



Climate Change Impacts on Estuarine Larval Fish Composition

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Introduction

The impacts of climate change are becoming more apparent and extensively studied, however it is more difficult to study the ecological response in marine systems. The response of estuaries can be particularly important because they serve as nurseries for the larvae of estuarine dependent species and because they are shallow, they are easily affected by increasing temperatures. Therefore, it is important to understand the potential implications of increasing temperatures on larval fish assemblages, especially for species of economical and ecological importance. Utilizing the longest continuous ingress data set (weekly, 1989-2010) on the east coast, we evaluated trends in larval fish composition in a New Jersey estuary in response to increasing temperatures.

Questions

- Have average estuarine water temperatures changed over this time series?
- Has the species diversity and abundance of northern and southern fish species changed over time?

Materials and Methods

Weekly sampling occurred at a bridge over Little Sheepshead Creek to capture larval fish ingressing through Little Egg Inlet from the Atlantic Ocean into the Great Bay/Little Egg Harbor estuary (Figure 1). Three thirty minute plankton tows (1 m length, 1 mm mesh) were conducted weekly on night, flood tides from 1989-2010 (n= 3300+ tows). Flow and physical variables were recorded and samples were identified to the lowest taxon (n = 350,000+ larval fish)

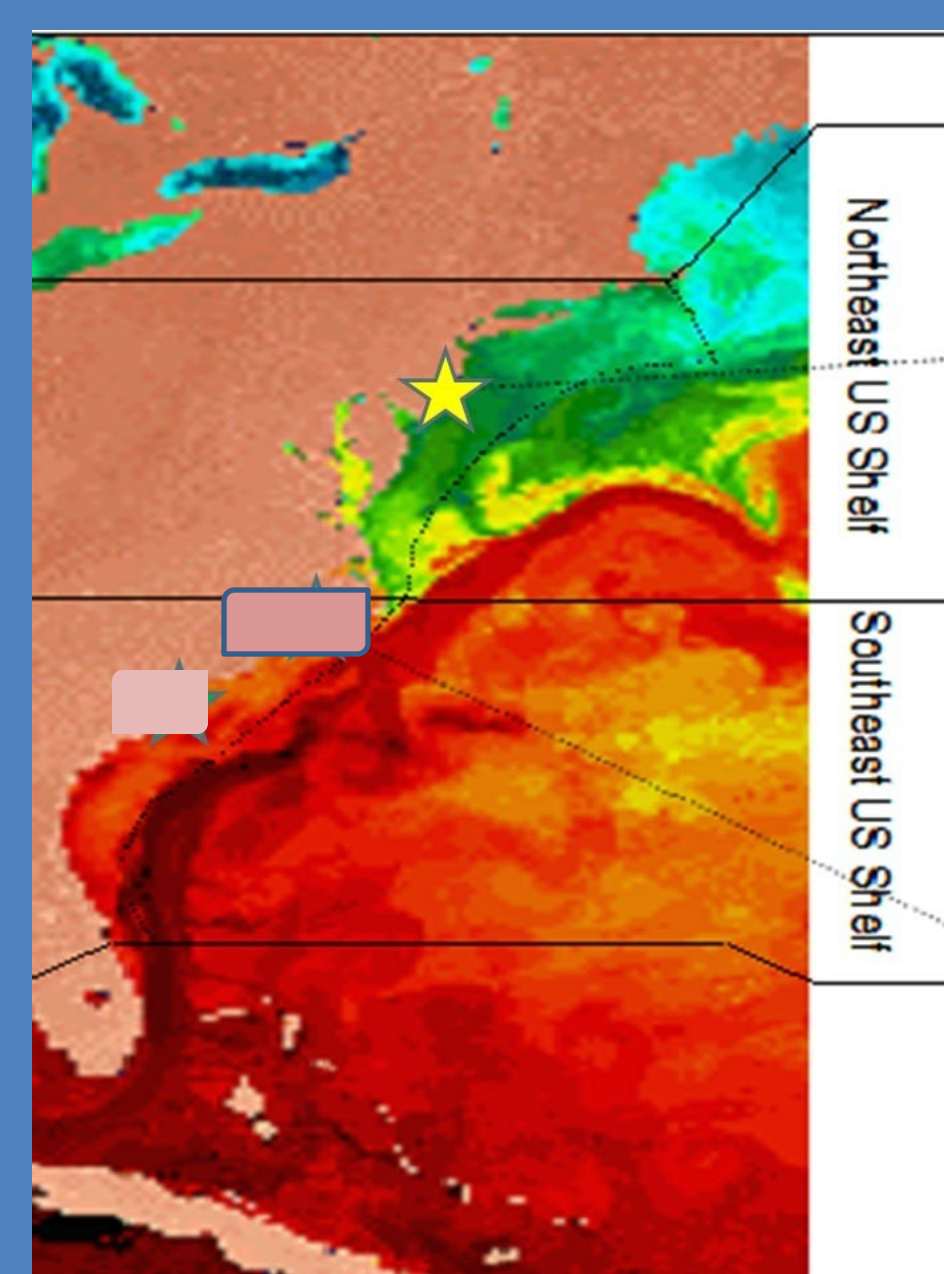
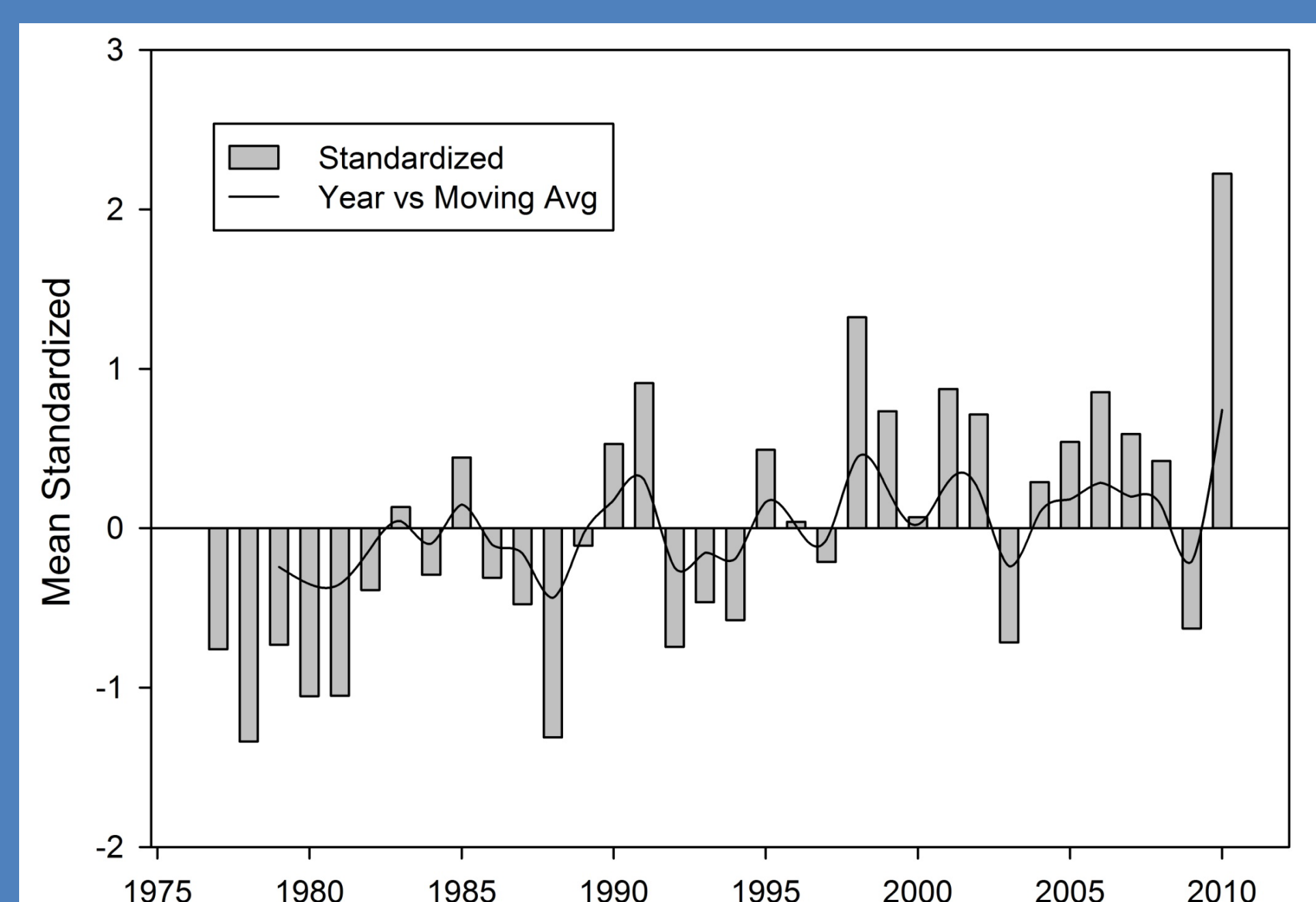


