Biotelemetry of Cownose Rays in Chesapeake Bay: Habitat Use and Ray Movement

Final Contract Report for Award No. 15-PO-392-0000336084 (Extension of 2014 Biotelemetry research objectives)

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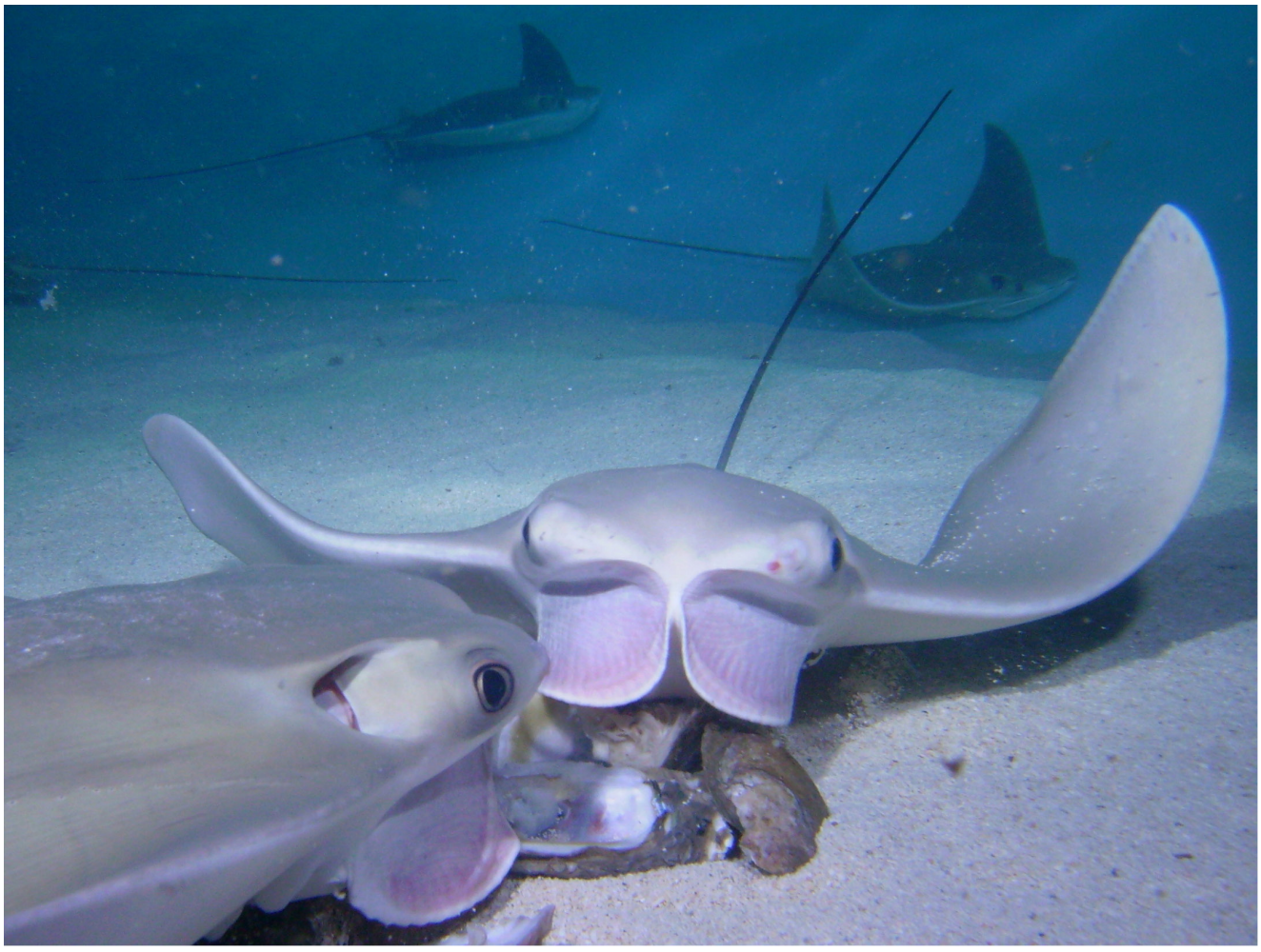

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Problem Statement

The cownose ray, *Rhinoptera bonasus*, provides an interesting model of the difficult and sometimes conflicting challenges of conserving and managing elasmobranch populations, especially when relatively little is known of their natural history and behavioral ecology. Concerns that cownose rays are adversely affecting oyster and clam aquaculture have inspired efforts to develop a commercial cownose ray fishery (Fisher 2010). However, the slow growth rate of cownose ray populations (only a single offspring pup is produced annually) makes them highly susceptible to overfishing (Fisher 2010), resulting in an IUCN Red List status of "near-threatened" (Barker 2006). Despite its common presence along the U.S. Atlantic coast, there are significant gaps in our understanding of the basic biology and ecology of cownose rays that inhibit our ability to make management decisions based on sound science.

