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 2008– April 2009

Project Title:

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

Award number:
NA06NMF-4720095

Submitted:
July 13, 2009

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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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Carl Wilson, Maine Department of Marine Resources**,** W. Boothbay Harbor, ME 04575**,** carl.wilson@maine.gov**,** 207 633 9538

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. 2009). 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 retrieval. 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 2008, we completed the planned objectives for the two year project with extended collaborations in the US and Canada considerably augmenting our results. Since we completed our objectives under budget, NEC granted our request to extend the project into the summer of 2009 to address two additional objectives enabling initial exploration of lobster settlement on Georges Bank and Nantucket Shoals:

• ***Objective 4:*** Determine the existence and pattern of lobster settlement on two offshore bank regions, George's Bank and Nantucket Shoals.

• ***Objective 5:*** Collect data on water column thermal structure and bottom temperature time series in the two offshore bank regions to associate with settlement data.

As of June 1, 2009 all permits were in hand and 100 collectors have been deployed between these two areas by collaborating fisherman, Bobby Colbert.

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 first three 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 (near shore and offshore). The location of each collector was marked with the on-board GPS. 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 two deviations from our proposed work plan (1) in years 1 and 2 an additional harvester with a smaller vessel was contracted for the retrieval of collectors at shallow sites in RI. (2) In 2008 we deployed an additional 34 collectors on Platts Bank off midcoast Maine in an attempt to measure settlement on an offshore bank within the Gulf of Maine.

<u>Work completed to date</u>: *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 our original three objectives were addressed in first two years of the project. As in 2007, in 2008 300 collectors were deployed for the second year in the three oceanographically contrasting regions in New England, accompanied by temperature in each region. An additional 34 collectors were deployed on Platt's Bank in approximately 60 m depth.

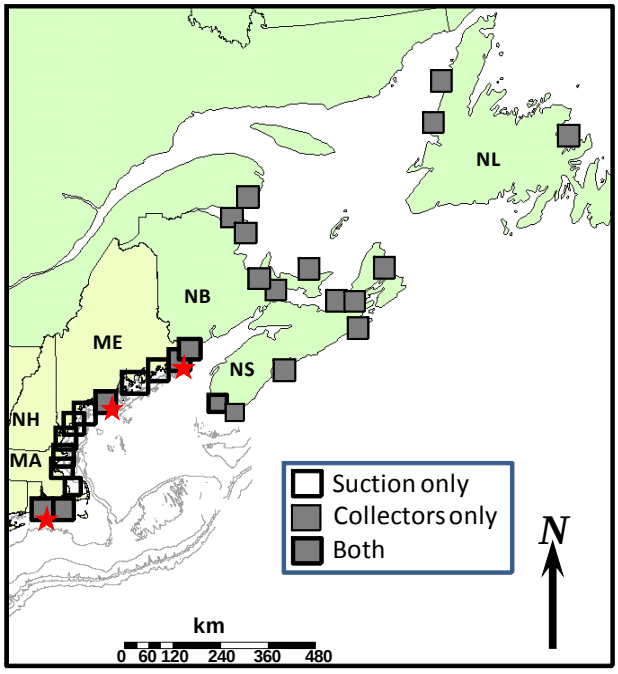

Figure 1. Sampling regions where lobster settlement data were collected in 2008 either by suction sampling, passive collector, or both. The site sampled under this NEC funded project are marked by red stars. Initiated in Maine and Rhode Island in 1989-90, annual suction sampling spans some 65 sites from RI to New Brunswick. The addition of passive collectors to some of these, as well as new regions has considerably added spatial coverage.

