The tropical lionfish, a favorite at the Atlantis Marine World, has also been sighted in Long Island Sound!
Photo by Chris Paparo
Atlantis Marine World
www.fishguyphotos.com

COMING TO MARINE WATERS NEAR YOU

The introduction of new species into the Great Lakes and other freshwater bodies, and resultant economic and ecological impacts on freshwater ecosystems has been well documented by years of research. More recently, there has been increased media coverage about similar impacts in marine ecosystems.

Take the case of the lionfish. Reports of this colorful tropical fish (*Pterosis volitans*) in eastern Long Island Sound are quite surprising because this popular aquarium species usually lives in the tropical waters of the Pacific and Indian Oceans. Conditions on the northeastern seaboard are not ideal to support lionfish survival, and, seasonal presence of this exotic would not be cause for alarm if these fish died with the onset of winter. However, increased lionfish sightings could suggest a year-round presence in eastern Long Island Sound.

Invasives Making Waves

How do such species get here? Non-native species may be transported by many vectors including natural means such as ocean currents and hurricanes, by accidental means, and, intentional release by humans. Anglers that fish in Shinnecock Canal on eastern Long Island observe the seasonal arrival of tropical exotic fish such as triggerfish, porcupine fish, and angelfish—a delightful treat! These exotics are transported up the East Coast by seasonal ocean currents and they rarely (if ever) live much beyond the time when water temperatures drop in winter. The earliest sailing ships carried pioneer explorers across the globe and unwittingly transported marine invertebrates in the wooden hulls. Shipworms and sea lice were transported to the United States from Europe in this way more than 500 years ago. Hulls and keels provide a surface for fouling flora and fauna macrocosms to thrive, and, a number of non-native algae and bivalves were transported to Long Island Sound by this method.

Ballast tanks on commercial vessels are filled with water to maintain stability when the vessel is not loaded. Ballast water must be off-loaded (or discharged) when a vessel takes on additional cargo. Oftentimes, non-native species are taken up in ballast materials when the ballast tanks are being filled, and they are transported and released in new areas when the ballast water is discharged. The Chinese mitten crab (*Eriocheir sinensis*) was introduced into waters off the west coast of the U.S. in ballast discharge released by ships that moved cargo from the Pacific coast of Korea and China. This crab was first

The Chinese mitten crab (*Eriocheir sinensis*), introduced into the western U.S. through ship ballast water, appears to be heading east.
Photo courtesy of Paul Heinwitz, Oregon Sea Grant

reported in the mouth of a tributary in the Chesapeake Bay, Maryland, in 2005; more recent reports place it in the lower St. Lawrence River and the lower Hudson River.

Two other non-native crabs have been introduced to the Atlantic coast of the U.S. in ballast discharge. The European green crab (*Carcinus maenas*) is native in waters from Northern Africa to the Baltic Sea. This crab was first recorded in the Mid-Atlantic in 1817, and established communities exist on rocky shores from New Jersey to Prince Edward Island, Canada. The Japanese (or Asian) shore crab (*Hemigrapsus sanguineus*) was first reported in the U.S. in 1988 in New Jersey and has since spread northwards to Maine and southwards to North Carolina. This crab is a permanent resident in LI Sound with large crab communities established on the shores around Westchester County. Populations of native crabs and, ironically, the non-native European green crab declined significantly in LI Sound since the emergence of Japanese shore crabs.

Other industries also create pathways for transporting non-native species. Problems can develop when non-native species are transported and inadvertently introduced in areas where they were not intended to be released. For example, brood stock oysters are shipped in mud and seaweed that provide a refuge for other hitchhiking organisms. In the tristate area, anglers fish in the ocean with bait worms that were imported from Maine while packed in seaweed. Dr. **George Kraemer** (Purchase College, SUNY) is working with a team of researchers at the University of Connecticut to determine if the packaging material shipped with this popular bait is putting recreational and commercial fisheries in Long Island Sound at risk from harmful non-native species that may include animals and toxin-producing microalgae.

Non-native species are usually introduced unintentionally, but, there are exceptions. For example, intentional introductions occur when aquaria pets are set free by their owners; this vector may have facilitated the lionfish introduction in Long Island Sound. Anglers can introduce non-native species when they fish with bait imported from distant regions that was purchased over the Internet. Individuals have been caught trying to smuggle non-native species for the purpose of release in the wild in the hopes of establishing a new fishery, especially when the organism is considered a delicacy.

New Species Impact Marine Ecology

Significant ecological impacts can occur when a non-native species depends on native species as a major food source and later threatens the native species' long term survival. Asian shore crabs eat juvenile lobsters and dense communities of this invasive crab could be disastrous for the lobster fishery that continues to suffer from a major population decline. The European green crab has a voracious appetite for soft shell clams; its introduction was blamed for the collapse of Maine's soft shell clam fishery in the 1950s.

