Long-term annual variations in the abundance of juvenile finfish and portunid crabs relative to increasing water temperatures in Narraganset Bay, RI

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This study examined the effect of increasing water temperature on the estuarine biota of Narraganset Bay, Rhode Island (RI), with a specific focus on three juvenile finfish and portunid crab species: bluefish, summer flounder, winter flounder, blue crab, green crab, and lady crab. Data supporting this study were derived from the RI Department of Environmental Management, Division of Marine Fisheries (DMF) long-term seine survey (1988-2021). Sampling of target species was performed monthly from June to October using a beach-seine set (61 × 3.1 m) at 15 fixed sites throughout the bay. Target species were enumerated, and variations in annual abundance [Log(CPUE)] were examined relative to year and ambient temperature via linear regression analyses. Mean monthly temperatures significantly increased in Narragansett Bay ($R^2 = 0.15$, $p < 0.05$) at a rate of ~ 0.03 ^oC per year, i.e., 1 ^oC increase from 1988 to 2021. During this time series, bluefish abundance remained relatively constant ($R^2 = 0.08$, $p = 0.10$). Conversely, summer flounder and blue crab abundances significantly increased over time ($R^2 = 0.31$-0.38, $p < 0.0001$-0.0005), with summer flounder abundance unrelated to temperature ($R^2 = 0.005$, $p = 0.69$) and blue crab catches positively correlated with warming waters ($R^2 = 0.15$, $p < 0.05$). Winter flounder and green crab abundances significantly declined across years ($R^2 = 0.34$-0.56, $p < 0.0001$-0.0005), with catches inversely related to temperature ($R^2 = 0.15$-0.26, $p < 0.005$-0.05). Similarly, the lady crab population decreased over time ($R^2 = 0.78$, $p < 0.0001$), but annual abundances were independent of temperature ($R^2 = 0.06$, $p = 0.20$) and negatively correlated with increased blue crab numbers ($R^2 = 0.18$, $p < 0.05$). These results suggest that Narragansett Bay has undergone significant changes in species composition over the last three decades, with seasonal water temperatures partially explaining annual variations in the abundance of select organisms (e.g., winter flounder, green crabs, and blue crabs). Moreover, putative biotic interactions among estuarine organisms may regulate intra-specific abundances, e.g., lady crabs potentially displaced by the influx of blue crabs via predator-prey and/or competitive interactions. Further analysis of the expansive RI DMF data set relative to other biotic or abiotic factors may provide additional insights into the mechanisms underlying temporal variations in the community composition of the bay.

This work was supported by RI NSF EPSCoR C-AIM