CHARACTERIZING KEMP'S RIDLEY AND LOGGERHEAD HABITAT PARTITIONING IN VIRGINIA AND MARYLAND STATE WATERS

Gwendolyn Lockhart[1], Andrew DiMatteo[1,2], Susan G. Barco[3], Danielle Jones[1], Laura Busch[4]

[1]Naval Facilities Engineering Command (NAVFAC) Atlantic, Norfolk, VA, USA [2] CheloniData LLC, Boulder, CO, USA

[3]Virginia Aquarium & Marine Science Center, Virginia Beach, VA, USA [4]United States Fleet Forces Command, Norfolk, VA, USA

PROJECT INTRODUCTION

Virginia and Maryland coastal and estuarine waters (Figure 1) are an important seasonal foraging habitat for juvenile Kemp's ridley (*Lepidochelys kempii*) and loggerhead (*Caretta caretta*) sea turtles [1][2][3]. This area is also one of the busiest navy hubs on the United States (U.S.) east coast. The U.S. Navy has partnered with the Virginia Aquarium & Marine Science Center (VAQF) and CheloniData LLC. to conduct sea turtle tracking and analysis since 2013. This effort has included processing historical data collected by VAQF and deploying satellite tags on stranded, incidentally caught, and wild caught sea turtles. The tagging effort ended in 2018, and the U.S. Navy is leveraging the tag data to answer biological and management questions. The study presented here was designed to understand species-specific behavior, so U.S. Navy environmental planning can improve assessment of the potential impacts to protected species identified in permitting documents.

STUDY GOALS

- Use satellite tag data to conduct GIS analysis that facilitates visual and quantitative comparisons between Kemp's ridley and loggerhead habitat use in the study area
- Identify potential interspecific resource partitions in the study area
- Use information to inform resource selection modeling efforts

STUDY METHODS

- Deployed Argos/GPS enabled satellite tags on Kemp's ridley and loggerhead sea turtles between 2009-2018 (Table 1).
- Data were managed in movebank.org. ARGOS data were filtered with the Douglas ARGOS Filter Algorithm (version 8.50) in Movebank using the parameters suggested by the Turtle Expert Working Group ([4][5]).
- All tracks were smoothed in to six-hour time steps using the R Statistical Package ([6]) and bsam library.
- ArcGIS™ 10.3 was used to create three surfaces (all species, Kemp's ridley, and loggerhead) using points from the smoothed tracks (Figures 2-4). The surfaces contained 5000x5000 meter grids with a count of location points assigned as the grid value.
- ArcGIS™ 10.3 was used to calculate the distance from shore and distance from the nearest coastal naval installation, as well as extract a depth value (from the ETOP01 model) for each location.
- Mean distance from shore, distance to installation, and depth were compared within state waters, for both species, using a one-way analysis of variance in R Statistical Package.

STUDY RESULTS

- The surface created with both species shows that tagged sea turtles occurred throughout VA and MD estuarine and ocean waters, but were more common in lower Chesapeake Bay and southeastern Virginia ocean waters (Figure 2).
- Tagged loggerheads spent more time in the center of Chesapeake Bay than closer to the shoreline (Figure 3).
- Kemp's ridleys spent more time along the shoreline and in southern river mouths than in the center of Chesapeake Bay (Figure 4).
- The difference between the two species' distance from shore, distance from installations, and depth values were all statistically significant ($p<0.001$) (Table 2).
- Kemp's ridleys spent 59% more tracked time in the study area than loggerheads (Table 1). This was due to loggerheads having a longer tag retention time (Table 2).

Species	Number of Tags	Total Tracking Time	Mean Tracking Time per Tag
All Turtles	45	4,362 Days	97 days
Kemp's ridley	19	430 Days	23 days
Loggerhead	26	3,880 Days	149 days

Table 1: The number of tags deployed, total tracking time for all tags, and the average time tracked for one tag. The sums were calculated from the entire dataset and not just for the study area.

Metric	Lk (n=1,737)	Cc (n=6,078)
Distance from Shore (meters)	Mean=1,669 Range=0-15,392 StDv=1,975	Mean=5,281 Range=0-17,120 StDv=3,956
Distance from Installation (meters)	Mean=22,102 Range=0-66,103 StDv=15,392	Mean=23,660 Range=0-72,949 StDv=17,694
Mean Depth (meters)	Mean=-3.91 Range=-25-5 StDv=3.17	Mean=-9.47 Range=-30-5 StDv=5.08
% Time in State Waters	89% 430 days	39% 1,699 days

Table 2: Statistics for distance to shore and installation, depth, and percent time in study area.