Figure 1a. Setting a plankton net on Little Sheepshead Creek Bridge
Figure 1b. Map of sea surface temperature. Yellow star indicates study site. The Gulf of Maine and Georges Bank are in the cooler zone (blue), the Mid Atlantic Bight is in a temperate zone (green), and the South Atlantic Bight is in a sub-tropical zone (red).

Results

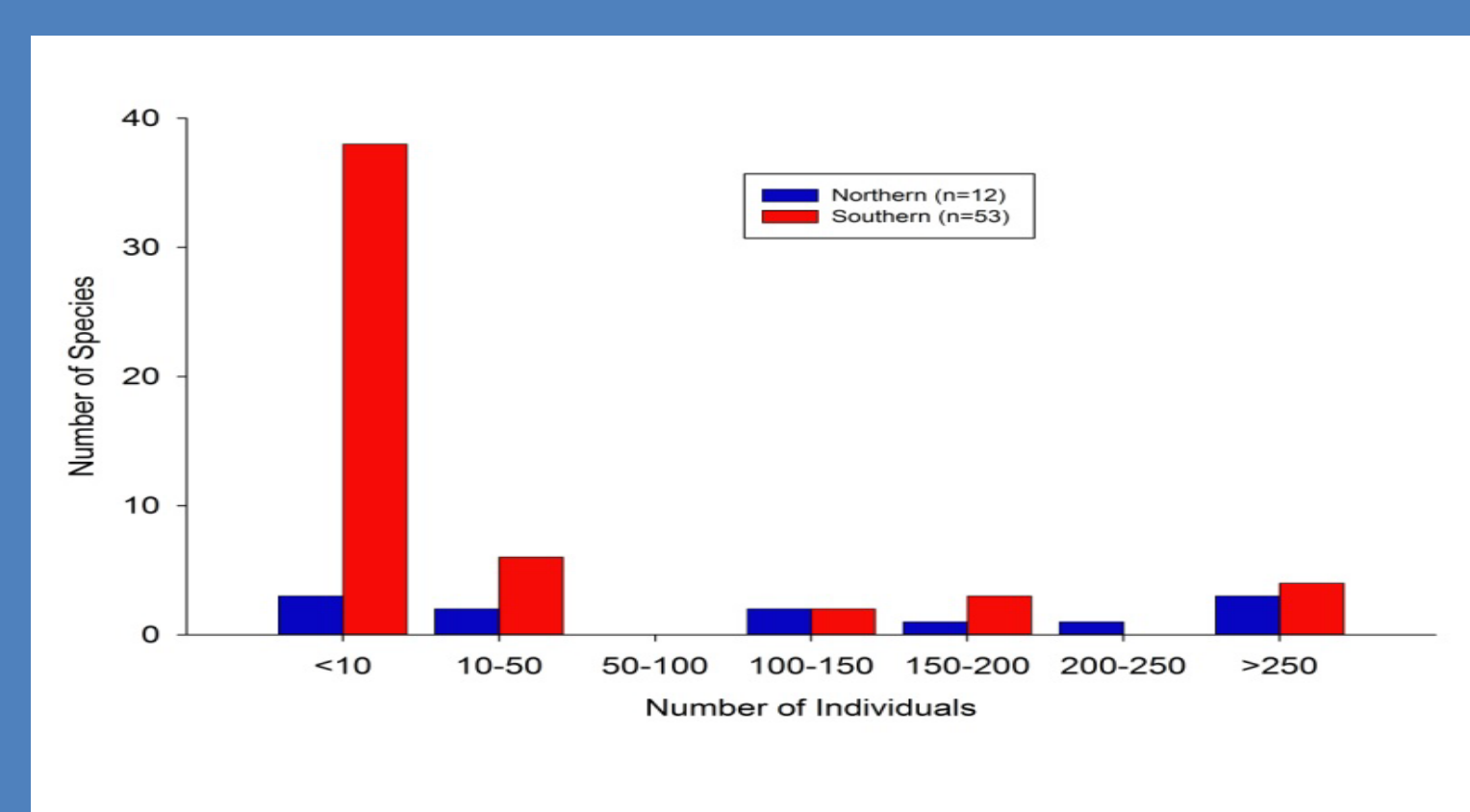
1. Temperature

Average temperature has increased during the past 30 years as seen in the mean standardized yearly average and 3 year moving average estuarine water temperatures collected on site. 0 represents the average temperature of all years.

