

Title page: Include project title, award number, period of performance, date of annual report submission, and contact information of the principal investigator.

NORTHEAST CONSORTIUM

Annual Report

For activity from May 2007– April 2008

Project Title:

Depth-related Settlement Patterns of the American Lobster in the Gulf of Maine and Southern New England

Award number:

NA06NMF-4720095

Submitted:

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Other Participants: List all participants in the project with their contact information. For projects involving many participants, indicate those who played a key role in project design and implementation.

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Project objectives and scientific hypotheses: *Detail and provide clear reasons for any changes to the project's objectives, goals, and rationale.*

In 2005, with Northeast Consortium Project Development support, we successfully tested a method to evaluate deepwater settlement of the American Lobster (Wahle et al. in press). This project built on previous collector designs that have been used to describe local and regional patterns of lobster and crab settlement in coastal Maine and Rhode Island. With these trials we were able to demonstrate that the collectors sample newly settled lobsters and crabs effectively and in densities comparable to adjacent monitoring sites in coastal Maine. Moreover, in two different experiments we found no significant losses of lobsters from the collectors during the haul-back. It was therefore unnecessary to incorporate a mechanism to cover the collectors prior to hauling. Having fulfilled the NEC panel recommendation to conduct proof-of-concept tests of the collector design, we successfully gained support for a two-year project to evaluate depth-specific patterns of lobster settlement in oceanographically contrasting segments of the American lobster's geographic range between eastern Maine and Rhode Island.

The objectives of the project are as follows:

- **Objective 1:** Determine the depth-specific pattern of lobster settlement in eastern, Maine, mid-coast Maine and Rhode Island, three regions of contrasting oceanography.
- **Objective 2:** For the shallowest set of collectors determine the difference in settlement density to artificial collectors and adjacent natural nursery sites.
- **Objective 3:** Collect data on water column thermal structure and bottom temperature time series in the three regions to associate with settlement data.

As of December 2007, we completed our first field season and addressed all three objectives.

Methods and work plan: *Detail and provide clear reasons for any changes to the experimental design and explain why this approach has been used.*

To address our objectives we deployed cobble-filled passive postlarval collectors over a range of depths in the three regions. Three-hundred collectors were distributed among three depth intervals (10-20, 30-50, and 70-80 m) along inshore-to-offshore transects off eastern and midcoast Maine, as well as Rhode Island. Collectors were deployed prior the onset of the settlement season: June in Rhode Island; July in Maine. The location of each collector was marked with GPS by the boat as well as hand recorded. Collectors at the shallowest depth were deployed adjacent to existing monitoring sites to permit comparisons of the two methods (Objective 2).

All collectors were retrieved at the end of the settlement season: late August in Rhode Island; early-mid-October in Maine. As recommended by reviewers of our NEC planning letter, however, we redeployed a subset of collectors, for an additional two weeks in each region to account of the possibility of late season settlement.

Our NEC development project demonstrated that newly settled lobsters remain in collectors and do not take flight during the haul-back process. Still, special care was taken to haul back collectors slowly and in a horizontal position. With collectors on deck, they are rinsed down, opened, and rocks carefully removed to assess the contents. Lobsters and associated fauna were counted, measured, and released. CTD casts were taken at each location to provide temperature profiles over the course of the season. Hobotemp temperature loggers were

deployed in each depth stratum to obtain temperature time series at the surface and bottom. There were no deviations from our proposed work plan, except to include a harvester with a smaller vessel for the retrieval of collectors at shallow sites in RI.

Work completed to date: *Explain what has been accomplished in the last 12 months. Describe and explain any changes from the original statement of work and/or any unexpected difficulties encountered in project planning or implementation. State what work is complete and what has yet to be done.*

All objectives listed above were addressed in our first year. Three-hundred collectors were deployed among the three regions, with temperature loggers at each depth stratum in each region, as well as periodic CTD casts taken. An additional 400 collectors were deployed according to our standard by our extended collaborators in the US and Canada (Fig. 1). For the three regions included in the NEC project (RI, mid-coast and eastern Maine), a subset of collectors was redeployed to assess late season settlement. The first retrievals in each region coincided with the annual suction sampling in that region. Suction sampling for the annual settlement index was also completed by participating states and provinces (Fig.1)