One of the most significant data gaps is our poor understanding of the annual migrations of adult cownose rays to Chesapeake Bay, the cownose rays' most important nursery ground, and their movements and habitat use while there. Adult cownose rays arrive in Chesapeake Bay each year beginning in late April, reach their peak abundance in August and September, and leave by early October (Blaylock 1993; Fisher 2010). The sex ratio is nearly equal in early summer but sexes appear to segregate after mating occurs in July, with adult males largely disappearing from nearshore areas (Fisher 2010). Little is known about movement and habitat use of individuals during summer when they are in the bay (Fisher 2010), although they are frequent visitors to smaller sub-estuaries.

Young of year (YOY) and juvenile ray migrations and habitat use are unknown. A second component of this study is to collect the first acoustic telemetry data on early life history of Chesapeake Bay cownose rays. Females give birth in late July (Fisher 2010)

Passive acoustic telemetry, with transmitters (tags) attached to or implanted into fish and an array of stationary hydrophones (receivers), has been used extensively to track fish movements at larger spatial scales, including seasonal migrations between estuaries and the coastal ocean (Able *et al.* 2013). In Chesapeake Bay, passive acoustic telemetry has been used to study migratory behavior of striped bass (Wingate *et al.* 2011), Atlantic sturgeon (Greg Garman, personal communication), and blue catfish (Matt Ogburn, personal communication). Through the Smithsonian Environmental Research Center (SERC) participation in the Atlantic Coastal Telemetry (ACT), a network of collaborative acoustic telemetry projects using standard VEMCO telemetry equipment, data sharing on fish detections throughout the network will be performed. In 2014, the first use of acoustic tagging on cownose rays was performed (Fisher 2014), providing initial small and large scale ray movement and habitat use information (SERC data) in Chesapeake Bay and along the US eastern seaboard.

Objectives

It was proposed to use passive acoustic telemetry to continue studying the movement and habitat use of cownose rays within Chesapeake Bay, as well as their seasonal migration along the Atlantic coast. Up to 14 acoustic tags (eight V16 and six V13 tags) were proposed to be implanted in adult and YOY cownose rays to help answer specific research questions:

1) To what extent do individual cownose rays remain within (residence time) or move between major sub estuaries of Chesapeake Bay?
2) Do individual cownose rays return to the same areas in summer in multiple years?
3) Where do YOY and juvenile rays spend the early years of their life history?

Accomplished Scope of Work

Adult and YOY cownose rays were tagged in the lower portion of Chesapeake Bay over two tagging efforts in October 2015 for the purpose of tracking their movements through the array of stationary hydrophones. Cownose rays were captured as by-catch in cooperation with commercial haul seine fishermen from of the Lower Chesapeake Bay near Goodwin Neck, and from pound nets operating off Lynnhaven, VA. All YOY rays collected were from pound nets.

Captured rays were placed in large insulated holding totes onboard fishing vessel with ambient water continually being added to totes by deck hose (continuous overflowing) and held until off-loading (1-2 hours). Live rays were transferred from holding totes on fishing vessel to large holding totes on pickup truck and transported to a partial re-circulating holding tank measuring 4.3 m x 6.4 m at a depth of 0.71 m at the Virginia Institute of Marine Science (VIMS) for subsequent tagging. The serrated venomous barb at the base of ray's tail was clipped off with wire cutters upon transfer from commercial fishing vessel to VIMS transport tanks to help protect closely confined rays from injuring each other during transport.

The rays were acclimated 24-72 hours in VIMS tank, at which point ray health was evaluated before subjecting to tagging. Rays displaying significant wounds, stress, or of lethargic nature were not subjected to tagging and released. A single industry standard VEMCO V13 (13 diameter x36 mm long) or V16 (16 mm diameter x 54 mm long) acoustic transmitter was implanted within the ray's abdominal cavity Rays were positioned ventral side up onto a flat, padded platform with adjustable elastic cord stretched and secured over both pectoral fins to help support ray on platform during surgery. The surgery platform was positioned and secured in the water at an angle (~20-25^0) in which ray head, spiral valves, and gill slits were submerged but incision site was above water line (Figure 1). Incision site was initially treated with Betadine, with incision made through the abdominal wall with sterilized surgical knife at a position approximately 100 mm anterior of cloacal opening and 50 mm to anatomical right side of ventral midline. Incision site to the right of midline was favored based on female cownose ray reproductive anatomy, with the right uterus vestigial within their paired oviducts thus providing more available space in abdominal cavity during late stages of gestation. Incision site in males was kept constant with that of females though males have functionality from both paired reproductive organs.

