

# Movement Patterns of Juvenile Goliath Grouper (*Epinephelus itajara*) in two South Florida Estuaries

## Patrones de movimiento del mero juvenil (*Epinephelus itajara*) en dos estuarios del sur de la Florida

## Modèles de mouvement du mérrou Goliath juvénile (*Epinephelus itajara*) dans deux estuaires du sud de la Floride

ROBERT ELLIS<sup>1</sup>, DEREK COX<sup>2</sup>, ERICK AULT<sup>3</sup>, SARAH WEBB<sup>3</sup>, PHILIP STEVENS<sup>1</sup>

<sup>1</sup>Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, 100 8th Ave SE, St Petersburg, FL, 33701, USA

<sup>2</sup>Florida Fish and Wildlife Conservation Commission, Division of Marine Fisheries Management, FWC South Regional Office, 8535 Northlake Blvd, West Palm Beach, FL, 33412, USA

<sup>3</sup>Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, Tequesta Field Laboratory, 19100 SE Federal Hwy, Tequesta, FL, 33469, USA

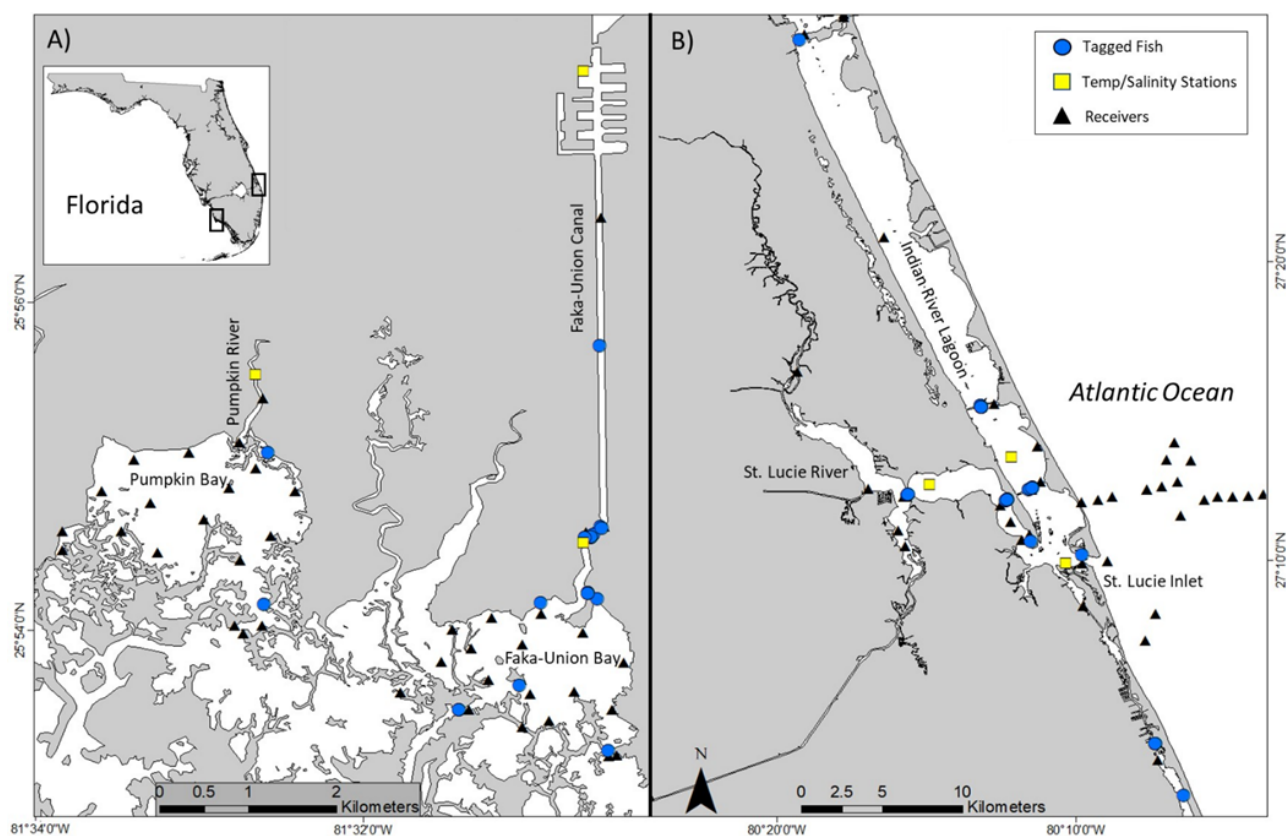
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### EXTENDED ABSTRACT

