

## New England Lobster Settlement Index: Update 2003

Richard Wahle (Bigelow Laboratory for Ocean Sciences), Robert Glenn (Massachusetts Div. Marine Fisheries), Peter Lawton, David Robichaud, (DFO Canada), Robert Steneck (Univ. Maine), Carl Wilson (Maine Dept Marine Resources), and Andrew Pershing (Cornell University)

This is the third annual update of the New England lobster settlement index, a monitoring program that is independently supported by Rhode Island, Massachusetts, Maine, and New Brunswick, Canada, as well as the fishing industry throughout. The aim is to evaluate the strength of lobster year classes when they first arrive by post-larval settlement from the plankton in shallow near-shore nurseries where they spend their first few years of life. The data are being used to gain a better understanding of the role of environmental factors in determining regional population trends, a potentially valuable tool in lobster fishery stock assessment and forecasting. Each update will feature an aspect of the data analyses being conducted with the time series. In this update we examine the degree to which annual fluctuations in settlement are synchronous from region to region.

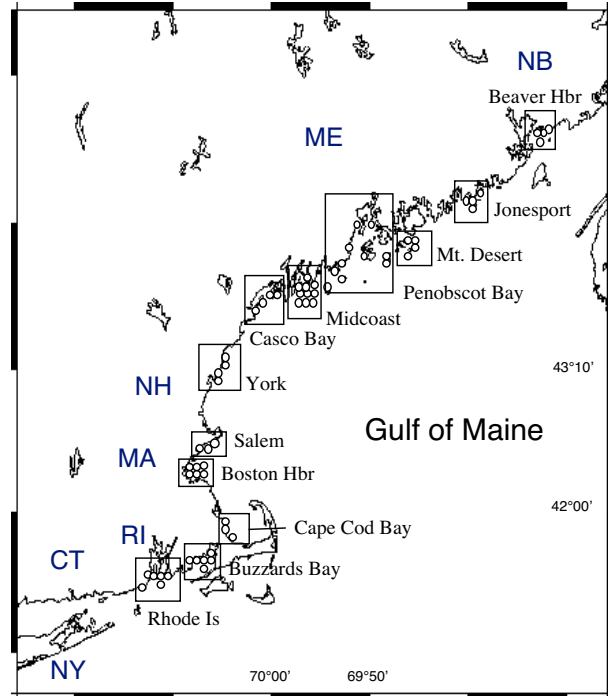


Fig. 1. Sampling sites for the New England lobster settlement index. Boxes surround sites used for regional averages shown in Fig. 2.

First, some background. Surveys are conducted by divers using suction samplers in shallow cobble-boulder nurseries. Earlier studies demonstrated that patterns in the density of benthic young-of-year lobsters sampled at the end of the settlement season reflect the planktonic post-larval supply, and also reliably predict the abundance of nursery-dwelling 1- and 2-year-old lobsters in

subsequent surveys (Wahle & Incze 1997, Incze et al. 1997).

The time series began on Maine's mid-coast in 1989. It expanded to Rhode Island, Massachusetts and Maine's Mt. Desert region in the 1990's; then in 2000, to the remainder of Maine's seven lobster fishing zones. Canadian sampling began as early as 1991, and in 2002 data were combined with New England's for the first time. Sampling is now conducted at some 65 sites from Beaver Harbour, New Brunswick to Point Judith, Rhode Island (Fig. 1),

Spatial patterns of settlement along the coast continue to be consistent from year to year (Fig. 2). That is, eastern Maine continues to see lower settlement compared to the west or further east, a pattern generally reflected in the lower commercial landings

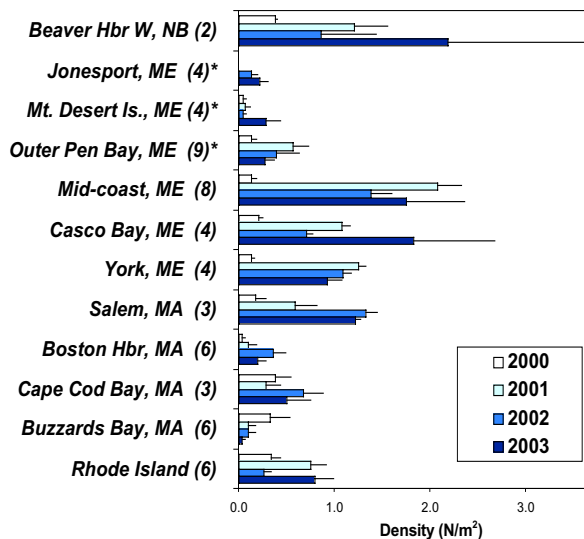


Fig. 2. Regional average lobster settlement throughout New England from 2000 to 2003. In parentheses, the number of sites included in the regional mean. \* Some sampling sites in Jonesport, Mt Desert and Penobscot Bay have changed in the past 2 years, so time trends may not be reliable.