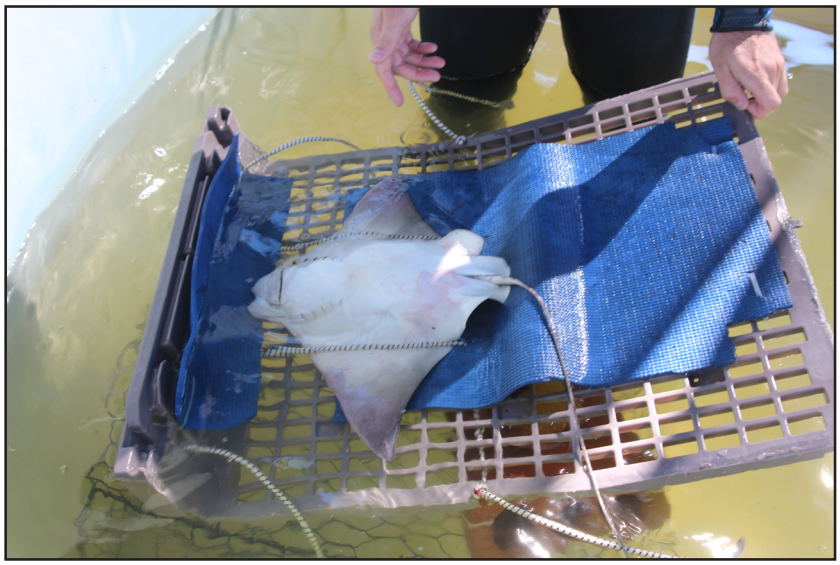

Figure 1. Young-of-year cownose ray positioned and fastened on surgery platform which is constructed to hold varying size rays.

The acoustic transmitter tags were implanted within the ray's abdominal cavity via a small (18-25mm) incision made on ray's ventral surface. Tags, knives, and needles were sterilized in Betadine prior to use. Tags were coated with antibiotic gel and inserted perpendicular to incision into abdominal cavity then guided caudally to facilitate positioning parallel to spiral valve. Incision was closed using synthetic absorbable sutures and surgical needle. Directly after tagging procedure, ray disc width (DW) was measured, DNA sample taken (5mm fin clip from trailing edge of pectoral fin), and an external dart tag with unique numbering was inserted into dorsal surface of rays right pectoral fin.

Ray recovery from surgery was monitored throughout a 24 hr recovery period during which time each ray was observed for full recovery from tagging procedure, suture retention, and overall animal health (ray behavior; swimming, lethargy). Once observations indicate successful tag retention and good animal health, rays were released at Gloucester Point (VIMS) into the York River. Considering late date of capture and falling water temperatures, these rays were considered to be some of the last rays leaving the bay for southern migration to over-wintering grounds. Cownose rays are very social animals and travel in groups, therefore, the decision was made to release rays from each tagging effort together to facilitate their movement out of the bay as a group. A temporary holding pen was made in shallow water to allow for rays to be transferred one-at-a-time from holding tank to bank of York River prior to release (Figure 2). Verification of tag operation in released rays was obtained by

detections received from a VEMCO receiver positioned at VIMS adjacent to release cite.

Results

A total of 12 cownose rays were tagged and released with internal acoustic telemetry tags via surgical implantation within ray's abdominal cavity during 2 separate tagging efforts on October 12 and October 19, 2015. (Tables 1, 2). Seven V-16 tags and five V-13 acoustic tags were used. Three YOY were tagged, all with V-13 tags. Seven adult females were tagged, two with V-13 tags and five with V-16 tags. One of these females (acoustic tag ID #21839), measured at 88 cm disc width (DW) and showing mating marks, likely mated for the first time, and was implanted with a V-16 tag which has a battery life of 6+ years. Two near-mature rays, one female (acoustic tag ID#21842) and one male (acoustic tag ID#21840), were both tagged with a V-16 tag. This immature female, at 80.5 cm DW and displaying no mating marks, likely joined the reproductive migration mass for the first time in spring, but did not mate.

Figure 2. A holding pen created at point of release so rays could be released together at one time. Tagged rays were moved one-at-a-time from shore-side tagging/ holding tank to this pen prior to release.

During tagging effort on October 12, the first YOY cownose ray was tagged following protocol previous used with adult cownose rays. Directly after tagging, ray behavior was normal (strong swimming mechanics and interaction with other rays) with no signs of stress. However, within 18 hours post-tagging, this YOY ray became lethargic and discontinued swimming activity, then died. Upon necropsy, it was revealed that the distal end of rays right liver lobe was picked up during suturing, resulting in the liver being sewn onto the interior lining of abdominal cavity wall (peritoneum). Also observed during necropsy was the very limited space available within the YOY ray abdominal cavity. With the high biological importance of the liver in cownose ray, as in most elasmobranchs, liver development in YOY rays is highly accelerated, resulting in

