Habitat Hotline Atlantic

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# Explaining the Long Island Sound Lobster Die-off: The Perfect Storm

August 1999 was unusual for commercial lobster fishers in Long Island Sound (LIS). Catches were unexpectedly dropping and large numbers of dead lobsters were being pulled up in the western part of the Sound. Dead lobsters were not limited to adults but also included sub-legals, molting lobsters and berried (females bearing eggs) lobsters.

The situation did not improve in September. There was almost no fall run or fall molts in parts of the Sound. Hard shell lobsters were weak and lethargic with many lobsters dying within hours of being landed. Overall mortality increased and landings declined.

The situation worsened in October 1999 as the die-off spread to other organisms including blue crabs, rock crabs, spider crabs, sea urchins and starfish. Wholesalers reported high mortality of lobsters within days of receipt. Landings continued to be lower than normal and lobster fishers also found berried lobsters molting, an unusual situation.

The die-off in western LIS had a significant economic and ecological effect on the lobster resource. Landings decreased anywhere from 64-99% in the western part of LIS (**Figure 1**). Approximately 70% of the lobster fishers surveyed by the Connecticut Department of Environmental Protection (CTDEP) in western Long Island Sound lost 100% of their total income and the remainder lost 30% to 90% of their total income. The die-off continued into 2000 raising concern about the ability of the population to rebound. Surveys since 1999 have found low abundances of females and low numbers of larvae.

**Lobster Biology**

Lobsters are cold-blooded animals with an extreme sensitivity to environmental conditions that can alter their metabolism. LIS is the southern end of the commercial fishery of American lobsters and is near the limit of their inshore range (Factor and Clemetson 2003). Summer water temperatures in LIS can reach the upper

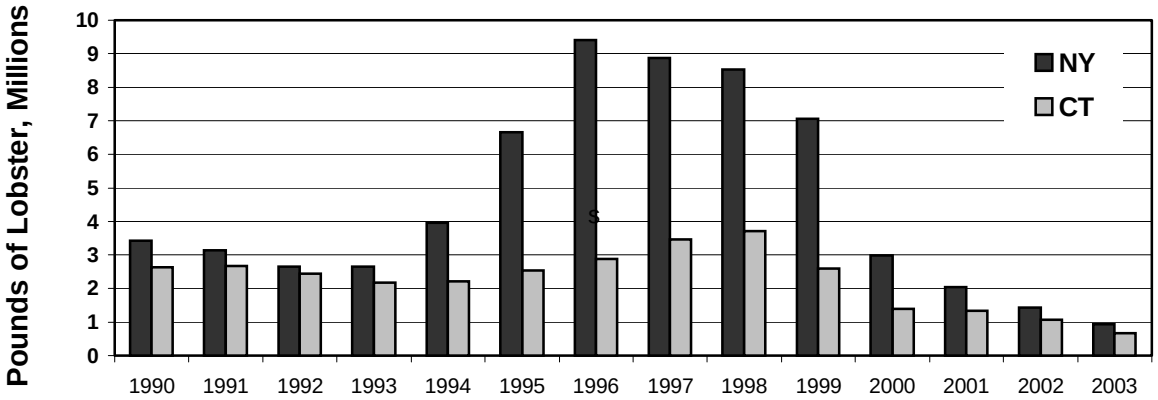


**Figure 1. Landings of American Lobster in New York and Connecticut from 1990 - 2003 (from ASMFC 2004 Lobster FMP Review).**

*(continued on page 2)*

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*Working towards healthy, self-sustaining populations of all Atlantic coast fish species or successful restoration well in progress by the year 2015.*

*(continued from page 1)*

margin of lobsters' tolerance limits, about 68° F. Lobsters can withstand higher temperatures, up to 35° C (95° F), however, when water temperatures go above 68° F, lobster's respiration rate increases and the animal can become physiologically stressed. Hypoxia (low dissolved oxygen) in the water column can also stress lobsters. Hypoxia often coincides with higher temperatures when lobsters need the most oxygen to maintain equilibrium. These conditions can lead to death, disruption of hormone systems and reduced immunity to pathogens.

