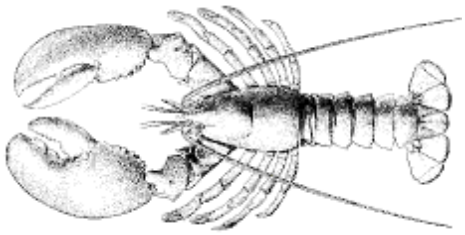
INFORMATION REGARDING THE IMPACT OF 1999 LOBSTER MORTALITIES IN LONG ISLAND SOUND



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EXECUTIVE SUMMARY

The Governors of Connecticut and New York contacted the U.S. Secretary of Commerce during early December 1999 requesting disaster assistance under Section 312(a) of the Sustainable Fisheries Act due to a widespread die-off of lobsters in Long Island Sound (LIS). Based on preliminary information submitted by the states and information from commercial lobster fishers, the Secretary on January 26, 2000 declared a commercial fishery failure in the LIS lobster fishery. Research conducted by the University of Connecticut at the request of the Department of Environmental Protection (DEP) indicates that a protozoan parasite is the immediate cause of the die-off.

The DEP has compiled information to further document and substantiate the magnitude of reductions in landings and losses. This information has been requested by the National Marine Fisheries Service and will form the basis for development of an assistance program. The information includes the following: 1) history of lobster mortality in LIS, 2) information on the die-off from fishers and dealers obtained from phone calls, meetings, mail surveys and newspaper articles, 3) lobster abundance indices from DEP trawl surveys, 4) commercial landings, fishing effort, and catch characterization information from the DEP commercial logbook system and sea-sampling, 5) research efforts into the cause of the die-off, 6) an assessment of the human dimensions of the fishery collapse, and 7) a characterization of the lobster fishery e.g., number of active participants, number of pots fished by port and related data.

Lobster mortalities have occurred intermittently in LIS. Past mortality events had been attributed to adverse environmental conditions (high temperatures, low dissolved oxygen) and gaffkemia, a common lobster disease also known as “red tail” or “wasting disease.” These past abnormal mortality events (1990 & 1991, 1993 and 1997) were much less severe than the catastrophic events that began in the fall of 1998 and became widespread in the fall of 1999. The DEP became aware of the recent die-offs from phone calls from lobster fishers. A few reports of abnormal mortalities were received in the late summer and fall of 1998 from western LIS lobster fishers. Reports received in the late summer and early fall of 1999 indicated severe wide spread lobster mortality that began in western LIS. Lobster dealers also reported newly caught lobsters dying in holding tanks at their markets. Commercial fishers were very concerned because of the occurrence of numerous dead and dying lobsters and crabs, the dramatic decrease in their catches, and eventually, the extreme scarcity of lobsters of all ages and sizes. They also reported the absence of the 1999 fall molt and “fall run.”

The DEP began investigations into the cause of the mortalities during September 1999 in cooperation with the New York Department of Environmental Conservation (NYDEC) and the National Marine Fisheries Service (NMFS) Milford, Connecticut Laboratory. The agencies collected water quality and sediment samples for chemical and physical analysis, collected and sent lobsters to several laboratories for analysis of pathogens (parasites & bacteria) and toxic substances. The state agencies expanded sea-sampling efforts with commercial lobster fishers, conducted bottom trawl surveys to determine if other species (fish and invertebrates) were being affected, and to characterize the

abundance and status of the lobster population in western LIS. Sea-sampling of the commercial fishery conducted by the DEP from late September to early December revealed that 7% of the lobsters caught were dead, 32% were lethargic or moribund, and 61% appeared normal. The water quality and sediment analyses revealed no abnormal levels or conditions and, the initial trawl survey (September 1999) showed a normal assemblage and abundance of finfish and crustaceans. Initial analysis of lobsters for diseases and parasites by the NMFS Milford Laboratory and several other laboratories did not reveal a probable pathogen. During mid-November the University of Connecticut Pathobiology Laboratory identified a protozoan parasite (*Paramoeba spp)* as the immediate cause of mortality of lobsters sampled from western LIS. All lobsters examined from western LIS had extensive infestations. The parasite has not been detected in the small number of lobsters examined to date from eastern LIS. Analyses for toxic substances in lobsters has not been completed.

DEP annual spring and fall trawl survey data show declining lobster abundance indices from historic highs beginning in the fall of 1998 and continuing to the spring and fall of 1999. The decline in these abundance indices is consistent with anecdotal information from commercial fishers regarding a die-off of lobsters. Central LIS abundance indices from a special December 1999 trawl at five sample sites were not significantly different from the 1995-1998 average, but western LIS abundance indices for five sites were significantly less than the 1995-1998 average.

The fall 1999 commercial landings for all ports declined dramatically from the 1995-1998 average**. Fall landings for all ports from Norwalk to Greenwich declined 91% to 99%. Reductions in fall landings for ports to the east of Norwalk ranged from 64% to 91%. These data reveal a catastrophic failure of the fall fishery throughout LIS with western ports most severely affected**. Catch per unit of effort (catch per trap haul) also showed significant reductions in the fall of 1999. Comparison of the fall catch per trap haul to the 1995-1998 average shows a decline of 83% for western LIS and 39% for central LIS.

The future of the LIS lobster fishery cannot be fully ascertained at this time. The dramatic reduction in fall 1999 landings can be attributed to the die-offs and to some extent an extremely late fall molt. Additional commercial sea sampling and fishery independent sampling in 2000 are needed to determine the relative abundance, composition and structure of the remaining lobster population and viability of the fishery. In addition, research is needed to determine the frequency of occurrence and geographical distribution of the parasite in LIS lobsters. Research is also needed to investigate potential physical and chemical causes of the die-off and how these parameters could relate to general lobster health.

A consultant conducted a preliminary assessment of human dimensions related to the collapse of the lobster fishery through a rapid response survey of western LIS lobster fishers. The study found that approximately 70% of the fishers surveyed had lost 100% of their total income and the remainder lost 30% to 90%. The duration of losses ranged from 2 to 16 months with an average of 6.8 months. The report also stated that retraining

lobster fishers for other jobs would be difficult because their average age is high (45 years), their long time lobstering (23 year average), and their commitment to fishing. The report documented significant social economic and psychological damage to fishing families and communities. An additional study would be needed for a comprehensive impact assessment of all fishers.

The notoriety of the lobster die-off has affected the marketability of LIS lobsters, both locally and for export markets. A mail survey has been distributed to Connecticut lobster dealers which will characterize the impact on their markets and business. The survey results will be compiled and analyzed and submitted as an addendum to this report.

Due to the importance of the LIS lobster fishery, and the suddenness, severity and magnitude of the lobster die-off, assistance is needed for a significant amount of research and monitoring to determine the current status of the LIS lobster population, causes of the die-off, impacts on the commercial lobster fishery, future viability of the fishery in LIS, and the socio-economic impact of the die-off on fishers, their families, and communities. Specific research and monitoring studies are needed to:

- Determine the relative abundance and composition of the LIS lobster population by area.
- Monitor and determine the status of the LIS commercial lobster fishery e.g, number of participants, fishing effort, marketability of LIS lobsters. Determine the frequency of occurrence, severity and distribution of lobster pathogens in LIS.
- Determine if environmental or chemical factors were contributors to lobster mortality in LIS.
- Document the social, psychological and economic impact on lobster fishers, their crews and families.
- Quantify the effects on local and export markets for LIS lobsters.
- Determine the effects on local communities and infrastructure.

This list is not all inclusive but is presented to indicate the type of research and monitoring that would be needed. Moreover the results of these studies may reveal additional research needs.

More immediate direct financial and social support assistance is needed by commercial lobster fishers, their families and communities to cope with dramatic reductions in income and revenue, and resulting social and psychological impacts.

A) REQUEST FOR ASSISTANCE

During December 1999 the Governors of Connecticut and New York wrote William Daley, the U.S. Secretary of Commerce, requesting disaster assistance under Section 312(a) of the Sustainable Fisheries Act due to a wide spread die-off of lobsters in LIS. At the request of the DEP, research by the University of Connecticut Pathobiology Laboratory indicates that a protozoan parasite is the probable immediate cause of the lobster die-off.

To assist the Secretary in his determination of whether or not a commercial failure has occurred due to a fishery resource disaster, the National Marine Fisheries Service (NMFS) Northeast Regional Office requested that the States of Connecticut and New York submit sampling information regarding the commercial LIS lobster fishery and associated information to document reductions in lobster landings. This information was requested to include statistical surveys, economic analyses and results of interviews with lobstermen, if available. In subsequent phone communications, NMFS also asked that information to characterize the lobster commercial fishery e.g., number of license holders, number of lobster pots fished by port, etc., and the price per pound received by lobstermen be included in the information submitted by the states. NMFS also requested preliminary information pending compilation of the comprehensive data reports. In response to the NMFS request, the DEP and the NYDEC submitted preliminary information that the Secretary used to make his determination on January 26, 2000 that there is a failure of the commercial lobster fishery in LIS.

Information Submitted to Support the Request for Assistance

The DEP has compiled the following information to further substantiate commercial failure of the LIS lobster fishery. This information can be used to quantify the magnitude of the reductions in landings and losses to provide the necessary basis for development of an assistance program:

- History of Lobster Mortalities: Brief history of lobster die-offs in LIS.
- Anecdotal Information and Newspaper Articles: Information from fishermen and interviews.
- Mail Surveys: 1) Lobster fishers, 2) Lobster dealers.
- Fishery Independent Data: 1) Abundance indices from the DEP annual spring and fall trawl surveys, 2) Abundance indices from a special December 1999 trawl survey.
- Fishery Dependent Data: 1) Landings data from the DEP commercial logbook system by specific ports and geographical area, 2) Fishing effort (trap hauls) and catch per unit of effort from the logbooks, 3) Commercial sea sampling.

- Research Efforts and Findings: 1) The cause of the die-off; diseases and parasites, water & sediment quality, 2) Research needs.

- Preliminary Socio-Economic Study: Impact of the die-off.

- Characterization of the Commercial Lobster Fishery: 1) Number of lobster fishers and pots fished by port, 2) Average monthly price paid to fishers for lobster for 1995 to 1998, 3) Number of commercial licenses by type for 1995 to 1999.

B) HISTORY OF LOBSTER MORTALITY IN LIS

The lobster fishery is the most important commercial fishery for Connecticut in Long Island Sound, excluding shellfish, accounting for approximately 75% of the total harvest by weight and over 90% of the value of commercial landings from the Sound.

