phytoplankton and zooplankton, the tiny plants and animals that drift with the currents, and the fine sediment that continually cycles through the estuary. Learn about where these resources originate, how they are investigated, their role in the ecology of the Sound, and their influence on human society.

Inside

FEBRUARY 2006
No. 21

Our Links To The LIS Food Chain

When we were in grade school, many of us learned about the "food chain" in our science classes. In Long Island Sound, as in any aquatic ecosystem, that food chain starts with the microscopic plants known as phytoplankton. The phytoplankton are eaten by small animals known as zooplankton. Both the phytoplankton and zooplankton are eaten by shellfish, crustaceans, and small fish, which are in turn consumed by larger fish, birds, marine mammals and humans.

Algae, the most basic of marine plants, are an important component of phytoplankton, and require fertilizer, or nutrients, just as do terrestrial plants. Those nutrients (carbon, nitrogen and phosphorous) are released as upland plants and animal wastes decay and are washed by rain water into the streams and rivers that ultimately flow into Long Island Sound and the ocean beyond. As human populations grow and development expands, more nutrients are added to the land and carried downstream. This can upset the balance of the food chain.

If we are not careful, human waste from our homes and excess fertilizer from our lawns and farming activities can over-enrich lakes, rivers and the Sound. In salt-water environments, nitrogen is the most important nutrient for stimulating phytoplankton growth. Wastewater treatment plants in Connecticut and New York discharge treated waste that contains nitrogen compounds to LIS. Over the years those increased nutrients have stimulated the growth of phytoplankton, causing algal blooms. Algal blooms become a problem when they block sunlight from reaching the estuary bottom where it is needed to support the growth of eelgrass and other "submerged aquatic vegetation," itself a habitat for shellfish and a food source for aquatic organisms.

When there is more phytoplankton production than the zooplankton and fish can eat, the food chain is disrupted, and unassimilated algae sink to the bottom, along with animal waste, and die. Oxygen in the bottom water is depleted as those materials decay. The result of so much more organic material undergoing decay is "hypoxia" (low dissolved oxygen), which causes respiratory stress for fish and shellfish that must either swim out of the area or die. Connecticut and New York are working to reduce nitrogen levels and hypoxia in the Sound. Any little things we can do to reduce the discharge of excess fertilizers and other nutrients will help in a big way to make Long Island Sound a healthier place for plants and animals to live.

HAB in LIS

Our cover article described the effect that algal blooms can have on the marine community in Long Island Sound due to the shading of submerged aquatic vegetation and shellfish. Blooms of algae that contain neurotoxins can also harm and kill finfish and shellfish directly, and potentially make humans sick; these are called harmful algal blooms (HAB). These blooms are often distinguished by and named for the photopigments they contain. Several HABs have occurred in or close to LIS.


Heterosigma akashiwo, flagellated golden brown algae

The dinoflagellate *Prorocentrum minimum* forms blooms called "mahogany tides" (due to a combination of red and brown pigments) in coastal bays from New England through the Mid-Atlantic that have been associated with mass mortalities of oysters and other marinlife. Dinoflagellates are mostly single celled organisms. They have filamentous structures called flagella that are used to propel them through the water. In some cases, the effects of algal blooms have been attributed to the shading and hypoxia conditions previously discussed, but in other cases, direct toxicity was suggested. *Prorocentrum minimum* blooms tend to be highly-localized and short in duration. *Heterosigma akashiwo*, a flagellated, single-celled golden brown algae, produces a toxin that causes gill-tissue damage in both finfish and shellfish. Finfish respond to the resulting respiratory stress by producing mucous at the gills. Oysters and other shellfish avoid contact with the toxin by closing their shells.

Other HABs have occurred in nearby waters, but have thus far not infiltrated Long Island Sound. "Brown tide" produced by blooms of phytoplankton in the genus *Aureococcus* have occurred in poorly-flushed mid-Atlantic estuaries in late spring and early summer when organic nitrogen concentrations are elevated. *Aureococcus* blooms are severely toxic to bivalves, producing a substance called "mucopolysaccharide" that clogs their gills, inhibiting their ability to eat, grow, and reproduce, ultimately causing them to stop feeding and starve to death. An *Aureococcus* bloom caused the collapse of the scallop fishery in Peconic Bay, an estuary on the north fork of Long Island, in 1985.

