

- April 17-18, 2000 in Stamford, Connecticut
- Co-sponsors: National, NY, CT Sea Grant College Programs (also Sea Grant programs in New Hampshire and Massachusetts [MIT, WHOI]; NYSDEC; CTDEP; USEPA; National Marine Fisheries Service; The University at Stony Brook's Marine Sciences Research Center

Summary of Research Priorities for the Long Island Sound Lobster Resource

27 April 2000

On April 18, 2000, five working groups of university, agency and industry experts were convened to begin to develop the framework for a Research Plan of Action to address the significant health issues affecting the Long Island Sound lobster resource. The working groups addressed socioeconomic, pathological, oceanographic/environmental, anthropogenic inputs and resource assessment concerns and issues. Catastrophic die-offs of lobsters in the western Sound resulted in the commercial fishery being designated a marine resource disaster in January 2000. The groups identified key problems, developed goals and objectives, and identified priority tasks that must be addressed to shed light on the possible cause(s) of the die-offs, the abnormal molting patterns observed and the dramatic increase in the incidence of shell disease. No one factor emerged as the primary cause of the lobster health problems; the general consensus of the experts was that most likely the health problems are caused by a number of factors.

This document summarizes the research priorities identified by the working groups. Some of the problems or priority tasks identified were duplicative among groups, and have been combined under one category, although reference to them may be made in other categories. The coordinators for each category will be working in concert, and all information will be shared through a common database and network to facilitate collaborations and avoid duplicative effort.

This document is a work in progress towards the development of a comprehensive Research Plan of Action. It will continue to evolve as more information becomes available.

Common Priorities

Priority Task One: RECONSTRUCT A CALENDAR/TIMELINE OF KEY EVENTS LEADING UP TO AND THROUGH 1999

- Needs detailed input from lobstermen Soundwide. NY and CT Sea Grant will work with lobstermen's associations to reconstruct timeline from their observations. Use states' data to ground truth.
- Needs to include:
 - Pre-existing conditions from 1997-1998
 - State water chemistry data, including high water temperatures / degree days, DO, salinity, sulfide, hypoxia
 - Oceanographic/meteorological data like dates of rainfall events (1999), water clarity
 - Dated observations for presence of paramoeba, developmental abnormalities such as early molting, other species dying
 - Ecological factors like species composition change, heavy barnacle recruitment, increase in lobster population
 - Mosquito control spraying schedule and toxicological data on compounds applied
 - Lobster population estimates (not landings)
 - Information on other chemical inputs.

Priority Task Two: REVIEW THE CALENDAR/TIMELINE FOR CLUES AS TO THE MOST LIKELY STRESSORS AND CAUSES OF DISEASE / MORTALITY. FOCUS EFFORTS ON AND CONDUCT TESTS USING THOSE SHOWING THE MOST PROMISE FIRST.

Priority Task Three: SET UP A COORDINATED DATABASE AND INFORMATION NETWORK THAT EVERYONE CONTRIBUTES TO AND CAN MAKE USE OF IN A TIMELY AND APPROPRIATE MANNER.

- The database should be interactive, like a bulletin board, to allow for discussions.
- The EPA LISS office has offered their website as a possible location for the lobster data.
- ENSR in Acton, MA has also offered database management services.

Priority Task Four: INVOLVE LOBSTERMEN IN THE RESEARCH EFFORTS TO UNCOVER THE CAUSES OF THE PROBLEMS AFFECTING THE LOBSTER RESOURCE.

Priority Task Five: JOIN RESOURCES AND PIGGYBACK EFFORTS TO CONTINUE AND EXPAND THE BENEFIT OF ONGOING EFFORTS NOW .

SOCIOECONOMICS

Coordinators: Chris Dyer, Human Ecology Associates, Rhode Island
David Allee, Local EDA Center, Cornell University

Problem: There is a lack of information, effective response, and interface between industry and agencies that can provide assistance.

