



# American Lobster Settlement Index | Update 2017

**Compiled by:** R. Wahle, K. Reardon, C. Brown, W. Favitta and A. Goode

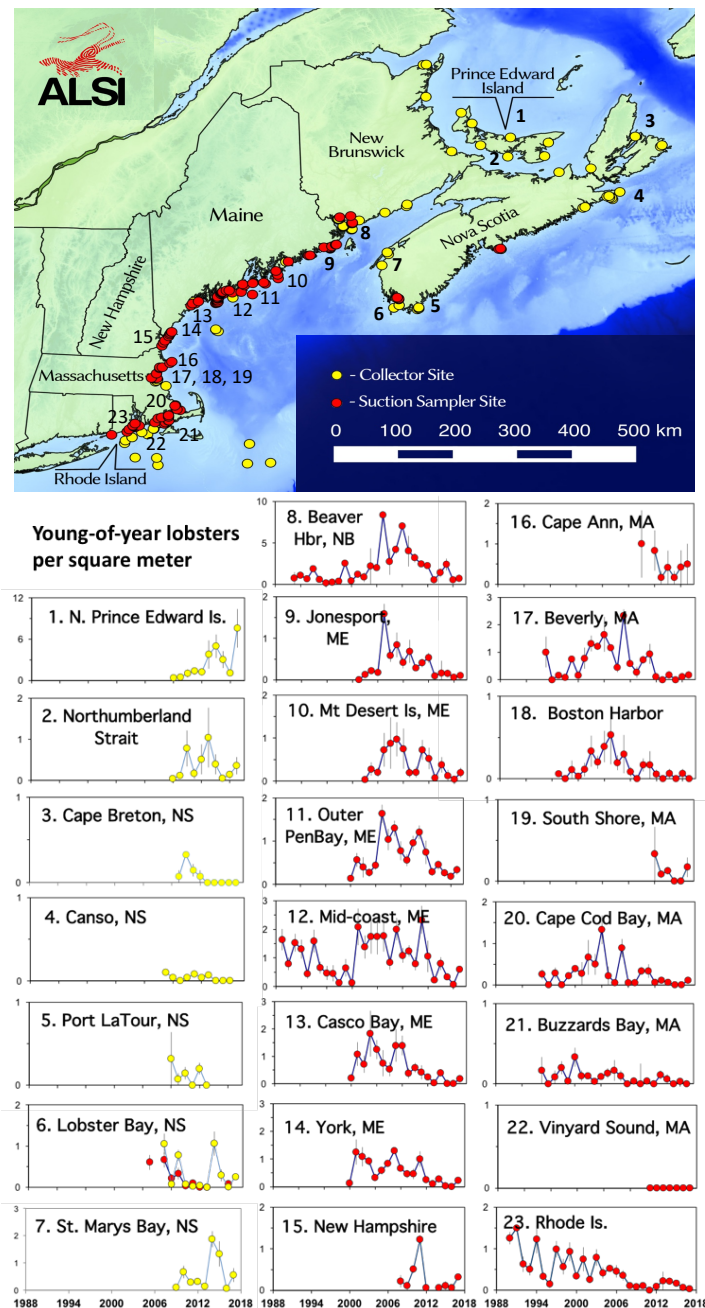
**Participants:** ME DMR (K. Reardon, R. Russell), MA DMF (T. Pugh, K. Whitmore), RI DFW (S. Olszewski, C. McManus), NH F&G (J. Carloni), DFO Canada (M. Comeau, J. Gaudette, P. Lawton, S. Armsworthy, A. Cook), UNB, St. John (R. Rochette), GCIFA (E. O'Leary), PEIFA (L. Ramsay, M. Giffen), PEI DAF (R. MacMillan), Fishermen & Scientists Research Society (S. Scott-Tibbets), C. Brown (Ready Seafood Co.), N. Lemieux (F/V Christina Marie)

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

Lobster landings in the US dropped considerably in 2017 when Maine reported a 16% decline from 2016's historic highs. On one hand, the decline was consistent with our ALSI-based forecast, and in last year's *Update* we suggested the possibility that recent declines in settlement, despite high brood stock abundance, might reflect reduced larval survival, limited by the supply of planktonic foods. But other indicators, such as the Maine Department of Marine Resources (DMR) trawl and ventless trap surveys, have not reported similar declines. DMR sea sampling bares out harvester reports of unusually high numbers of undersize lobster in deep water. It raises the question of whether we're missing part of the settlement signal, one that could cause us to under-represent year class strength. An alternative scenario to the elevated larval mortality hypothesis is that declining settlement density signals not so much a decline in abundance as an expansion of settlement over a wider area of thermally suitable seabed in a warming ocean. Not accounting for that expansion could lead us to overstate the predicted fall-off in landings. This ALSI *Update* gives the latest settlement in US and Canadian waters, and then revisits the evidence and implications of deep water settlement.