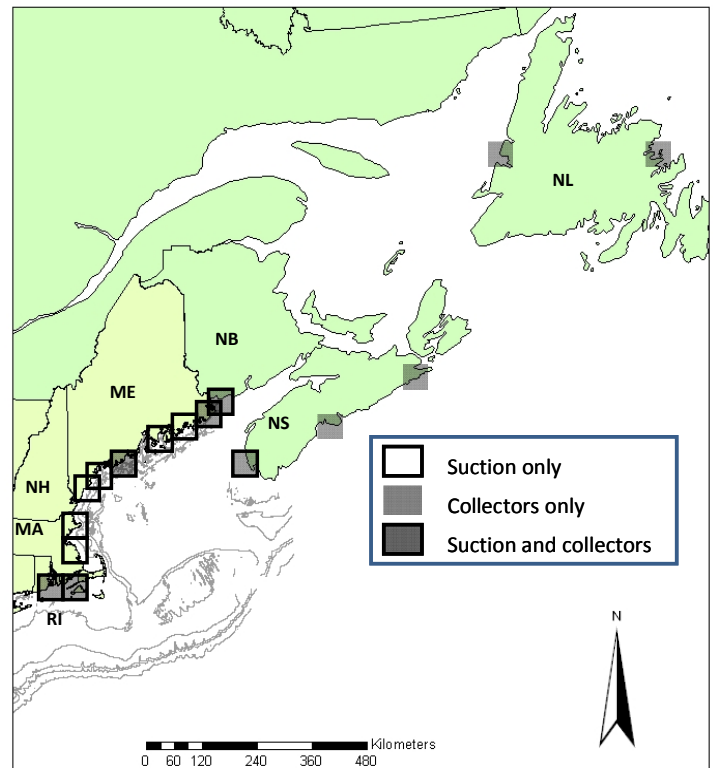


Figure 1. Sampling regions where lobster settlement data were collected in 2007 either by suction sampling, passive collector, or both. Initiated in Maine and Rhode Island in 1989-90, annual suction sampling spans some 65 sites from RI to New Brunswick. The addition of passive collectors to some of these, as well as new regions has considerably added spatial coverage.

Results to date: *Describe the scientific and/or technical results of the project to date, emphasizing not only what was done, but what was learned.*

Of the 300 collectors deployed as part of the NEC project, some 265 were recovered. Preliminary results from our first season indicate a strong response to the thermocline (Fig 2a). Locations such as mid-coast Maine and coastal Rhode Island that develop a steep thermocline during the summer revealed a more striking gradient in the abundance of newly settled and older juveniles than did locations such as eastern Maine, at the mouth of the Bay of Fundy, that are well mixed and have no thermocline. These patterns are generally consistent with behavioral observations of postlarvae remaining above the thermocline. Young-of-year lobsters found at >80 m are the deepest records of lobster settlement to date. These findings have important implications for offshore lobster production. The expanded collaboration among US and Canadian workers has resulted in the largest synoptic view of lobster settlement to date (Fig. 2b).