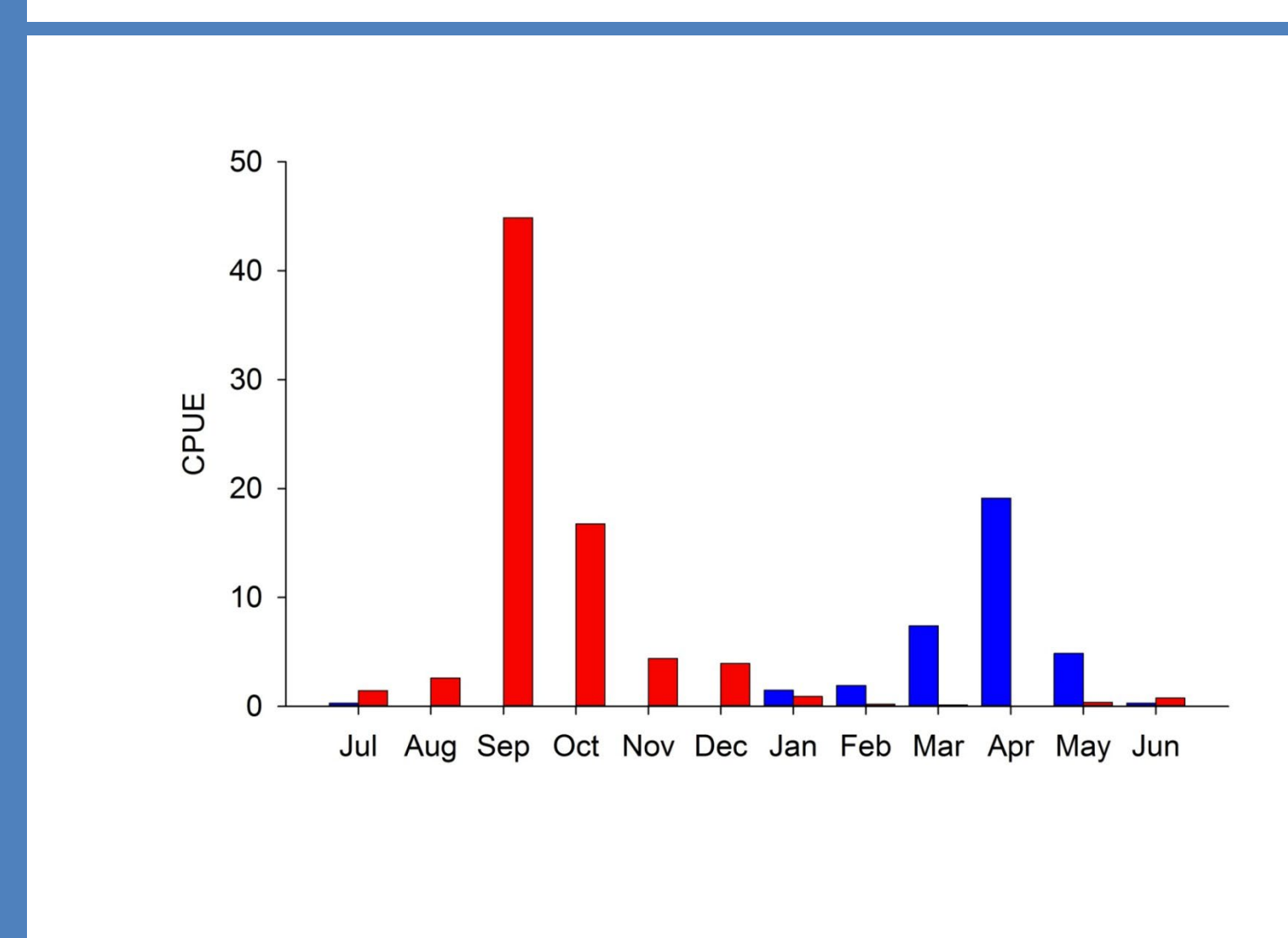


2. Species of northern origin and species of southern origin

a. The contribution of northern species (e.g. Atlantic herring, Atlantic sand lance) is evenly distributed among frequency categories but southern species (e.g. Atlantic