Fortunately, none of these species have caused the paralytic shellfish poisoning (PSP) in Long Island Sound or elsewhere that can make humans ill and even cause death. It is the general scientific consensus, however, that harmful algal blooms are increasing in frequency. In discussing brown tides in particular, Woods Hole Oceanographic Institution biologist Donald Anderson stated that "now virtually every coastal state is threatened, in many cases over large geographic areas and by more than one harmful or toxic species. Scientists are trying to determine what changes in the environment might be promoting algal blooms like brown tides. Explanations for the expansion of these harmful blooms include coastal development, global warming, and transport of algae in ballast water. Until the basic biology of brown tide is understood, there is little hope of managing the problem."

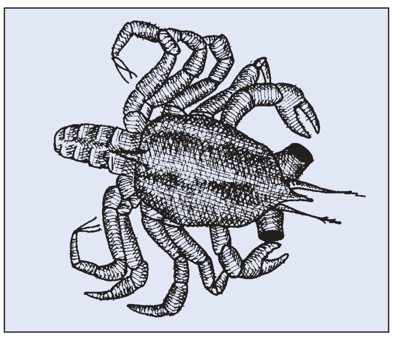
Information for this article was provided by Dr. Gary Wikfors of the National Oceanic and Atmospheric Administration (NOAA) laboratory in Milford, CT. For further information about HABs in Long Island Sound, contact Mark Parker at 860-424-3276 or by email at **mark.parker@po.state.ct.us**.

Combatting Alien Invasions

The previous article described how native microorganisms may, under certain environmental conditions, become a danger. While Long Island Sound may be threatened in the future by such changes in the population dynamics of native species, it has long been affected by the introduction of non-indigenous species (NIS). Two examples of NIS that have made their way to LIS include the green crab (*Carcinus maenas*) and the Asian (aka Japanese) shore crab (*Hemigrapsus sanguineus*). While green crabs initially arrived in U.S. waters as adults associated with solid ballast, both species are today most likely transported as planktonic larvae in ballast water. When a vessel loads or picks up cargo, ballast water tanks are often emptied to stabilize the vessel, thereby discharging organisms entrained at the ship's last port-of-call.

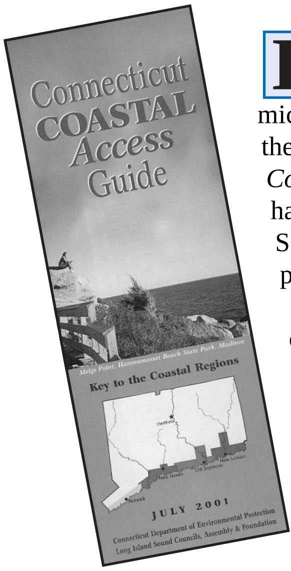

Asian shore crab (Photo courtesy of the SoundWaters Environmental Education Center, Stamford, CT., **www.soundwaters.org**)

The green crab, a native of Europe and northern Africa, arrived in LIS in the late 1800s and rapidly spread to other U.S. waters. A voracious omnivore, it quickly dominated intertidal habitats, consuming native species, including both harvested and non-harvested shellfish, as well as other intertidal invertebrates and algae. Green crabs are thought to have caused the collapse of the soft-shell clam resource in New England. The Asian shore crab, first sighted in New Jersey in 1988, has migrated throughout the East coast. By taking advantage of marginal and underutilized rocky intertidal and subtidal habitats, it has supplanted the green crab to become the dominant crab species in the Sound. The omnivorous Asian shore crab also consumes intertidal algae and invertebrates, and affects both commercial shellfish and aquacultural resources.


Typical crab larvae -- planktonic megalops stage

see **Combatting Alien Invasions** *continued on page 5*

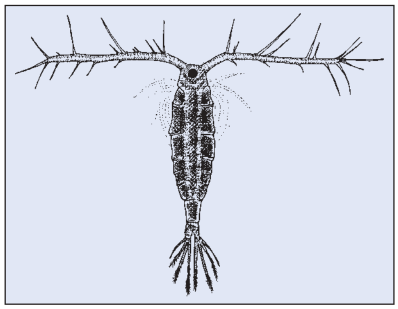
SPOTLIGHTED Coastal Access:
Norwalk Maritime Aquarium - Plankton Sampling



Have the articles in this issue of *Sound Outlook* inspired you to take an "up-close and personal" look at some of the microorganisms present in Long Island Sound? Then plan to visit the Norwalk Maritime Aquarium, (Site #22 on the printed *Connecticut Coastal Access Guide* map). The Aquarium offers hands-on opportunities to learn about the inhabitants of the Sound, and specifically, to observe and assist in the collection of plankton.