Over the two years additional collaborators in the US and Canada, interested in the prospect of using collectors as a lobster and biodiversity monitoring tool, added considerably to the effort. In 2007, 400 additional collectors build and deployed according to our standards, were deployed by our extended collaborators (Fig. 1). In 2008 their effort further expanded to include 790 collectors giving a total deployment of 1128 collectors that year. 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 diver

based suction sampling of adjacent natural lobster nursery habitats. Suction sampling for the annual settlement index was also completed by some of the extended collaborators (Fig.1)

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 334 collectors deployed in 2008 as part of the NEC project, some 315 were recovered. Results from the two-year effort indicate a strong response of settlement patterns 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, where the water column is well mixed and the thermocline is negligible. These patterns are generally consistent with previous observations of postlarval behavior. We also observed that densities of lobsters found in collectors compare favorably with densities in adjacent natural cobble nurseries sampled by divers with suction samplers.

Newly settled lobsters found at >80 m are the deepest records of lobster settlement to date. This finding suggests the possibility of settlement at over significant areas of deep water in the Gulf of Maine and New England shelf waters, and has important implications for offshore lobster production. Furthermore, the expanded collaboration among US and Canadian workers has resulted in the largest synoptic view of lobster settlement to date (Fig. 2b).

A. B.

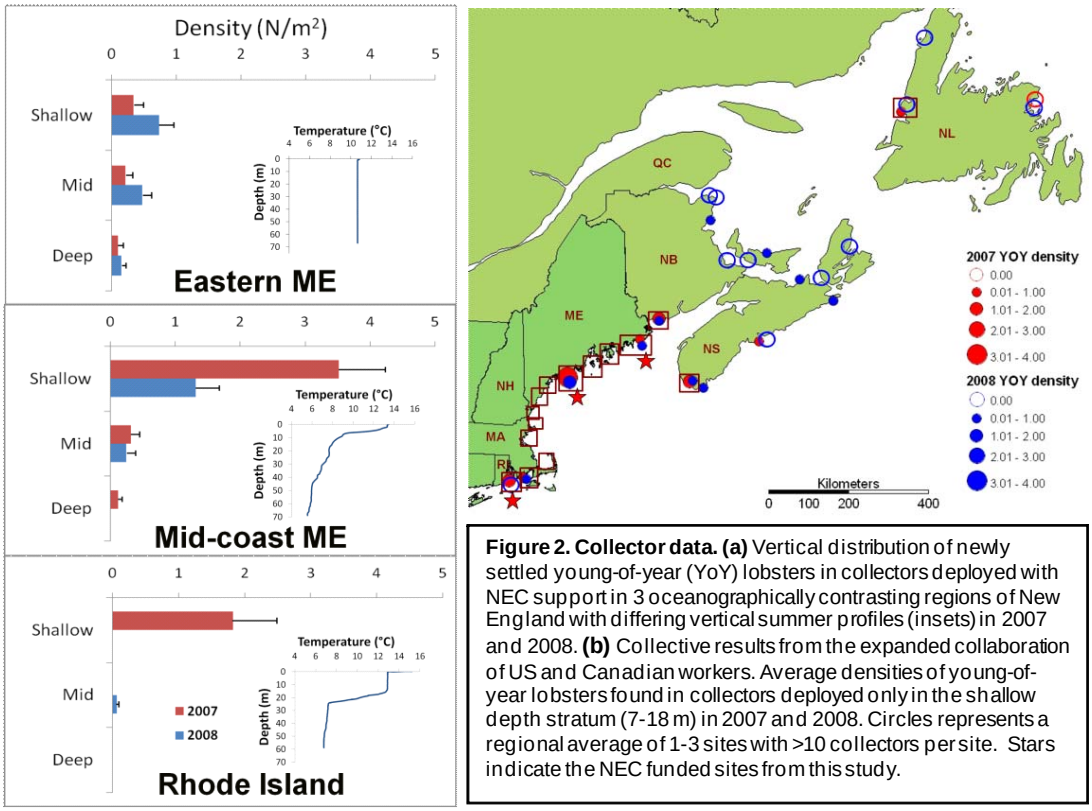

Figure 2. Collector data. (a) Vertical distribution of newly settled young-of-year (YoY) lobsters in collectors deployed with NEC support in 3 oceanographically contrasting regions of New England with differing vertical summer profiles (insets) in 2007 and 2008. **(b)** Collective results from the expanded 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 and 2008. Circles represents a regional average of 1-3 sites with >10 collectors per site. Stars indicate the NEC funded sites from this study.

