# NORTHEAST CONSORTIUM

**Final Report**

Performance period: May 2007 through September 2010

**Project Title:**

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

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**Abstract:**

This NEC project met its objectives, and in the process catalyzed a much wider collaboration with fishermen and scientists in the US and Canada. For more than two decades the the **American Lobster Settlement Index** has been a useful indicator of year class strength in New England, and in the last year has been elevated to the status of a Reference Point for the health of the lobster fishery. To date, however, monitoring has been limited to diver-based sampling in shallow waters. Passive postlarval collectors permit the expansion of sampling capabilities into areas beyond the limits of diving, thereby enhancing its ability to inform lobster stock assessment and recruitment models. This project's primary objective, therefore, was to use passive postlarval collectors developed earlier with NEC seed support to evaluate the depth-wise distribution of recently settled, young-of-year (YoY) and older juvenile lobsters in three oceanographically contrasting regions of the Gulf of Maine (GOM) and southern New England shelf (SNE). In 2007 and 2008 we deployed 300 cobble-filled collectors at three depths (10-20, 30-50, and 70-80 m) in eastern and midcoast Maine, and Rhode Island. Water column thermal structure was described at all three regions. The project extended into a third year with the first exploratory deployment of 120 collectors on Georges Bank. In all, we found that the pattern of depth-wise settlement was strongly linked to the degree of thermal stratification: in stratified regions, such as the western GOM and SNE, larval settlement was concentrated within the shallowest strata. In well mixed regions such as the eastern GOM, in contrast, larval settlement spread uniformly over the depths, and was generally lower overall. No settlement was detected in pilot deployments on Georges and Platts Banks. Settlement in collectors compared favorably with suction sample-based samples collected at the same depth and location. Because the collectors proved effective at sampling a number of other invertebrates and fish species, there may be potential application in biodiversity studies.

The unique feature of this project is the widened collaboration it inspired with other scientists and harvesters in New England, Atlantic Canada, and Europe. Our collective effort more than quadruple the number of collectors deployed, and achieved an unprecedented spatial coverage from Newfoundland to Rhode Island. As the largest synoptic survey of its kind to date, the project dramatically expanded the limits of our knowledge of lobster recruitment processes, and further demonstrated the synergies realized through cooperative research.

**Introduction:**

The American lobster is the most valuable single-species fishery in New England. A collapse of this industry would be catastrophic to the region with repercussions going well beyond the dock. Developing a forecasting ability – an early warning system - for trends in the lobster harvest is one of the prime goals of lobster research today. Several research, monitoring, and modeling efforts are making significant progress toward that goal. The **American Lobster Settlement Index** is a monitoring program that annually quantifies the abundance of newly settled young-of-year lobsters and older juveniles in cobble nurseries in New England and parts of Atlantic Canada by way of diver-based suction sampling. Important gaps exist, however, in our knowledge of the distribution of new benthic recruits. Understanding the depth distribution of lobster settlement is important because of the impact it will have on our estimates of lobster production throughout the species range.

To be a nursery, an area of sea bed must satisfy at least two criteria: (1) it must have suitable habitat, including benthic and water column attributes, and (2) it must be exposed to a supply of competent larvae. Artificial collectors could help us understand the "supply side" of the deep water lobster nursery question, while future sea bed mapping will contribute to our understanding of habitat availability in these areas. Collectors are not used in the current shallow lobster nursery monitoring because diver-based suction sampling of natural cobble beds has proven to be accurate and more time- and cost-effective. However, where diving is impractical or unsafe, collectors remain the only alternative.

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 those in natural cobble sampled by suction samplers. Moreover, in two different experiments we found no significant losses of lobsters from the collectors during retrieval. It was therefore unnecessary to incorporate a mechanism to cover the collectors prior to hauling. Having completed these proof-of-concept tests, we successfully gained support for a larger scale study. In collaboration with three harvesters, this two-year project (2007-2008) we aimed to evaluate depth-specific patterns of lobster settlement in three oceanographically contrasting segments of the American lobster's range between eastern Maine and Rhode Island. Remaining funds from this project provided the opportunity in 2009 to add a fourth collaborating harvester to conduct exploratory deployments of collectors into offshore waters of Georges Bank and Nantucket Shoals where lobster settlement has never been evaluated. Over the course of the three years, growing interest in the collectors among other groups resulted in a widening deployments of collectors in other regions from Massachusetts and throughout Atlantic Canada, as well as two in Scandinavia.