Environmental conditions and habitat define the range of marine finfish and crustaceans. Long Island Sound is near the southern extent of the inshore range of the American lobster. Lobsters are found south of Long Island to North Carolina but generally occur offshore in deeper waters. It is reasonable to assume that as a species nears the limits of its range, populations would be more susceptible to stress caused by variations from normal environmental conditions.

Reports of low levels of lobster mortality in LIS during the fall have not been uncommon. These mortalities have generally been attributed to adverse summer environmental conditions such as high water temperatures and low dissolved oxygen that may stress lobsters or makes them more vulnerable to disease. Periodically, *abnormally* high levels of mortality have occurred in LIS. During 1990 and 1991, abnormally high lobster mortalities were observed. At that time a study conducted by the DEP and NYDEC of lobsters and water samples found gaffkemia (*Aerococcus viridans homari*), known as wasting or red tail disease, to be the probable cause. In the fall of 1993 gaffkemia was again found to be the cause of abnormal lobster mortalities. During the fall of 1997 reports of dead lobsters were received from western LIS. The DEP documented these lobster mortalities but did not investigate further because the level of mortality, while appearing somewhat higher than normal, did not appear extreme.

During the fall of 1998 incidences of mortalities were reported from western LIS with highest mortality occurring in the far western areas of LIS, particularly in the Greenwich and Stamford areas. Thirty lobsters collected in the fall of 1998 tested negative for gaffkemia. Fishers did not indicate the severity of the 1998 mortalities to the DEP until the die-offs became even more severe in 1999. Beginning in late summer and early fall of 1999 reports of large numbers of dead and dying lobsters were received from western LIS. Reports of the incidence of dead and lethargic lobsters in the central areas of LIS (Branford/Guilford) also increased significantly soon thereafter. Large numbers of dead and dying lobsters prompted the DEP and NYDEC to begin investigations into the possible causes of the die-offs and to compile information documenting the impact on the lobster population and the commercial fishery. The occurrence of dead and dying

lobsters continued through the fall of 1999 with reports of dying lobsters still being received, and documented through commercial sea sampling in January 2000.

C) ANECDOTAL INFORMATION FROM LOBSTER FISHERS

The DEP and NYDEC became aware of dead and dying lobsters during late August and early September 1999 through phone calls and personal contacts with LIS lobster fishers. The lobster mortalities and the apparent dramatic reduction in the number of juvenile and adult lobsters observed and caught by lobster fishers during the fall of 1998 and 1999 generated numerous phone calls to the DEP Marine Fisheries Office. The following is a summary of significant consistent comments regarding the die-off, the impact on the fishery this year, and the status of the lobster population:

Summary of Phone Calls

- Lobster mortalities began in the fall of 1998, primarily in western LIS from Norwalk to Greenwich. Some dead lobsters were also seen in the fall of 1997.

- Lethargic, moribund and dead lobsters were observed from Norwalk west to Greenwich beginning late August-early September 1999, increasing in severity during late September through October and early November.

- The mortalities were much more severe and widespread in 1999 than in previous years.

- A few reports of lethargic and dead lobsters were received during September and October from eastern LIS lobster fishers, along with a few calls from citizens finding dead lobsters in localized along the beaches from Groton to Niantic.

- Western LIS lobster fishers also reported dead and dying blue crabs, rock crabs, and sea urchins.

- Lobster fishers from Norwalk west to Greenwich reported total 1999 landings through November down 30% to 90%, with the most severe reductions in the Greenwich area.

- Many lobster fishers in western LIS and some in the remainder of LIS gave up fishing during the 1999 fall and winter because their catches did not justify the effort and operating expense.

- The spring and summer lobster fishery for the central and eastern portions of LIS equaled or exceeded catch and landings for the same period last year, but the spring and summer fishery from Norwalk west to Greenwich

was significantly reduced from last year.

- Lobster fishers throughout LIS were seeing few lobsters this fall and winter, including sub-legals.

- Central and eastern LIS lobster fishers reported an extreme scarcity of lobsters of all sizes and ages during fall and winter 1999.

- Lobster fishers throughout LIS did not see a fall run.

- The fall molt was delayed, soft-shell and new shell lobsters were not seen until mid-late December 1999.

Newspaper Articles

The fall and winter 1999 lobster die-off resulted in numerous newspaper articles. These articles contain personal interviews with lobster fishers that provide insight into the extent and severity of the die-off and the impact on the fishery and businesses. A sampling of these articles is presented in Appendix 1.

D) MAIL SURVEY OF COMMERCIAL LOBSTER FISHERS AND DEALERS

The DEP and NYDEC had no quantitative information regarding the occurrence, location and magnitude of the lobster die-offs reported by commercial fishers. Therefore, both state agencies conducted a mail survey of their licensed lobster fishers and seafood dealers.

Survey of Fishers

A mail survey was sent to 416 Connecticut commercial lobster license holders on October 27, 1999. The survey was also distributed at two lobster public informational meetings held on October 20 & 21, 1999. The survey requested information on when and where dead or dying lobsters were observed, the percentage dead or dying lobsters, as well as information on other species also affected (see Appendix 2 for survey form). To date, 59 surveys (14%) have been returned of which five were not useable for various reasons. Due to the low response rate the survey was revised and re-mailed on January 20, 2000. License holders were instructed not to fill out the second survey if they had responded to the first survey.

Responses from the initial survey were compiled and results presented below. This information will be updated as responses from the second survey are received.

Survey Results

- Sixty three percent of respondents from Area 1 reported dead or dying lobsters in their pots in 1999, 80% (12 of 15) in Area 2, and 93% (14 of 15) in Areas 3 and 4 (Commercial Fisheries Catch Logbook Areas of LIS, Figure 1). No surveys were returned from fishers in Areas 5 or 6 (New York waters of LIS).

- At least half of all reported dead lobsters in 1999 were legal size ('keepers'). In Areas 1 and 2, approximately two-thirds to three-quarters of observed dead lobsters were keepers, with the remaining shorts and a few eggers (eggers were ~1 in 10). In Areas 3 and 4, approximately half of observed dead lobsters were keepers with the remaining half equally divided between shorts and eggers (eggers were ~1 in 5) (Table 1). These differences could reflect lobster availability (relative abundance in areas) as well as differences in susceptibility to disease.

- A similar pattern of mortality was reported for dying lobsters in 1999 as that outlined above for dead lobsters (Table 1).

- There were no clear differences in mortality between the sexes of observed dead or dying lobsters in 1999 (Table 2).

- For all years-combined (1997-99) almost all respondents reported mortalities in September and October (Figure 2). In Areas 2, 3 and 4 few mortalities were reported in July-August, and November-December, while none were reported in other months. In Area 1, some mortality was reported in all months.

- Similar monthly patterns of mortality were seen in 1997 and 1998, as in 1999 although fewer respondents reported seeing mortalities in the earlier years (Figure 2).

- Only respondents fishing in Areas 3 and 4 reported severe mortality (25-100% dead), the frequency increasing from 1997 to 1999. Moderate mortalities (10-25% dead) were reported in Area 1 all years, but in higher frequency in Area 2, 3 and 4 in 1998 and 1999 (Table 3, Figure 3). Slight mortality (1-10% dead) and no mortality were reported by the large majority of respondents in Areas 1 and 2 all years, and in Area 3 in 1997.

- All but one respondent for Areas 3 and 4 reported other animals dead in their pots, while only one-half of respondents in Areas 1 and 2 reported other animals dead in their pots (Table 4).

- Very few respondents reported unusual water color, odor or plant growth.

- One-half of the respondents from Area 1 reported incidents of shell rot compared to only 27% (4 of 15 in Area 2), and none in Areas 3 and 4.

- Many of those respondents reporting severe mortality (25%-100% dead) also reported longer set times (Table 5). The relationship is not statistically significant (chi-square = 8.74, df=6, p>0.10), but a larger sample size may clarify if any true relationship exists.

Survey of Dealers

A mail survey of all licensed Connecticut seafood dealers that handle lobsters was sent out on January 14, 2000. The survey requested information on local marketability and export of lobsters, the impact of the die off on availability of lobsters for purchase, and the impact on their business (Appendix 3). The dealers were asked to return the surveys by January 21, 2000. The results of the survey will be compiled and summarized as soon as possible.

The survey information will provide insight into the importance of the Canadian and European markets for LIS lobsters. Canadian regulators considered, but did not implement a ban on U.S. lobster imports. However, Canadian processors have agreed to avoid buying lobsters taken from the waters south of Massachusetts to safeguard against the spread of the parasite linked to deaths of lobsters in LIS. French government officials have also questioned the safety of American lobsters because of the parasite found in LIS lobsters (Appendix 4).

E) FISHERY INDEPENDENT INFORMATION (DEP Bottom Trawl Surveys)

Abundance Indices from the DEP Annual Spring and Fall Trawl Survey

Samples are collected annually by the R/V John Dempsey during spring (April-June) and fall (September-October). A total of 200 sites are randomly sampled (40 each month), 120 during spring cruises and 80 during fall. An annual index of lobster abundance per bottom trawl tow has been calculated for the spring and fall sampling periods since 1984. Both spring and fall indices show an increasing abundance of lobsters starting in 1989 with the exception of a slight downturn in 1994-1995. Abundances increased dramatically in 1997 and 1998 to record high levels before declining in the fall of 1998 and spring and fall of 1999 (Figures 4&5). Note that despite the decline from 1998, the 1999 spring index was the second highest and the 1999 fall index third highest in the 16 year time series. The declining abundance indices appear consistent with anecdotal information from commercial fishers regarding a lobster die-off that began in the western LIS during the fall of 1998. The central and eastern portions of LIS did not appear to be significantly affected by the lobster die-off until the late summer and fall of 1999.

The trawl indices discussed above are mean estimates calculated from samples obtained over the entire Long Island Sound. Relative abundance in specific areas of the Sound could be significantly higher or lower than these seasonal means. Further analysis of the data would be necessary to calculate and compare abundance means by specific geographical areas within the Sound. We will not have current comprehensive survey

data to document the status of the LIS lobster population until the spring trawl surveys which will begin in April 2000.

Abundance Indices from a Special December 1999 Trawl Survey

A special bottom trawl survey was conducted on December 16 & 17, 1999 utilizing the R/V John Dempsey. The abundance indices obtained from these tows when compared to mean abundance indices obtained from the DEP fall trawl survey for the same sites for the period 1995 to 1998, should provide fishery independent comparisons to give insight into impact of the die-off on the relative abundance of lobsters. The materials and methods for the surveys are presented in Appendix 5.