**The Perfect Storm**

Scientists identified four possible factors that contributed to the die-off: changes in water quality conditions including elevated temperatures and changes in dissolved oxygen levels; changes in environmental conditions such as pesticide levels or changes from storms; lobster crowding; and diseases (**Figure 2**).

In June 2001, Congress earmarked special funds for research on the lobster die-off. Over $3.5 million in federal and state of Connecticut research grants were awarded to 17 science research teams to investigate the causes behind the die-off. In October 2004, after three years of research, scientists summarized their results at the 4th Annual Lobster Health Symposium.

Scientists believe that a series of environmental factors and events combined to create habitat conditions leading to the die-off of lobsters in western LIS. Warmer water temperatures, low oxygen levels, overcrowding and disease collectively contributed to the die-off of lobsters (**Figure 2**).

*Physical & Chemical Conditions*

Hypoxia, temperature and rainfall all contributed to the die-off by making the lobsters physiologically stressed and more vulnerable to pathogens and chemical stressors (**Figure 2**). Increases in population densities and changes in land use patterns have resulted in increases in nitrogen and silica, both indicators of eutrophication. Increasing air and water temperatures caused a decrease in the renewal of oxygen in the water leading to hypoxic conditions. Sediment samples confirm LIS waters were severely hypoxic just prior to the 1999 die-off.

Surface and bottom temperatures were higher than normal during the summer and fall of 1999. Lack of rainfall led to a highly stratified water column with slow estuarine circulation. Stratification was reduced by a strong mixing event, Hurricane Dennis, which stirred up a cold front and winds, causing the temperature at the bottom of LIS to rise by more than 2° C in six hours. Tropical Storm Floyd then dropped three inches of rain and caused heavy runoff from surrounding areas, leading to restratification of the water column and continued above-average water temperatures. Scientists conclude that the environmental conditions (higher water temperatures and low dissolved oxygen) present in the summer and fall of 1999 alone were enough to cause high lobster mortalities. The inability of the already-stressed lobsters to tolerate the additional change in water temperature may have compounded the problem by inhibiting immune response.