**Project Objectives and Scientific Hypotheses:**

The primary objectives of the NEC project 2007 – 2008 were 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 these regions to associate with settlement data.

The objective of the NEC project extension in 2009 was to:
• ***Objective 1:*** Determine the pattern of lobster settlement at three off-shore shallow sites; Little George's Bank, Great South Channel, and Nantucket Shoals.
• ***Objective 2:*** Collect data on water column thermal structure and bottom temperature time series at the three sites to associate with settlement data.

The common objective of the wider collaboration was to broaden the spatial coverage of collector deployment to assess geographic patterns of lobster settlement as broadly as possible with the same methodology. A secondary objective was to evaluate the utility of collectors as a tool in biodiversity studies. Individual groups adopting the collector design had their own additional objectives.

**Participants**:

Participants in the NEC-supported project as well as the wider collaboration are listed in Table 1.

**Table 1.** List of participants in the core NEC project and the wider non-NEC collaboration.

| | Vessel, Location | Email | Phone |
|---|---|---|---|
| **NEC Project Collaborators** | | | |
| ***Harvesters*** | | | |
| Matt Parkhurst | F/V *Sea Spray*, Boothbay Harbor, ME | parkmatt@adelphia.net | 207 633 3637 |
| John O'Leary | F/V *Captain Bligh*, Wakefield, RI | captblighinc@cs.com | 401 789 5202 |
| Norbert Lemieux | F/V *Christina-Marie*, Cutler, ME | norbert11@earthlink.net | 207 259 3690 |
| Lanny Delinger | Wakefield, RI | LAD0626@aol.com | 401 215 3704 |
| Robert & Dennis Colbert | F/V *Virginia Marie* & F/V *Miss Julie*, Manomet, MA | e.eaa3@verizon.net | 781 831 4004 |
| | | | |
| ***Scientist*** | | | |
| Carl Wilson | Maine DMR, W. Boothbay Harbor, ME | carl.wilson@maine.gov | 207 633 9538 |
| | | | |
| **Non-NEC Project Collaborators** | | | |
| Victoria Burdett-Coutts*, Kate Jones* (Paul Snelgrove) | Memorial University, St. Johns, NL | victoriaburdettcoutts@gmail.com, kmjones@mun.ca | |
| Michel Comeau | DFO Moncton, NB | Michel.Comeau@dfo-mpo.gc.ca | |
| Louise Gendron | DFO, Mont Joli, QC | Louise.Gendron@dfo-mpo.gc.ca | |
| Robert Glenn | MA DMF, New Bedford, MA | Robert.Glenn@state.ma.us | |
| Patty King | Fishermen & Scientists Research Society, DFO, Halifax | pmdservices@eastlink.ca | |
| Peter Lawton | DFO, St. Andrews, NB | LawtonP@mar.dfo-mpo.gc.ca | |
| Peter Milligan* (Kevin Stokesbury) | SMAST, New Bedford, MA | u_pmilligan@umassd.edu | |
| Eugene O'Leary | Guysborough County Inshore Fishermen's Association | gcifa@gcifa.ns.ca | |
| Remy Rochette | Univ New Brunswick, St. John, NB | rochette@unbsj.ca | |
| John Tremblay | DFO Halifax, NS | TremblayJ@mar.dfo-mpo.gc.ca | |
| Vidar, Oresland | Inst. Marine Research, Lysekil, Sweden | vidar.oresland@fiskeriverket.se | |
| Jan Alte Knutsen | Inst. Marine Research, Flodevigen, Norway | Jan.Atle.Knutsen@imr.no | |

*Graduate students (and Advisor).

