Final Report

Site Fidelity/Residency Patterns/Habitat Modeling

Tonya R. Wiley and Colin A. Simpfendorfer

Center for Shark Research
Mote Marine Laboratory
1600 Ken Thompson Parkway
Sarasota, FL 34236

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INTRODUCTION

The smalltooth sawfish (*Pristis pectinata*), a once common inhabitant of coastal and estuarine waters throughout Florida and the southeastern United States (Bigelow and Schroeder, 1953), is currently only found in significant numbers in the waters of south-west Florida (Seitz and Poulakis, 2002; Poulakis and Seitz, 2004; Simpfendorfer and Wiley, 2005). The decline of the smalltooth sawfish population resulted in National Marine Fisheries Service (NMFS) listing this species as Endangered under the US Endangered Species Act in April 2003. The implementation of conservation measures for the smalltooth sawfish is hindered by the paucity of available information on their critical habitats and movement patterns. From 2003-2007 twenty-four individuals were fitted with acoustic tags for long-term monitoring of residency. Preliminary monitoring results indicated that juveniles have high levels of site fidelity for specific nursery areas for periods up to almost three months, but over the longer term had low levels of fidelity.

METHODS

FIELD SAMPLING

Sampling was conducted utilizing longlines, gill nets, and rod and reel throughout Florida. Longlines consisted of a 400-800 m bottom set mainline of 8 mm braided nylon rope anchored at both ends. Gangions were constructed of 1 m of 5 mm braided nylon cord and 1 m of stainless steel wire leader. Mustad tuna circle hooks ranging in size from 10/0 to 16/0 were baited with frozen mullet (*Mugil cephalus* Linnaeus, 1758 or *Mugil curema* Valenciennes, 1836) and fresh hardhead catfish (*Arius felis* (Linnaeus, 1766)), pinfish (*Lagodon rhomboids* (Linnaeus, 1766)), crevalle jack (*Caranx hippos* (Linnaeus, 1766)) or ladyfish (*Elops saurus* Linnaeus, 1766). Fresh
bait was only used when available, and at least half of all hooks on the lines were baited with frozen mullet. Size 10/0 hooks were also baited with frozen shrimp (*Penaeus* spp.) when available. Gangions were spaced approximately 10 m apart along the mainline.

Gill nets were 75 m of 7.62 cm (3 inch) stretch mesh 0.52 mm (26 pound) monofilament anchored at both ends. The float line contained a foam core and the lead line contained a lead core. Surface buoys were used to mark the location of the net every 10 m. Gill nets were monitored continuously to allow removal of animals as they were captured. Gill net sets were completed mostly in shallow areas adjacent to mangrove shorelines. Rod and reel fishing utilized Penn 7500SS reels and Star ST 15/30 rods with 40 lb monofilament line and a 10/0 Mustad tuna circle hook with approximately 0.5 m of plastic coated wire leader. Hooks were baited with the same baits used on the longlines. Rod and reel sets were conducted in areas that were too confined for use of other gear, or at times when the tide or weather precluded extended sampling periods in an area.

The date, time, depth and location of all sets were recorded. Physical parameters (water temperature, dissolved oxygen and salinity) were recorded at each sampling location midway between the surface and bottom utilizing a YSI 85 water quality meter.

Sawfish larger than 200 cm were left in the water and secured to the boat by tying ropes around the saw, mid-section and tail. Smaller sawfish were brought aboard the boat with a large landing net. When possible, five measurements of length (to the nearest 0.5 cm) were taken: saw length (SL), precaudal length (PCL), fork length (FL), total length (TL) and stretched total length.
Large sawfish were measured with a flexible fiberglass tape measure, while smaller animals were measured on a fish measuring board. The weight (to the nearest 0.1 kg) of small individuals was determined by placing the sawfish in a mesh bag and suspending below a spring balance. Unless otherwise indicated all length measures are given in STL. The sex of sawfish was determined by examining all individuals for the presence of claspers on the pelvic fins of males. Young individuals had to be examined carefully as the claspers are small and can be easily missed. Sawfish were tagged with individually numbered external identification tags (cattle ear rototag or jumbo rototag (Dalton, England)) on the first and/or second dorsal fins, a nylon anchor streamer tag (Hallprint, South Australia) at the base of the first dorsal fin, and a small (12 mm x 1.5 mm) intra-muscular passive-integrated transponder (PIT) tag at the base of the first dorsal fin. Sawfish to be tracked were fitted with individually coded transmitters. The transmitters were attached to the rototag applied to the first or second dorsal fin.

**ACOUSTIC MONITORING**

To investigate long-term site fidelity and periods of residency acoustic monitoring was used. Acoustic monitoring tags (Vemco V9) transmit their unique pulse series at random intervals between 45 and 75 seconds on frequencies of 69 kHz. Random signal transmission times prevent signals from more than one animal continuously overlapping and blocking reception by receivers (Heupel and Hueter, 2001). The life expectancy of these tags is 6 months. Monitoring arrays were deployed in two areas in the Ten Thousand Islands/Everglades National Park region: Mud Bay and Faka Union Bay (Figure 1). In addition several sawfish were monitored from 2005 to 2007 in an array deployed in the Caloosahatchee River in collaboration with a Mote Marine Laboratory bull shark study.
Figure 1. Location of VR2 receivers in Mud Bay, Everglades National Park (top panel) and Faka Union Bay, Ten Thousand Islands (bottom panel).
Each array consisted of three Vemco VR2 receivers. When sawfish carrying transmitters were within detection range of the monitors the date, time and tag identification number were logged. Detection range of the receivers can vary with behavior of the animal, noise from boat traffic, biological sources such as shrimp and oysters, or current flow, salinity, water depth and turbidity (Heupel et al 2006). Depth sensor tags (Vemco V9P) also transmit the depth of the tag. Data were retrieved by downloading the data to a laptop computer via Vemco VR2pc software.

