Residency and movements of juvenile great hammerheads, *Sphyrna mokarran*, in the Tampa Bay area: preliminary results

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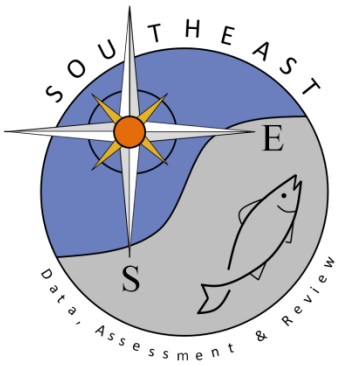

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Residency and movements of juvenile great hammerheads, *Sphyrna mokarran*, in the Tampa Bay area: preliminary results

Jayne M. Gardiner[1,*], Tonya R. Wiley[2], Susan K. Lowerre-Barbieri[3,4], Kim Bassos-Hull[5,6], and Krystan Wilkinson[5,6]

[1]Division of Natural Sciences, New College of Florida, Sarasota, FL 34243, U.S.A.
[2]Havenworth Coastal Conservation, Palmetto, FL 34221, USA
[3]Fisheries and Aquatic Sciences Program, School of Forest Resources and Conservation, University of Florida, Gainesville, FL 32611, USA
[4]Fish and Wildlife Research Institute, Florida Fish and Wildlife Conservation Commission, St Petersburg, FL 33701, USA
[5]Mote Marine Laboratory, Sarasota, FL 34236, USA
[6]Chicago Zoological Society's Sarasota Bay Dolphin Research Program, Sarasota, FL 34236, USA

[*]Correspondence: jgardiner@ncf.edu

Note

This is a working paper that contains preliminary data and analyses of acoustic telemetry data for juvenile great hammerheads that were tagged in Tampa Bay, Florida. Data from outside this region are received through collaborative telemetry networks; due to differences in the timing of equipment downloads, data for the time period under consideration may not be complete. Data collection is ongoing and analyses are considered preliminary.

1. Introduction

The presence of young-of-the-year (YOY) and juvenile great hammerheads, *Sphyrna mokarran*, has been documented in lower Tampa Bay (Hueter and Tyminski, 2007), including Terra Ceia Bay and the estuarine portion of the Manatee River (Deacy et al., 2017, Deacy et al., 2018, Deacy et al., 2019, Moncrief-Cox et al., 2020). Based on seasonal captures of YOY animals across multiple years of sampling, the Tampa Bay estuary has been suggested to function as a nursery area for this species (Hueter and Tyminski, 2007). This pilot study was carried out to examine the spatiotemporal patterns of habitat use in the Tampa Bay estuary by juvenile great hammerheads.

2. Materials and Methods

Four juvenile (Piercy et al., 2010) great hammerheads, captured using longline gear, were tagged with surgically-implanted acoustic transmitters (V16-4L and V9-2L, Innovasea), two in 2019 and two in 2020. Upon release, their movements within the Tampa Bay area and Sarasota Bay area were tracked by arrays of passive acoustic receivers maintained by the authors (Figure 1). Detection data from receivers in other areas were obtained via collaborative telemetry networks, Integrated Tracking of Aquatic Animals in the Gulf of Mexico (iTAG) and the FACT Network. Detection data are current through November 2021 for the New College of Florida/Havenworth Coastal Conservation array and through

Summer 2021 for the Sarasota Coast Acoustic Network and Florida Fish and Wildlife Conservation Commission arrays. Detection data were filtered to remove false detections (Pincock, 2012). Residency indices at the regional (Tampa Bay, Sarasota Bay, Gulf of Mexico) level were computed following the methods of Kessel et al (2016). All work was conducted under Special Activities Licenses from the Florida Fish and Wildlife Conservation Commission (SAL-1666-SRP and SAL-1918-SRP), in accordance with University of South Florida Institutional Animal Care and Use Committee protocols IS00004541 and IS00008435. Analyses were conducted in *R* (version 4.0.3; R Core Team, 2020) using the *glatos* package (Holbrooke et al, 2020).

3. Results

All four great hammerheads displayed residency in Tampa Bay. The smallest individual, a 1.3m male, also exhibited residency in Sarasota Bay (Table 1). All individuals were seasonally present in the Tampa Bay estuary (or Sarasota Bay estuary) during spring/summer and moved out into the Gulf of Mexico during late fall to winter, returning inshore in spring (Figure 2). Movements maps indicate that the smallest individual was detected primarily in inshore areas, while larger individuals were detected in deeper offshore areas. One individual moved from the Gulf of Mexico to the Atlantic and subsequently returned to Tampa Bay (Figure 3).

4. Discussion

All four individual great hammerheads were found to use the Tampa Bay estuary for extended periods and to return to the same areas across multiple years. These data are preliminary, as tags are still active and data for movements within and outside the Tampa Bay area continue to be received as arrays are downloaded, but they provide further evidence of a potential nursery area in lower Tampa Bay.