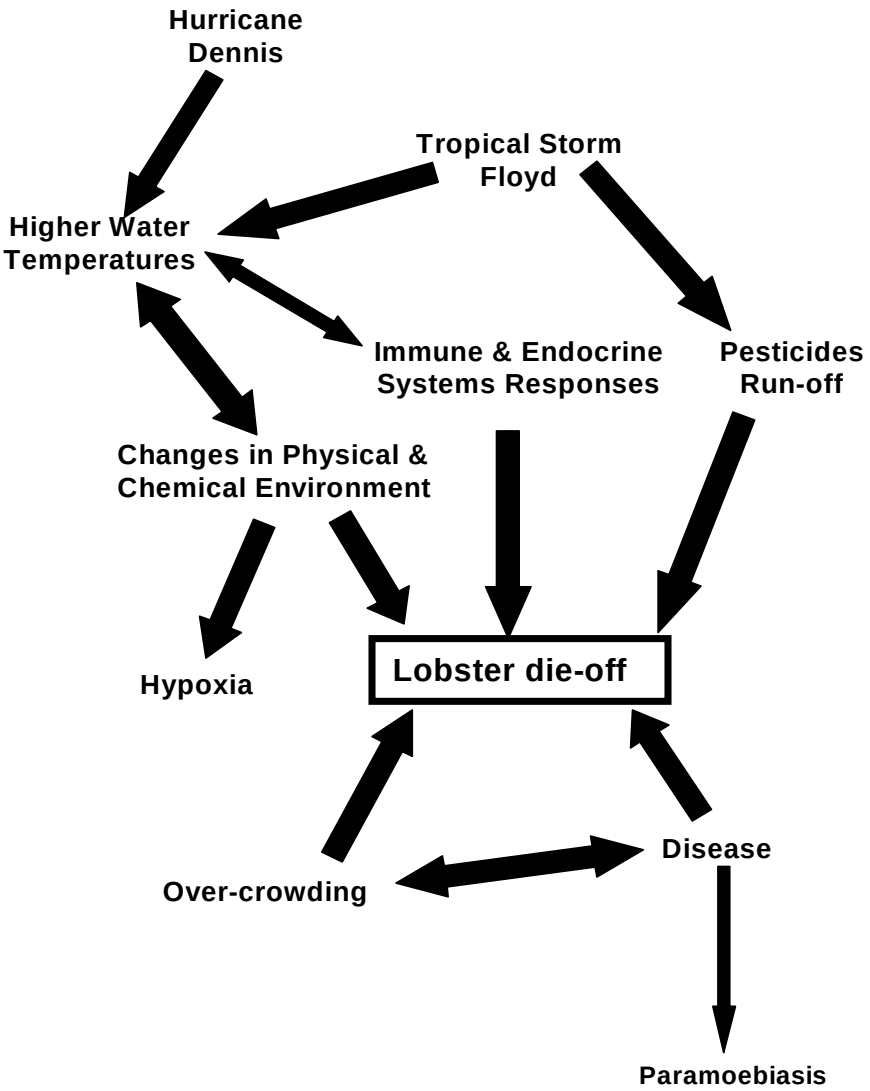


**Figure 2. Diagram illustrating the factors involved in the Long Island Sound lobster die-off.**

**Physiological (Immune & Endocrine) Responses Study**

Lobsters show reduced immune function and disruption of hormone systems, such as the molting hormone, in late summer when water temperatures increase. In 1999, higher temperatures combined with hypoxic conditions left lobsters unable to physiologically cope with the changes in the environment and often led to death.

*Disease*

Some lobsters caught in 1999 were infected with the disease paramoebiasis. Amoebae were found in the nervous, glandular and connective tissues of the lobsters. Scientists think that record high lobster densities combined with higher water temperatures and hypoxic conditions promoted infection of lobsters with paramoebae. Long-term monitoring data suggest that increased bottom water temperatures also contributed significantly to the spread of disease.

Shell disease was known to cause death in lobsters in previous years but nowhere near the level of the die-off. Lobsters can generally respond to and fight shell disease but when the carapace is breached or ulcerated by the pathogen, internal lesions can lead to death. In normal environmental conditions, shell disease is not thought to cause mass lobster mortalities. Stressful environmental conditions, however, can make lobsters more susceptible to death from shell disease. Recent research by the Long Island Sound Lobster Initiative shows that few lobsters actually die from shell disease and it was not a major factor in the die-off. The disease still remains a priority in lobster research as it can compromise lobster health and marketability and is spreading to Rhode Island and Massachusetts.

In summer 2002, another lobster die-off occurred in the LIS Central Basin, although on a much smaller scale than the 1999 die-off. Scientists identified a new metabolic disease called calcinosis that may have contributed to lobster mortality. Calcinosis is an accumulation of calcium in lobster tissue, which in advanced stages affects the gills and causes the animals to suffocate. Characteristics of a lobster suffering from calcinosis include an orange belly and rusty gills covered with abnormal growths. Preliminary results link the deaths in 2002 from calcinosis to a long period of warm bottom water temperature in LIS.

*Pesticide Concentrations*

Researchers also explored the possibility that higher levels of pesticides in LIS caused the die-off. Some lobster fishers believed that pesticides used to combat the West Nile virus caused the lobster die-off. Both New York and Connecticut sprayed pesticides in the summer of 1999 to kill mosquitoes that might carry the West Nile virus. Over 100 lobster fishers filed a class action suit against pesticide manufacturers, contending that the lobsters were exposed to high levels of pesticides washed into LIS after a four-day period of heavy rains from Tropical Storm Floyd.

