

Understanding the Northward Expansion of Fish Communities and Predictive Management Strategies in a Dynamic Florida Estuary



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Introduction

Historically, water temperatures restricted marine fish ranges. However, rising sea temperatures are pushing some species poleward, potentially affecting coastal fish and fisheries. This phenomenon has been explored on the west coast of Florida with the common snook, *Centropomus undecimalis*, but this remains poorly understood with species on the east coast.¹

Methodology

Using multi-decadal fisheries and environmental data from the Florida Fish and Wildlife Fisheries Independent Monitoring (FIM) Program, ten numerically abundant species, comprising five higher trophic level sportfish and five mid-trophic level forage fish, were selected as model species within the study system (Figure 1).

Figure 1. Selected Species from FIM Data

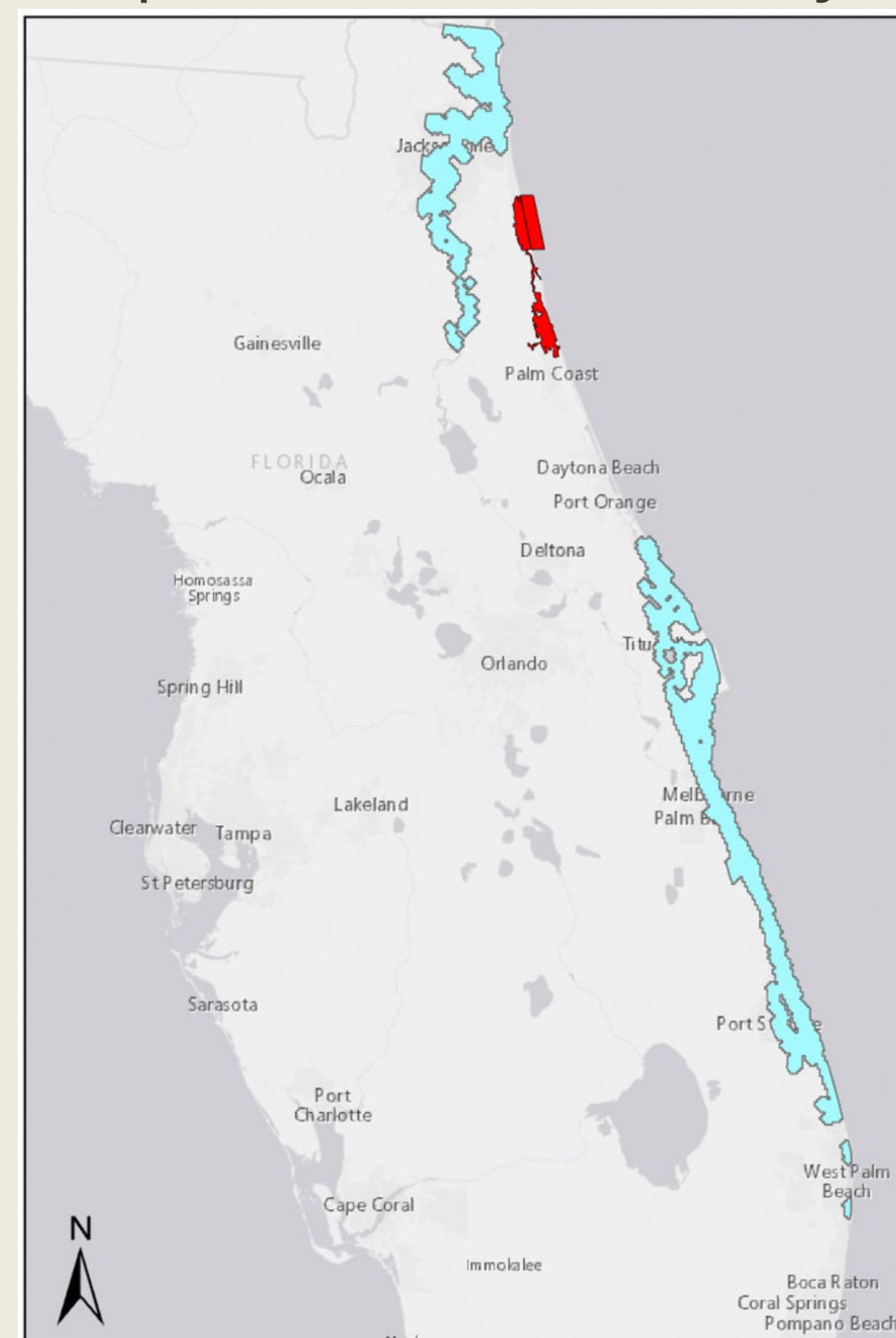
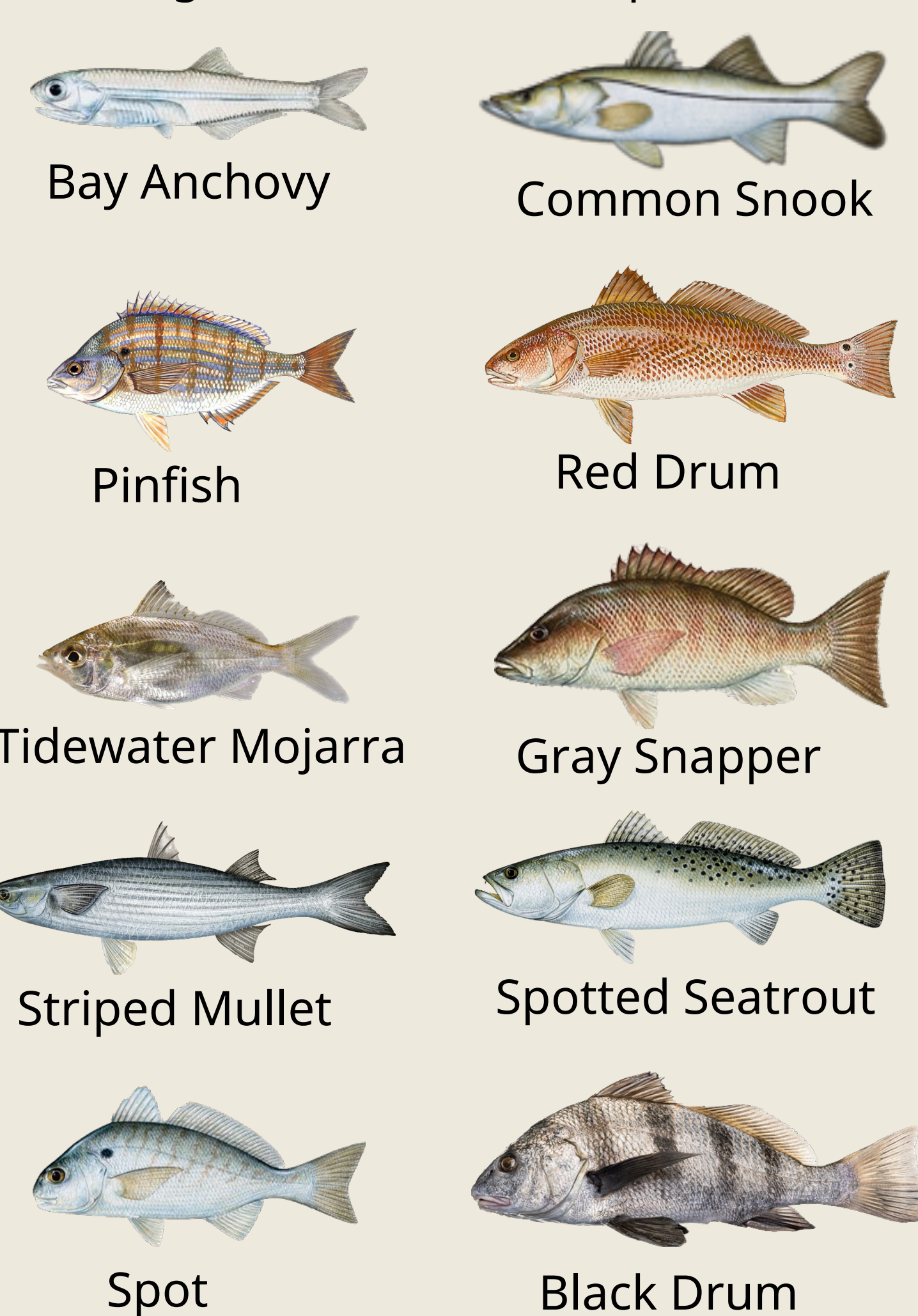


Figure 2. Location of Guana Tolomato Matanzas (GTM) Reserve. GTM Reserve is within red bounded area. Blue bounded regions represent FIM sampling in the Indian River Lagoon (IRL) and St. Johns River.

Utilizing ArcGIS, geo-spatial hot spot analyses revealed areas with significant changes in abundance between 2001 and 2021. Non-metric multidimensional scaling (NMDS) and environmental fit tests assessed northward shifts and related environmental drivers.

