American Lobster Settlement Index | Update 2016

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http://umaine.edu/wahlelab/current-projects/american-lobster-settlement-index/

Just as US and Canadian lobster landings seem to be breaking all the records, settlement has been dipping to all-time lows. The disconnect is causing a lot of people to scratch their heads. Harvests on both sides of the border have sustained an almost uninterrupted surge in abundance for more than a decade. By 2015, US harvests had nearly doubled since 2003, and since 2000 for Canada, making for a combined volume of 157 thousand metric tons (346 million lbs) with a value of $US1.48 billion. Fishery independent state and federal surveys leave no doubt that there have been real and dramatic increases in abundance. While the 2016 landings are still being tallied, if Maine's impressive performance is any indication (Maine harvests about 80% of the US share), 2016 is likely to go down as another banner year both in volume and value. By all indications, the reproductive output of the American lobster population should be greater than ever, but for some reason it does not seem to be translating into record breaking settlement.

This ***ALSI Update*** adds 2016's settlement numbers to our continuing time series of diver-based and bio-collector-based sampling in New England and Atlantic Canada. In this update we also feature an analysis led by Joshua Carloni, of New Hampshire Department of Fish & Game, to take a closer look at what might be behind the puzzling disconnect between what should be record-breaking larval production and the paltry settlement reports across the region.

Settlement 2016: Young-of-year lobster densities in 2016 continued a downward spiral. Many areas reported some of the lowest settlement on record since monitoring began, and the list of areas reporting downturns seems to be growing (Fig. 1). Working from south to north, the low numbers in southern New England have been the status quo for nearly a decade, but at least they remain steady in the face of persistent shell disease. In the Gulf of Maine, most monitoring sites from Beaver Harbour, NB, to Cape Cod Bay report some of the lowest settlement since the late 1990s or early 2000s. Collector-based time series in Canada are relatively short, so the long-term perspective isn't possible. Lobster Bay and St. Mary's Bay of southwest

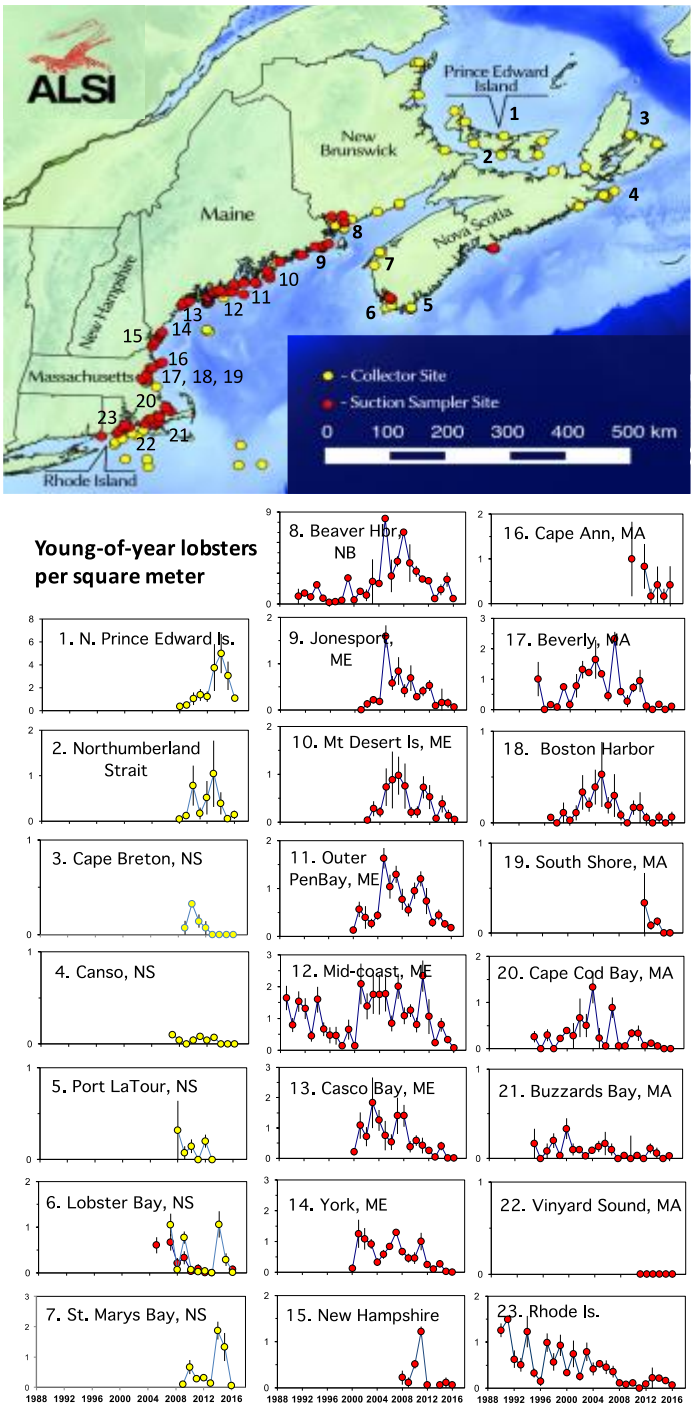

Figure 1. ALSI sampling in New England and Atlantic Canada. Diver-based suction sampling (red) and vessel-deployed collector (yellow). Corresponding time series for groups of sites in study areas numbered on the map.

Nova Scotia had a recent spike in 2014, but have since fallen off. Settlement along the eastern shore of Nova Scotia (Cape Breton and Canso) has been nil for the past 3-4 years. It may be too early to tell, but in the southern Gulf of St. Lawrence, Prince Edward Island seems to be sliding off its impressive surge that peaked in 2014.