**Methods:**

***Collector Deployments and sample processing:*** To address our objectives we deployed cobble-filled passive postlarval collectors (Fig.1, 2) 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 (Fig. 2). Collectors were deployed in locations where diver-based suction sampling had been conducted in shallow water for many years, thereby permitting comparisons of the two sampling methods. 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.

**Figure 1.** Cobble-filled passive collector.

Our previous NEC development project demonstrated that newly settled lobsters remain in collectors and do not take flight during the haul-back process (Wahle et al. 2009). Still, special care was taken to retrieve collectors slowly and in a horizontal orientation. With collectors on deck, we rinsed and opened them, and removed rocks carefully 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. During the summer of 2009, with residual funds from the original project, we conducted the first exploratory deployments of collectors on Georges Bank (Fig. 2). Collectors were set in two depth strata (40-60, and 80-120 m) in three locations on the Bank. To avoid gear conflicts, we were restricted to locations closed to dragging.

In the wider collaboration beyond our NEC project, participants agreed to adopt our collector design and to apply the same protocols. Participants and their contact information are listed in Table 1, and specific locations of deployment are given in Table 2 and Fig. 2.

***Building on Prior Research:*** The project builds on prior research by expanding our sampling capacity beyond the safe and practical limits of scuba diving. Although the diver-based sampling will continue to be the method of choice for most shallow water locations in the US, passive collectors make possible to dramatically expand exploration and monitoring of lobster settlement.

***Deviations from Original Plan:*** There were three deviations from the original statement of work: (1) we were able to get a third year of sampling out of the original 2-year project through the exploratory deployments on Georges Bank and Nantucket Shoals., (2) we were able to leverage a considerable amount of additional collaboration from other groups, more than

quadrupling collector deployments throughout the species range, and (3) Collectors proved to be significant biodiversity indicators, so associated fauna were quantified in addition to lobsters. Across all groups, at minimum lobsters, crabs and fish were quantified. Other groups went into more detail.

## Data:

Data for submission to NEC will include: collector locations; collector contents information including species, carapace or total 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 the NEC database by 31 December 2010.

The PI is currently working with the **Atlantic Coastal Cooperative Statistics Program** (ACCSP) to automate data entry of suction sampling and collector-based data used in monitoring for the American Lobster Settlement Index.

## Results and Conclusions:

Results from the depthwise deployments of collectors in 2007 and 2008 indicate a strong relationship between the strength of the thermocline and vertical pattern of both recently settled young-of-year and older juvenile lobsters (Fig. 3). In thermally stratified regions, such as the mid-coast Maine and Rhode Island, densities of recently settled young-of-year lobsters and older juveniles were concentrated within the shallowest strata. In well mixed regions such as the eastern Maine, in contrast, settlement spread uniformly over the depths, and was generally lower overall. These patterns are generally consistent with behavioral observations that lobster postlarvae remain above the thermocline, generally above the 12°C isotherm (Annis 2001). No settlement was detected, however, in pilot deployments in 2009 on Georges and Platts Banks.

The combination of collector-based and diver-based suction sampling in the US and Canada has resulted in the largest synoptic view of American lobster settlement to date (Fig. 4), enhancing our ability to make generalizations about nursery populations of the American lobster. All participants deployed collectors according to our design specifications. Taken together, our results provide the deepest record (80 m), and northern-most record (Bonne Bay, NL) of lobster settlement to date. Crabs, fish and other benthic organisms found in these collectors have been identified and catalogued and await further analysis. These findings have important implications for lobster production in deep water and offshore, however, our understanding of settlement patterns on offshore banks and shelf waters remains minimal. Offshore collector deployments should be an area of further investigation.

## Partnerships:

Within the core 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. Parkhurst contributed heavily to the design and fabrication of collectors in the NEC Development Project and constructed all the collectors for the subsequent project. He played an important advisory role for other groups that have adopted the design. O'Leary and Lemieux were added in the current project to expand geographic coverage to eastern Maine and Rhode Island. **Lanny Delinger**, President of the RI

Lobstermen's Association, contributed to deployments and retrievals in nearshore RI waters in 2008. **Robert** and **Dennis Colbert** (F/V Virginia Marie and F/V Miss Julie), Sandwich, MA, joined the NEC collaboration in 2009 when they deployed collectors on Georges Bank. Each harvester has provided valuable insight into customizing collector deployment for the conditions unique to their own regions.