croaker, silver perch) are most dominant in species caught less than 10 times.



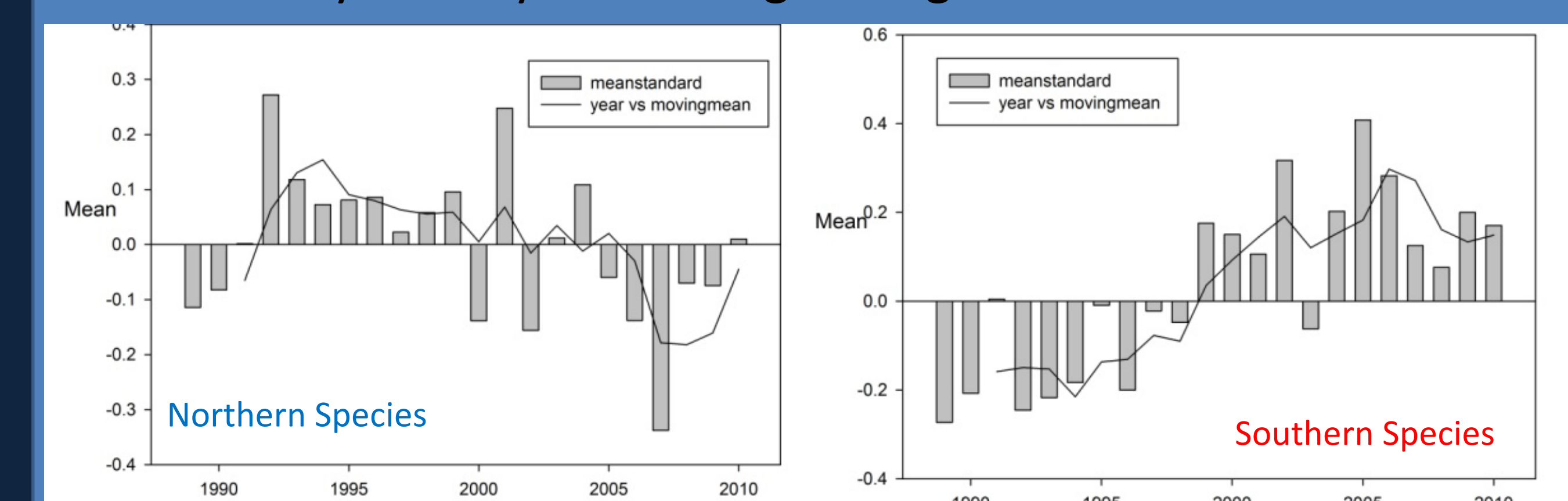
b. Southern species are caught in July-December with a peak in September and northern species are caught in January-May with a peak in April.