Two known areas of lobster concentration, one off New Haven (central sample area) and one between Bridgeport and Norwalk (west sample area) were identified for sampling (Figure 6). Five sites were sampled from each area for a total of 10. These sites corresponded exactly to sites previously sampled in the annual DEP October trawl survey. One 30-minute tow was conducted at each sample site. All lobsters collected were enumerated and a total composite weight recorded for each tow (Table 6). Simple t-tests of the 1995-1999 mean abundance per tow against the December 1999 sample mean were conducted. There was no significant difference ($t=0.11$, $df=9$, $P>0.05$) for the central sample area between the 1995-1999 mean abundance per tow of 121 lobsters and December 1999 mean of 113 lobsters per tow. The t-test for the western sample area showed a significant difference ($t-2.7$, $df=7$, $P<0.05$) between the 1995-1999 mean of 334 lobsters per tow and the December 1999 mean of 186 lobsters per tow (Table 7).

F) FISHERY DEPENDENT INFORMATION (Commercial Fishery & DEP Sea Sampling)

Commercial Landings Data

The commercial landings data must be carefully analyzed to accurately characterize the real impact of the lobster die-offs. Total annual lobster landings in LIS increased 46% from 1995 to 1998 primarily due to large annual increases in 1996 and 1997, 14% and 20%, respectively (Table 8). Comparison of total annual landings for January 1, 1999 through November 1999 reveals landings slightly below 1995 levels and 26% less than 1998 landings. But, examination of the reductions in landing by area, year, and season corresponding with reports of lobster die-offs reveal a more dire situation. Reports of significant numbers of dead lobsters were first received from the western LIS ports. The 1999 landings for these ports were affected by the fall 1998 die-off that is reflected in the magnitude of the reductions in the 1999 total annual landings through November. The central and eastern ports appear to not have been significantly affected until the late summer and early fall of 1999. The western ports (Norwalk to Greenwich) appear to have been affected by at least two consecutive years of lobster die-offs. Dramatic reductions in landings throughout LIS occurred during the fall of 1999 coincident with widespread reports of dead and dying lobsters from commercial fishers.

Total commercial lobster landings for the period January 1 through November 30, 1999 were compared to average landings for the same period for the years 1995 to 1998 for 17 ports from Greenwich to Stonington (Table 9). Significantly reduced landings were noted for ports from Norwalk west to Greenwich, ranging from 33% to 69%. Ports to the east, Westport to Stonington, generally showed landings above the1995-1998 mean with the exception of Milford, Groton/New London and Noank/Mystic, which had landings significantly below these levels (Table 10). **Note that these data do not include the fall run which accounts for approximately 27% of annual total landings. Landings to date and anecdotal information indicate that the 1999 fall run did not occur. Therefore, the 1999 percentage reduction in landings from the 1995 to 1998 period can be expected to further increase. The absence of a fall run is most likely due to disease and a late molt.** The large reduction in landings in the western LIS basin is significant as this area accounts for approximately 50%-60% of the total annual LIS lobster landings. The summer and fall Aruns@ account for the majority (90%) of the total annual harvest.

An indication of the differences in 1999 landings from the 1995-1998 mean by geographical area within LIS, can be obtained from catch data by DEP statistical data collection areas (Figure 1). Areas 3 & 4, which encompass both Connecticut and New York waters west of the Housatonic River, showed 27% and 39% reductions in catch, respectively. In contrast, landings east of these areas, (areas 1, 2 & 5) showed small increases over 1998 for the similar period. Area 6 which encompasses the ARace@ showed a 13% reduction (Table 11). It is important to note that Area 3, which encompasses Connecticut waters of the western LIS basin, includes the ports of Westport east to Stratford/Derby. These ports had landings that exceeded the 1995-1998 mean therefore, offsetting the larger reductions seen in the ports from Norwalk to Greenwich, and resulting in a mean reduction of only 27% for Area 3 (Table 10).

An important consideration in evaluating current landings data is the timing of the lobster die-offs in relation to the areas where the die-offs were observed. The DEP first received reports of a significant die-off of lobsters during the late summer and fall of 1998 from western LIS lobster fishers. Reports of dead, moribund and lethargic lobsters were again received in early fall (September) of 1999, first from western LIS, and also from central LIS and some portions of eastern LIS. The most severe die-offs appear to have occurred in western LIS in late summer and fall of 1998 and 1999. This is reflected in the 1999 landings for the ports from Norwalk west to Greenwich. Central and eastern portions of LIS were not significantly affected by die-offs until the fall of 1999.

Landings for the fall period October 13, 1999 through December 1, 1999 were compared to average landings for the same period for 1995-1998 for 17 ports from Greenwich to Stonington (Table 12). **The dramatic impact of the 1999 late summer and fall die-off is apparent for the entire LIS. There was virtually no fall fishery from Norwalk to Greenwich with landings off 91% to 99%. Moreover, the ports to the east of Norwalk also showed dramatic reductions in fall landings generally ranging from 64% to 91%. These data reveal a catastrophic failure of the fall fishery throughout**

LIS with the western ports most severely impacted. Fall landings for the ports of Greenwich and Stamford were off 99%; Darien and Norwalk were off 91% and 96%, respectively. With the exception of Clinton/Westbrook and Stonington, reductions for the ports east of Norwalk ranged from 65% to 92%. Reductions in 1999 fall catch by geographical area when compared to the fall 1995–1998 mean landings showed reductions of 91%, and 72% for areas 3 and 2, the primary lobster production areas in Connecticut waters. Areas 4, 5, & 6, which encompass New York waters of LIS, showed reductions of 95%, 75% and 56% for the fall period (Table 13, Figure 1). Areas 1 & 6, the far eastern areas of LIS, appear to be less seriously impacted by the lobster die-off and reductions in landings.

The fall 1999 landings data are perhaps the most significant evidence demonstrating the severity and magnitude of the die-off on the commercial lobster fishery in LIS. These data presage the future lobster fishery in LIS and indicate a significant reduction in the lobster population Sound-wide which could result in a failure of the commercial lobster fishery for the year 2000 and beyond.

Catch Per Unit of Effort (CPUE)

Catch per unit of effort (CPUE) measured as the number of pounds of lobsters caught per trap haul is an indication of the relative abundance of lobsters and the viability of the commercial fishery. The Connecticut commercial logbook system was utilized to calculate the number of traps hauled, catch and CPUE on a weekly basis for the six logbook areas. Comparisons of the CPUE for 1999 to the average CPUE for 1995-1998 were made for each of the six logbook areas (Table 14). The percentage reduction in the 1999 CPUE was the highest for areas 3 & 4 (48% and 46%, respectively) with an overall average reduction of approximately 30% for all areas.

However, examination of the fall 1999 CPUE in comparison to the 1995-1998 average CPUE reveals a much more severe reduction especially for western and central LIS areas (Table 15). CPUE in areas 3 and 4 declined 83% and 78%, respectively. Significant reductions also occurred in area 2 (59%), and area 5 (63%), and areas 1 & 6 (32% and 43%, respectively). Note that areas 1 and 6 are at the far eastern end of LIS and may be augmented by migration of lobsters into those areas from outside of LIS.

Commercial Sea Sampling Information

Six sampling trips were made between September 27 and December 3, 1999 with commercial lobstermen from Cos Cob, Stamford, and Norwalk. A total of 568 pots (84 trawls) were hauled and 946 lobsters caught. Of the total number of lobsters caught 7% (68) were dead, 31.5% (300) were lethargic or moribund and could be expected to die, and 60.7% (578) appeared normal (Table 16). Catches (lbs.) per trap haul (CPUE) estimates were low and declined from late September to late November. CPUE ranged from 0.457 lbs./trap haul in early late September to 0.022 lbs./trap haul in late November, compared to an average CPUE for 1995-1998 of 1.02 lbs/trap haul.

The average percentage of soft-shell lobsters observed for the six sampling trips was 0.2%, and the average percentage of new shell lobsters was 1% (Table 16). These low proportions of soft and new shell lobsters indicate that the fall molt had not occurred.

G) INVESTIGATION AND RESEARCH IN THE CAUSE OF THE LOBSTER DIE-OFF

The DEP, in cooperation with the NYDEC, conducted studies of water quality and bottom sediment, and investigated with the help of cooperating laboratories, the possibility that viruses, bacteria or parasites, pesticides or chemicals are the cause of the observed lobster mortality. The DEP also contacted the Maine Lobster Institute at the University of Maine to obtain assistance and advice in dealing with the lobster mortalities as Maine reportedly had occurrences of significant mortalities in 1997 and 1998.

On October 29, 1999 the DEP Water Bureau in cooperation with the Marine Fisheries Office collected samples for water quality analyses at 30 sites in western LIS. Chemical analysis were done for volatile organic (66 compounds), semi volatile organics (137), organo-chlorine pesticides (30), chlorinated herbicides (18) and toxic algae. Tests revealed no abnormal levels (Appendix 6**).**

On November 1, 1999 the R/V John Dempsey conducted bottom trawl tows at four sites from Bridgeport to Norwalk to sample finfish and crustaceans to determine if other species were being affected as well as sampling lobsters. These samples revealed the normal fall assemblage of species (finfish and crustaceans) with no apparent illness observed. Approximately 100 lobsters were collected, 10% to 15% appeared lethargic or ill, three were dead and the remainder appeared healthy.

The Department's Marine Fisheries staff conducted six sea sampling trips from late September through early December with cooperating western LIS commercial lobstermen to document the incidence of dead and dying lobsters, to assess the impact on the fishery, and collect lobsters for laboratory analysis. Additional sea sampling trips are scheduled for western LIS and we are also expanding these efforts to central and eastern LIS.

The DEP has coordinated efforts with the NYDEC to share information regarding the lobster die off. During early October DEP Marine Fisheries staff contacted the NYDEC to recommend that the two agencies develop a cooperative coordinated approach to address the problem. Two conference calls were held to exchange information and develop an immediate initial coordinated program to identify where assistance could be obtained from experts in lobster pathology, and to collect lobsters for analysis of parasites, viruses, and bacteria. Based on information shared, lobsters were collected and sent to the U.S. Food and Drug Administration (FDA) laboratory in Washington, DC and the University of Arizona for evaluation. The DEP and NYDEC staff also organized and held a "Lobster Summit" on October 20, 1999 at the NMFS Milford Laboratory to share information, review data regarding the nature and extent of the lobster mortalities, review what has been done to date and the results, and develop a plan of action. DEP and

NYDEC staff, NMFS staff from Milford and Woods Hole, Massachusetts, and a representative from the University of Connecticut attended the summit. A joint Action Plan was developed that included five recommendations:

- Undertake visual observations of the bottom for dead and dying organisms and benthic community structure utilizing a remote operated vehicle (ROV).