**Settlement 2017:** The big news in 2017 was the tremendous settlement surge in the southern Gulf of St. Lawrence, and specifically on the north shore of PEI (Fig. 1). There, settlement reached historic highs for that region, and rivaled our all-time record breaker at Beaver Harbor, NB, in 2006. This comes as a surprise, as expectations began to dim after two successive years of decline followed a previous settlement peak in 2014. In contrast, the northeast shore of Nova Scotia (Cape Breton and Canso) has reported very low to undetectable settlement for the past few years, but sampling along the rest of the eastern shore is sparse, so it is hard to say whether that represents a broader pattern. Settlement in southwest Nova Scotia in 2016 and 2017 has also been down compared to the highs reported in 2014 and 2015. Similarly, in 2017, the remainder of the Gulf of Maine (GoM), from Beaver Harbor to Cape Cod Bay, gave only a slight uptick above 2016's low. And finally, south of Cape Cod still shows no recovery from their long-term lows.

**Probing the depths:** The vessel-deployed 'bio-collector,' developed in 2005 with NOAA Sea Grant support in collaboration with US harvesters, and now widely used in Canada (Fig. 1), has opened a window on lobster settlement



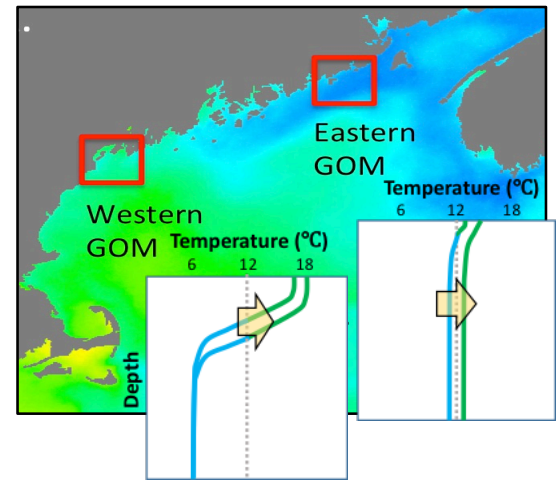
**Figure 1.** ALSI sampling in New England and Atlantic Canada. Diver-based suction (red) and vessel-deployed collector (yellow) sampling locations and corresponding time series of young-of-year (YoY) settlement for selected groups of sites in numbered study areas.

beyond the reach of divers. To date, in the GoM, our glimpse of deep water settlement is limited to two 2-year time frames: 2007-08, and 2016-2017. On both occasions, to better understand the influence of temperature on settlement patterns, we intentionally deployed collectors across thermally contrasting regimes along the eastern and western Maine coast and by depth (**Fig. 2**).