The project was initiated by fishermen and the results are manifestly of interest to scientists and fishermen concerned with the American lobster. Ancillary partnerships in the US and Canada are listed in Table 1. In Canada, the Fisherman and Scientist Research Society played a key role in promoting and coordinating the participation of scientists and harvests. The FSRS also has hosted annual workshops for the collaborative since 2007. This has perhaps been the most rewarding aspect of our project, because of the potential to permanently expand the geographic coverage of lobster settlement monitoring well beyond the end date of the original NEC project.

**Table 2.** Locations of all collector deployments, investigators and number of collectors deployed. The core NEC project supported deployments at locations 1, 3-6 from 2007 to 2009. The remaining deployments by the wider group of collaborators were catalyzed by, but not funded by the NEC project. Deployments by other participants continue into 2010, but numbers of collectors are not yet known. See Fig. 2 for map.

| Map Code | Region | Science collaborators | Affiliation | 2007 | 2008 | 2009 | 2010 |
|---|---|---|---|---|---|---|---|
| 1 | Rhode Island | Wahle &Wilson[ab]; Glenn[c] | Bigelow Laboratory & Maine DMR; Mass DM | 100 | 100 | 108 | |
| 2 | Buzzards Bay, MA | Milligan (Stokesbury)[ab]; Glenn[c] | UMass, Dartmouth; Mass DMF | 30 | 30 | 116 | |
| 3 | Mid-coast, ME | Wahle &Wilson | Bigelow Laboratory & Maine DMR | 100 | 100 | | |
| 4 | Platt's Bank, Gulf of Maine | Wahle &Wilson | Bigelow Laboratory & Maine DMR | | 34 | | |
| 5 | George's Bank, Gulf of Maine | Wahle &Wilson | Bigelow Laboratory & Maine DMR | | | 121 | |
| 6 | Eastern Maine | Wahle &Wilson | Bigelow Laboratory & Maine DMR | 100 | 100 | | |
| 7 | Beaver Hbr, NB | Lawton[ab]; Rochette[abc] | DFO St. Andrews; Univ New Brunswick | 32 | 50 | 300 | * |
| 8 | St Mary's Bay, NS | Tremblay | DFO Halifax | | | 75 | * |
| 9 | Lobster Bay, NS | Tremblay | DFO Halifax | 140 | 138 | 136 | * |
| 10 | Port La Tour, NS | Tremblay | DFO Halifax | | 50 | 50 | * |
| 11 | Halifax, NS | Sharp[a], Tremblay[bc] | DFO Halifax | 40 | 50 | 50 | * |
| 12 | Eastern shore, NS | Tremblay | DFO Halifax | | | 50 | * |
| 13 | Canso/Whitehead, NS | Newell[a]; Tremblay[bc] | GCIFA; DFO Halifax | 20 | 50 | 75 | * |
| 14 | East Cape Breton, NS | Tremblay | DFO Halifax | | | 50 | * |
| 15 | North Cape Breton, NS | Tremblay | DFO Halifax | | 50 | | |
| 16 | St. Georges Bay, NS | Comeau | DFO, Moncton | | 25 | | |
| 17 | Arisaig, NS | Comeau | DFO, Moncton | | 30 | 30 | * |
| 18 | Eastern PEI | Comeau | DFO, Moncton | | | 60 | * |
| 19 | Covehead, PEI | Comeau | DFO, Moncton | | 30 | 30 | * |
| 20 | Southern PEI | Comeau | DFO, Moncton | | | 30 | * |
| 21 | Bedeque, PEI | Comeau | DFO, Moncton | | 30 | | |
| 22 | Northwest PEI | Comeau | DFO, Moncton | | | 60 | * |
| 23 | Shediac, NB | Comeau | DFO, Moncton | | 30 | | |
| 24 | Neguac, NB | Comeau | DFO, Moncton | | 30 | | |
| 25 | Baie des Chaleurs, NB | Comeau | DFO, Moncton | | 55 | | |
| 26 | Magdelain Islands, QC | Gendron | DFO, Mt Joli | | 24 | | |
| 27 | Bonne Bay, NL | Burdett-Coutts (Snelgrove) | Memorial Univ. | 70 | 53 | | |
| 28 | St. John Bay, NL | Burdett-Coutts (Snelgrove) | Memorial Univ. | | 17 | | |
| 29 | Eastport, NL | Jones (Snelgrove) | Memorial Univ. | 50 | 49 | | |
| 30 | Sweden | Oresland | IMR Swedish Bd Fisheries , Lysekil | | 4 | | |
| 31 | Norway | Knutsen | Inst. Marine Research, Flødevigen | 10 | | | |
| | [a] 2007, [b]2008, [c]2009 | | Number of regions | 10 | 22 | 16 | |
| | * Number of collectors not yet reported | | Total number of collectors | 682 | 1125 | 1341 | |

