LONG ISLAND SOUND

Lobster Health Symposium

Identifying the Driving Forces Behind the 1999 Lobster Mortality Event — Fitting Together the Pieces of the Puzzle

The extensive research effort addressing the potential causes of the 1999 lobster mortality event in Long Island Sound has reached its culmination, and the time has come to put the pieces of the puzzle together. A wealth of new information on how American lobsters interact with their environment, their physiological responses in the presence of various stressors, and findings on two new infectious lobster diseases will be of long-term benefit to researchers and resource managers throughout the range of this species.

During the 1990s, the lobster population in Long Island Sound was increasing, reaching an all-time high abundance in 1997-1998. Localized lobster mortality events were reported to state resource managers by lobstermen and dealers in 1997 and 1998. The substantial body of evidence from 1999 shows that an unusual synergism of factors pushed the western Long Island Sound lobster population far out of equilibrium with its environment, subjecting the lobsters to sustained, increasingly hostile conditions. Above average bottom water temperature for a sustained period of time was the driving force behind the snowball effect of environmental, oceanographic, and climatic factors that compounded the physiological stress of a population of lobsters at record-high abundance, and caused widespread morbidity.

The 1998-1999 winter was 'warmer-than-average'. Temperatures remained above average throughout the summer, coupled with drought conditions. The lobsters, already living at the southernmost edge of their inshore range, were exposed to water temperatures above their upper threshold temperature of 20 °C for several months (a total of 83 "degree days"). The lobsters began to concentrate in deeper waters to avoid the warmer shallower waters, and in western Long Island Sound, moved away from hypoxic areas in late summer, causing additional crowding. Beginning in late summer, ammonia and sulfides were released from the bottom sediments into the sediment-water interface, and the effects of low dissolved oxygen and the toxicity of these substances associated with reducing conditions further compounded the animals' stress. A cold front in late August, coupled with winds from Hurricane Dennis to the south, suddenly and completely mixed waters that had been stratified for much of the summer by temperature and salinity. Bottom water temperature increased ~1 °C (2 °F) in a matter of about six hours to more than 22 °C, exposing the lobsters to rapid, additional thermal stress. In

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mid-September, Tropical Storm Floyd moved through the region, bringing more than three inches of rain. The subsequent freshwater runoff caused the water column to re-stratify by salinity. Some lobsters, their immune systems compromised by these sustained and increasingly hostile environmental conditions, started to succumb directly. Others, in their weakened state, were unable to fend off infection by paramoebae and died of paramoebiasis. By mid-September, lobstermen were reporting notable numbers of dead and dying lobsters.

One or more of these stressors have been present in other years, and may have caused stress to lobsters or even localized mortality events. However, it was the unlucky and coincidental compounding of all these factors occurring all together that resulted in a significant mortality of lobsters in 1999. In 1999, West Nile Virus, new to the Connecticut-New York area, caused seven human deaths in New York. As the virus is carried by mosquitoes, three pesticides (methoprene, malathion, and pyrethroids) were applied in different areas and by different means to control the mosquitoes. The apparent coincidence between the timing of the lobster deaths and the pesticide applications raised questions as to cause and effect. Subsequent laboratory studies demonstrated both lethal (larvae) and sub-lethal (adults and juveniles) effects in lobsters caused by exposure to these pesticides. Studies were then undertaken to factor the amount of the individual pesticides applied, the timing of the applications, and the pesticides' decay rates into hydrodynamic models for Long Island Sound, to determine if the pesticides could have been responsible for the mortality of the lobsters. Two independent modeling efforts did not implicate pesticides (methoprene, malathion, and resmithrin) as playing a significant role in the 1999 mortality event. Further investigation is warranted to rule out sumithrin as a stressor in limited areas as it was not specifically studied as part of the research initiative. Research is continuing to refine the preliminary results of the model.

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