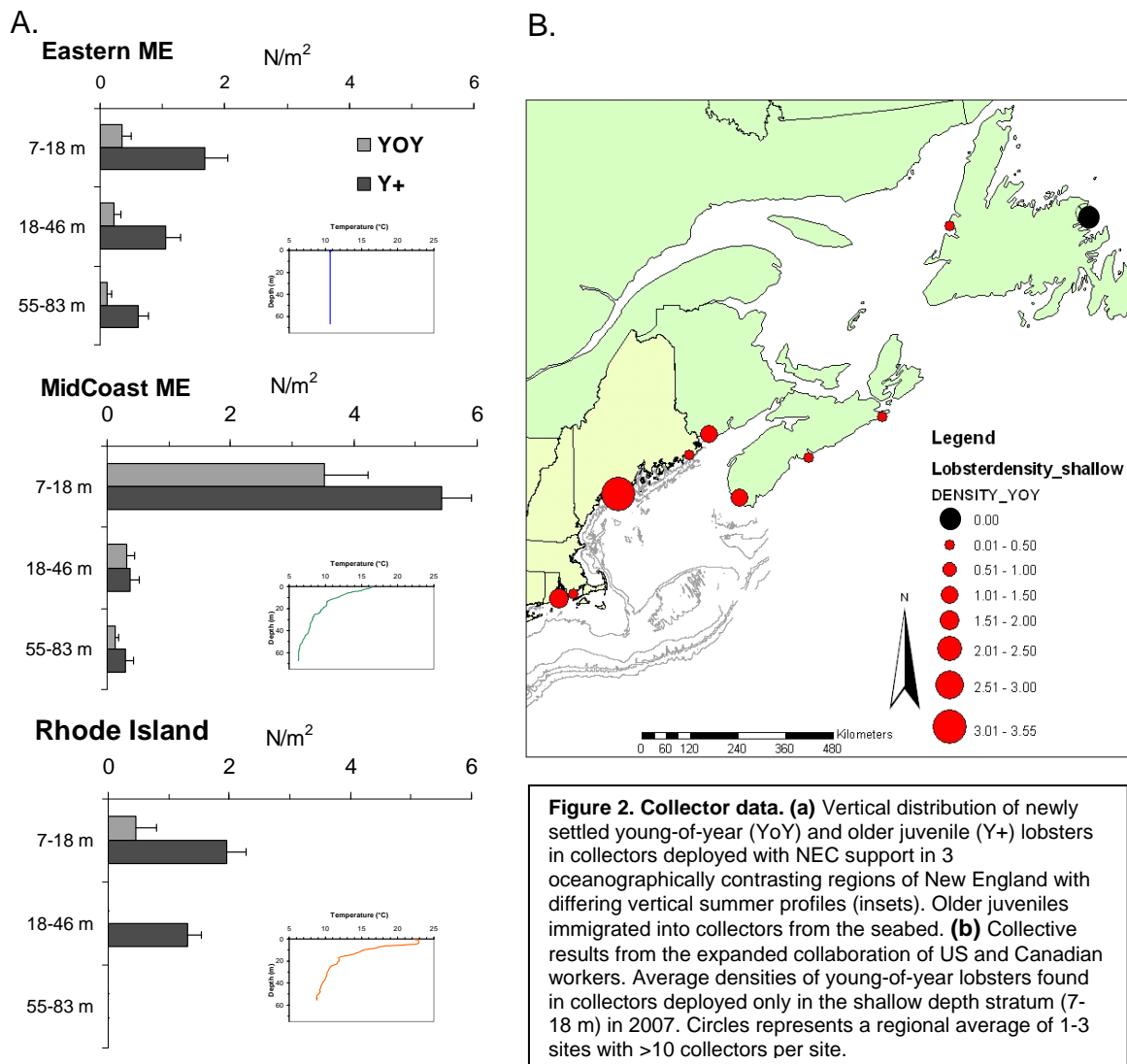


Figure 2. Collector data. (a) Vertical distribution of newly settled young-of-year (YoY) and older juvenile (Y+) lobsters in collectors deployed with NEC support in 3 oceanographically contrasting regions of New England with differing vertical summer profiles (insets). Older juveniles immigrated into collectors from the seabed. **(b)** Collective results from the expanded collaboration of US and Canadian workers. Average densities of young-of-year lobsters found in collectors deployed only in the shallow depth stratum (7-18 m) in 2007. Circles represent a regional average of 1-3 sites with >10 collectors per site.

Data: All data from Northeast Consortium-funded projects should be submitted to the Northeast Consortium Fisheries & Ocean Database (www.northeastconsortium.org/data.shtml). State whether or not the data have been submitted to the Northeast Consortium database, and if not, indicate when the data will be submitted. If the data are internet-accessible in another format, provide the internet address (URL).

Data for submission to NEC will include: collector locations; collector contents information including species, carapace or tail length, and for lobsters, sex, and number of claws; CTD temperature depth profiles taken throughout the season in all regions; and surface and bottom temperature data from each depth strata in all regions.

Data will be submitted to NEC at the end of the project.

Impacts and applications: Identify who would best benefit by knowing about the project. Describe the present or future impacts of the data and conclusions.

The most gratifying aspect of this project is the amount of interest it has generated among other investigators and industry members in the US, Canada, and Scandinavia. It has resulted in the largest synoptic view of lobster settlement to date. The PI is coordinating the expanded collaboration, and held the first meeting as a group at the Fisherman & Scientist Research

Society Meeting in Halifax in February 2008. Participants view collectors as a viable alternative when diver-based sampling is impractical. It is a method that lends itself especially well to industry participation and can provide useful information for stock assessment.

Related projects: *If this project was done in association with, or leveraged by, other research, outreach, or education projects, explain the nature of the collaboration and identify the source(s) of funding.*

First and foremost, this project was largely leveraged by the long-standing New England Lobster Settlement Index, an annual diver-based suction sampling survey, initiated by the PI and now carried out by New England’s largest lobster producing states New Brunswick and Nova Scotia. See http://www.bigelow.org/srs/lobster_index.html for annual updates of the survey at the PI’s website.

This research has also spawned satellite collector projects led by investigators at UMass, Memorial University, Newfoundland, DFO Canada, and independent industry groups in Canada. (Fig. 1; Table 1). These groups are constructing and deploying collectors according to standards we have collectively established, permitting ‘apples-to-apples’ comparisons among regions, and considerably expanding the geographic scope of the project.

Table 1. Names and affiliations of collaborators on the 2007 collector deployment, and prospective collaborators for 2008 who have secured support or expressed interest.