STUDY AREA MAP

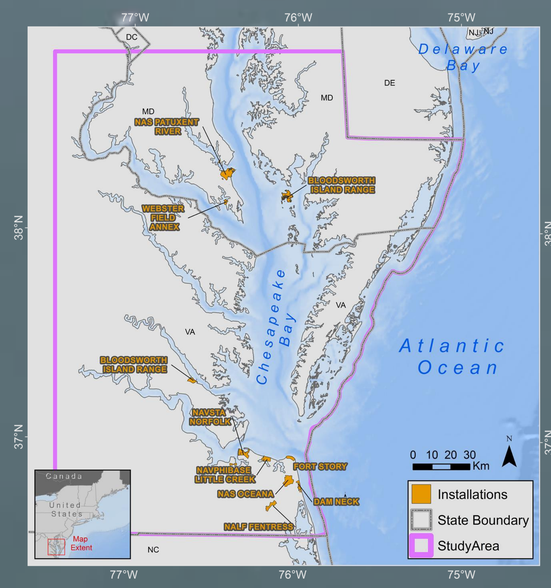

Figure 1: The study are (pink polygon) was area was used to select location points for the analysis.

POINT COUNT GRID – ALL SPECIES (n=45)

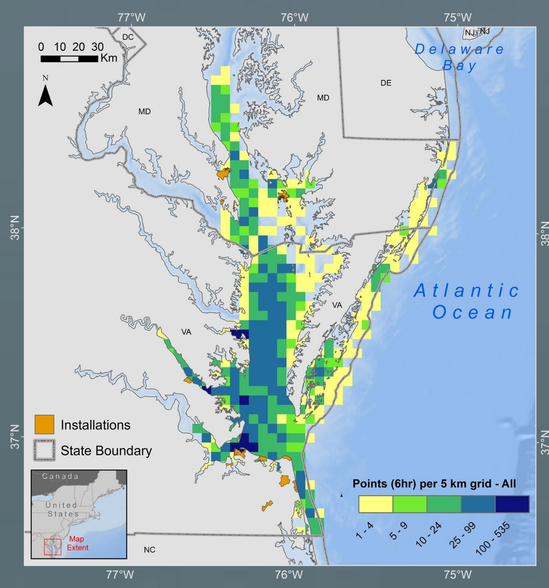

Figure 2: Point count surface for all satellite tagged Kemp's ridley and loggerhead sea turtles.

POINT COUNT GRID – KEMP'S RIDLEY (n=19)

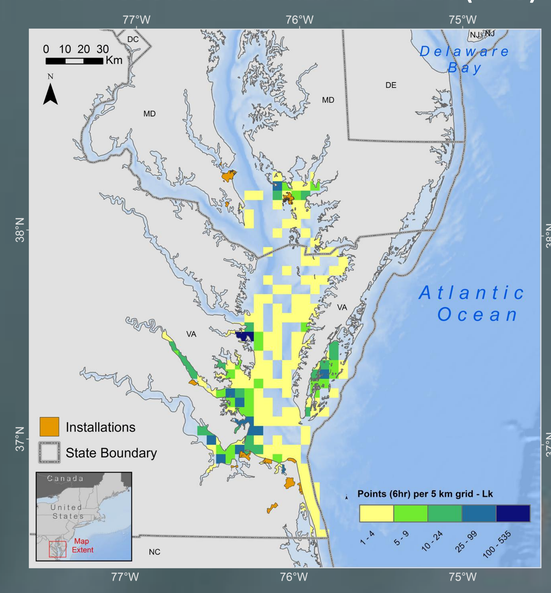

Figure 3: Point count surface for all satellite tagged Kemp's ridley sea turtles.

POINT COUNT GRID – LOGGERHEADS (n=26)

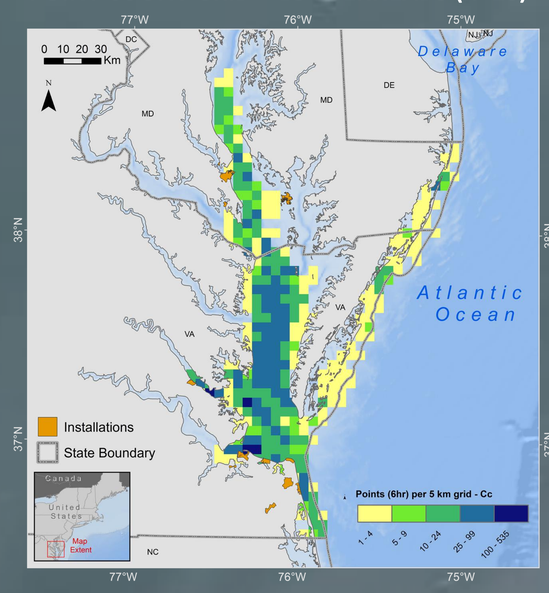

Figure 4: Point count surface for all satellite tagged loggerhead sea turtles.

STUDY DISCUSSION

Distribution of tagged sea turtles closely resembled the density of loggerhead turtles developed from aerial surveys [7]. Sea turtles could be exhibiting resource partitioning with loggerheads using deeper, more open waters and Kemp's ridleys using shallow water closer to shore. Based on these results, it is particularly important for the U.S Navy to consider potential impacts to the endangered Kemp's ridley sea turtle when conducting exercises near naval installations. In 2019, the U.S. Navy will be collaborating with project partners to produce a Kemp's ridley resource selection model for Virginia and Maryland state waters. Future work could include the production of a comparable loggerhead resource selection model.

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