- Collect and analyze bottom sediment and water at the sediment interface for various pollutants.

- Undertake histological examination of lobster tissues and organs for damage and presence of toxic substances.

- Continue pathological work to determine the presence of bacteria, viruses or parasites.

- Survey lobster fishers to obtain more quantitative information on the die-off.

As a result of the plan the following tasks were initiated or completed:

- The DEP and the NYDEC developed and distributed a mail survey of all licensed lobster fishers and dealers.

- A survey of the bottom sediment composition and chemistry (bottom profile sampling) at 5 north/south transects and 5 additional sites in western LIS was conducted utilizing a contractor and a remote operated device.

- Lobsters were collected and sent to the University of Connecticut Pathology Department for analysis of tissues for parasites and presence of toxic substances.

- Additional lobster samples were sent to the NMFS Milford laboratory, FDA Washington, DC and University of Arizona laboratories, and a commercial laboratory in Maine (Micro Technologies) for bacteriological analysis.

- Visual observations of the bottom were conducted by ROV in cooperation with the NYDEC and the Iroquois Pipeline Company.

- Lobster samples were sent to cooperators at the Virginia Institute of Marine Sciences and the New York Aquarium.

- The DEP and the NYDEC in cooperation with the EPA LIS Office have applied for an EPA grant in the amount of $125,000 to continue the 5-point program for the year 2000.

In November, University of Connecticut researchers identified a protozoan parasite as the probable cause of the lobster moralities. The DEP continues to collect lobsters for analysis by the University pathobiology laboratory to further document the extent of the parasite in LIS. The DEP will continue to carefully monitor this situation and will continue to coordinate with the lobster fishery representatives and the State of New York on this issue.

At this time it is unknown if the parasite, a protozoan known as a paramoeba, is the primary or secondary agent in the mortalities. Presently, infectivity studies are being conducted by injecting the parasite into healthy lobsters to see if the pathology observed in LIS can be reproduced

H) RESEARCH AND MONITORING NEEDS

The die-off of lobsters in LIS and its affect on the lobster population and commercial fishery have underscored the need for additional or expanded monitoring and research. The DEP, NYDEC, Connecticut and New York Sea Grant, the U.S. EPA Long Island Sound Program, and the University of Connecticut are planning to hold a lobster technical workshop in early 2000 to review the lobster die-off in LIS and to develop a research and monitoring plan. The information shared at the workshop and the identification of issues, problems and needs regarding the lobster die-off and status of the lobster population and commercial fishery will be utilized to develop the plan. It is expected that the plan will identify research studies to: 1) characterize the geographical extent and frequency of occurrence of pathogens in LIS, 2) identify the probable causes of lobster mortality, 3) delineate the status of the LIS lobster population and the commercial fishery, and 4) determine the socio-economic impact of the lobster die-off on the LIS commercial fishery and fishing families. The following is a listing of the types of research and monitoring needs that will be developed at the workshop:

Lobster Pathology and Immunology

- The geographical extent and frequency of occurrence of lobster pathogens in LIS.
- The presence, frequency of occurrence, and level of toxic substances in lobsters in LIS.
- Examination of the histology of lobsters.
- Infectivity studies to determine the pathogen responsible for lobster die-offs.
- Studies of lobster immune systems in relation to stresses and selected chemical compounds.

Environmental and Chemical

- Collect and analyze water samples for pesticides and other chemical compounds at lobster collection sites.
- Collect and analyze samples of sediments for chemical compounds and chemical changes at the sediment/water interface.

- Monitor routine parameters such as dissolved oxygen and temperature

Fishery Independent and Fishery Dependent Monitoring

- Monitor the relative abundance and population composition of lobsters in all areas of LIS.
- Expand commercial sea sampling to assess the commercial fishery and lobster population.
- Compile and analyze commercial lobster catch, harvest and fishing effort data to document and monitor the status of the fishery.

Socio-Economic Analysis

- Social, psychological & economic impact to fishing households.
- Commercial market analysis (loss of markets, products & networks).
- Economic impact by port and community.

Additional resources will be needed by the state agencies and the University of Connecticut to undertake these necessary research and monitoring activities.

I) CHARACTERIZATION OF THE FISHERY

The NMFS has requested the following information to characterize the lobster fishery in Connecticut waters of LIS:

- The number of resident lobster pot fishermen by home port (Table 17)

- The number of Connecticut Commercial fishing licenses by type and month for 1995 to 1999 (Table 18).

- The number of pots fished by port and fishermen for 1998 and 1999 (Table 19).

- The average monthly lobster price paid to fishers by month for 1995 to 1999 (Table 20)

J) STUDY OF THE SOCIAL IMPACT OF THE LOBSTER DIE-OFF

Human Ecology Associates (HEA) of Narragansett, Rhode Island conducted a preliminary assessment of the human dimensions of the collapse of the LIS commercial lobster fishery. HEA was conducting interviews with commercial fishermen in Connecticut during December 1999 as part of an ongoing regional-community study funded by the NMFS Marine Fisheries Initiative, when they learned of the lobster die-off and the severe impact on the commercial fishery. HEA principals contacted the DEP Marine Fisheries Office and offered to conduct a rapid response assessment of the LIS

lobster fishery disaster. The DEP accepted their offer and provided them with information to assist them in conducting the study.

The study was completed on January 17, 2000 and focuses on lobster fishermen, their crew, and families (Appendix 9). The report documents the baseline human condition of the fishery in western LIS and lays the groundwork for a comprehensive impact assessment. The study used a rapid response survey conducted in cooperation with the Western Long Island Sound Commercial Lobstermen's Association (WLOSCLA). The study found that approximately 70% of the fishers surveyed have lost 100% of their total income and the remainder (30%) have lost 30% to 90% of total income. The duration of income losses ranged from 2 to 16 months with an average of 6.8 months. The study noted that because of the severity and suddenness of the disaster, the adaptive characteristics of the fishing population has been negated. Moreover, it found that lobster fishers are not fungible i.e., cannot be easily trained or adapted to new vocations. The report also documented significant social, economic and psychological damage to fishing families and communities. It concluded that they need immediate assistance.

K) KEY FINDINGS

- The U.S. Secretary of Commerce on January 26, 2000 declared a failure of the commercial lobster fishery in LIS.

- A protozoan parasite (*Paramoeba spp*) was found by University of Connecticut researchers in all lobsters sampled from western LIS.

- Preliminary testing of the water for chemical compounds and algae, and sediment testing did not reveal abnormal levels that could be linked to the lobster deaths.

- Lobsters began dying in the fall of 1998 in western LIS. The die-off occurred again in fall and winter of 1999, but was much more severe and occurred throughout most of LIS.

- Eastern and central LIS did not appear to be as affected by the die-off until the fall and winter of 1999; western LIS may have been affected by the die-off for two consecutive years, 1998 and 1999.

- A catastrophic decline in lobster landings throughout LIS occurred during the fall and winter of 1999.

- Commercial sea sampling documented the occurrence of dead and lethargic lobsters and reduced CPUE.

- The fall "run" did not occur in 1999, and the molt as evidenced by occurrence of soft and new shell lobsters, did not occur until mid-December.

- DEP trawl surveys show increasing lobster abundance since 1989 peaking in 1998, before declining in the fall of 1998 and spring and fall of 1999.

- The relative abundance of lobsters from a December 1999 trawl survey showed no significant difference from the 1995-98 average at five sites off New Haven/Branford, but the relative abundance at five sample sites off Norwalk/Bridgeport were significantly less than the 1995-98 average.

- Canadian processors have agreed not to purchase lobsters from south of Cape Cod. European markets are concerned with importing American lobsters.

- The dramatic decline in 1999 landings resulted in a significant decline in total annual income for lobster fishers ranging from 30% to 100%.

- Lobster fishers cannot be easily trained or adapted to new vocations.

- Lobster fishers, their families and communities have suffered significant social, economic and psychological damage

L) CONCLUSIONS:

- The lobster fishery in LIS suffered a commercial failure during the fall and winter of 1999.

- A protozoan parasite (*Paramoeba spp*) is the probable immediate cause of the lobster mortalities. Infectivity testing is required to confirm the paramoeba as the definite cause.

- The dramatic reduction in the fall 1999 landings can be attributed to lobster mortality and to some extent, the absence of a fall run and late molt.

- Additional testing of lobsters is necessary to determine the geographical occurrence and frequency of infestation of lobster pathogens in LIS.

- The present status of the lobster population in LIS is uncertain and additional fishery independent sampling is needed to determine the relative stock abundance and composition by area.

- Additional water quality, sediment, and lobster tissue sampling and analysis are necessary to determine the cause of the lobster die-off and impact on lobster health.

- The notoriety of the LIS lobster die-off has affected the local marketability and export markets for LIS lobsters.

- The future of the LIS commercial lobster fishery is uncertain because of the uncertainty of the stock status and the marketability of LIS lobsters.

- Lobster fishers and their communities need immediate financial assistance

Table: 1- 20

Table 1: Approximate percentages of each lobster type in the population of dead and dying lobsters observed by respondents. *The observed proportion of keepers (legal size), shorts (sublegal size), and eggers was given a rank of 1 to 6, and the average rank for each type was expressed as a percentage of 6. Percentages add to approximately 100% by row. Number (N) of respondents, and number giving no response, are listed*

COMPOSITION of DEAD LOBSTERS

Location	Keepers	Shorts	Eggers	*N*	*no response*
Area 1	60%	28%	10%	13	2
Area 2	78%	12%	8%	11	1
Area 3 – 4	50%	27%	23%	12	2

COMPOSITION of DYING LOBSTERS

Location	Keepers	Shorts	Eggers	*N*	*no response*
Area 1	50%	19%	19%	8	7
Area 2	91%	5%	5%	7	5
Area 3 – 4	47%	27%	19%	12	2

Table 2: Occurrence of males versus females among dead and dying lobsters observed by respondents for legal (keeper) and sublegal (short) size classes. *The number of respondents who thought dead or dying lobsters were mostly male, mostly female, or both sexes equally mixed is listed for each area. Number (N) of respondents, and number giving no response, is listed.*

COMPOSITION of KEEPER LOBSTERS

Location	Mostly Males	Mostly Females	Both sexes	*N*	*no response*
Area 1	2	1	5	8	7
Area 2	3	1	4	8	4
Area 3 – 4	2	0	7	9	4

COMPOSITION of SHORT LOBSTERS

Location	Mostly Males	Mostly Females	Both sexes	*N*	*no response*
Area 1	2	1	5	8	7
Area 2	0	0	2	2	10
Area 3 – 4	1	0	6	7	7

Table 3: Percent of respondents reporting lobster mortality that was severe (25-100% dead), moderate (10-25% dead), slight (1-10% dead), or no mortality.
Percentages add to 100% by area and year including the percentage not answering the question (no response). Note that these percentages are shown in Figure 3 excluding the percent no response.