The Great Disconnect: The nagging mystery is why settlement would be so low when the brood stock is at record-breaking highs. To dig deeper into this problem we examined a unique long-term time series of lobster larval abundance that bridges the gap between egg production and settlement. Larval samples have been collected annually by the environmental consultant, Normandeau Associates, Inc. since 1988 as part of coastal impact studies for New Hampshire's Seabrook Nuclear Power Station. They use a specialized plankton sampler called a neuston net designed to skim the sea surface where lobster larvae concentrate.

The larval time series reveals the upward trend in early stage larvae that we would expect from the growing numbers of adult lobsters evident both in commercial landings and NOAA trawl surveys (Fig. 2a). The disconnect comes soon thereafter. By the time larvae mature to the still-planktonic postlarval stage a couple weeks later, the trend has turned decidedly downward since 2007 (Fig. 2b). We would naturally expect the numbers of stage I larvae to determine the abundance postlarvae, but we found no correlation. We did find, though, that annual fluctuations in postlarvae at Seabrook strongly determine the abundance of young-of-year settlers in our western Gulf of Maine ALSI study areas. With the exception of 1990, a year of exceptionally high postlarval numbers but low settlement, this was true even for mid-coast Maine, our longest standing ALSI time series, some 100 nautical miles away from Seabrook (Fig. 2b). Our analysis indicates the correlation with Seabrook weakens for ALSI monitoring sites further east in the Gulf of Maine and south of Cape Cod.

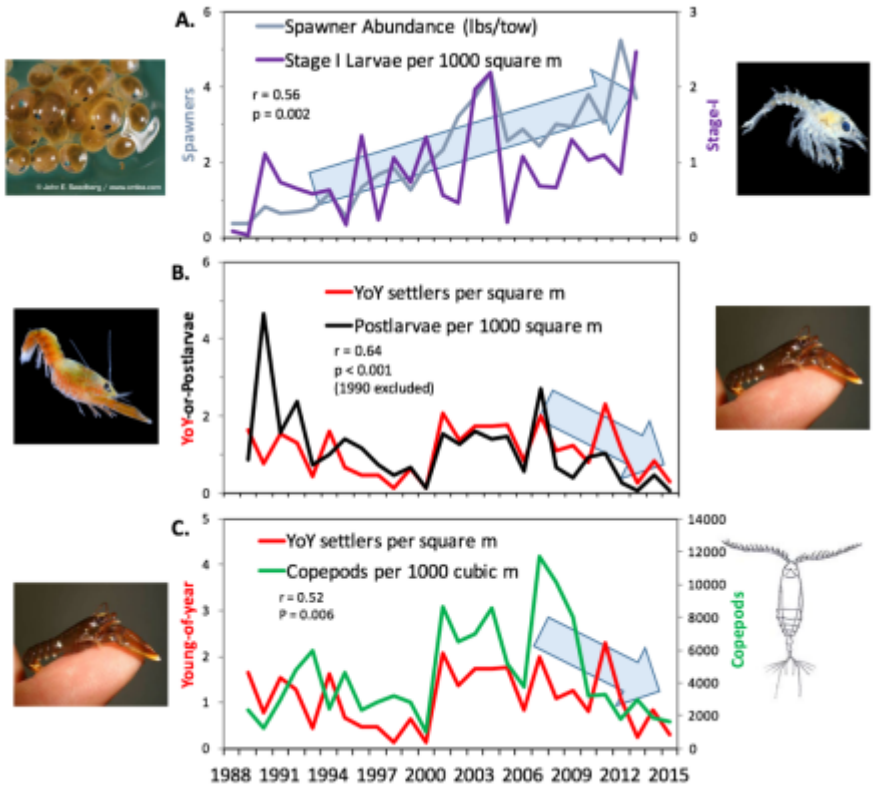

Figure 2. The Great Disconnect. The surge in lobster broodstock correlates well with increases first stage planktonic larvae (a), but not with declines in planktonic postlarvae, which dictate trends in young-of-year (YoY) settlement (b). Postlarval abundance and settlement are also strongly linked to changes in copepod abundance (c), an important food of larval lobsters. (image credits: eggs – J.E. Swedberg; Stage I larva & postlarva - J. Waller; Young-of-year: -Wahle Lab; copepod – thefullwiki.org)

One interpretation of the disconnect between stage I larvae and postlarvae is that survival rates in the intermediate larval stages have been declining over the years despite burgeoning egg production. Could it be that rising numbers of predators, or a shrinking food supply, or unfavorable currents are heightening losses of lobster larvae? One line of evidence hints that recent declines in zooplankton prey that lobster larvae eat may be a contributing factor. An independent set of plankton tows conducted by Normandeau, also at Seabrook have recorded a decline in several species of zooplankton in recent years. Over the 27 year time series we find a robust alignment between changes in postlarvae, young-of-year settlement, and the abundance of the copepod, *Calanus finmarchicus*, a key node of the Gulf of Maine's planktonic food web (Fig. 2c). Is this a cause-effect relationship, or is something larger causing a decline in both lobster larvae and copepods?

If we can generalize from this admittedly limited larval data set, the take-away is that larval production seems to be doing just fine, rising with the historic surge in brood stock. But times seem to have been getting harder for larvae as they run the month-long gauntlet from hatch to settlement. Clearly, we need to better understand these linkages to know whether larval food supply could be a limiting factor in recruitment of Gulf of Maine lobster and the implications of these trends for the future of the fishery. Most importantly, this is a prime example of why spawner abundance and egg production has been a notoriously poor predictor of recruitment to so many fisheries, and why ALSI may be a useful bellwether for the future. **θ**