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 identity, counts, and body size. In addition, CTD temperature depth profiles taken throughout the season in all regions; and surface and bottom temperature time series data during collector deployment from each depth stratum 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 and a second meeting in 2009. 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.

In June 2009, a workshop was hosted by Bigelow Laboratory and Maine Department of Marine Resources to celebrate the 20th anniversary of the American Lobster Settlement Index. The workshop was both a retrospective of scientific accomplishments over the past 20 years as well as an opportunity to plan for the future goals of the monitoring program. The collaborations and scientific results of this NEC supported project have helped set the stage for a new chapter in this monitoring program.

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 the major lobster-producing states and provinces of New England and Atlantic Canada. 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. Locations, investigator affiliations of collaborators, and number of collectors deployed in 2008.

State/Province (# of sites)	Investigator	# collectors
Newfoundland (13)	Memorial University	118
Gaspé, QC (1)	DFO, Institut Maurice-Lamontagne	24
Nova Scotia (16)	DFO, Bedford Institute & DFO, Moncton	393
Prince Edward Island (2)	DFO, Moncton	60
New Brunswick (5)	University of New Brunswick & DFO, Moncton	165
Maine (14)	Bigelow Lab	234
Massachusetts (3)	UMass, Dartmouth	30
Rhode Island (6)	Bigelow Lab	100
Total		1124

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.*

Talks:

Wahle, R.A., C. Wilson, M. Parkhurst, C. Bergeron. 2008. "Collectors to assess deepwater settlement of the American lobster", Fisherman and Scientist Annual Meeting, February, 15-16, 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.

Wahle, R.A., C. Wilson, M. Parkhurst, C. Bergeron. 2009. "Update on the lobster collector project", FSRS Annual Meeting, February 19-20, 2009, Truro, Nova Scotia.

Wahle, R.A., C.E. Bergeron, C. Wilson, M. Parkhurst, N. Lemieux, and J. O'Leary. 2009. Passive postlarval collectors expand lobster settlement surveys. NEC Participants Meeting, March, 2009, Portsmouth, NH.

Workshops:

Collector Collaborators Workshop, at Fisherman and Scientist Annual Meeting, Feb 15, 2008, Truro, Nova Scotia.

Collector Collaborators Workshop, at Fisherman and Scientist Annual Meeting, Feb 19, 2009, Truro, Nova Scotia.

American Lobster Settlement Index at 20 years: Looking back/Looking ahead. Hosted by Bigelow Laboratory & Maine DMR. June 19-21, 2009. Burnt Island, Boothbay Harbor, ME..

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. –2007
Daniel Shea - Governer 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
Mahima Jaini – University of Maine, Orono, MSc. candidate – in progress
Charlene Bergeron - University of Maine, Orono, MSc. candidate – in progress
Justin Proctor – University of Maine, Machias – 2008
Maggie Johnson – Northeastern University, MSc. –2007
Hannah Bloom - Northeastern University –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, 2009 A vessel-deployed passive postlarval collector to assess settlement of the American lobster. *New Zealand Journal of Marine and Freshwater Research. Vol. 43*: 465–474.

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 & June 2008; June 2009.

<u>Images</u>: *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, Matt Parkhurst, Boothbay Harbor, ME

2008 crew: Rick Wahle, Matt Parkhurst, Maggie Johnson, Justin Procter, Charlene Bergeron


Maggie Johnson labeling buoys


Canadian collaborators in southern Gulf of St Lawrence go wild for our collectors! (Photo: M. Comeau)