Goals:

- Complete a comprehensive assessment of the socio-cultural-economic impacts from the lobster die-off. (Information)
- Assess the current response mechanisms. (Response)
- Develop strategies to improve organizational collaboration in response to natural resource disasters. (Interface)

Priority Objectives / Tasks:

- Conduct a needs/impact survey of lobster harvesters/dealers (short-term)
- Conduct assessment of current response mechanism (short-term)
- Use 1 & 2 to help facilitate services to affected parties *(i.e., economic relief, social support services, education and technical assistance) (short-term)
- Coordinate with federal (Economic Development Administration-Dept. of Commerce), state, local governments and non-governmental organizations (NGOs) to design a present and future response to natural resource disasters (short and long-term)

What has been done?

- Rapid assessment response for Connecticut
- Needs prioritization meeting in New York
- Marine disaster designation (January 2000)

Action plan:

- Prepare and submit proposal to EDA to achieve short-term goals (*Currently In Preparation*)
- Seek funding from other agencies for long-term goals

RESOURCE ASSESSMENT

Coordinators: Ernie Beckwith, CT DEP
Gordon Colvin, NYSDEC

Problems:

- Mortality (don't know proportion of affected life-stages including larvae)
- Status of stock (relative abundance by area /size/sex, this year & future)
- Definition of stock, within LIS and Atlantic interaction
- Does crab abundance have any relationship to die-off?
- Incidence and effects of shell rot (effect on growth, reproduction, mortality, economic impact, effect on meat quality, related to die off)?
- Commercial reporting: if no effort, no log books or landings data in year 2000
- Need industry observations, more contact, more widespread reporting
- How will fishery be managed after die-off, what are management objectives?
- LIS lobsters market and value have been largely decimated.

Goal: Restore a sustainable fishery and population of lobsters in Long Island Sound

Objectives:

- Characterize population now in ELIS, WLIS (trawling, traps, sea sampling, log books)
- Determine the extent of the infection/mortality problem.
- Determine the effect of the infection/mortality on the population (legals, sub-legals) and calculate the carrying capacity of LIS for lobsters.
- Develop the means to protect the remaining lobster population, rebuild, and manage it
- Restore credibility of LIS lobsters in market

Priority Tasks:

- Expand coverage/frequency of sea sampling (needs to be more observers, more boats volunteering)
- Develop sentinel fisherman program (to keep some data coming in during periods of no fishing) – industry to select sentinel fishers
- Consider the use of experimental traps to catch sub-legal life stages (i.e., 3 extra traps (tandem with their gear))
- Trawl for juveniles, expand trawling sites in Western LIS (CTDEP)
- Collect and share data quickly!
- Employ / compensate industry to collect data

- Conduct tagging studies to look at movement of lobsters within the Sound and between the Sound and the Atlantic Ocean.
- Examine options for restocking population once cause of mortality is determined.
- Convene meeting by early May (Sea Grant (CT, NY), CTDEP, NYDEC, Lobster Associations) to develop uniform State Data Form (for use by key industry people, distribute)
- Involve NY Seafood Council and CT Seafood Council in assisting lobstermen in rebuilding market for LIS lobsters.

Active Investigators in this Area: NYSDEC, CTDEP, Northeast Utilities, ASMFC, Industry, NGOs

PATHOLOGY

Coordinators: Dr. Richard French, Dept. of Pathobiology, University of Connecticut
Dr. Richard Robohm, National Marine Fisheries Service, Milford

Problem: The cause(s) of onset of infections and mortality in lobsters in Long Island Sound is unknown.