The R/V *Oceanic* (RVO) collects plankton samples year round on all Marine Life Study Cruises and Winter Creature Cruises. The cruises are run for the public and for schools as part of the Maritime Aquarium's Biodiversity Census. Passengers aboard the research vessel assist with the deployment and retrieval of the plankton sampling nets.

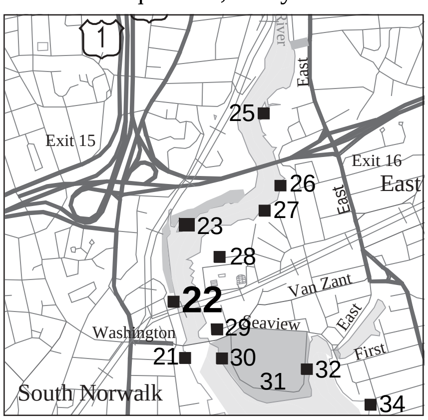
When the samples are brought on board, the RVO crew drains the net receptacle of water and rinses down the sides of the net where most plankton are caught. The samples are then studied under a video microscope with a TV display for all to see. Collections include phytoplankton (plants) and zooplankton (animals) in various stages of development. Copepods are a constant highlight of the plankton sample. This creature, with one eye and very long antennae, seems to be the model for the character "Evil Plankton" on the cartoon Sponge Bob Squarepants.

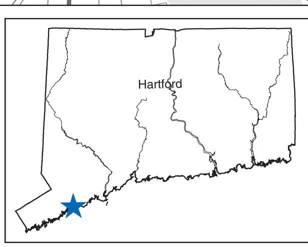


Typical Copepod of the genus *Calanus*

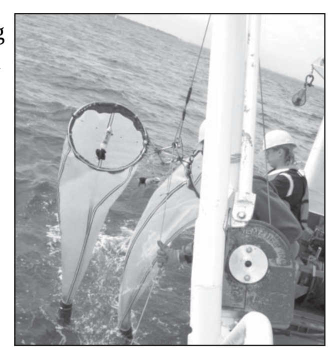
Plankton tows also gather meroplankton, which include larvae of crabs, lobster, horshoe crabs, shrimp, barnacles, mollusks, worms and many other marine animals. There are countless other organisms too small to be identified with the ship's current microscope. The Aquarium staff also describe how the color and turbidity of Long Island Sound water is related to the abundance of the plankton observed.

After you return to the dock, take time to view the many other exhibits at the Maritime Aquarium, many of which are interactive, and to tour Maritime Aquarium Park on the bank of the Norwalk River. This site is described in detail, with maps and photographs and parking information, at the *Connecticut Coastal Access Guide website*, **www.lisrc.uconn.edu/coastalaccess/index.asp.**





Norwalk Maritime Aquarium educator uses on-board video microscope to view plankton sampled on Marine Life Study Cruise



DEP Water Quality Monitoring staff deploy plankton net from the R/V *John Dempsey* into Long Island Sound

LOOK OUT for upcoming events!!

Norwalk Maritime Aquarium
10 North Water St., Norwalk, CT
Call 203-852-0700 x2206 for information and registration for the following programs:

Winter Creature Cruises
Saturdays and Sundays, Feb. 4-Apr. 8; times vary.
Cruise aboard the R/V *Oceanic* in search of waterfowl and wintering seals.

Marine Life Study Cruises
Saturdays and Sundays, Apr. 20 **-May 29; times vary.**
Cruise aboard the R/V *Oceanic* to collect fish, crabs, lobsters and sea stars utilizing plankton tows, mud grabs, and otter trawls.

Long Island Sound Educators Conference
Norwalk Maritime Aquarium
10 North Water St., Norwalk, CT
Friday, March 31, 2006
Sponsored by the Southeastern New England Marine Educators.
See **www.seneme.org** for information.

Long Island Sound Watershed Alliance (LISWA) Long Island Sound Summit
Holiday Inn and Conference Center
1070 Main St., Bridgeport, CT
Saturday, April 8, 2006
Theme: Climate Change and its impact on LIS. See **www.savethesound.org/mb2_calendar.htm** for information

NOTE: LIS License Plate Requests for Proposals will be mailed and posted on the DEP website in June 2006. Contact Kate Brown, DEP, Office of Long Island Sound Programs, at 860-424-3034 or by email at kate.brown@po.state.ct.us for more information.