Researchers measured mortality and immune response to three pesticides likely to be found in LIS in larval and juvenile lobsters: methoprene, malathion and resmethrin. Methoprene bioaccumulated in tissues of lobsters but models suggest that the maximum concentration in LIS was well below the threshold for effects in lobsters. The maximum malathion concentrations found in LIS in bottom waters were not within the range of concentrations having effects in lobsters. Studies show that resmethrin has several lethal and sublethal effects in lobsters. Modeling of pesticides levels suggest that maximum concentrations in LIS surface and bottom waters may have had lethal effects on larvae and sublethal immune effects on adults in a few localized embayments. Scientists still need to study the possible impact of the pesticide sumithrin as a stressor in limited areas.

**Habitat Conditions**

LIS habitat is changing. Periods of hypoxia are now a regular, annual feature in late summer and appear to be lasting longer each year. Scientists warn that the conditions leading up to the die-off in LIS could happen again and could affect other organisms. Clams, oysters and finfish have also experienced mortality incidences but not as significant as the lobster die-off.

In 1994, the Long Island Sound Study (LISS) completed a Comprehensive Conservation and Management Plan that identified seven management issues: (1) hypoxia, (2) toxic contamination, (3) pathogen contamination, (4) floatable debris, (5) living resources and habitat management, (6) land use and development, and (7) public involvement and education. In 2003, the U.S. Environmental Protection Agency, New York and Connecticut signed the 2003 Long Island Sound Agreement reaffirming the 1994 agreement and identifying specific management goals. Some of the goals include eliminating or reducing hypoxia, reducing bioaccumulation of contaminants in living resources, cleaning up contaminated sites that contribute to pollution and restoring the ecological functions and health of lost and degraded habitats. Agencies involved in managing LIS understand maintenance of the habitat is critical to helping the lobster population rebound.

**ASMFC Efforts**

The Atlantic States Marine Fisheries Commission's (ASMFC) Lobster Health Steering Committee is working to continue research regarding the causes and effects of lobster diseases and for monitoring lobster health over the entire range of the resource.

For more information see the NY/CT Sea Grant's Long Island Lobster Initiative web site at http://www.seagrant.sunysb.edu/LILobsters.

Sources: NY/CT Sea Grant, ASMFC.

Connecticut Department of Environmental Protection. 2001. Information Regarding The Impact Of 1999 Lobster Mortalities In Long Island Sound.

Factor, J.R. and A. Clemetson. 2003. Life as a Lobster in Long Island Sound: Biology and Life Cycle. Lobster Health News Supplement, Joint Publication of the Sea Grant College Programs of Connecticut and New York.

# Around the Coast: Spotlight on Protecting Corals

## Two Florida Corals Proposed for Threatened Status

The National Oceanic and Atmospheric Administration, National Marine Fisheries Service (NOAA Fisheries) announced that it will propose listing staghorn (*Acropora cervicornis*) and elkhorn (*Acropora palmata*) corals as threatened under the Endangered Species Act (ESA). NOAA Fisheries conducted a status review and determined that staghorn and elkhorn corals warrant listing as threatened under the ESA. This would be the first listing of any coral species as threatened or endangered under the ESA.

Staghorn and elkhorn corals are branching corals found in shallow water on reefs throughout the Bahamas, Florida and the Caribbean. They grow best in clear water free from excess nutrients, run-off or algal blooms. These corals are particularly sensitive to sediment, as they are some of the least effective reef-building corals at trapping and removing sediment from their surface. Prolonged exposure to high water temperatures and other stresses can lead to the loss of zooxanthellae (symbiotic algae) from the coral, generally referred to as bleaching. The algae give corals their color, provide food to the coral and remove some of the corals waste products.

Staghorn and elkhorn corals were once abundant but now remain at low levels despite efforts to monitor stresses that cause their decline. Physical damage from human activities, hurricanes, disease and temperature-induced bleaching have all contributed to the decline says retired Navy Vice Admiral Conrad C. Lautenbacher, Jr., Ph.D, undersecretary of commerce for oceans and atmosphere and NOAA administrator.

