

USING ACOUSTIC TELEMETRY TO INVESTIGATE HABITAT USE PATTERNS AND RESIDENCY TIME FOR SEA TURTLES IN THE LOWER CHESAPEAKE BAY AND COASTAL WATERS OF VIRGINIA, USA

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INTRODUCTION

- The Lower Chesapeake Bay and nearshore Virginia (VA) waters surrounding the mouth of the bay represent the busiest hub of naval activity on the United States (U.S.) east coast.
- In 2013, we initiated a sea turtle tagging project with the Virginia Aquarium & Marine Science Center (VAQF) for this east coast region. Loggerhead and Kemp's ridley sea turtles were mainly targeted since they are the most abundant and regularly occurring species in VA [2]; [3]; [4].
- The **goal of the project** was to better understand how sea turtles utilize waters near U.S. Navy facilities in southeastern VA.
 - One of the **primary objectives** was to assess occurrence and habitat use for loggerhead and Kemp's ridley turtles using acoustic telemetry.
- Acoustic tags (Vemco) were used to leverage the existing underwater acoustic receiver array (Figure 1) that is located within the Chesapeake Bay and off the VA coast. The array is maintained by the U.S. Navy and other members of the Atlantic Cooperative Telemetry Network.

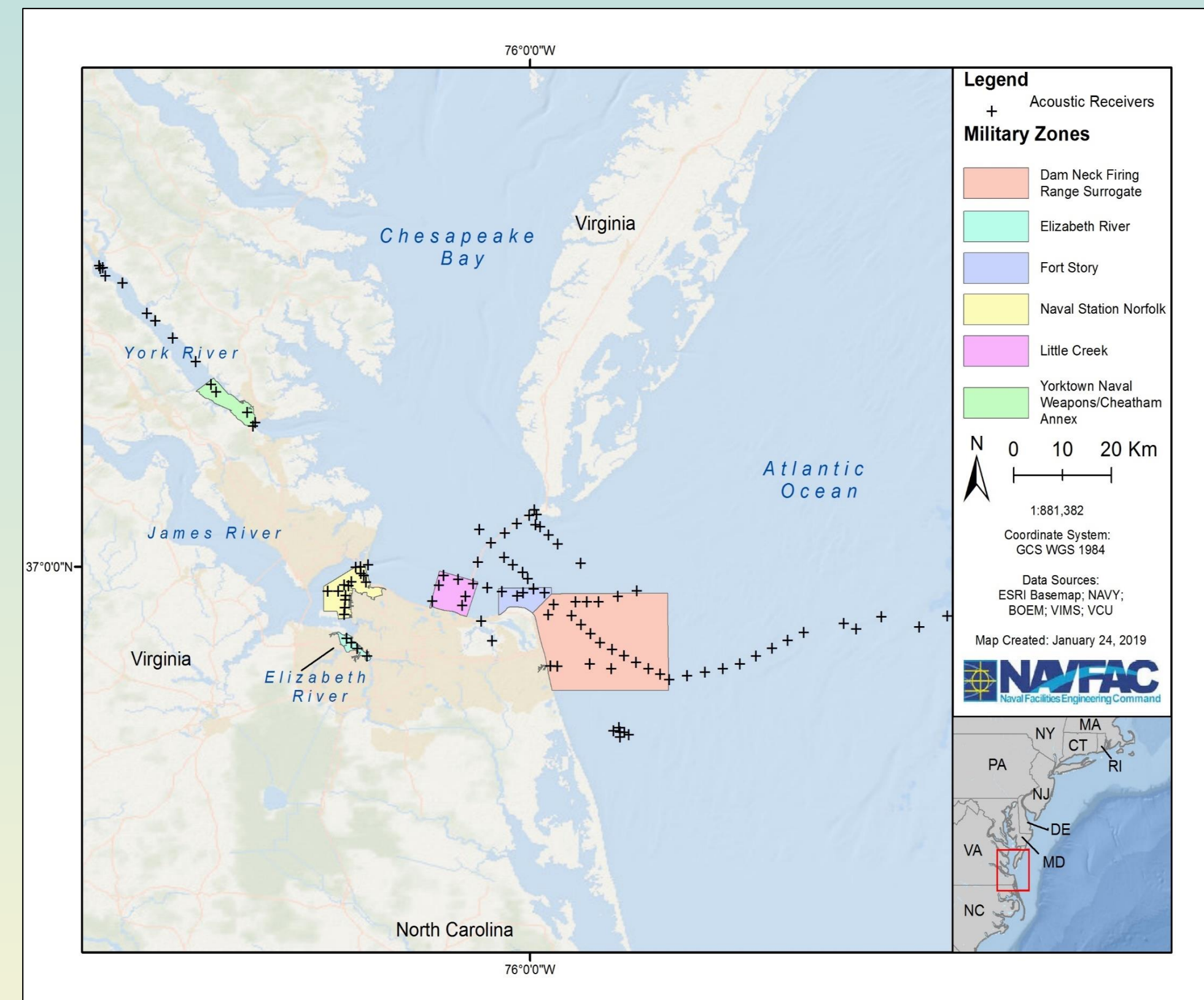


Figure 1. The acoustic receiver array in the Lower Chesapeake Bay and coastal Virginia waters along with military zones of interest

METHODS: TAGGING

- Turtles were obtained in three ways between 2013-2017: direct capture by researchers (n=1), incidental capture in commercial fisheries (n=6), or rehabilitation and release of stranded animals (n=59).
 - Only turtles deemed healthy/normal (e.g., no deformities, blindness, etc.) were tagged.
- Acoustic tags were attached to the caudal vertebral or marginal scutes of the carapace using just epoxy or both coated steel wire and epoxy (Figure 2). Several models of Vemco tags (V9, V13, and V16) were deployed; the specific model depended on the size of the turtle.