Please be sure and check the Calendar of Events listed in DEP's website: www.ct.gov/dep

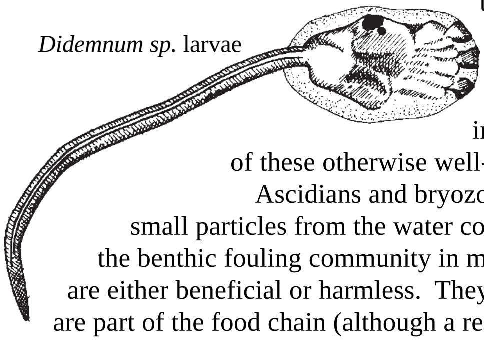
View past issues of *Sound Outlook* at **www.ct.gov/dep/olisp/soundout/soundout.htm**.

Putting Your LIS Plate Money to Work:

NEW IDENTIFICATION GUIDE TO ASCIDIANS AND BRYOZOANS

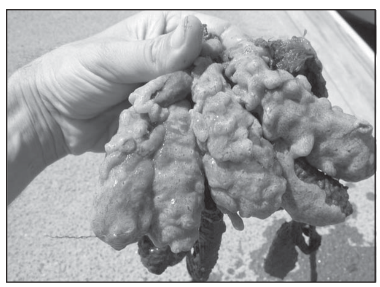
Among the most abundant members of the subtidal benthic community in Long Island Sound and other coastal waters are ascidians and bryozoans, known respectively as tunicates (often called "sea squirts") and moss animals. These animals begin their life cycle as larvae that drift with other planktonic organisms in the water column until they reach their adult, sessile stage, when they attach themselves to pilings, rocks and other hard substrates. Until recently, no taxonomic guide has existed to assist LIS researchers and coastal managers in identifying the larvae and early stages of these otherwise well-known animals.

Didemnum sp. larvae



Ascidians and bryozoans are filter-feeders that strain or pick small particles from the water column. They make up more than 80% of the benthic fouling community in many areas of LIS. For the most part they are either beneficial or harmless. They provide shelter for other organisms and are part of the food chain (although a relatively minor part, since not many things eat them). In some cases, however, they can be detrimental. One genus, the invasive carpet tunicate *Didemnum sp*., a native of Pacific waters first observed in eastern LIS in 2000, seems to be having a large impact on the Sound. Large colonies of this fast-growing ascidian now form nearly solid mats that may smother other benthic organisms.

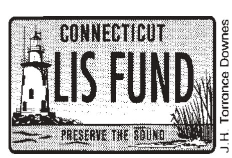
With a $4,486.00 grant from the Long Island Sound Fund and additional support from Connecticut Sea Grant and the National Science Foundation, University of Connecticut researchers Dr. Stephan G. Bullard (now at the University of Hartford, Hillyer College) and Dr. Robert W. Whitlatch investigated the ascidians and bryozoans found in Long Island Sound and published a handy, laminated taxonomic guide to assist in the early life stage identification of these species. As described elsewhere in this issue of *Sound Outlook*, there is concern that these and other invasive plants and animals may be inadvertently transported into and out of LIS in ballast water and on ships' hulls. As we work to preserve the ecological functions and values of Long Island Sound and its native species, this guide will assist researchers in recognizing unfamiliar and potentially invasive ascidians and bryozoans at the larval and juvenile stages.



Didemnum sp. colony of adults
(Photo courtesy of Dr. Stephan G. Bullard)

Copies of *A Guide to the Larval and Juvenile Stages of Common Long Island Sound Ascidians and Bryozoans* can be purchased by contacting the Connecticut Sea Grant Communications Office at 860-405-9141.

Purchase of an LIS License Plate Supports the LIS Fund



As of 11/30/05 - 130,259:

- Plates sold: 128,856
- Funds raised: Over $ $4.7 million
- Projects funded: 283

The LIS Fund supports projects in the areas of education, public access to the shoreline, habitat restoration, and research.

For information on ordering a Long Island Sound license plate, call 1-800-CT-SOUND.

If you did not receive this issue of *Sound Outlook* in the mail and would like to be placed on the mailing list, please send your name and address to: *Sound Outlook,* Connecticut DEP, Office of Long Island Sound Programs, 79 Elm Street, Hartford, CT 06106-5127; or email your address to **laurie.valente@po.state.ct.us.**

Sound Tips

Protect Yourself from Harmful Microorganisms

Unfortunately, some of the microorganisms in Long Island Sound are harmful or may cause illness. Please be mindful of the things you can do to protect yourself from them.