Public comments will be solicited and reviewed once NOAA formally proposes to list the two species. If listed, the corals will have a variety of protections put in place. Direct take of the corals will be prohibited, critical habitat areas will be protected and recovery plans will be developed and implemented. Finally, the listing of these corals will require greenhouse-gas emitting industries to consider the well-being and recovery of these corals before they are given permits to pollute.

Source: NOAA

## Coral Reefs Report Published

The Global Coral Reef Monitoring Network, a consortium of 240 experts from 96 countries, published its most recent report, **The Status of Coral Reefs of the World: 2004**, which documents the continuing impact human activities have on coral reefs worldwide. The report details initiatives aimed at reversing coral reef degradation, identifies major stresses to coral reefs and makes recommendations for protection of coral reefs. Reefs of most concern are in the wider Caribbean, Persian Gulf and Southeast Asia where declines in overall cover are severe and reefs are beyond repair in some cases. The report calls for larger networks of no-take Marine Protected Areas and a greater commitment to reef preservation from the international community. The report is available online at http://www.aims.gov.au/pages/search/search-coral-bleaching.html

Source: Australian Institute of Marine Science

## Boaters Help Protect Coral Reefs and Seagrass Beds

The U.S. Department of the Interior and the Boat Owners Association of the United States (Boat U.S.) signed an agreement on October 29, 2004 to work together to protect coral reefs, seagrass beds and other important marine habitat. The educational efforts will include information on how boaters can do their part to avoid groundings that damage these fragile habitats and how to report groundings as soon as they happen so restoration efforts can begin.

Coral reefs and seagrass beds provide important fish habitat and protect shorelines from storms. Seagrass beds provide habitat for redfish, snook, stone crabs and other valuable species. Coral reefs and seagrass beds are fragile habitats that have been damaged by pollution, overuse and props that tear out grasses when boaters inadvertently run aground on reefs or seagrass beds. Coral reefs and seagrass beds in Florida are valued at $8 billion.

Source: U.S. Department of Interior

## U.S. and Australia Partner for Coral Reef Research

The State of Florida, Great Barrier Reef Marine Park Authority and the National Oceanic and Atmospheric Administration (NOAA) Coral Reef Program signed a Memorandum of Agreement to improve coral reef resilience. Resilience is the natural ability of corals to survive and recover from stresses in the environment. The partnership will emphasize coordinating scientific research, exchanging information on emerging management strategies and developing joint research projects. The partnership focuses on the Florida Keys National Marine Sanctuary and the Great Barrier Reef Marine Park.

Source: NOAA

# President Bush Responds to Ocean Commission Recommendations

On December 17, 2004, President Bush issued an Executive Order establishing a Cabinet-level Committee on Ocean Policy and issued the U.S. Ocean Action Plan in response to the final report of the U.S. Commission on Ocean Policy. The Committee will develop a work plan to address governance principles, filling gaps in legislative authority and streamlining overlapping authorities on ocean, coastal and Great Lakes issues. The Ocean Action Plan provides direction for immediate and future ocean policy. Following are some habitat-related actions proposed in the document.

**Enhancing Ocean Leadership and Coordination**

- Establish a Cabinet-level committee on ocean policy that will advise the President and agency heads on ocean-related matters.

**Advancing our Understanding of the Oceans, Coasts and Great Lakes**

- Develop a plan that will evaluate research needs and identify areas of greatest priority and opportunity.
- Create a National Water Quality Monitoring Network to provide recommendations on the design and creation of a comprehensive national water quality monitoring network.

