Seasonal and Long-term Patterns in the Distribution and Abundance of Sharks and Rays along the Coast of New Jersey

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Introduction

- Land-based shark fishing is popular in New Jersey
- Sandbar sharks (*Carcharhinus plumbeus*) and sand tiger sharks (*Carcharias taurus*) are specifically targeted and roughtail rays (*Dasyatis centroura*) are bycatch
- Both sharks are prohibited species
- New Jersey Department of Environmental Protection (NJDEP) trawl survey provides data on these species
- Maps needed to assess seasonal and long-term changes in distribution of sharks and rays
- *Hypothesis*: Warming shifts species northward

Methods

- Species distribution maps based on trawl data and kernel estimates
- Seasonal maps for summer and fall, and long-term changes based on differences between late 1980s – early 2000s and the 2010s – present
- Species clustering evaluated using average nearest neighbor statistic

Results

Species distribution maps

- Both sharks follow similar seasonal patterns (see Sand Tiger in Figure 1A and 1B)
  - Highest frequency in southern New Jersey in summer and northern New Jersey in fall
- Ray distribution less concentrated in summer (Figure 1C and 1D)
- Long-term shift from Cape May to Long Beach Island for both sharks (see Sand Tiger in Figure 2A and 2B)
- Ray more broadly distributed in later time period after 2010 (Figure 2C and 2D)

Species clustering

- Both shark species are not significantly clustered
  - Distribution changed from evenly dispersed to random over the long-term
- Ray significantly clustered over the long-term
  - Distribution clustered for both time periods in Figure 2C and 2D
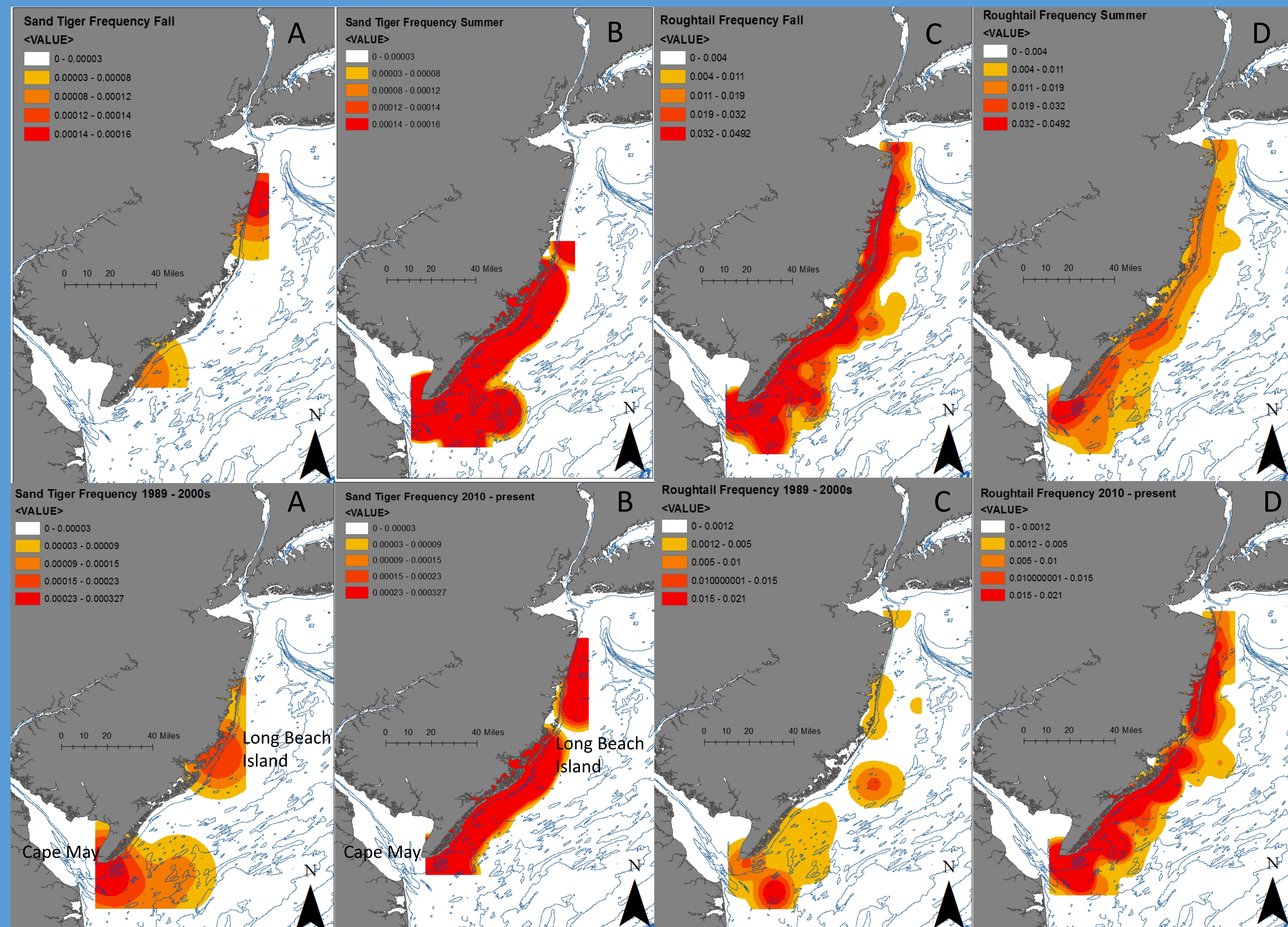
Seasonal and Long-term Species Distribution Maps

Figure 1: Seasonal distribution maps of sharks and rays along the coast of New Jersey. **(A)** Sand tiger frequency, fall. **(B)** Sand tiger frequency, summer. **(C)** Ray frequency, fall. **(D)** Ray frequency, summer.

Figure 2: Long-term distribution maps of sharks and rays along the coast of New Jersey. **(A)** Sand tiger frequency, 1989 – 2000s. **(B)** Sand tiger frequency, 2010 – present. **(C)** Ray frequency, 1989 – 2000s. **(D)** Ray frequency, 2010 – present.

Discussion and Conclusions

- Long-term changes larger than seasonal changes
  - May signify effects of climate change
  - Warm-water species expanding north and are more broadly distributed
- Possible effects of climate change
  - Warming ocean temperatures
  - Broader range of sharks and rays
  - Shark distribution no longer evenly dispersed and could be clustered in the future
  - Greater chance of human/shark interactions
- Future work
  - Control for sampling bias in trawl surveys as this may be influencing results
  - Relate shark/ray population to sea surface temperatures to evaluate climate change effects on species distribution
  - Greater emphasis on shark monitoring due to growing range