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Animal_ID	Sex	TL (cm)	Tag Date	Tag Location	Last Detection	Number of detections	Residence Index				Tag model	Battery life (days)
							TB	GoM	SB	Atl		
A69-9001-8529	M	232	4/15/2019	Terra Ceia Bay	11/9/2020	5894	0.71	0.32	0	0	V16-4L	3650
A69-9001-18214	F	204	5/14/2019	Manatee River	4/9/2021	3220	0.72	0.24	0.06	0.01	V16-4L	3650
A69-1602-12138	F	208	6/30/2020	Tampa Bay	5/10/2021	1116	0.81	0.22	0	0	V9-2L	655
A69-9001-2917	M	133	8/18/2020	Terra Ceia Bay	6/23/2021	3747	0.40	0.16	0.45	0	V16-4L	3650

Table 1. Summary of juvenile great hammerheads, *Sphyrna mokarran*, tagged with acoustic transmitters. TL = total length. TB = Tampa Bay, GoM = Gulf of Mexico, SB = Sarasota Bay, Atl = Atlantic Ocean

Figure 1. Map of acoustic receiver stations in the Tampa Bay and Sarasota Bay areas (2019-2021). Green = New College of Florida/Havenworth Coastal Conservation stations, gray = Florida Fish and Wildlife Conservation Commission stations, blue = Sarasota Coast Acoustic Network (a multi-institutional collaboration: Mote Marine Laboratory, Chicago Zoological Society, New College of Florida) stations.