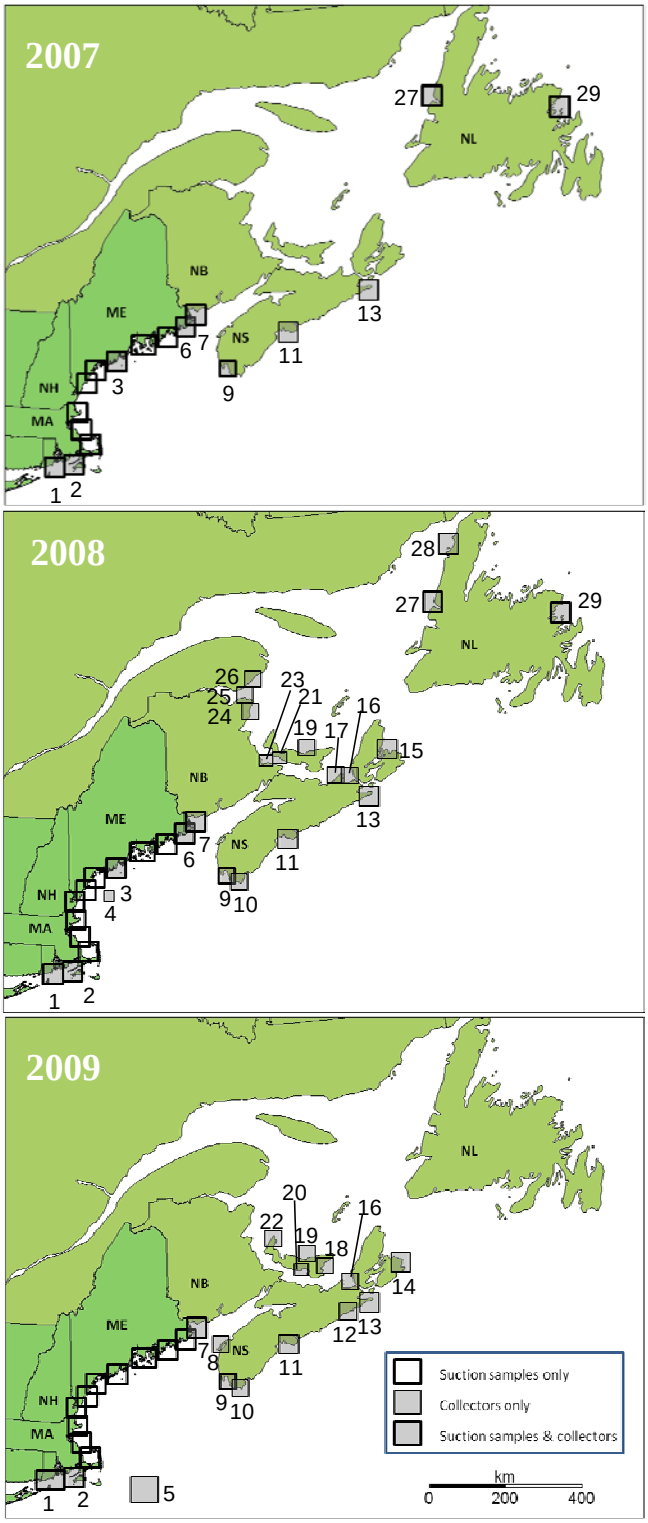


**Figure 2.** Sampling locations in 2007, 2008 and 2009 by suction sampling and passive postlarval collectors. Boxes surround multiple sites nested within regions. See Table 2 for details.

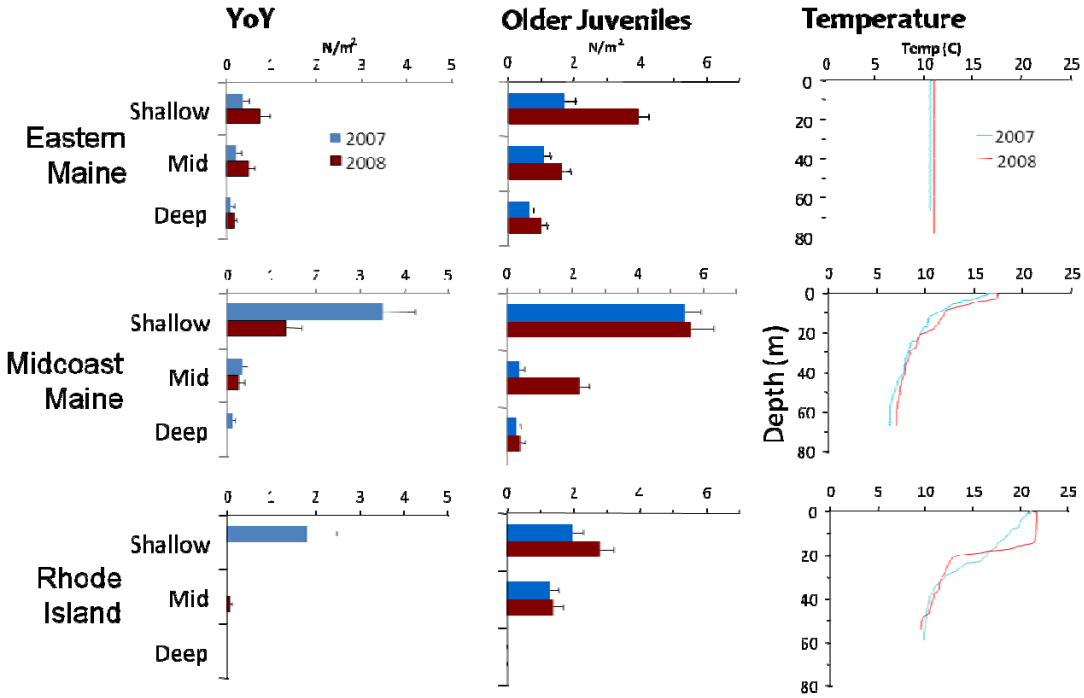


**Figure 3.** Depthwise distributions of young-of-year and older juvenile lobsters sampled by collectors and corresponding temperature profiles in three oceanographically contrasting regions of New England at the time of collector retrieval in 2007 and 2008. Shallow, mid, and deep strata are at depths of 10-20, 30-50, and 70-80 m, respectively.

