Drivers of Species Community Dynamics in Pamlico Sound: a Multivariate Approach

Caid Menzel[1] and Jim Morley[1]

Introduction

Myriad forces from rising water temperatures to increased fisheries pressures can alter community assemblages in estuaries. These complex systems are characterized by dynamic interactions among both biotic and abiotic factors. To effectively manage estuaries, a better understanding of the intricate factors driving community dynamics is necessary. Unlike other major estuarine systems, the aquatic community of the Pamlico Sound has not been described using multivariate approaches, which serve to digest the massive amounts of data available, in both numbers of variables and length of the time series. Such analyses provide novel understanding of the most important drivers of community change. Non-metric multidimensional scaling (NMDS) was used to compare annual and seasonal communities across time and identify factors most important in regulating species assemblages. Large changes have been seen across the time series, which resulted in notably different communities.

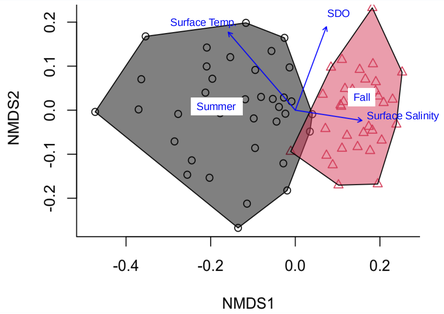
Data and Methodology

Trawl data

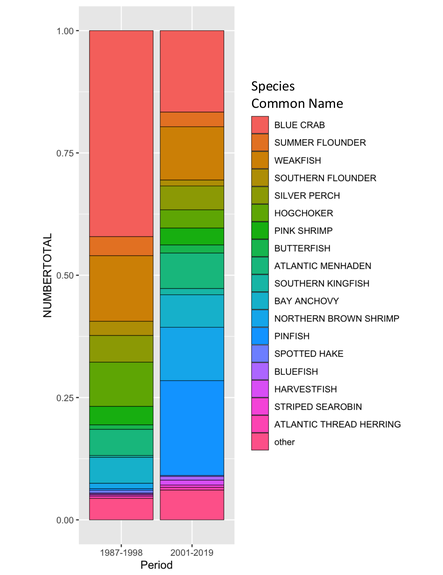
- North Carolina Division of Marine Fisheries P195 Trawl Survey (fisheries independent)
- Covers Pamlico Sound, Neuse River, Pamlico River, and Pungo River (hereon referred to as Pamlico Sound)
- Conducted in June and September (Summer and Fall)
- Using data from 1987-2023

Non-metric Multidimensional Scaling (NMDS)

- Selected the ~30 most common species to represent the community
- These species make up 99.5% of the total catch by count, so we are confident they are representative of larger community change
- Ordination performed using both abundance and weights
- Chronological Clustering Analysis (CCA) groups years based on NMDS dissimilarity



NMDS of Seasonal Abundances 1987–2023
35 Species (p<0.001)



The 18 most common species, omitting Spot and Atlantic Croaker (together >75%) so other species can be scrutinized, showing massive changes in certain species between periods.

Implications & Directions

Distinct communities were evident ($p < 0.001$) between summer and fall, while differences among sampling strata, representing habitats, were non-significant.

Sequential years exhibited strong similarity in community structure. However, during a transitional period between 1997 and 2001 the annual species assemblage exhibited greater variation. Chronological Clustering Analysis exhibits major breaks in both seasons and species metrics, indicating a possible regime shift.

Shifting abiotic characteristics may catalyze increased dominance by other species and groups (ex. generalists, elasmobranchs, warm-adapted species), reinforced by inter-species dynamics.

Additional statistical testing will isolate year groupings and which species consistently correlate with the larger community change.

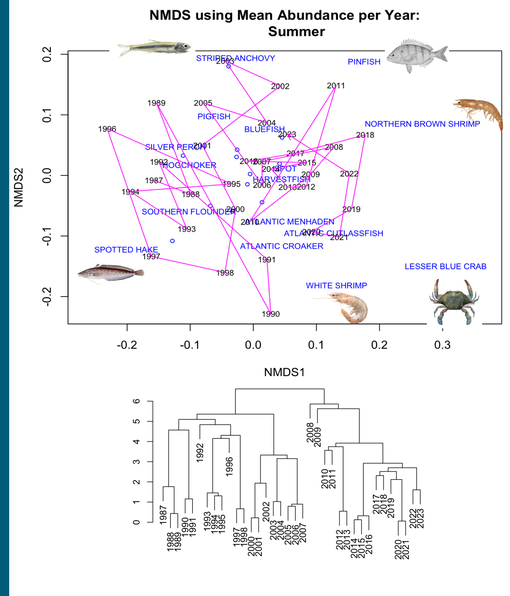
Environmental variables, both within the dataset and supplemental, can be applied to the biological data, better explaining drivers of changes in species abundance and assemblage.