		----------Mortality----------				No
Area	Year	severe	moderate	slight	none	Response
1 (N=24)	1999	*none*	13%	38%	42%	8%
	1998	*none*	4%	25%	46%	25%
	1997	*none*	4%	17%	50%	29%
2 (N=14)	1999	*none*	29%	50%	21%	7%
	1998	*none*	*none*	14%	64%	21%
	1997	*none*	*none*	14%	64%	21%
3-4 (N=15)	1999	60%	20%	7%	7%	7%
	1998	20%	33%	20%	13%	13%
	1997	7%	*none*	53%	27%	13%

Table 4: Percent of respondents reporting other animals found dead in their pots.

	---------- Crabs ----------					
Area	Blue	Spider	Rock	Fish	None	N
1	20%	27%	20%	*none*	53%	15
2	33%	42%	25%	25%	42%	12
3-4	86%	57%	57%	14%	7%	14

Table 5: Relationship between severity of mortality and trap set time based on the number of respondents in 1999 for all areas combined.

Mortality	--------Set Time in Days----------			
Reported	0-4	5-8	>8	Total
None	2	3	1	6
Slight (1-10%)	4	11	2	17
Moderate (10-25%)	3	5	1	9
Severe (25-100%)	1	3	5	9
Total Respondents	10	22	9	41

Table 6: Historic (October 1984-99) catch of lobsters compared to December 1999 catch at central and western Long Island Sound sites. *The number (n) of samples contributing to the historic mean is also listed.*

Historic Geometric Mean Catch Compared to December 1999 Catch

Area	Site	October 1984-99 Mean (n)	December 1999
Central Long Island Sound	1124	14 (3)	20
	1022	88 (4)	67
	1021	281 (3)	375
	0920	103 (3)	44
	1119	132 (2)	61
Western Long Island Sound	0611	324 (4)	88
	0411	332 (3)	136
	0312	441 (2)	190
	0313	194 (2)	271
	0115	99 (1)	246

Table 7: Statistical comparison (Student t-test) of current (December 1999) and historic (October, 1995-1999) geometric mean catch per tow of lobsters in central and western Long Island Sound. *Logbook area designations are also given*.

**********Central (Area=2)**********

Period	N	Mean	Std Dev	Std Error	Variances	T	DF	Prob>|T|
Current	5	113.00	146.4838	65.5095	Equal	-0.1148	9.0	0.9111
Historic	6	121.00	81.7411	33.3706				
For HO: Variances are equal, F' = 3.21 DF = (4,5) Prob>F' = 0.2327								

**********Western (Area=3)**********

Period	N	Mean	Std Dev	Std Error	Variances	T	DF	Prob>|T|
Current	5	186.20	75.7377	33.8709	Equal	-2.7228	7.0	0.0296
Historic	4	333.75	87.0570	43.5285				
For HO: Variances are equal, F' = 1.32 DF = (3,4) Prob>F' = 0.7686								

Individual Sites and Catches Used for Student t-test Analysis

Area	Site	Catch	Year
Central Long Island Sound	0920	154	1996
	1021	260	1999
	1022	68	1995
	1022	68	1998
	1022	139	1999
	1124	37	1998
Western Long Island Sound	0312	268	1996
	0313	300	1998
	0411	305	1997
	0611	462	1995

Table 8: Total lobster landings (lbs) in Connecticut by month for 1995 to 1999.
Note: Federal Fishing Vessel Trip Reports included.

Month	Year				
	1995	1996	1997	1998	1999*
January	86,971	28,404	97,300	189,847	123,514
February	25,127	12,016	44,237	76,967	48,599
March	30,816	25,837	50,803	72,072	47,055
April	56,679	82,862	80,316	102,748	69,507
May	64,538	126,466	63,254	84,766	55,505
June	251,675	118,735	176,381	489,507	415,076
July	837,734	692,301	787,231	1,051,569	886,685
August	522,431	691,327	859,208	764,424	589,861
September	93,170	160,983	226,066	141,176	77,452
October	88,318	86,012	168,001	54,901	35,777
November	309,409	395,090	467,565	244,445	76,384
December	174,272	468,650	447,689	442,888	2,862 **
Total	2,541,140	2,888,683	3,468,051	3,715,310	2,428,277

* Data not adjusted for reports received after Jan 4th 2000.
** Data incomplete or has not been received from the monthly commercial catch reports.

Table 9: Comparison of the average 1995-1998 (January-November) landings (lbs) to 1999 landings (January-November) for 17 ports

Port	Port Rank	Ave 95-98 Landings Jan-Nov 30th	1999 Landings Jan-Nov 30th
Greenwich	6	159,174	47,840
Stamford	9	88,723	50,964
Darien	7	156,324	104,727
Norwalk	2	376,219	195,256
Westport,Fairfield	13	41,842	57,552
Bridgeport	1	516,704	508,479
Stratford,Derby	14	39,410	59,253
Milford	17	24,868	16,608
E,W,New Haven	3	318,723	314,635
Branford	8	103,277	139,814
Guildford,Madison	10	68,128	93,772
Clinton,Westbrook	16	32,036	47,317
Old Saybrk,Lyme,CT r.	12	50,818	69,279
Waterford	15	37,610	44,971
Groton,New London, Thames r.	4	290,132	237,829
Noank,Mystic	11	62,239	32,730
Stonington	5	242,236	289,379

Table 10: Percent difference between 1999 landings (lbs) and average 1995-1998 landings, January-November, for 17 ports.

Port	% Difference
Greenwich	-69.94
Stamford	-42.56
Darien	-33.01
Norwalk	-48.10
Westport,Fairfield	37.55
Bridgeport	-1.59
Stratford,Derby	50.35
Milford	-33.22
E,W,New Haven	-1.28
Branford	35.38
Guildford,Madison	37.64
Clinton,Westbrook	47.70
Old Saybrk,Old Lyme,CT R.	36.33
Waterford	19.57
Groton,New London, Thames R.	-18.03
Noank,Mystic	-47.41
Stonington	19.46
Total land CT/NY Ports	-16.22
Total land CT Ports	-11.41

Table 11: Percent difference between 1999 catch (lbs) and average 1995-1998 catch, January-November, for six logbook areas.

Area	% Difference
1	6.51
2	5.11
3	-26.93
4	-39.23
5	3.58
6	-13.32
All	-17.72

Table 12: Percent difference between 1999 fall (wk 40-47) landings (lbs) and average 1995-1998 fall (wk 40-47) landings for 17 ports.

Port	% Difference
Greenwich	-99.92
Stamford	-99.29
Darien	-91.17
Norwalk	-96.29
Westport,Fairfield	-84.44
Bridgeport	-78.98
Stratford,Derby	-91.71
Milford	-68.09
E,W,New Haven	-64.16
Branford	-77.82
Guildford,Madison	-76.21
Clinton,Westbrook	-43.28
Old Saybrk,Old Lyme,CT R.	-67.58
Waterford	-83.52
Groton,New London, Thames R.	-65.17
Noank,Mystic	-78.26
Stonington	-24.97

Table 13: Percent difference between 1999 fall (wk 40-47) catch (lbs) and average 1995-1998 fall (wk 40-47) catch, for six logbook areas.

Area	% Difference
1	-41.51
2	-72.10
3	-90.79
4	-95.37
5	-75.89
6	-55.90
All	-81.15

Table 14: Percent difference between 1999 catch per trap haul (wk 0-52) and average 1995-1998 catch per trap haul (wk 0-52) for six logbook areas.

Area	1995-1998 Ave wk 0-52	1999 Ave wk 0 to 52	% Difference
1	0.6692	0.5901	-11.82
2	0.8760	0.7472	-14.70
3	0.8427	0.4409	-47.68
4	0.8022	0.4295	-46.46
5	1.0158	0.7516	-26.02
6	1.6207	1.2863	-20.63
All	0.8838	0.6148	-30.44

Table 15: Percent difference between 1999 fall catch per trap haul (wk 40-52) and average 1995-1998 fall catch per trap haul (wk 40-52) for six logbook areas.

Area	1995-1998 Ave wk 42-52	1999 Ave wk 42 to 52	% Difference
1	0.7531	0.5085	-32.48
2	1.2082	0.4989	-58.71
3	1.0058	0.1734	-82.76
4	0.8535	0.1871	-78.07
5	1.0622	0.3887	-63.41
6	1.5593	0.8890	-42.99
All	1.0291	0.4626	-55.04

Table 16: Summary of six western Long Island Sound commercial lobster sea-sampling trips. *All trips were taken in November-December, 1999, and observed catches from a total of 568 traps (84 trawls).*

		Number	Percent
Market Category	sublegal and eggers	813	86%
	legal size	133	14%
	Total	*946*	

		Number	Percent
Observed Activity Level	dead	68	7%
	lethargic	300	32%
	normal	578	61%
	Total	*946*	

		Number	Percent
Shell Hardness	Soft shell	2	0.2%
	New hard shell	10	1.1%
	Old hard shell	934	98.7%
	Total	*946*	

Table 17: Number of resident lobster pot fishermen by homeport for 1995-1999.