Name	Affiliation	State/ Province/ Country
2007 Participants		
Jan Knutsen	Institute of Marine Research, Floedevigen	Norway
Paul Snelgrove, Victoria Burdett-Coutts, Kate Jones	Memorial University	Newfoundland
John Tremblay, Glyn Sharp	Bedford Institute of Oceanography, DFO	Nova Scotia
Patricia King	Fisherman & Scientist Research Society	Nova Scotia
Peter Lawton	Dept Fisheries & Oceans, Saint Andrews	New Brunswick
Remy Rochette	University of New Brunswick	New Brunswick
Kevin Stokesbury, Peter Mulligan	UMass, Dartmouth	Massachusetts
2008 Prospective Participants		
Vidar Oresland	Institute of Marine Research, Lysekil	Sweden
Michel Comeau	Dept Fisheries & Oceans, Moncton	New Brunswick
Louise Gendron	Dept Fisheries & Oceans, Mont Joli	Quebec
Robert Glenn	Department of Marine Fisheries	Massachusetts
John Manascalco	Department of Environmental Protection	New York

Partnerships: *Describe the quality and extent of the fisherman-scientist partnership(s) and how many fishermen and scientists have been involved with the project over the past 12 months. What aspects of the project have the fishermen been involved with (e.g. project design; data collection, analysis and interpretation; communication of findings to end users, etc.).*

Within the NEC project, **Matt Parkhurst** (F/V *Sea Spray*) of Boothbay Harbor, ME, **Norbert Lemieux** (F/V *Christina-Marie*) of Cutler, ME, and **John O’Leary** (F/V *Captain Bligh*) of Wakefield, RI are the collaborating harvesters. In the Development Project Parkhurst contributed heavily to the design and fabrication of collectors. O’Leary and Lemieux were added in the current project to expand our geographic coverage. Each has provided valuable

insight into customize deployment and “fish” collectors for the conditions unique to their own regions. **Richard Wahle** is the Principle Investigator for the project. His technician, Charlene Bergeron, coordinates the logistics of the project, conduct data entry and analysis, and oversee activities of the seasonal intern. **Carl Wilson**, Lobster Biologist at Maine Department of Marine Resources, has provided useful guidance from the management perspective and facilitated permitting in Maine waters.

The expanded partnerships through the satellite projects (Table 1) have further augmented the reach of this project internationally.

Presentations: *Provide information for all presentations related to this project made in the past 12 months, including: name of presenter(s), title, meeting, date, and location.*

Bergeron, C. E., R.A. Wahle, C. Wilson, M. Parkhurst. 2007. “Probing uncharted waters: a passive postlarval collector to assess settlement of the American lobster”, 8th International Conference & Workshop on Lobster Biology & Management, September 26, 2007, Charlottetown, Prince Edward Island, Canada.

Wahle, R.A., C. Wilson, M. Parkhurst, C. Bergeron. 2008. “Collectors to assess deepwater settlement of the American lobster”, FSRS, February, 15, 2008, Truro, Nova Scotia.

Wahle, R.A., C. Wilson, M. Parkhurst, C. Bergeron. 2008. “Probing uncharted waters: a passive postlarval collector to assess settlement of the American lobster” Benthic Ecology Meeting, April 9-12, 2008, Providence, RI.

Student participation: *List how many students have been associated with this project, counting high school, undergraduate, and graduate students separately including the name of their institution.*

Kathryn Kershaw - Northeastern University, MSc. – class, 2007

Daniel Shea - Govenner Dummer Academy, Andover, Mass. - 2007

Bradley Kiehl - University of New Hampshire - 2008

Nicole Ritchie - Bates College - 2008

Sussana Izzo – University of Rhode Island - 2008

Sam Rosen, Vinalhaven Highschool 2008

Published reports and papers: *List reports and papers that have resulted from this project during the past 12 months, either published or submitted, including newsletter and web-based materials. Provide citations or internet addresses for each.*

Wahle, R.A., C. Wilson, M. Parkhurst. C.E. Bergeron, In press.. A vessel-deployed passive postlarval collector to assess settlement of the American lobster. *New Zealand Journal of Marine and Freshwater Research*.

Wahle, R.A., C. Wilson, M. Parkhurst. C.E. Bergeron, 2008. Probing uncharted waters: a passive postlarval collector for the American lobster. *The Lobster Newsletter vol. 21*.

Newspaper Publicity:

Commercial Fisheries News, February 2008.

Images: *Submission of project images is encouraged (i.e. photo, diagram, or data summary) as a separate file (JPG or TIFF preferred).*

See data figures above. Hundreds of photos are available from this project. A few follow→



Intern, Rich Crowley & collector



Harvester, Norbert Lemieux, Cutler, ME



Loading Norb's boat.



Technician, Charlene Bergeron,
& intern, Brad Kiehl, prep collectors.



RI Lobstermen Assn President, Lanny
Delininger (right), and his sternman find the first settler in a collector off the RI coast.