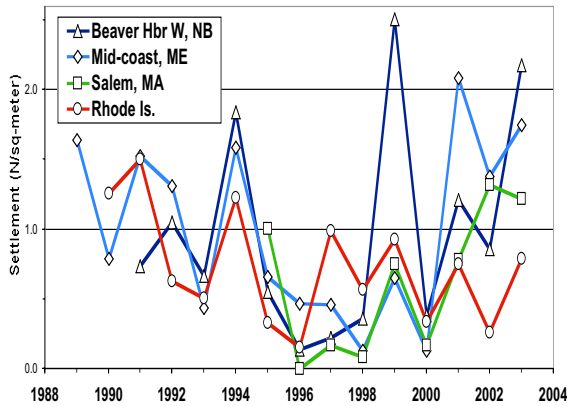


Fig. 3. Lobster settlement index time series for four selected regions spanning the full length of coastline surveyed.

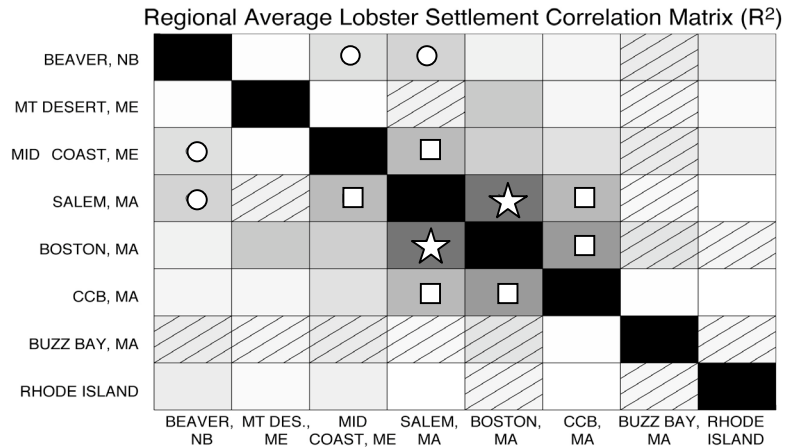


Fig. 4. Correlation matrix showing the strength to which annual fluctuations in settlement are correlated between pairs of regions (some regions not shown). Read across and down as you would a mileage chart. The strength of the correlation increases in gray scale from white to black; negative correlations, where highs in one region relate to lows in another, are crosshatched. Statistically significant correlations are indicated with a circle ( $p < 0.1$ ), square ( $p < 0.05$ ), or star ( $p < 0.01$ ).

per-area in eastern Maine than to the west (Steneck and Wilson 2001). But there have been dramatic fluctuations in settlement in some regions over the years. For example, while 2001 and 2003 were banner years for many parts of Maine and New Brunswick, 2000 was one of the poorest on record (Fig. 2).

Synchrony in annual fluctuations among different regions - or spatial coherence as oceanographers refer to it - is another emergent pattern of the survey (Figs. 3 and 4). Significant statistical correlations are found over a broad geographic area. For example, it may not be surprising that Boston Harbor is strongly correlated with nearby Salem Harbor, but it becomes more interesting when those regions are significantly correlated with more far-flung regions like mid-coast Maine and even New Brunswick. In fact, among the four widely separated regions whose time series appear in Fig. 3, annual ups-and-downs have been in synch more often than not. The explanation remains elusive. Widespread coherence could point to a factor influencing annual differences in egg production, larval survival, or transport at a large geographic scale. It is possible that an oceanic/atmospheric mechanism may dominate annual patterns of settlement. On the other hand, other locales, such as Buzzards Bay, which does not correlate strongly even with neighboring regions, appear to vary according to their own local dynamics. The next step is to evaluate environmental signals that might correlate with the settlement index, something we hope to be able to say more about in next year's update.

### Literature Cited

- Incze, L.S., Wahle, R.A., Cobb, J.S., 1997. Quantitative relationships between postlarval supply and benthic recruitment in the American lobster, *Homarus americanus*. *Mar. Freshw. Res.* 48,729-743.
- Incze, L.S., Wahle, R.A., Palma, A.T., 2000. Advection and settlement rates in a benthic invertebrate, recruitment to first benthic stage in *Homarus americanus*. *ICES J. Mar. Sci.* 57, 430-437.
- Steneck, R.S., and Wilson, C. J., 2001. Large-scale and long-term spatial and temporal patterns in demography and landings of the American lobster, *Homarus americanus*, in Maine. *Mar. Freshw. Res.* 52, 1303-1320.
- Wahle, R.A., and Incze, L.S. 1997. Pre- and post-settlement processes in recruitment of the American lobster. *J. Exp. Mar. Biol. Ecol.* 217: 179-207.