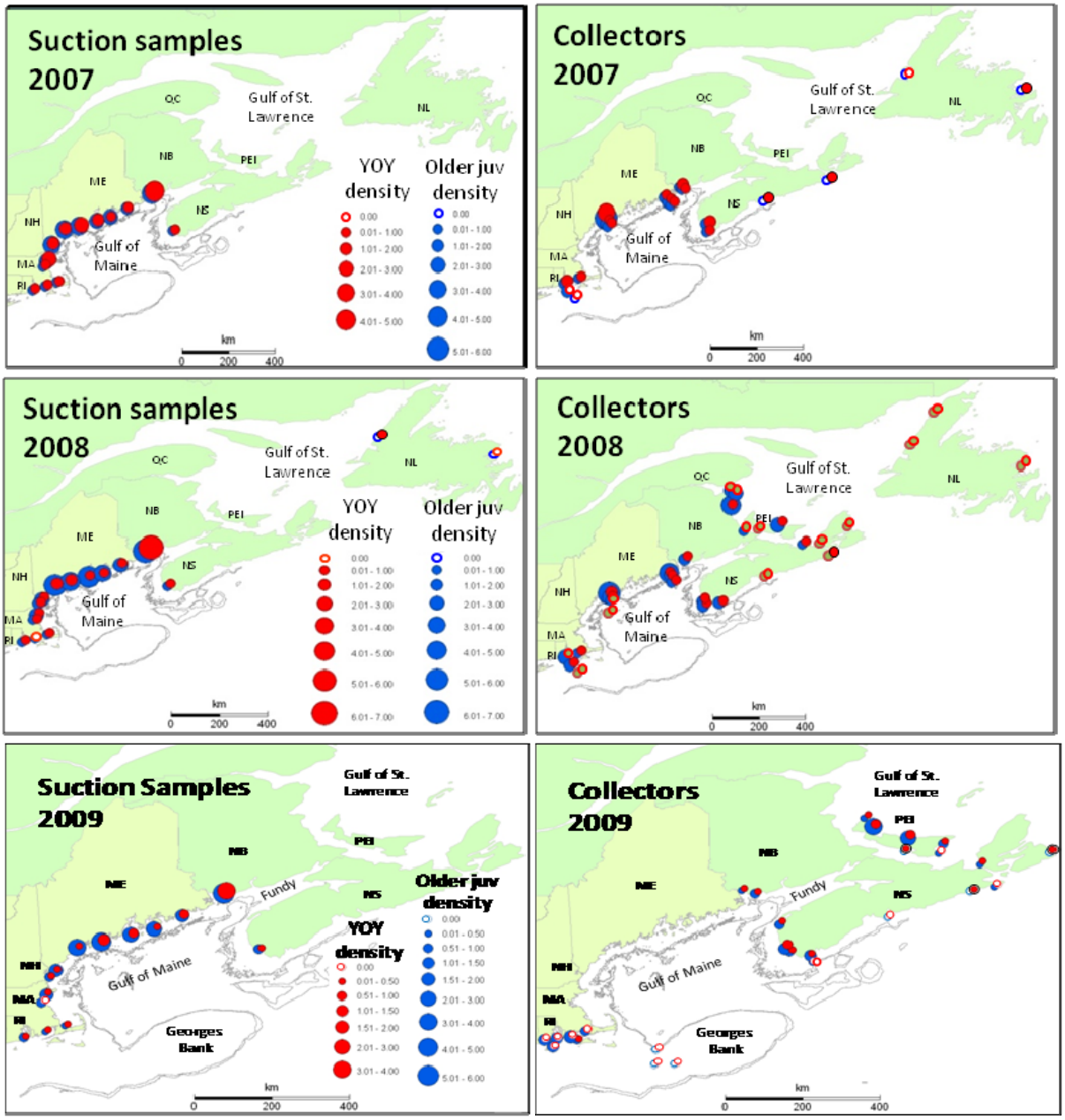


**Figure 4.** Spatial patterns by suction sampling and collector. Average densities (N/m2) of young-of-year (red) and older juvenile lobsters (blue) found in suction samples (left), and collectors (right) deployed in 2007, 2008, and 2009. Symbols represent regional multi-site averages. See Table 2 and Fig. 2 for location details