Data from each of the acoustic monitoring sites were used to determine the period of residency within the nursery areas. A sawfish was considered to be present on a particular day if at least one signal detections occurred. Residency histories were plotted on a common time line graph to provide a visually interpretable record.

RESULTS

FAKA UNION BAY

Twelve *P. pectinata* were monitored in Faka Union Bay (Table 1). Consecutive days of residency after release were 2 to 80 days (Figure 2). Total monitored periods were 3 to 118 days. However, the sawfish that was only monitored for three days (#31D) was due to the transmitter being removed from the animal after the third day. Periods of absence ranged from 1 to 37 days prior to returning to the bay. The average period of residency was 51.42 days, or 55.82 days if you remove #31D.
Table 1. Juvenile smalltooth sawfish acoustically monitored in Faka Union Bay.

<table>
<thead>
<tr>
<th>Date captured</th>
<th>STL (cm)</th>
<th>Weight (kg)</th>
<th>Sex</th>
<th>Tag #</th>
<th>Total Monitored Period</th>
<th>Longest Consecutive Days Present</th>
<th>Longest Consecutive Days Absent</th>
<th># of Absences</th>
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Figure 2. Residency history of acoustic monitored smalltooth sawfish in Faka Union Bay.
**MUD BAY**

Twelve *P. pectinata* were monitored in Mud Bay (Table 2). Consecutive days of residency after release were 0 to 16 days (Figure 3). Total monitored periods were 1 to 41 days. Periods of absence ranged from 1 to 18 days prior to returning to the bay. The average period of residency was 15.25 days.

Table 2. Juvenile smalltooth sawfish acoustically monitored in Mud Bay.

<table>
<thead>
<tr>
<th>Date captured</th>
<th>STL (cm)</th>
<th>Weight (kg)</th>
<th>Sex</th>
<th>Tag #</th>
<th>Total Monitored Period</th>
<th>Longest Consecutive Days Present</th>
<th>Longest Consecutive Days Absent</th>
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</table>
Figure 3. Residency history of acoustic monitored smalltooth sawfish in Mud Bay.

CALOOSAHATCHEE RIVER

Fifty-five P. pectinata were monitored in the Caloosahatchee River array. Sawfish were tagged by both Mote Marine Laboratory and Florida Fish and Wildlife Conservation Commission Charlotte Harbor Field Lab personnel. Analysis of these data is currently underway.

DEPTH ANALYSIS

Two sawfish in Faka Union Bay (#s 31D and 32D) and one sawfish in Mud Bay (#31D) were fitted with depth transmitters. These three animals spent the majority of their time in water 0.3 m or less (Figures 4-6). These data are consistent with results of manual tracks of animals in
these same systems. However, monitored data were from longer periods of time (3 to 19 days) than manual tracks providing an extended profile of habitat use.

Figure 4. Depth profile of transmissions from monitored transmitter #31D in Faka Union Bay 2005.

![Depth profile of transmissions from monitored transmitter #31D in Faka Union Bay 2005.](image)

Figure 5. Depth profile of transmissions from monitored transmitter #32D in Faka Union Bay 2005.

![Depth profile of transmissions from monitored transmitter #32D in Faka Union Bay 2005.](image)
The size frequency distribution of sawfish captured and tracked in Mud Bay and Faka Union also show size use patterns. Faka Union Bay holds animals 70-90 cm (Figure 7) and 150-190 cm indicating animals of two year classes use this area. In contrast, only sawfish 80-110 cm were captured in Mud Bay (Figure 8) indicating this area may be used only by first year animals.

Figure 6. Depth profile of transmissions from monitored transmitter #31D in Mud Bay 2005.

Figure 7. Size distribution of acoustic monitored sawfish in Faka Union Bay.
Figure 8. Size distribution of acoustic monitored sawfish in Mud Bay.

Not detecting the animal could mean several things, the tag fell off the sawfish while it was outside of the monitored areas, the battery in the transmitter died, the animal was removed from the area (fishermen), or the animal left the area. It is unknown where these sawfish went when they left the monitored areas or how far they traveled before returning. It is also unknown how long these animals were in the monitored systems prior to being captured.

CONCLUSIONS:

- Juveniles smalltooth sawfish have high levels of site fidelity for specific nursery areas for periods up to almost three months, but over the longer term had low levels of fidelity
- Juvenile smalltooth sawfish fitted with depth transmitters spent the majority of their time in water 0.3 m or less
• It is unknown where these sawfish went when they left the monitored areas or how far they traveled before returning

• Data analysis currently underway of manual tracks will provide information on site fidelity, habitat use, distance and speed of movement, home range, linearity of movement, and depth use

• Preliminary analysis indicates that the consistent depth profiles of both manually tracked and monitored sawfish implies that the capture, handling and tagging process does not alter the behavior of sawfish during short term manual tracks

• The combination of tracking and monitoring techniques used expanded the range of information gathered by generating both short and long term data
LITERATURE CITED