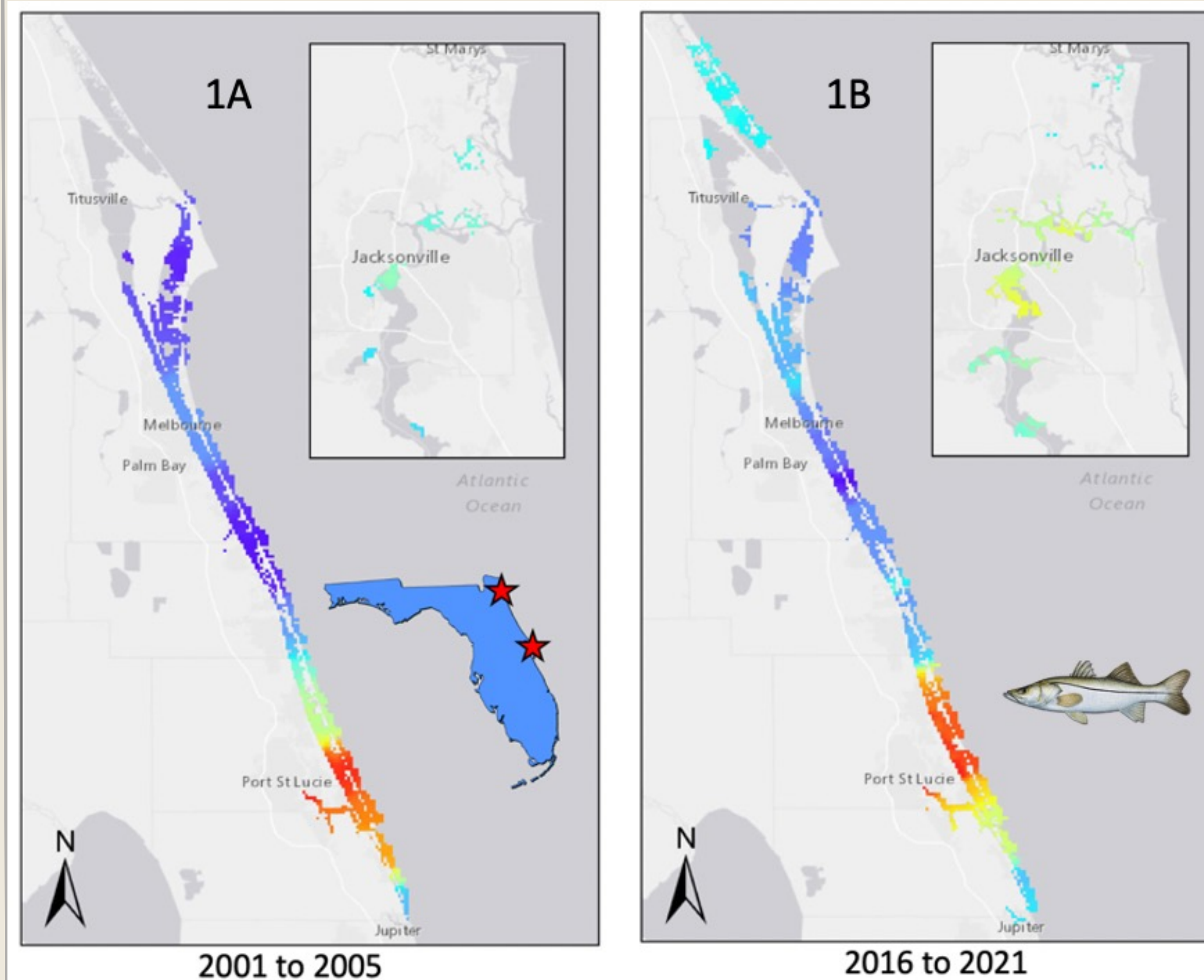


Figure 3. Mean distribution and abundance of snook in the IRL and Jacksonville (inset map) from 2001-2005 (1A) and 2016-2021 (1B). Warmer/cooler colors indicate relatively higher/lower abundance.