- Abnormal molts (CLIS and WLIS; ELIS?)
Need to identify areas where this was observed and monitor for future occurrences. Need to consider normal and abnormal molt triggers and relation between egg-bearing and molting. Need to look at estrogenic compound effects on females (work mostly done in males to this point).
- Epizootics of shell disease (ELIS)
- Parameobic infection (WLIS) and gaffkemia
- Immunosuppression (reduced phagocytic cell activity (DeGuise, UConn))
Immunosuppression can be measured in lobsters by looking at phagocytic cell activity so can be used as a measure of stress. Could be used in research to identify or rule out different inputs as contributors to lobster problem (no stress response would mean no relation to problem).
- Suspected lack of genetic diversity (WLIS)

Goals:

- To determine the cause(s) of the lobster die-off in the western Long Island Sound.
- To determine the cause(s) of the abnormal molting patterns observed in 1999.
- To determine if the incidence of shell disease has been increasing in the Eastern Long Island Sound, (CT and NY), Rhode Island and Massachusetts in recent years.

Priority Objectives / Tasks:

Lobster Die-Off

- Develop the tools/indices to identify what a “healthy” lobster is.
e.g., heat shock proteins, other immunological indicators like c-reactive proteins involved in inflammation, inducible proteins (HSP, CRP), hormone levels (ecdysone, methyl farnesoate), hemocyte numbers, serum proteins, cortisol, reproductive effort

- Based on timeline, assign priorities to potential environmental stressors and test most promising ones FIRST against live *lobsters* (*Priority Tasks #1 and #2*). Look at dose-response relationship of this matrix. Coordinate with those doing bioassays (ERI-UCONN, SUNY, UMAINE)
 - Potential environmental stressors are:
 - Oceanographic (temperature/degree days, salinity, sulfide/ammonia toxicity stress, hypoxia/anoxia)
 - Anthropogenic (malathion, pyroxyenes, methoprene and other endocrine disruptors, pyrethroids, sewage inputs – chlorine and by-products (remote), MTBE (remote))
- Compile a database of pesticides and metabolites and their effects on invertebrates (HIGH PRIORITY) – *tie into anthropogenic group*
- Characterize the pathogens (paramoeba, shell disease) (HIGH PRIORITY)
 - What is the agent, its prevalence?
 - Develop severity indices (*currently in development at NMFS, Milford forshell disease*).
 - Include targeted disease and random samples
 - What is the agent's mode of entry (vertical vs horizontal) / how is it transmitted?
 - Are there life-stage influences?
 - Identify the paramoeba to species.
- Culture the paramoeba and attempt to infect *.(Active effort ongoing – HIGH PRIORITY)*
- Continue field survey for paramoeba. Assess all life stages of lobsters and include other species like blue crabs.
- Conduct field surveys and lab infection studies with reservoir species (blue crabs, amphipods, copepods, etc.)

Shell Disease

- Conduct a field study (CT, NY, RI, MA) to determine severity and prevalence
 - Develop fisherman participation (postcard system?)
 - Utilize severity scale currently in development by NMFS, Milford
- Continue to characterize assemblage of bacteria at lesion
 - Classic culture technology
 - Molecular identification (UCONN)
- Investigate succession of bacteria
- Characterize host response / level of stress
- Characterize stressors on host (temperature, crowding, nutritional status, contaminants)

Active Investigators in this Area: UCONN, NMFS, MBL, VIMS

ANTHROPOGENIC INPUTS

Coordinators: TBD

Problem: There may be a link between anthropogenic inputs to Long Island Sound and the lobster infection / mortality problem. Need to examine the following information in terms of spatial and sequential relationships in order to create accurate correlations, if any, based on the timeline (*Priority Task #1*) and a prioritization of the most likely stressors (*Priority Task #2*):

- Lobstermen documentation: when, where, type of problem, observations
- LIS Data on water quality
- STP, permitted discharges (remote)
- Bait use/tracking
- Mosquito control efforts (new pesticide registrations)
- Lobster survey data (pathology data)
- Shipping data (spills and toxic releases)
- Dredge material disposal/monitoring results (remote)
- REMOTS data
- Other outbreak reports, other species, etc.