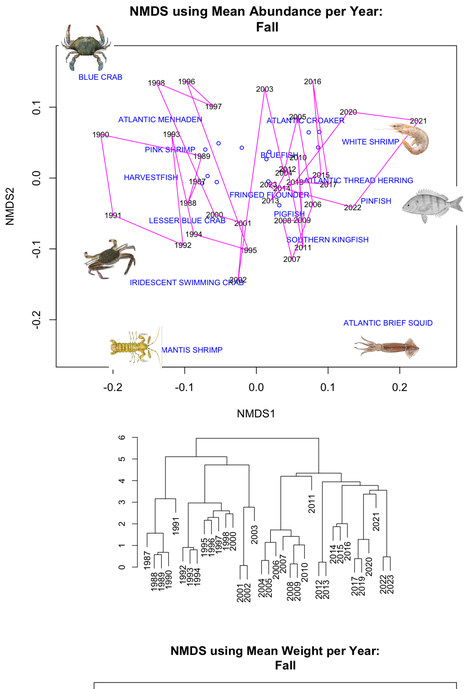
[1]Department of Biology, East Carolina University

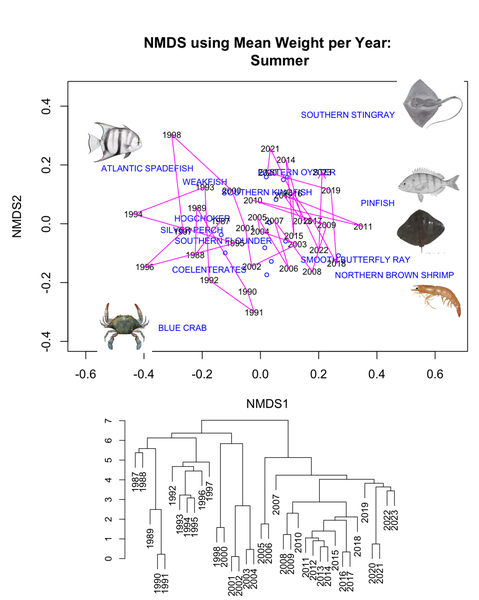
Acknowledgments
I would like to express my sincere gratitude to my advisors, Jim Morley, Rachel Gittman, and Patrick Harris, for their invaluable guidance, support, encouragement, and patience throughout this research, and to the diligent work of the DMF employees collecting and processing the P195 data. I also thank Kyra Hagge for her support and encouragement at every turn.

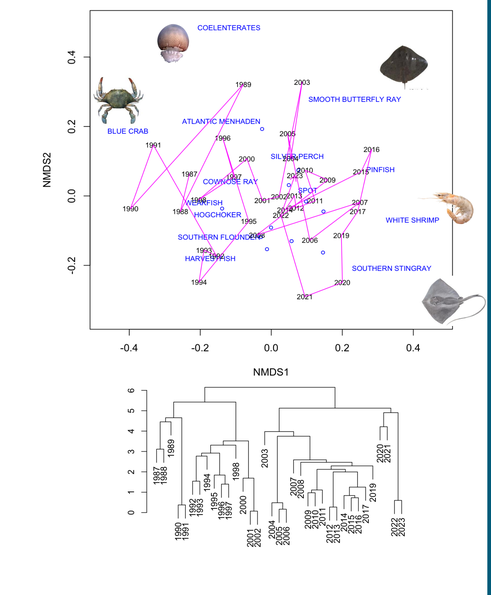
With shifting climatic factors and anthropogenic pressures species historically less present in the Pamlico Sound may be driving community change and establishing dominance.

Preliminary Findings









NMDS of the most common ~30 species, using abundance(top) and weight(bottom), split by season(left vs right). Species near the edge of the plot explain more variation in the community, positively associated with nearby years.

Clustering analysis below each NMDS reveals large shifts, indicating possible regime change.
Interannual variability is strong, so even closely related years can have vastly different species compositions, however, sequential years are often more related.

Feedback, ideas, suggestions, and comments are greatly appreciated!

menzelca21@students.ecu.edu
https://www.morleylab.com