**Enhancing the Use and Conservation of Ocean, Coastal and Great Lakes Resources**

- Implement local coral reef action strategies.
- Form new international partnerships to enhance management of coral reefs.
- Foster coral reef protection and conservation by recreational and agricultural interests.
- Develop criteria for coral reefs that allow resource managers to identify reefs at risk and to assess the effectiveness of restoration techniques.
- Establish Aquaculture Effluent Guidelines.
- Coordinate and improve integration of the existing network of marine managed areas.
- Adopt an ocean parks strategy that promotes characterization of marine species and habitats, evaluates their condition, increases the understanding of marine ecosystems function and develops cooperative science based fishery management plans.

**Managing Coasts and their Watershed**

- Support the reauthorization of Coastal Zone Management Act.
- Award Targeted Watersheds Grants and Conservation Innovation Grants that fund projects that develop innovative conservation technologies and approaches.
- Establish a forecasting system for harmful algal blooms.
- Promote local restoration projects.

For a copy of the entire document, please visit http://ocean.ceq.gov/.

# ASMFC News

**Staff Changes at the Commission**

**Carrie Selberg** — In January 2005, Carrie Selberg started a new position working for NOAA's Office of Legislative Affairs. In her five years at the Commission, Carrie was an integral part of the Commission's interstate fisheries management program and the backbone of the Habitat Program. Working with the Commission's Habitat Committee, Carrie was instrumental in elevating the importance of Atlantic coastal fisheries habitat issues at the state, regional and national levels. Through her efforts, she increased our knowledge of coastal habitat and its critical role in supporting successful fisheries management activities.

**Julie Nygard –** In January, Julie Nygard joined the Commission as its newest Fisheries Management Plan & Habitat Coordinator. Julie recently received her Master's in Conservation Biology & Ecology from San Francisco State University. While in graduate school she worked for the National Park Service analyzing data for restoration projects in the Presidio of San Francisco. Julie also has experience working for an environmental consulting firm doing public relations on environmental projects. Julie is looking forward to furthering the work of the ASMFC Habitat Committee. Please contact Julie if you have any questions about our Habitat program.

**Announcement – Habitat Folders Available for Distribution**

The Commission recently published habitat fact sheets for 11 of our 22 managed species. When complete, the habitat folders will have a habitat fact sheet for all of our species. Folders are available for distribution now and will be updated with the second half of the fact sheets by the end of the year. Please contact Julie Nygard for more information.

# In the News

**New Invasive Species Identified**

U.S. Geological Survey scientists have identified a potentially threatening exotic marine species. *Didenium* cf. *lahillei* is a colonial sea squirt that has been observed in the North Atlantic, specifically the continental shelf off of New England and the Gulf of Maine. Concerns are mounting as the sea squirt exhibits the characteristics of a highly invasive species: sudden occurrence where not known before, rapid reproduction and no known predators. The sea squirt is found on hard substrates such as docks, pilings, moorings, rock outcrops, gravel seabed and ship hulls. The sea squirt overgrows native sea squirts, sponges, anemones, scallops, mussels and oysters, ultimately threatening important habitat for native organisms. For more information, please visit http://woodshole.er.usgs.gov/project-pages/stellwagen/didemnum/ .

**Artificial Reefs Research Continues**

North Carolina Sea Grant researches have shown that artificial reefs built in patches may be better for aquatic species colonizing the reefs. Artificial reefs that varied in height, edge and complexity were used more by crabs and pinfish, both important food sources for other fish species.

**ASMFC Joins Partnership to Protect Fish Habitat**

The Atlantic States Marine Fisheries Commission (ASMFC) recently joined the Southeast Aquatic Resources Partnership (SARP), a coalition of state, federal and conservation agencies committed to working together to, "protect, conserve and restore aquatic resources including habitats throughout the Southeast for the continuing benefit, use and enjoyment of the American people." The SARP is focusing on six key aquatic resource issue areas: public use, mitigation of fishery losses due to dams, imperiled fish and aquatic species recovery, interjurisdictional fisheries, aquatic habitat conservation and aquatic nuisance species. More information on current activities is available at http://southeast.fws.gov/news/2004/r04-103.html .

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