LONG ISLAND SOUND

Lobster Health Symposium

Modeling Pesticide Concentrations in Long Island Sound

A phased approach was used for applying numerical models developed previously by HydroQual to address quantitatively whether or not application of four pesticides (i.e., methoprene, malathion, resmethrin, and sumithrin) to combat mosquitoes carrying West Nile virus alone could have caused the massive die-off of lobsters observed in Long Island sound during 1999. In Phase I model application, an overly conservative model input assumption, that entire mass of pesticides applied in the watershed reached the open waters of Long Island Sound without any attenuation or decay in either the watershed or the Sound, was used. Model calculated 24-hour average ambient levels of methoprene in the Sound are well below the lowest reported ecological endpoint (i.e., 2.8 µg/L stage 2 larvae LC_{50}). Under the assumed conservative model loadings, results for malathion are highest in the East River and are much lower in the western Sound area of the lobster die-off, and are below the lowest reported ecological endpoints (i.e., 4.1 µg/L larvae LC_{50}) in near bottom waters of western Long Island Sound. The higest 24-hour average pyrethroid concentrations calculated with the most conservative model loadings and no attenuation, were higher than the lowest reported ecological endpoints, 0.01 µg/L and 0.095 µg/L for reduction in adult phagocytosis and larval 96-hour LC_{50}, respectively.

In phase II, malathion, resmethrin, and sumithrin were modeled with a less conservative and more realistic set of assumptions which included decay of the pesticide within the receiving water. On this basis, 24 hour average concentrations throughout Long Island Sound that were calculated by the model did not implicate malathion and resmethrin as significant sources for stress in adult lobsters in 1999. For the pyrethroids, we cannot fully rule out the possibility that sumithrin may have been a stressor. The pesticide modeling is continuing to refine these preliminary results.

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Effects of Pesticides in American Lobsters

The possible contribution of pesticides to the 1999 lobster die-off was investigated in several laboratories to assess (1) the concentrations of pesticides that cause effects (lethal and sublethal) in lobsters of different age classes (larvae, juveniles and adults), and (2) whether these concentrations might have been found in Long Island Sound (LIS) in 1999 (using results from modeling conducted by an independent party based on pesticide application data). It was determined that methoprene bioaccumulated in tissues of lobsters, with mortality of larvae (LC_{50}) at 2.8 ppb as the most sensitive endpoint, molting problems in post-larvae at 5 ppb, decrease in protein synthesis in juveniles at 25 ppb, and changes in immune functions at 33 ppb. The maximum methoprene concentration likely to have reached LIS based upon the pesticide model was 0.02 ppb, well below the threshold for effects in lobsters. The LC_{50} for malathion was 4.1 and 38 ppb in lobster larvae and adults, respectively, with effects on immune functions of adult lobsters at 5 ppb. The maximum malathion concentrations likely found in LIS based upon the pesticide model were 5.4 ppb in surface water and 1.6 ppb in near bottom water, the former within the range of concentrations having effects in lobsters. Resmethrin had several lethal and sublethal effects in lobsters in the laboratory experiments, including LC_{50} in larvae at 0.095 ppb, changes in phenoloxidase (although not consistent) in juveniles at 0.03 ppb, and reduction in immune functions in adults at 0.01 ppb. The maximum resmethrin concentrations likely calculated in LIS based upon the pesticide model were 0.58-0.73 ppb in surface water and 0.39-0.54 ppb in near bottom water, which may had lethal effect on larvae and immune compromise in adults in LIS in 1999, based on the pesticide model results.

Based upon these research results, pesticdes have not been implicated in the 1999 lobster mortalities, and the research is continuing to refine the preliminary modeling results.

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