Known as pathogens, these organisms include bacteria and viruses. Sources of pathogens in LIS include inadequately treated human sewage and wild or domestic animal wastes. Human exposure to pathogens occurs either by direct contact with or ingestion of contaminated waters, or by eating raw or partially cooked shellfish from contaminated waters. Exposure can cause gastroenteritis, salmonellosis and hepatitis A.

When bacterial concentrations in coastal waters are found to exceed safe levels, those areas are closed to commercial and recreational harvesting. The Dept. of Agriculture, Bureau of Aquaculture will publish a notice of the closure in local newspapers and post signs at or near closed shellfish beds. Recreational shellfishers should be careful to heed those signs.

The DEP is striving to eliminate sources of pathogens by establishing No-discharge Zones in LIS, upgrading sewage treatment plants, eliminating failing septic systems and combined sewer overflows, and controlling runoff of agriculture-related animal wastes.

Another problematic microorganism in LIS is the Schistosome parasite that causes the skin rash known as Clam Digger's Itch. This parasite is released from infected snails and migrates throughout the water column. Clam Digger's Itch occurs during the summer and may be more common in hot weather. Toweling off vigorously after swimming in water infested with the parasite, rather than air drying, can prevent the rash, which can be severe and last several days. Swimmers should pay attention to signs posted in affected areas, advising bathers of the presence of the parasites and precautions for preventing the rash.

SPOTLIGHTED Coastal Resource:
Sediment Deposition and its Effect on the Environmental Quality of Long Island Sound

The preceding articles in this issue of *Sound Outlook* describe the role of small organisms in the ecology of Long Island Sound. Of equal importance to LIS is the influence of inorganic particulates, i.e., sediment, on the estuary's water quality and environmental integrity. Clean sediment is critical to the vitality of the Sound. It provides healthy habitat for commercial and recreational shellfish and other invertebrates, as well as productive forage habitat for many finfish. Fine sediment enters the Sound through natural processes such as riverine input, agricultural and urban runoff, and shoreline erosion, including erosion of glacially formed bluffs and moraines, and as discharges from sewage treatment plants. Sediment also enters the Sound through the disposal of dredged material. The total combined input of sediment to the Sound from natural sources has been calculated to equal about 946 million kilo-grams per year, while the total amount of dredged material deposited annually in the Sound equals approximately 410 million kilograms. Thus, dredging contributes about 43 percent as much sediment to the Sound on an annual basis as do natural sources, or about 30 percent of the total annual sediment input to Long Island Sound. Sediment disposal in the Sound is tracked by the U.S. Army Corps of Engineers, New England District's Disposal Area Monitoring System, known as DAMOS.

Sediment dredged from harbors and channels in Connecticut and New York that is not suitable for reuse such as beach sand or landfill cover is, with approval by DEP and the Army Corps of Engineers, barged to and deposited at four open water disposal sites in Long Island Sound. Disposal mounds are formed at three of those sites, which are located in natural bottom depressions in Connecticut waters offshore of Norwalk, New Haven and New London. Sediment is tested for contamination before it is dredged, and polluted sediments are "capped" with cleaner dredged material. The fourth disposal site, offshore of Old Saybrook, is reserved for uncontaminated sediment. This site is more exposed to bottom currents, allowing deposits to more readily drift off-site.

The DAMOS program is also used to evaluate the stability of the disposal mounds and the "remobilization" to Sound waters of any contaminants in the dredged material deposits. Periodic monitoring shows that most of that material is retained within the central mounds and thin flank deposits. However, local erosion, or winnowing, of fine sediment from the mound apex by bottom currents can occur over a period of several months until the mound is covered by a thin layer of coarser sediments. Once that veneer forms, further erosion generally occurs only during severe storms or hurricanes. Bathymetric surveys of the LIS disposal sites immediately following the passage of Hurricane Gloria in 1985 indicated no significant loss of dredged material. DAMOS measurements have shown that a maximum of 3-4 percent of the sediment deposited annually at disposal sites is lost from the sites and redistributed throughout the Sound through the combination of plume dispersion during the disposal process, winnowing and hurricanes. By comparison, therefore, more than 90 percent of the sediment that is resuspended annually in the Sound consists of sediment that enters the Sound through natural processes.