Objectives:

- Examine issues of potential concern from 1995 or earlier to present, such as sewage treatment plants (STPs) (BOD, metals, nutrients, endocrine disrupters); pesticides; lobster bait; introduced species (Japanese crab as parasite vector?); Dump site materials; nonpoint source pollutants (nutrients, pathogens, toxics, etc. from runoff, tributaries and atmospheric deposition); boats (ballast water, toxic releases)

Pesticides need to be studied in terms of fate and transport in marine systems. Probably react differently in salt water than in fresh water. Need bioassays for actual effects on lobsters (LC50s and immunosuppression) before looking for measurable levels of pesticides in lobster, sediment and water samples (*ties into Pathology group*). Need to look at both mosquito control and lawn care products.

Bait: is it all coming from the same place? Could it be bringing in a pathogen (*Pfiesteria* was mentioned as a potential concern) or other contaminant? Need to track and test sources, particularly those from southern areas.

- Examine confounding stresses: hypoxia, crowding, elevated temperature, and “inbreeding”

For hypoxia, need to relate REDOX surveys to lobster population surveys and bottom temperatures. Need DO readings closer than 1m from bottom to capture anoxia. Sulfides, ammonia and metals all released into water column if REDOX zone gets above sediment surface need to be evaluated for stress/mortality impacts.

- Examine known (anecdotal (A) or monitoring (M)) changes in Sound in recent past:
Increased (before die-off) lobster populations (M); Increased bait inputs (A); Decreased nitrogen loads from STPs (M); Decreased chlorophyll concentrations (M); Changes in other species populations (A and M); Increased pesticide use (lawn and mosquito control) up-watershed (A); Increased water temperatures (M); Slight increase in dredge materials disposal (but down from historic levels)(M); Strong sulfur smell on traps (A, 1999, WLIS)
- Compare to calendar / timeline of events and prioritize most likely stressors to focus on. (*Priority Tasks #1 and #2, page one*)

Priority Tasks:

- Based on information from Priority Tasks #1 and #2:
 - a. Determine the fate and transport of selected pesticides in marine waters
Bioassays (*tie into pathology group*)/literature searches/risk analysis
 - b. REDOX-literature search/larvae and adults exposures
historical data, REMOTS, DEP, EPA, NOAA
surveys-correlate to 1m below bottom
lobster exposure (bioassay immuno-suppression, not LC50) metals release
 - c. STP Effluent/chlorinated by-products
brief bioassay? (*tie into pathology group*)
(chlorine impact remote: freshwater effluent; chlorinated by-products
difficult to track and relate to the problem)
 - d. Abnormal molts (triggers, estrogenic compounds?) – *tie into pathology group*
 - e. Traps, baits, populations-gene pool restructuring
 - f. ELIS Dredge spoils (ongoing) (remote)
 - g. Is MTBE a factor? (remote)

Active Investigators in this Area: Industry, NGOs, UCONN, SUNY, DEP, NYCDEP, NYSDEC, ACOE, ENSR, USGS, NMFS, EPA, Interstate Sanitation, NOAA, NYSDEC, municipalities, NYSDOW, NYSDOS

OCEANOGRAPHIC/ ENVIRONMENTAL PROCESSES

Coordinators: TBD

Problem:

- Need to understand lobster ecosystem/ trap environment
- LIS lobsters are at southern limit of range
- LIS lobsters are in an area with a significant anthropogenic impact
- Lobster fishery practices have influenced or modified LIS environment

Goals and Objectives:

1. To examine oceanographic and climate factors and their impacts.

- Example: water column structure, salinity, temperature, stratification, chemistry
- Why has there been a change in water clarity (water column stability, energetics)?
- What is structure of phytoplankton population?

2. To examine the nature of change in benthic habitats (sediment/water interface).

- Examine water column down to benthos, 1m off sediment down through sediment and in overlying layer.
- Look at spatial and temporal characteristics.
- Examine co-occurring species.

Active Investigators in this Area:

Oceanographic: Industry, NGOs, UCONN, SUNY, CTDEP, NYCDEP, NYSDEC, ACOE, ENSR, USGS, NMFS, EPA

Benthic: SAIC, Univ. New Haven and those in oceanographic group