**Impacts and Applications**:

Now that the American Lobster Settlement Index has gained status as a Reference Point in the US lobster stock assessment, the need to maintain and expand monitoring is reinforced. While the diver-based suction sampling will continue to be the monitoring tool of choice in New England, collectors are likely to become the preferred method in Atlantic Canada and in areas of US waters where diving is impractical or unsafe. In addition to the participants listed in Table 1, additional users of the data are NMFS-NEFSC (contact: Larry Jacobson, Larry.Jacobson@noaa.gov), ASMFC Lobster Technical Committee (Carl Wilson, Carl.Wilson@maine.gov), NH Fish & Game (Joshua Carloni, Joshua.Carloni@wildlife.nh.gov), RI DEM (Mark Gibson, mark.gibson@dem.ri.gov), Maine Lobstermen's Association (Patrice McCarron, patrice@mainelobstermen.org), DFO Canada (John Tremblay, TremblayJ@mar.dfo-mpo.gc.ca), Fishermen's & Scientists Research Society (Patty King, pmdservices@eastlink.ca).

Data generated on associated fauna is also relevant to groups such as Census of Marine Life, NMFS and DFO interested in tools to measure biodiversity.

**Related Projects:**

As stated above, this project has inspired a large collaboration of US and Canadian scientists and industry members that have in effect, more than quadrupled the impact of our original NEC-supported project (see Tables 1, 2; Figs. 1, 2). The Fisherman and Scientist Research Society convened yearly participant meetings in Nova Scotia for annual updates, and coordination. At the most recent meeting in February 2011 the collaborative agreed to move forward with collector-based settlement monitoring in several regions of Atlantic Canada, and to continue to coordinate data management for the American Lobster Settlement Index.

In a separate effort in 2009 Robert Glenn of MA DMF supplemented his own collectors with unused collectors from our NEC project to continue to evaluate lobster settlement in southern New England shelf waters.

In 2010, John Maniscalco of New York DEP deployed collectors around Long Island, NY, in the first deployments in New York waters.

**Presentations:**

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.

Fisherman and Scientist Research Society (FSRS). Annual meeting. Feb. 20-22, 2009. Wahle co-chaired one-day workshop dedicated to updates and future planning of collector deployments by members of the US-Canadian collaborative.

Wahle, R.A. (Workshop host and organizer) 2009. The American Lobster Settlement Index at 20 years: Looking back/ looking ahead. Workshop by the same title held at Burnt Island, Boothbay Harbor, ME, June 19-21, 2009. Some 40 participants take a retrospective at the settlement index and discuss research priorities for the future.

## Published Reports and Papers:

Copies of publications and reports are submitted as pdf files with this report.

Wahle, R.A. 2006, 2007, 2008, 2009. Annual Updates of the American Lobster Settlement Index. Circulated to all stakeholders. Available at: http://www.umaine.edu/marine/people/sites/rwahle/LobsterSettlementIndex.htm/ and published in whole or in part in *Commercial Fisheries News*

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* 21: 3-7.

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 43*: 465–474

Wahle, R.A., J. Tremblay, C.Wilson, R. Rochette, P. Lawton , M. Comeau, V. Burdett-Coutts, R. Glenn, M. Gibson, C. Bergeron. (IN PREP). Patterns of American lobster benthic recruitment from Newfoundland to southern New England as measured by diver-based suction sampling and passive postlarval collectors.

## Future Research:

***Offshore sampling:*** The offshore banks, Georges Bank, Nantucket Shoals, Browns Bank, remain largely unexplored with respect to lobster larval settlement, although they are well known to be populated by large numbers of egg bearing females. Circulation on Georges Bank tends to be relatively closed, so there is reason to believe that larvae hatched there will settle there. Our pilot studies to date have produced no settlers, but they are inconclusive because of the limited areas they sampled.

***Data-base development:*** Both suction sampling and collector-based monitoring data will contribute to the American Lobster Settlement Index in the future. In the coming months the PI will be working with the ACCSP to develop a streamlined mechanism to centralize the data coming from the different states and provinces without duplicated effort. It will also allow us to automate the production of necessary graphs, maps and tables as part of the standard reporting, as well as customized reports.

***Biodiversity:*** Passive collectors are proving useful in biodiversity studies because they provide a standardized habitat that is preferred by the early life stages of many invertebrates and fishes. It is necessary to identify the key groups for which this method proves useful. Further development is needed.

## Images:

Images are provided in separate jpg files.