Port	Year				
	1995	1996	1997	1998	1999
Branford	14	16	18	20	23
Bridgeport	28	28	28	27	24
Clinton	9	8	9	7	7
Darien	9	7	6	7	6
Derby	1	1	1	1	1
East Haven	1	2	2	2	4
East Lyme	19	18	15	14	13
Fairfield	4	2	3	2	2
Greenwich	9	8	7	7	6
Groton	36	32	29	32	27
Guilford	11	7	7	8	8
Madison	6	4	2	4	4
Mystic	18	11	11	10	10
Milford	5	4	4	6	4
Montville	.	.	.	1	.
New Haven	9	10	9	13	11
New London	29	20	17	16	17
Norwalk	15	13	12	15	14
Old Lyme	6	8	9	6	10
Old Saybrook	9	10	9	9	11
Stamford	13	13	13	11	9
Stonington	43	32	32	38	37
Stratford	2	4	3	2	2
Waterford	21	20	13	18	13
Westbrook	11	10	13	12	12
Westport	2	1	1	.	.
Noank	24	23	25	22	20
unknown	13	10	8	.	.
Additional reporting under others logbook	30	24	31	24	24
Total	397	346	337	334	319

Table 18: Connecticut commercial fishing licenses issued by type for 1995-1999.
See Appendix 8 for gear types included.

	1995	1996	1997	1998	1999
01 - Commercial Fishing Vessel Permit	0	711	634	617	591
24 - Bait Dealers License	0	0	0	65	59
54 - Personal Use Gillnet License	0	0	62	248	281
55 - Res. Comm. Finfish (Creel Lim.)	136	138	146	151	132
56 - Non-Res. Comm. Finfish (Creel Lim.)	5	4	4	3	3
64 - Party / Charter Boat	96	89	123	143	159
65 - Non-Resident Comm. Finfish	20	8	5	9	8
84 - Seafood Dealers License	82	64	69	67	76
86 - Comm. Blue Crab	5	11	7	10	12
87 - Personal Use Lobster License	1280	1285	1314	1419	1537
88 - Inland Comm. Bait	20	18	19	16	17
89 - Marine Comm. Bait	19	24	22	22	25
90 - Marine Pound Net	2	3	3	2	3
91 - Comm. Landing	47	47	26	31	30
92 - Resident Comm. Fishing	513	445	427	441	419
93 - Non-Resident Comm. Fishing	115	101	95	97	101
94 - Comm. Shad	39	26	21	24	22
95 - Resident Comm. Finfish	302	235	183	133	128
97 - Non-Resident Purse Seine	12	11	3	0	0
98 - Resident Purse Seine	2	0	0	3	0
Total	2695	3220	3163	3501	3603

Table 19: Number of pots fished by resident fishermen for each port, 1998 and 1999. *This information was reported on license applications. Proxy ID numbers were assigned to each fishermen to facilitate year to year comparisons while maintaining confidentiality.*

Note: (-) Indicates data was not on fisherman's license application

(.) Indicates one of three things:

1) fisherman did not have a license that year

2) No activity was reported for that year

3) A different home port was designated that year

Port	ID	1998	1999
Branford	1	.	1500
	6	50	200
	20	.	-
	21	600	1000
	59	100	-
	89	-	.
	132	100	400
	178	50	200
	246	1000	500
	252	-	-
	287	1800	.
	304	2000	2500
	329	500	500
	335	200	400
	368	30	.
	403	.	20
	410	400	600
	445	300	1000
	447	3000	-
	454	.	-
	482	500	2000
	500	200	200
	507	300	200
	526	.	-
	551	2500	2200
Bridgeport	51	250	250
	124	1500	1700
	187	1200	1000
	215	646	.
	230	.	1000
	231	1200	1600
	259	2100	2500
	279	1000	1200
	299	1000	1000
	306	100	2000
	316	-	2000
	339	-	500
	425	150	150

Bridgeport (Continued)	470	300	1500
	473	2000	2000
	541	3000	3000
	549	100	1500
	553	1800	1600
	555	3000	3000
	567	-	3000
	571	500	.
	574	-	-
	576	1500	1500
	578	1800	1800
	585	2200	3000
	588	250	.
	597	3000	3000
Clinton	18	60	60
	26	20	.
	33	.	300
	43	150	-
	119	250	300
	121	300	400
	433	400	-
	589	400	700
Darien	221	2500	2000
	308	1000	.
	480	1000	1400
	515	300	600
	517	2500	2000
	557	3000	2000
	569	2000	2000
Derby	4	100	100
East Haven	77	.	850
	157	40	50
	287	.	1800
	513	2000	1700
East Lyme	25	50	.
	55	-	20
	61	150	100
	102	.	100
	144	600	-
	171	200	200
	180	300	300
	219	500	200
	226	1800	.
	242	200	400
	324	500	500
	366	.	50
	372	500	500

East Lyme (Continued)	443	200	.
	451	300	200
	565	100	50
Fairfield	29	-	.
	290	1000	1000
	326	.	40
Greenwich	115	560	600
	189	30	.
	195	800	850
	199	-	-
	261	800	900
	274	700	.
	397	1000	-
	587	.	600
Groton	14	200	-
	35	100	100
	67	100	100
	105	1500	1500
	111	50	50
	126	200	500
	149	1200	1200
	153	400	400
	155	400	.
	168	100	450
	185	1000	1000
	190	500	600
	201	100	400
	204	50	50
	206	500	400
	210	100	.
	211	400	400
	223	60	.
	263	1200	-
	269	1200	1500
	281	150	500
	295	350	500
	303	75	.
	333	-	200
	337	2000	2000
	341	100	1200
	348	40	.
	360	-	100
	382	350	450
	395	.	400
	468	.	100
	547	600	500
	561	1000	.

Groton (Continued)	582	1000	.
Guilford	16	200	200
	109	700	200
	192	40	-
	244	.	2000
	254	-	150
	297	150	750
	347	40	.
	412	1900	2500
	526	200	.
Madison	71	50	100
	78	300	800
	88	.	100
	194	.	200
	244	2000	.
	504	60	.
	94	30	50
	146	300	.
	173	200	200
	177	.	100
	310	-	.
	318	.	600
	352	100	500
	395	400	.
	493	.	1200
	495	250	200
	559	100	50
	595	.	-
Milford	39	600	-
	356	800	800
	378	75	50
	384	1200	.
	414	500	.
	437	1600	1400
Montville	466	20	.
New Haven	96	-	1500
	98	-	-
	117	2500	.
	140	100	1600
	250	2000	-
	257	400	400
	265	-	1500
	345	900	900
	417	2500	2400
	439	500	.
	467	300	.
	497	4500	4500

New Haven (Continued)	499	-	.
	509	.	4500
	584	.	2400
New London	65	-	-
	100	100	150
	103	200	450
	118	.	250
	130	.	150
	142	750	750
	156	.	500
	213	200	450
	223	.	100
	225	.	30
	236	100	-
	293	500	500
New London (Continued)	311	500	1000
	348	.	75
	394	-	.
	406	1800	2500
	444	75	.
	524	2000	2400
	529	80	.
	536	75	.
	543	450	400
Norwalk	23	300	-
	92	1500	1500
	123	300	.
	175	1000	1200
	233	100	.
	271	.	500
	308	.	-
	350	100	-
	367	1200	.
	376	800	800
	415	1400	1200
	429	1000	1200
	440	.	100
	449	300	300
	484	1200	2000
	528	800	.
	532	100	1600
	580	30	40
Old Lyme	47	33	120
	84	30	-
	131	.	50
	165	.	30
	166	100	100

Old Lyme (Continued)	168	.	300
	218	.	150
	272	200	200
	502	300	500
	545	75	-
Old Saybrook	151	200	200
	161	500	600
	216	30	100
	283	40	40
	321	500	800
	423	50	50
	472	.	200
	488	.	450
	491	800	800
Stamford	12	300	-
	73	300	-
	203	-	.
	208	25	30
	234	600	750
	311	1000	1200
	374	300	.
	386	1200	1500
	404	600	350
	421	500	700
	456	300	400
Stonington	10	40	42
	27	100	100
	30	75	50
	37	50	40
	53	150	100
	63	50	30
	128	-	300
	182	.	25
	228	125	250
	238	500	500
	240	51	60
	275	400	400
	277	-	300
	285	600	500
	289	75	.
	292	-	.
	323	200	.
	354	500	500
	358	800	1000
	369	500	.
	370	25	-
	388	3000	3400

Stonington (Continued)	401	1000	-
	408	300	300
	431	500	500
	435	1000	1000
	458	-	-
	462	500	1500
	464	150	120
	469	30	.
	486	50	50
	505	500	400
	510	.	800
	511	200	150
	519	500	800
	539	-	100
	572	1200	800
	583	.	-
	591	.	1000
	592	.	3000
	595	-	.
Stratford	134	100	100
	537	600	600
Waterford	32	100	.
	69	-	50
	80	250	200
	82	100	-
	90	-	250
	113	25	-
	183	100	100
	226	.	1500
	315	300	.
	364	-	100
	375	200	.
	390	200	150
	419	100	-
	427	1200	1800
	441	25	50
	453	250	.
	455	250	.
	460	40	100
Westbrook	33	300	.
	45	200	200
	57	35	20
	75	200	-
	86	300	300
	163	500	600
	267	250	200
	331	800	900

Westbrook (Continued)	362	100	150
	476	100	200
	478	100	-
	523	.	20
	530	-	200
Noank	2	100	100
	8	200	200
	41	75	-
	49	140	80
	107	50	40
	136	200	225
	138	20	20
	147	75	75
	159	40	100
	197	1800	1500
	248	350	500
	327	100	-
	343	100	-
	380	2000	2500
	392	800	800
	399	100	-
	489	150	-
	493	1200	.
	521	750	750
	534	500	600
	563	100	1500
	592	-	.

Table 20: Average price per pound for lobster by month for 1995-1999.