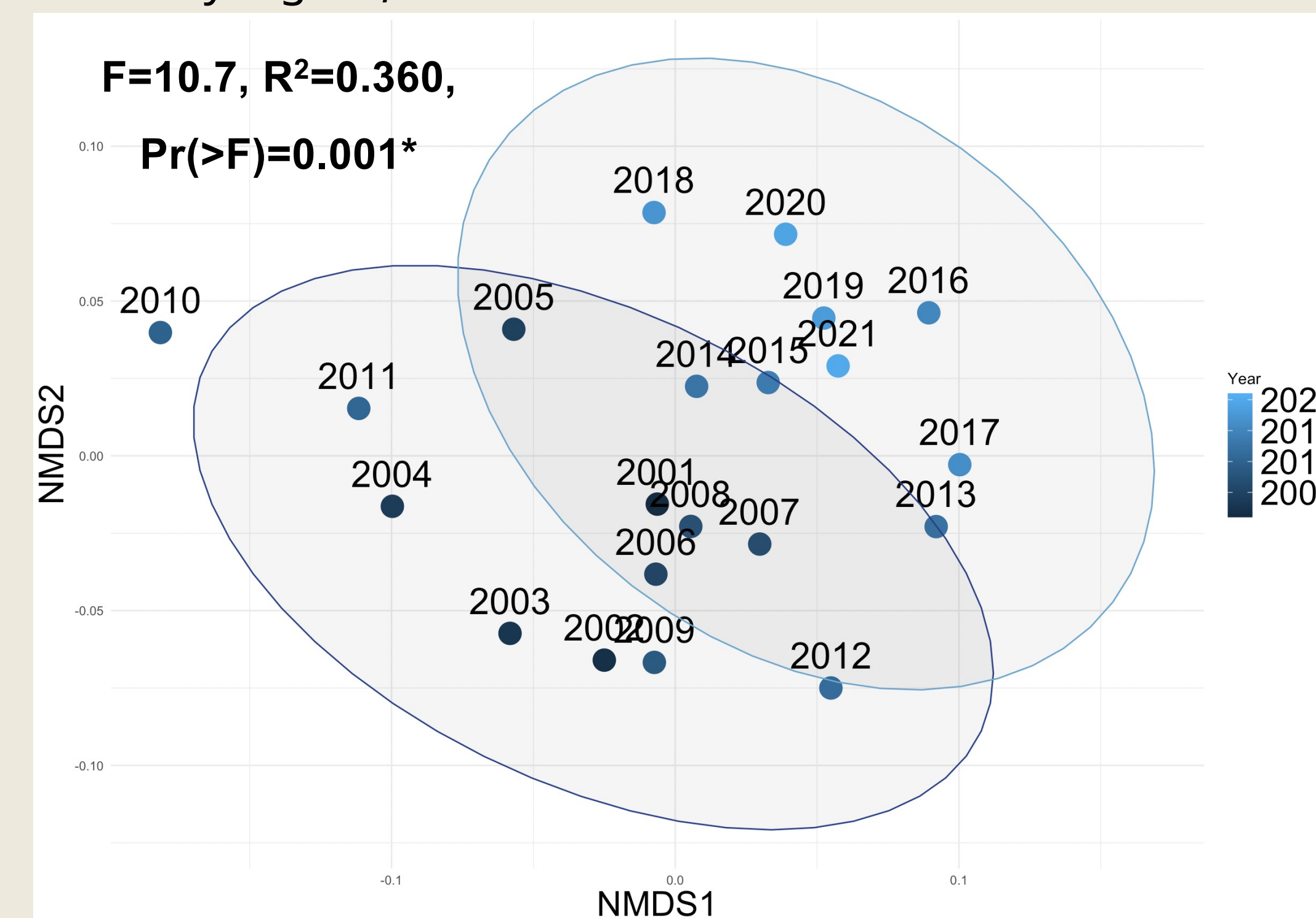


Figure 4. IRL and Jacksonville Fish Community Mean Abundance from 2001 to 2021. Ellipses represent 2001 to 2010 and 2011 to 2021.

Results

Gradual latitudinal range shifts occurred for some species indicating that this phenomenon was independent of trophic level status (Figure 3). Over time, the once more similar fish community exhibited increased divergence (Figure 4). The influence of environmental parameters on the fish community composition changed over time with the most influential factor in later years being annual mean temperature.

Next Steps in the GTM Reserve

The community wide impacts of poleward expanding fish moving from the IRL north to Jacksonville, including waters within the GTM Reserve, remains poorly understood (Figure 2). To address this lack of knowledge, and develop more effective proactive management strategies, it will require the following questions to be answered:

What is the historical and present-day fish community composition in the reserve?

Are the fish community and trophic dynamics distinct in different areas of the reserve (e.g. at different sites spanning the latitudinal extent of the reserve where there has been a shift in the relative proportion of mangrove and coastal salt marsh)?

What environmental and habitat factors best predict variation in the fish community?

Have environmental factors influencing fish community composition evolved over time, and can this knowledge be used to predict how fish and fisheries may change in the future?

This will increase our fundamental understanding of the impacts of local and regional pressures on the ecosystem structure and function, while generating actionable science that can be used to develop a predictive framework for increasing our ability to better manage natural resources in the GTM Reserve.

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References ¹Purtlebaugh, C. H., Martin, C. W., & Allen, M. S. (2020). Poleward expansion of common snook *Centropomus undecimalis* in the northeastern Gulf of Mexico and future research needs. *PLOS ONE*, 15(6), e0234083