Ray Sex	DW (cm)	Weight (kg)*	Tag Date	Tag Type	Acoustic Tag ID	Acoustic Tag #	External Tag #	Release Date
Female	96.5	14.6	10-12-15	V13	17621	1191666	2027	10-13-15
Female	98.3	15.6	10-12-15	V13	17620	1191665	2088	10-13-15
Male	84.5	9.0	10-12-15	V16	21840	1218512	2087	10-13-15
Female	96.2	14.5	10-12-15	V16	21838	1218510	2082	10-13-15
Female	95.2	14.0	10-12-15	V16	21841	1218513	2086	10-13-15
Female	101.8	17.4	10-12-15	V16	21843	1218515	2085	10-13-15
Female	80.5	8.1	10-12-15	V16	21842	1218514	2084	10-13-15
Female	94.5	13.7	10-12-15	V16	21836	1218508	2081	10-13-15
Female	88.0	10.6	10-12-15	V16	21839	1218511	2080	10-13-15
All females were believed to be pregnant and carrying first-term embryos with the exception of ray acoustic tag ID #21842 which was assessed as immature, first time joining reproductive effort but not mated with (no mating marks) and not pregnant. *Weight was derived from DW measurements after Fisher *et. al* 2013.								

Table 1. Cownose Ray Tagging on October 12, 2015

Ray Sex	DW (cm)	Weight (kg)*	Tag Date	Tag Type	Acoustic Tag ID	Acoustic Tag #	External Tag #	Release Date
Female	45.25	1.4	10-19-15	V13	17618	1191663	2073	10-20-15
Female	50.25	1.8	10-19-15	V13	17609	1191654	2077	10-20-15
Female	50.25	1.8	10-19-15	V13	17619	1191664	2079	10-20-15
All young-of-year (YOY) rays of age ~110 days old.								

Table 2. Cownose Ray Tagging on October 19, 2015

this organ taking up more available space within the abdominal cavity than that observed in adult rays. During tagging of adult rays, the incision is made just to the anatomical right of ventral midline and approximately 100 mm anterior of cloacal opening so as to insert tag into body cavity space medial of spiral valve and caudal of distal end of right liver lobe, which is shorter than that of rays left liver lobe due to the presence of spiral valve. However, the liver in YOY rays extends further caudally and taking up more space in the abdominal cavity relative to that observed in adult rays, resulting in the liver being sutured to cavity wall when attempting to follow adult ray tagging protocol. Therefore, the remaining YOY rays were tagged by moving tag insertion site further away from ventral midline, just medial and farthest posteriorly of abdominal cavity-ray body musculature junction(furthest laterally reach of cavity) to avoid distal end of liver lobe. This resulted in tag positioned laterally of spiral valve lying against right lateral side of abdominal cavity. Subsequent YOY tagging on October 19 resulted in healthy tagged rays which were successfully released.

Summary tagging information is presented in the following tables by tagging dates.

Weight was derived from DW measurements after Fisher et al 2013;

Females: weight = 5×10^{-6} ($DW^{3.2587}$) ($R^2 = 0.9881$)
And
Males: weight = 6×10^{-6}($DW^{3.2061}$) ($R^2 = 0.99$)

References

Able, K.W., Gothues, T.M., Turnure, J.T., Malone, M.A., Henkes, G.A. 2013. Dynamics of residency and egress in selected estuarine fishes: evidence from acoustic telemetry. Environmental Biology of Fish DOI 10.1007/s10641-013-0126-6.

Barker, A.S. 2006. *Rhinoptera bonasus.* In: IUCN 2013. IUCN Red List of Threatened Species. Version 2013.1. www.iucnredlist.org. Downloaded on 06 September 2013.

Blaylock, R.A. 1993. Distribution and abundance of the cownose ray, *Rhinoptera bonasus*, in lower Chesapeake Bay. Estuaries 16:255-263.

Fisher, R.A. 2014. Biotelemetry of Cownose Rays in Chesapeake Bay: Habitat Use and Ray Movement. VIMS Marine Resource Report No. 2014-13, VSG-14-07.

Fisher, R.A. 2010. Life history, trophic ecology, and prey handling by cownose ray, *Rhinoptera bonasus* from Chesapeake Bay. Report NA07NMF4570324 to National Oceanic and Atmospheric Administration. VIMS Marine Resource Report No. 2010-10. http://www.vims.edu/GreyLit/VIMS/mrr10-10.pdf

Fisher, R.A., G.C. Call, and R.D. Grubbs. 2013. Age, Growth, and Reproductive Biology of Cownose rays *(Rhinoptera bonasus)* in Chesapeake Bay. Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science. Vol. 5, Issue 1, 225-234.

Wingate, R.L., Secor, D.H., Kraus, R.T. 2011. Seasonal patterns of movement and residency by striped bass within a subestuary of the Chesapeake Bay. Transactions of the American Fisheries Society 140:1441-1450.