	Year				
	1995	**1996**	**1997**	**1998**	**1999**
January	3.80	4.03	3.19	3.96	3.82
February	4.50	4.74	3.93	4.30	4.18
March	4.11	5.67	4.43	4.98	5.23
April	4.74	5.39	4.44	4.49	4.29
May	4.23	3.84	4.15	3.79	3.92
June	3.62	3.83	3.98	3.32	3.84
July	2.86	3.63	3.21	3.03	3.54
August	2.97	3.04	3.04	2.98	3.49
September	3.00	3.08	3.14	3.09	3.68
October	3.02	2.99	3.10	3.19	3.75
November	2.98	2.89	2.88	3.09	3.73
December	3.10	2.92	3.00	3.27	-
Weighted Average	3.12	3.30	3.18	3.25	3.67

Figure: 1-6

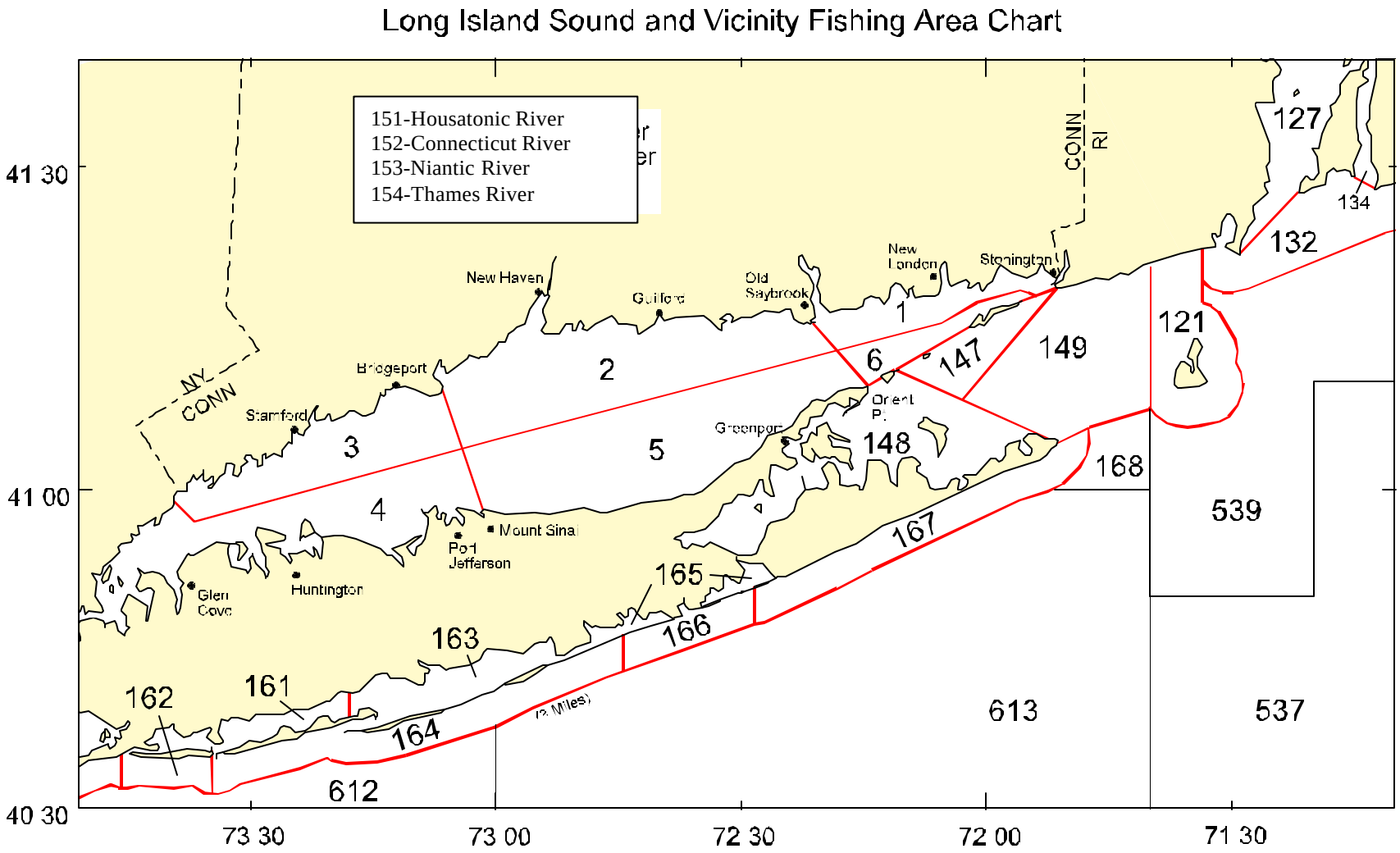

Figure 1: Fishing areas used in the CT DEP Marine Fisheries Information (logbook) System.

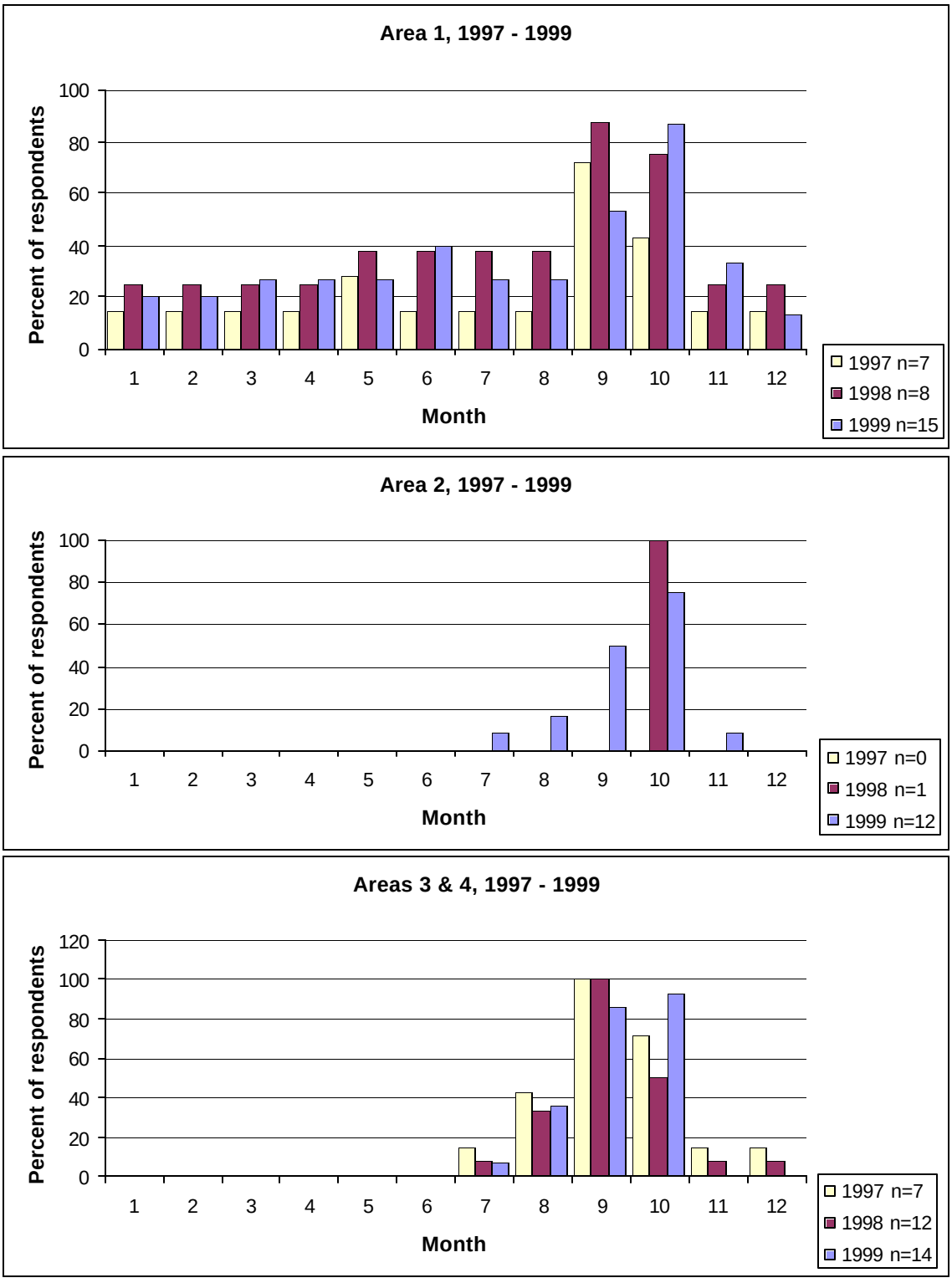

Figure 2. Percent respondents reporting lobster mortality events by month for areas 1, 2, and 3-4, 1997-1999. *Note the smaller sample sizes in 1997 and 1998, compared to 1999.*

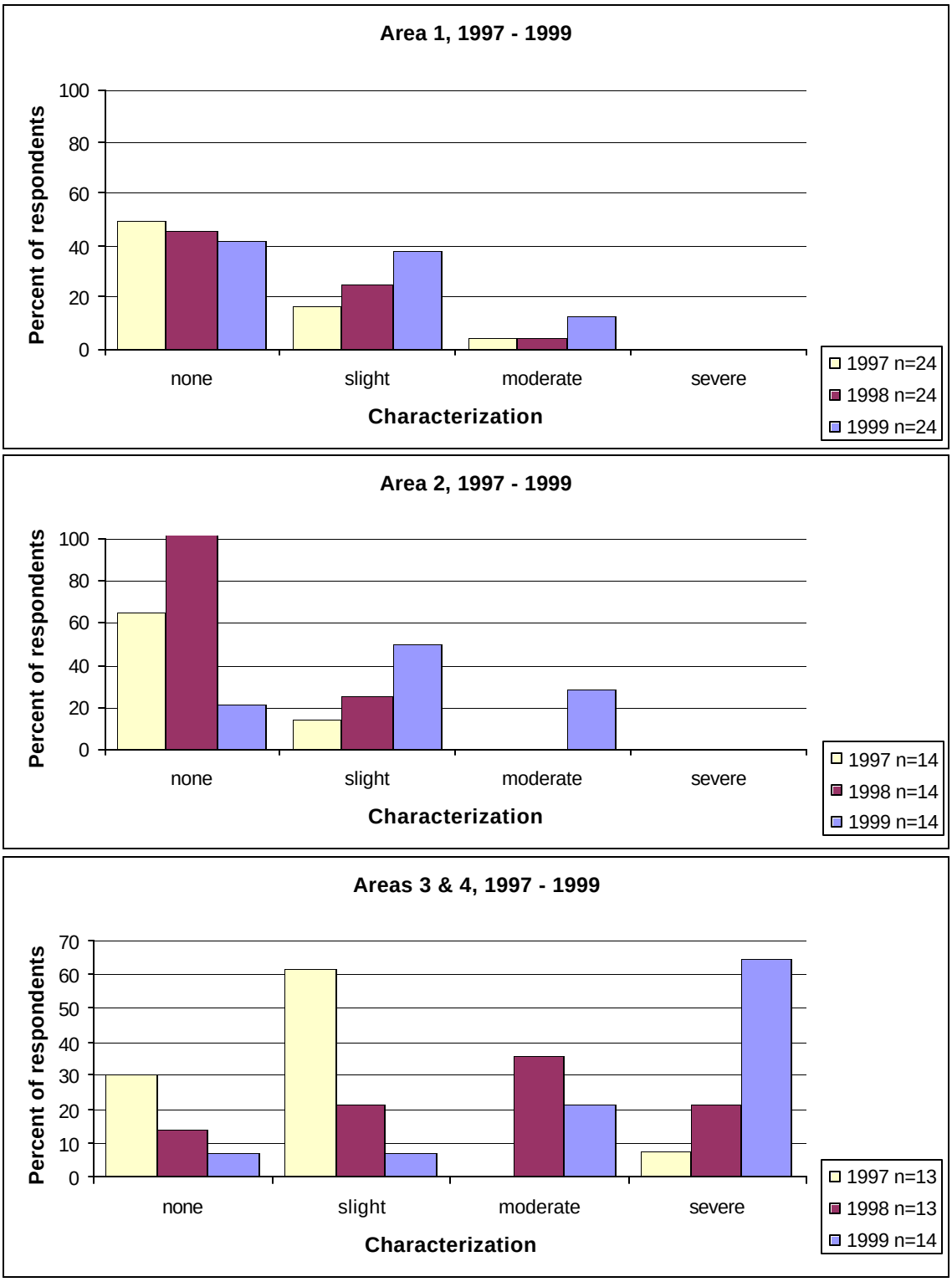

Figure 3. Percent respondents reporting severe (100% dead), moderate (10-25% dead), and slight (1-10% dead), and no mortality by area and year.