The Atlantic Goliath Grouper (*Epinephelus itajara*) population in US waters has shown significant recovery following the closure of the fishery in 1990 but despite a higher abundance of adults offshore and juveniles inshore, the extent of this recovery is unknown. Most research efforts to date have focused on adults and their associated spawning aggregations and have revealed patterns of high residency and site fidelity (Collins 2009; Ellis et al. 2014; Koenig et al. 2017). Less information currently exists on juvenile Goliath Grouper that typically utilize mangrove estuaries as nursery habitats (Schideler et al. 2015). Previous studies of habitat preferences and movement patterns of juvenile Goliath Grouper have focused primarily on the Ten Thousand Islands region of southwest Florida, an area of extensive continuous mangrove habitat that hosts a high abundance of the species (Eklund and Schull 2001; Koenig et al. 2007). However, juvenile Goliath Grouper are also found in many other south Florida estuaries, including those that have undergone extensive anthropogenic habitat alterations such as the Indian River Lagoon system located on the central Florida Atlantic coast. Use of human-altered habitats by marine fishes can lead to detrimental impacts including the accumulation of harmful contaminants, reduced growth rates due to altered prey availability, or altered survival due to changes in predation exposure (Curtis et al. 2013). To better understand the behaviors of juvenile Goliath Grouper within estuaries that experience different environmental conditions and varying levels of human-alteration, we are presently conducting an acoustic telemetry study in two South Florida estuaries: the St. Lucie River and southern Indian River Lagoon (St. Lucie), and the Faka-Union Canal and Bay (Faka-Union) located in the Ten Thousand Islands region of southwest Florida. Our objectives for this study are to: 1) describe habitat use by juvenile Goliath Grouper in estuaries with different environmental conditions; and 2) compare habitat use and movement patterns across time as environmental conditions change within estuaries. Additionally, by using long-term acoustic tags, we hope to detect ontogenetic shifts by individuals as they move between estuarine and offshore reef habitats and describe the environmental conditions that may precipitate such shifts.

From fall 2017 through spring 2019, we tagged 52 juvenile Goliath Grouper with acoustic telemetry tags (Innovasea V9 and V16 coded transmitter tags with 440 days [V9] and 6.5 years [V16] battery life) to investigate habitat use and movement patterns. A total of 30 juveniles (size range = 502 – 1132 mm TL) were tagged in the St. Lucie system, and 22 juveniles (270 – 846 mm TL) were tagged in the Faka-Union system (Figure 1). Juveniles were caught via hook and line, set line, and chevron or crab trap. Captured individuals were measured, tagged with an external identification tag, sampled for genetics via fin clip, and had an acoustic tag surgically implanted in the peritoneal cavity before release at the capture site. Tagged fish were tracked through arrays of acoustic telemetry receivers (Innovasea VR2W and VR2Tx) deployed throughout each estuary and, in the case of the St. Lucie system, extending through the inlet onto nearshore reef habitats.

We consistently captured juvenile Goliath Groupers under structures, which differed slightly between the two study systems. In the St. Lucie system, fish were mainly found under dock and bridge pilings, while in the Faka-Union system fish were found primarily near undercut mangroves. So far, tagged fish have exhibited high site fidelity at both locations but we have also detected individual movements related to changing environmental conditions. Preliminary results from tracking data suggest that tagged fish in the St. Lucie River moved out of the river into the adjacent estuary following drops in salinity (Figure 2a). The first few movements of fish from the St. Lucie estuary to offshore reefs appear to be triggered by drops in water temperature: so far we have detected 2 large juveniles (TL > 900 mm) on nearshore reefs following the passage of cold fronts during which the mean daily surface water temperature dropped below 17°C. Overall, the Faka-Union system was less variable compared to the St. Lucie system in terms of both salinity and temperature but we did not observe tagged fish movements in response to either changes in salinity or temperature. Tagged fish in the Faka-Union were



**Figure 1.** Tagging locations (blue dots) and acoustic receiver deployments (black triangles) within the two study systems: A) the Faka-Union Canal and Bay system, and B) the St. Lucie River and southern Indian River Lagoon. Temperature and salinity gauges are denoted by yellow boxes.

more likely to be detected in the bay during warm/wet periods and in the canal during cool/dry periods, which could reflect fish moving in response to seasonal changes in salinity and temperature (Figure 2b). However, additional data is needed to interpret these results and to more fully determine how movement patterns of tagged juvenile Goliath Grouper differ between the two estuaries in response to changing environmental conditions. Tracking will continue through the duration of tag life as these fish move through the study estuaries and the results will help elucidate the ecology and life history of this iconic species.