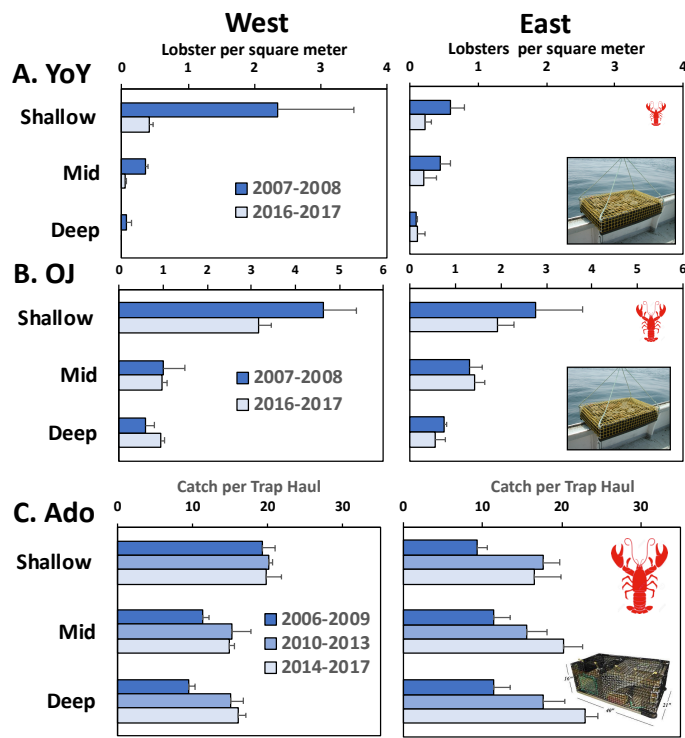
These collector deployments reveal that the depth distribution of newly settled young-of-year (YoY) lobsters mirrors the east-west difference in summer thermal regime: in the west settlers tend to concentrate in the warmer shallows, but in the east they spread more evenly over the full range of depths (**Fig 3a**). In addition, the more recent collector deployments reflect a 50-75% settlement downturn from 2007-08 levels also evident in our long-term diver-based survey (**Fig. 1**).

If young lobsters do not move much within the first few years of settling, we would expect the depth distribution of older juveniles (OJ; carapace <50 mm; <2") resulting from previous years of settlement to parallel the YoY pattern. Indeed, that seems to be the case, but while OJ densities were lower in the shallow strata in the more recent sampling of 2016-17, they remained on par in the deeper zones (**Fig. 3b**).

The larger adolescent and adult lobster (Ado; carapace >50 mm; >2") are more migratory, and the pattern changes dramatically. From Maine DMR's ventless trap survey (VTS), initiated in 2006, a picture emerges of the catch shifting to deeper water over the past decade (**Fig. 3c**). In the west, VTS catches were initially higher in the shallows than the deep from 2006-2009. But while the catch remained stable in the shallows in subsequent years, it expanded by as much as 30-40% in the deeper zones in 2010-13, where it has remained. Given the clearly stratified pattern of YoY and OJ's in western collectors, the expansion into deeper zones is best explained by a migration of lobster from shallows to the deep in the years after settlement.



**Figure 2. Contrasting thermal regimes in a warming ocean.** During the summer the western GOM develops a warm water layer to ~20 m depth that does not readily mix with the deeper cold waters below. But in the east temperatures remain almost uniform from surface to bottom by virtue of vigorous tidal mixing, keeping summer surface temperatures cooler, but bottom temperatures warmer, than the west. Insets show corresponding typical west and east vertical temperature profiles with favorable temperatures for settlement >12°C (53.6°F) shown in green. In a warming climate (yellow arrow) a few degrees of warming is expected to have a more dramatic positive effect on settlement in the east than in the west.



**Figure 3. East-west differences in the spread to the deeps.** A. Young-of-year (YoY) lobsters in collectors; B. Older juveniles (OJ) in collectors; and C. Adolescents and adults (Ado) in ventless traps. **Shallow** = 5-20 m (2.7-10.9 fa); **Mid** = 21-45m (10.5-24.6 fa); **Deep** = 46-90 m (25.2-49.2 fa).

In the east, by contrast, between 2006-09 and 2010-2013 the VTS catch nearly doubled in the shallows and increased considerably at depth. While catches stabilized in the shallows in 2014-2017, they continued to increase in deeper zones in 2010-13 and again in 2014-17.

Together, results from diver suction sampling, collector deployments and VTS monitoring, suggest the big settlement surge of 2005-2008 fueled much of the subsequent eastward expansion of the fishery, which included an expansion into deep waters by virtue of uniform temperatures over the full range of depths. Unfortunately, data on deep water settlement prior to 2007 are not available to put that idea to a better test.

Even with the eastward wave of settlement after 2005, the widespread settlement declines over the past 5-6 years may already be showing their effects in the slow-down of shallow water VTS catches. If settlement declines reported in shallow dive surveys have also occurred at depth, as the 2016-17 collector data suggest, we may expect declines in deep water VTS catches, and landings, in the coming years. Declines in settlement may explain the recent slow-down in landings, but the jury is still out. Meanwhile, thanks to support from Ready Seafood Co., deep water settlement monitoring will continue another year. **θ**