Sediments dredged from Connecticut and New York waters may contain pollutants derived from centuries of industrial, commercial and recreational use. DAMOS calculations indicate that the worst-case contribution of petroleum hydrocarbons from disposal sites during hurricane years is about 7 percent of total inputs to the Sound, while inputs of lead and copper are less than 2 percent, and inputs of mercury, zinc, and arsenic are less than 1 percent of total inputs. These calculations clearly demonstrate that dredged material disposal plays a very small role in sediment and contaminant fluxes in Long Island Sound. The dominant source of the metals is wastewater treatment plants and upstream sources, while most of the petroleum hydrocarbon input is from water treatment plants and urban runoff.

Information for this article was provided by the U.S. Army Corps of Engineers. For more information about dredged material management in Connecticut, contact George Wisker at 860-424-3034 or by email at **george.wisker@po.state.ct.us.**

Combatting Alien Invasions *(continued from page 2)*

It may be too late to control established invasive species like the crabs described above, but what is being done to control future alien invasions? The U.S. Coast Guard in 2004 promulgated its Mandatory Ballast Water Management Program for U.S. Waters. The program is intended to ensure compliance with the National Invasive Species Act (NISA) of 1996, which called for the development of state aquatic nuisance species (ANS) management plans. The Coast Guard plan requires that all ships from overseas ports must conduct mid-ocean ballast water exchanges before entering the U.S. Exclusive Economic Zone (EEZ) which extends 200 miles from shore. Ships enroute from one U.S. port to another that travel beyond the EEZ must also conduct mid-water exchanges. While not a failsafe measure, most organisms entrained in ballast water at foreign ports will be discharged or killed when ballast water tanks are flushed and refilled with cleaner ocean water, thus preventing their potential introduction to U.S. waters when ballast water is later discharged to facilitate berthing in shallow-water harbors.

For additional information on ballast water management in Long Island Sound, contact Tom Ouellette at 860-424-3034 or by email at **tom.ouellette@po.state.ct.us.**

2006 DEP Store Catalog

Great Connecticut-based items for anyone who likes to fish, bike, bird, garden, hike, boat or just loves nature!

To request a free copy of the catalog, contact Lisa D'Addario at 860-424-3555 or at **lisa.d'addario@po.state.ct.us**

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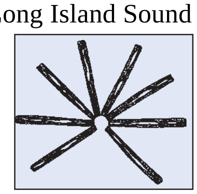
What Color Are Your Algae?

Color can tell us a lot about what kind of algae are in Long Island Sound. One of the parameters that DEP's Long Island Sound Water Quality Monitoring program measures in order to determine the amount and diversity of algae (phytoplankton) in the Sound is photopigmentation. Photopigments are chemical compounds found in the cells of algae that absorb or reflect different wavelengths of visible light, and then convert that light into chemical energy for powering photosynthesis. Different types of phytoplankton contain specific photopigments that help us identify them by taxonomic group or class - like a fingerprint of color. The phytoplankton include unicellular diatoms and dinoflagellates, such as those pictured here. Diatoms have double shells composed of silicon. Dinoflagellats have fine filamentous structures that propel them through the water.

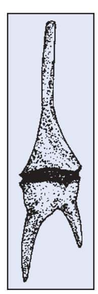


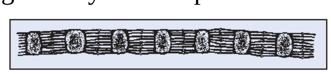
Thalassionema nitzschioides, diatom

Photopigment analysis technology is a boon to aquatic scientists. Traditionally, investigators had to examine droplets of water through a microscope, literally counting the number of phytoplankton cells to determine the types present, and their abundance, in a particular water body - a very time consuming procedure. Today, laboratory instruments can measure photopigments quickly to determine the class and quantities present.

The best known photopigment is chlorophyll-a, which appears green, and not surprisingly, is found in green algae. Other photopigments include the carotenoids, which have red, orange and yellow color. Carotenoids include diatoxanthin and fucoxanthin, brown pigments found in kelp, diatoms and dinoflagellates, and beta-carotene, which is present in almost all algae. Phycobilins provide the blue and red coloring found, respectively, in blue-green algae (cyanobacteria) and red algae.

Ceratium lineatum, dinoflagellate





Skeletonema costatum, diatom

The photopigments phycocyanin and phycoerythrin appear to be fluorescent in certain light, further enabling researchers to identify phytoplankton community composition. You can learn more about phytoplankton and photopigments on the DEP website at **www.dep.state.ct.us/wtr/lis/hypo/phytoplanktonfactsheet.pdf**.

Visit the DEP website at **www.ct.gov/dep**.

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