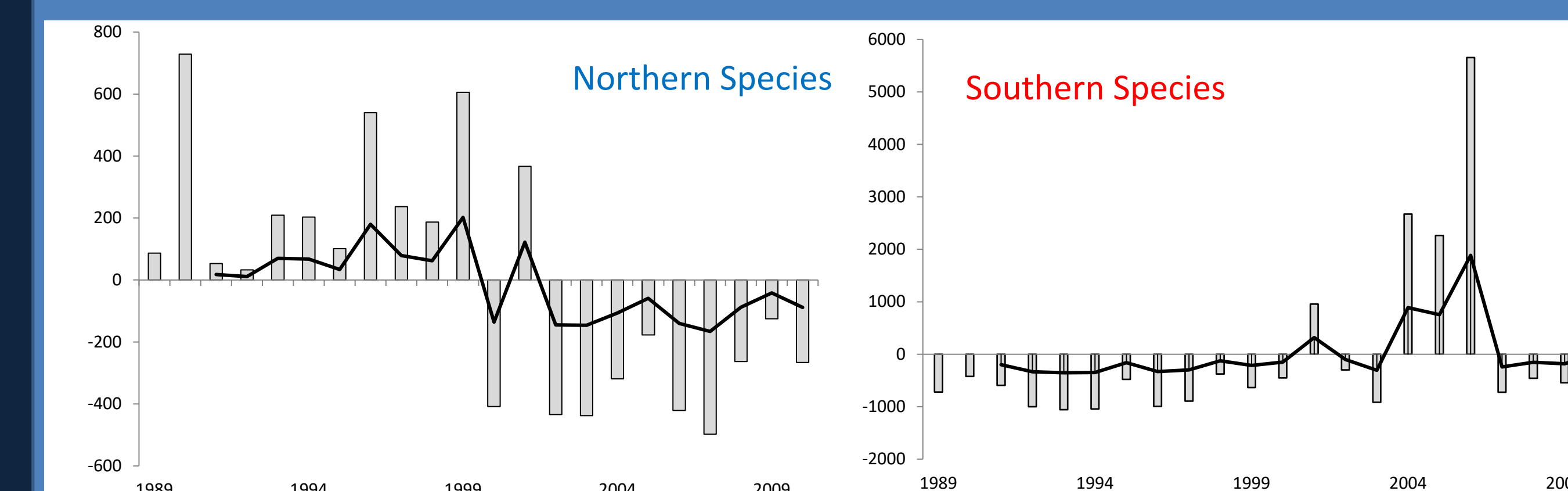
Results

3. Shifts in northern and southern species composition

a. The diversity of northern species has decreased since 2000 and the diversity of southern species has increased since 1998 based on yearly mean standardized species diversity and 3-year moving average.



b. The abundance of northern species has decreased since 1999 and the abundance of southern species has increased since 2003 based on yearly mean standardized species abundance and 3-year moving average. Following 2007, abundances dipped below the average, however this may be due to the extremely high numbers from 2004-2006 skewing the overall average. However, these values are still higher than numbers prior to 2000.



Conclusions

- There is evidence of increasing estuarine temperatures and this is influencing the larval species composition in this estuary and probably the region.
- This is especially true for species of northern and southern origin where there are decreases and increases (respectively) in species diversity and abundance over time.
- Thus climate change is having an impact on the larval species ingressing into New Jersey.
- Further research is required to understand the impacts of changing larval fish compositions to the overall community.