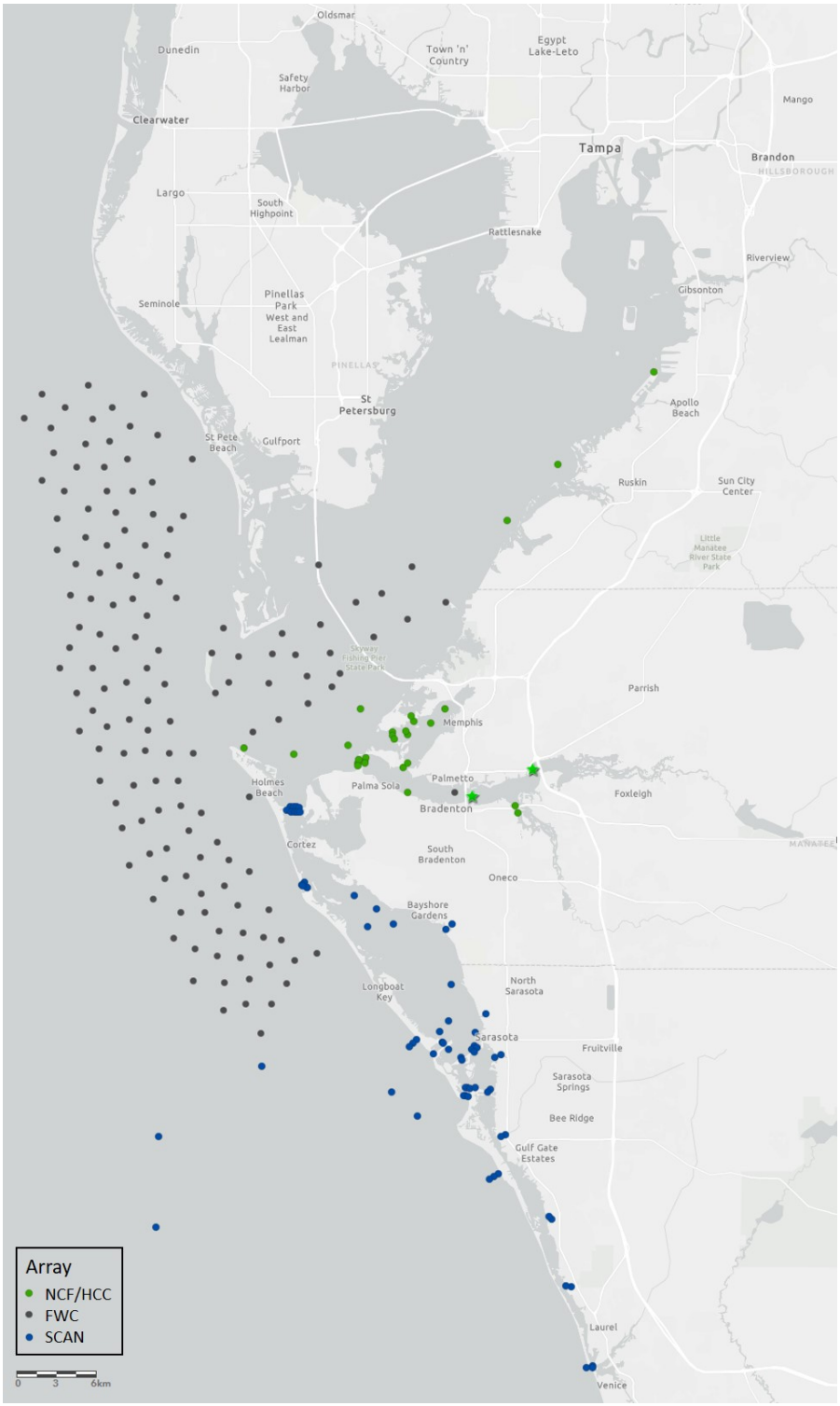

Figure 2. Abacus plot of detections by area of juvenile great hammerheads, *Sphyrna mokarran*. Dots represent acoustic tag detections, while triangles indicate tagging date.

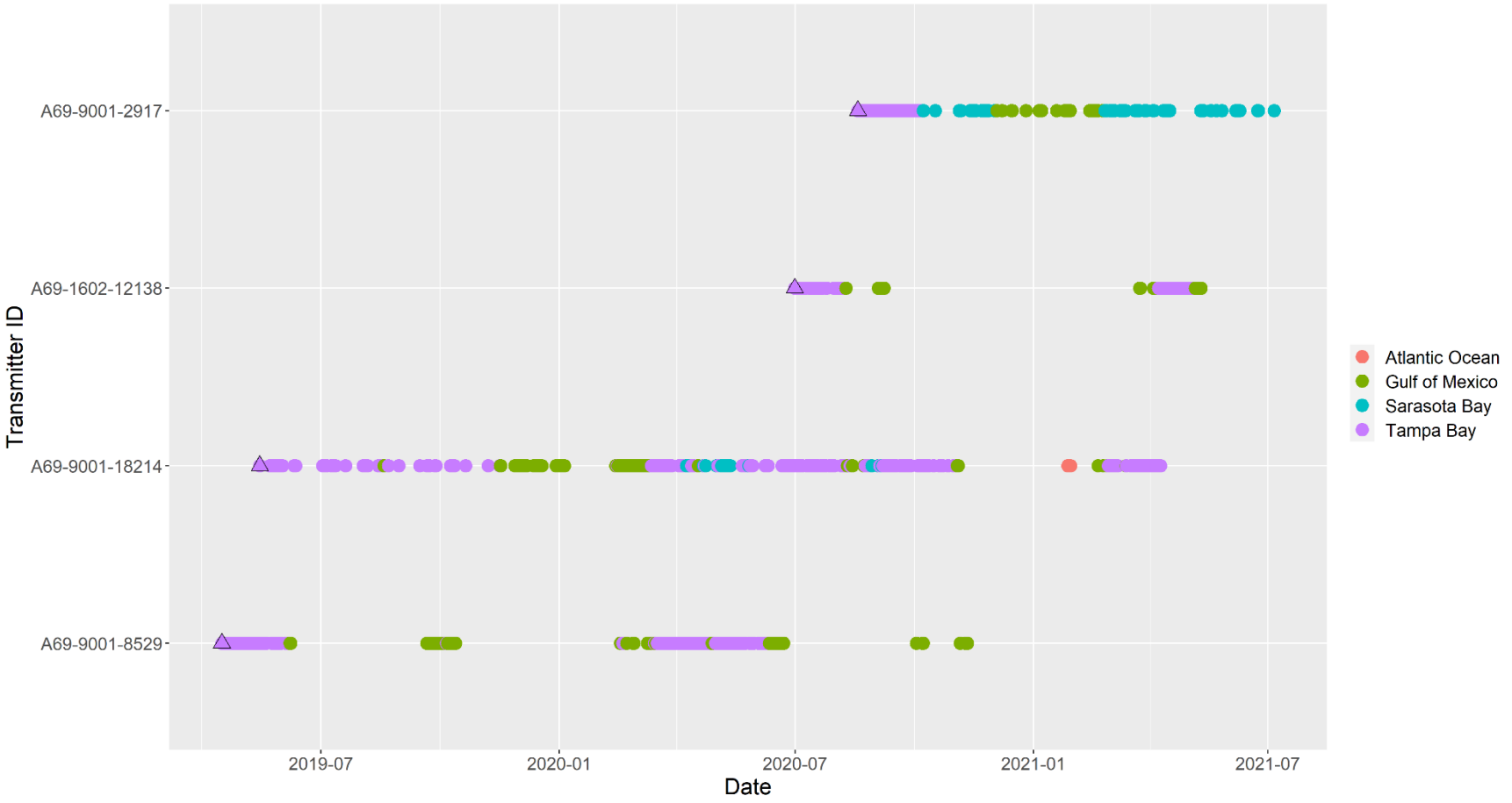

Figure 3. Map of movements of juvenile great hammerheads, *Sphyrna mokarran*, tagged with acoustic transmitters.