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Year	Mean
1984	7.09
1985	3.08
1986	2.76
1987	3.29
1988	2.22
1989	3.76
1990	5.31
1991	7.74
1992	7.8
1993	6.7
1994	4.06
1995	8.31
1996	6.78
1997	7.67
1998	18.59
1999	12.37
Average:	**5.47**

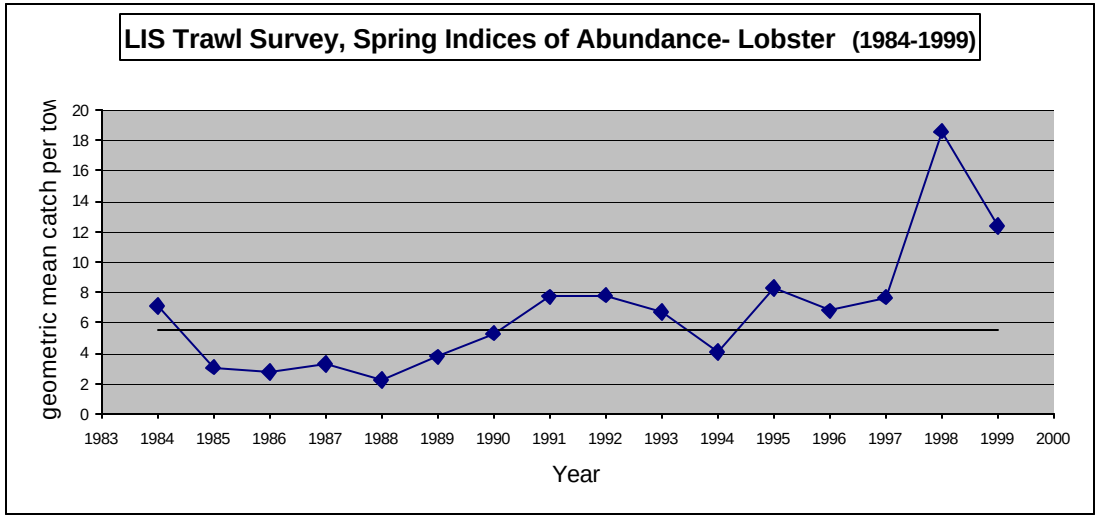

Figure 4. Spring indices of lobster abundance (geometric mean catch per tow) for 1984 to 1999 from the CT DEP Trawl Survey

Year	Mean
1984	7.04
1985	3.27
1986	4.71
1987	5.94
1988	3.54
1989	3.75
1990	7.29
1991	9.84
1992	9.52
1993	11.26
1994	10.13
1995	8.05
1996	10.05
1997	19.59
1998	10.47
1999	11.17
Average:	**8.48**

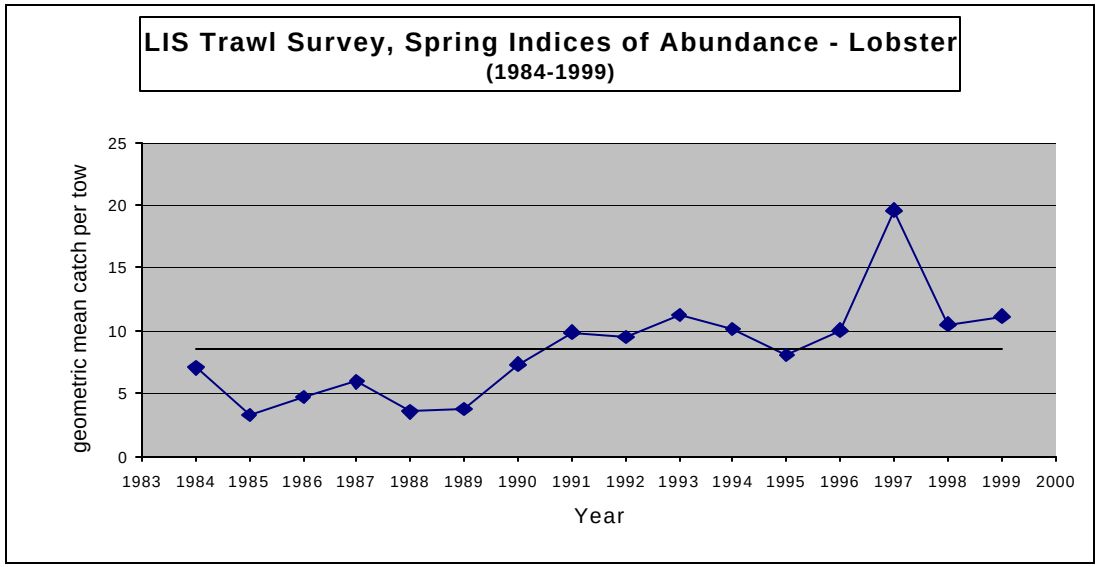

Figure 5. Fall indices of lobster abundance (geometric mean catch per tow) for 1984 to 1999 from the CT DEP Trawl Survey

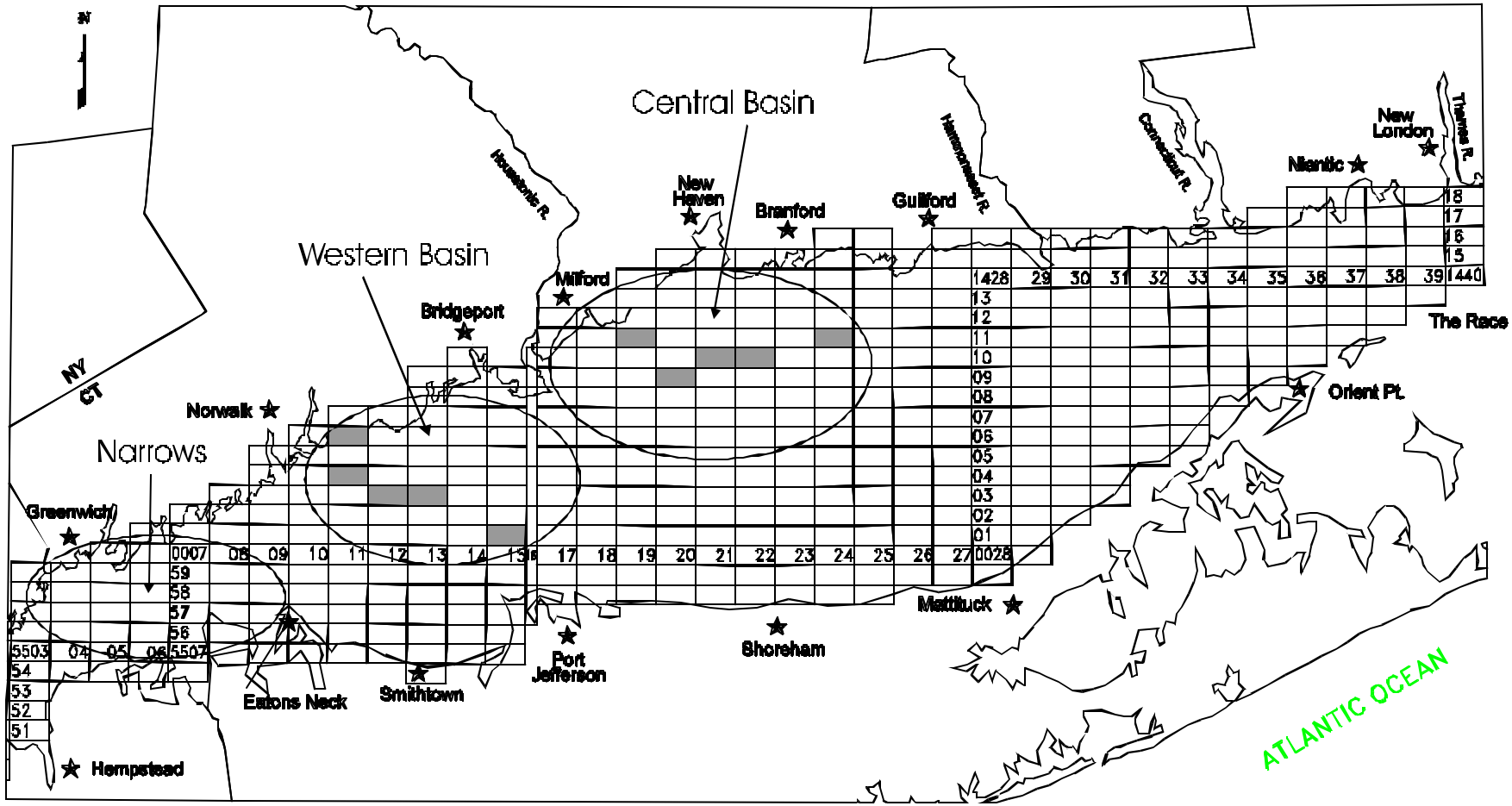

Figure 6. Sites sampled during December 1999 for abundance indices for lobsters.
Sites are displayed on the Marine Finfish Survey sampling area map**.** Each sampling site is 1x2 nmi (nautical miles). A four digit number identifies the site: the first two digits are the row number (corresponding to minutes of latitude) and the last two digits are the column number (corresponding to two nautical miles in length on the longitudinal axis). Examples: site 1428 near Guilford and 0028 near Mattituck. (Note: The sites in column 16 are approximately 2x1 nmi. The grid was drawn on the Eastern and Western Long Island Sound 80,000:1 nautical charts, which overlap by the area in column 16.)