**KEYWORDS:** Movement, Habitat, Mangrove, Estuary

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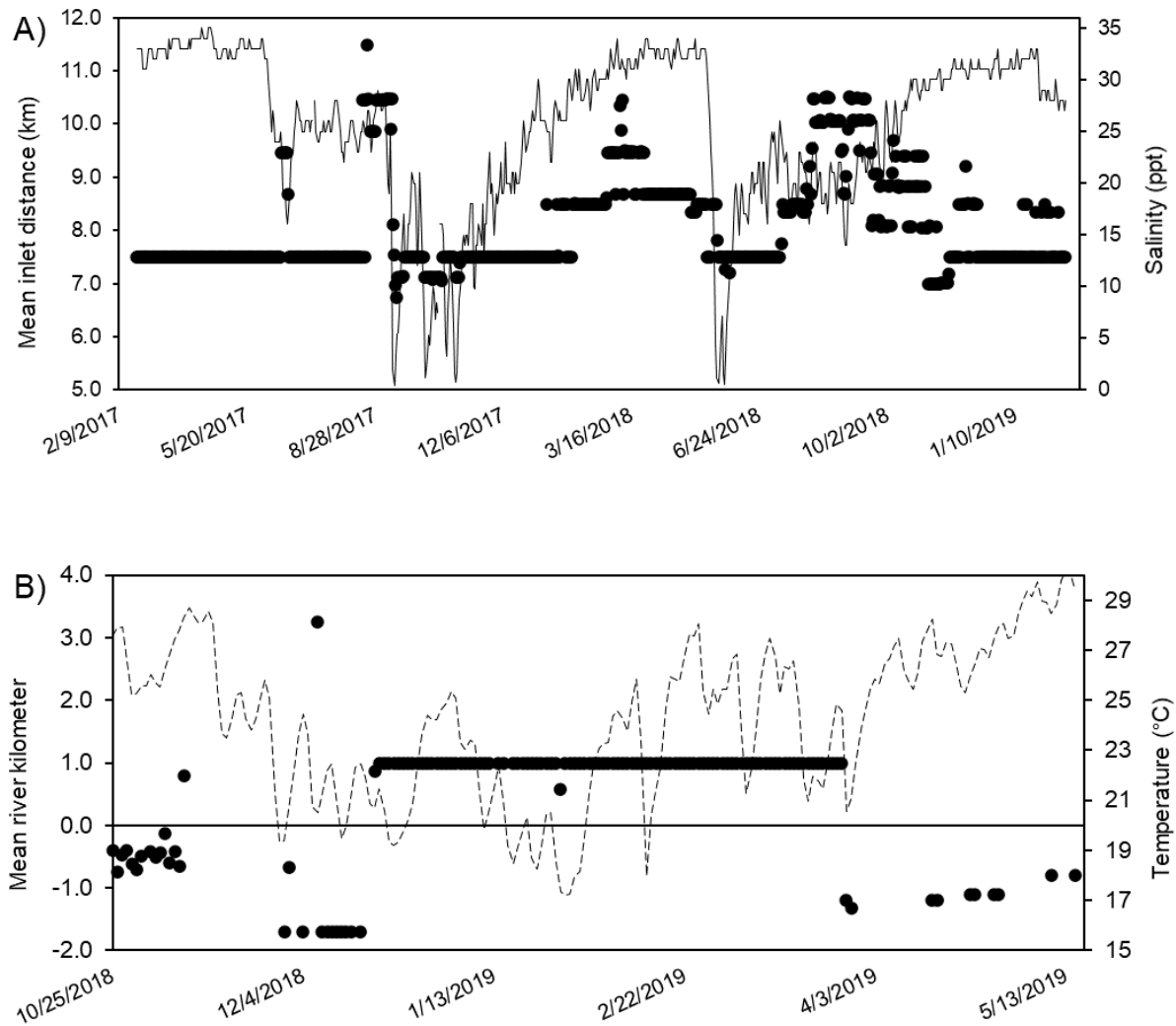
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**Figure 2.** Mean daily locations in the A) St. Lucie River, for  $n = 11$  tagged fish (black dots), with daily salinity measured at 8 km from the inlet (black line), and B) the Faka-Union Canal and Bay system, for  $n = 10$  tagged fish, with mean daily temperature measured at river kilometer 0.5 (dashed line). The transition between the St. Lucie River and the Indian River Lagoon occurs around 5 km from the inlet (inlet distance = 5km). The transition between the Faka-Union Canal and Faka-Union Bay occurs at river kilometer 0 and is indicated by the horizontal black line in panel B.