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Japanese (or Asian) shore crab (*Hemigrapsus sanguineus*) among algae, Montauk.
Photo by Alberto Knie

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... to read about exotic aquatic species on the move

THE LEXICON OF INVASION

Non-native species are plants and animals that have been transported, intentionally or unintentionally, into a geographic region outside their native ecosystem. Other terms for non-native species include: introduced, exotic, alien, foreign and transplant. These terms imply that an organism has been transported into a new ecosystem. Examples of non-natives include certain agricultural crops, ornamental plants, aquaculture and fishery stocks, livestock and pets. Such species may have significant benefits when kept under appropriate management.

Invasive species describes organisms that are non-native to the ecosystem where they were introduced and whose presence cause or are likely to cause economic or environmental harm, or create risks to human health.

Cryptogenic describes an organism that cannot be categorized as native or non-native. In the Mid-Atlantic region there are several cryptogenic sponges, jellyfish, and marine worms.

Naturalization occurs when a non-native species reproduces consistently to sustain populations over more than one generation without assistance from external sources, including humans. Although unfavorable conditions in a new ecosystem could kill non-native species, if the organism is resilient, it may adapt and thrive.

PLANTS ARE INVADERS, TOO!

When it comes to exotic invasive species, plants are no slouches. In coastal wetlands, exotic invasive plants such as common reed and purple loosestrife have been tenacious invaders displacing native species over large areas of habitat. Now another species can be added to the ranks of plant invaders on Long Island: Japanese knotweed. Already invasive worldwide, this species is spreading throughout Long Island.

Little is known about Japanese knotweed populations in North America, but thanks to NYSG- funded research, this gap is being addressed. Drs. Massimo Pigliucci and Christina Richards of Stony Brook University conducted a study of the genetics of LI knotweed populations. They found that the dominant way that knotweed spreads is through vegetative reproduction after initial introduction by seed. Their results offer evidence of limited clonal genetic diversity as well as the establishment of both non-hybrid and hybrid knotweed in the US. They also found substantial variation in traits and salt tolerance among plants. The ability to establish new populations by seed, and then spread over a site vegetatively, combined with adaptability to new conditions, contribute to the invasiveness of Japanese knotweed.

– Lane Smith

Invasive species have been linked to several disease outbreaks in New York's marine fisheries. Quahog Parasite Unknown (QPX), a prolific invasive pathogen that affects hard clams, was first recorded in New Brunswick, Canada, in 1959 and an epidemic occurred in New York waters in 2002. Recently, Viral Hemorrhagic Septicemia virus (VHSV) appeared in the Great Lakes, and is responsible for the deaths of several hundred thousand round gobies in the St. Lawrence River and a die-off of gizzard shad in Lakes Ontario and Erie in the spring of 2007.

Such disease outbreaks that occur in major fisheries call for immediate management response. For example, in response to the VHSV threat of 2007, regulations were passed to prohibit the transport of fish and bait between different freshwater bodies in the Great Lakes and the marine district. Actions taken by the State that necessitate closure of major fisheries or considerably limit fishing operations create financial hardship and income loss in coastal communities that depend on the affected fisheries.

Economic burdens may be created if fishermen are forced to spend more money to offset the impacts of invasive species. Baymen used to fish with traps constructed from wooden lathes, but these traps couldn't stand up to attacks from shipworms. Consequently, these fishermen use traps built from durable plastic-coated wire; plastic-coated gear is more expensive, but, doesn't act as a magnet for shipworms. Invasive species can also damage physical structures. Scientists are monitoring reports of Chinese mitten crabs in the Hudson River because these crabs can burrow into the embankment and increase erosion, which can cause blockages on screens that protect intake pipes at power plants, drinking water treatment facilities, and other industries.

A major problem in dealing with invasive species is that our ability to take action is very limited once these species are established. Marine habitats are very difficult ones in which to develop suitable treatment programs, and chemical treatment is usually not a viable option. Options for eradication are usually labor intensive and offer limited success. Given the suite of vectors that contribute to the spread of non-native species, it makes sense to adopt practices that do not exacerbate this problem, especially when non-native species have the potential to invade and control their new ecosystems. It is not easy to anticipate these ill-effects until after invasion is well underway, by which time options for control are limited.

— Antoinette Clemetson with contributions from Chuck O'Neill, Lane Smith and George Kraemer

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...for more information on invasive plants

Anglers that use marine sandworms release other organisms such as amphipods (inset) when they discard the seaweed packaging material into the water.

Photos by Barbara A. Branca