Figure 2. VAQF staff attaching an acoustic tag to a Kemp's ridley sea turtle using the wire and epoxy method. Photo © VAQF

METHODS: COMPARATIVE SPECIES ANALYSIS

- Signals or 'pings' from the acoustic tags were recorded by receivers as turtles passed nearby (at a range of up to 700 meters- based on VAQF's acoustic telemetry detection experiment [1]).
 - Aside from receiver location, date and time for each detection was also recorded.
 - Data were archived and downloaded from the array.
- Data were summarized by number of and percent detections per receiver/region/military zone in each season/year when the tagged turtles were present in the area for each species.
 - Seasons were defined as **Winter** (January-March), **Spring** (April-June), **Summer** (July-September), and **Fall** (October-December).
- Calculated deployment duration (deployment date to last detection) and days detected for residency time analysis.

Table 1. Summary statistics by species for turtles detected in the receiver array located in/around the Lower Chesapeake Bay and coastal VA waters between 2013-2017.

| Parameter | Kemp's ridley | Loggerhead |
|---|-----------------|-----------------|
| Maximum deployment duration (days) | 149 | 319 |
| Average (SD) deployment duration (days) | 39.81 (9.02) | 63.53 (90.42) |
| Maximum number of detections | 2982 | 1516 |
| Average (SD) number of detections | 161.94 (521.61) | 241.32 (385.58) |
| Maximum days detected | 93 | 39 |
| Average (SD) days detected | 7.31 (16.35) | 8.32 (10.02) |

RESULTS

- A total of 66 turtles were tagged in 2013-2015 and 2017.
 - Loggerheads: n=25
 - Kemp's ridleys: n=41
- 19 loggerheads and 31 Kemp's ridleys were detected in the receiver array.
- On average, loggerheads were slightly detected on more days, had more detections, and had a longer deployment duration (Table 1).
 - There was no significant difference between the two species for number of detections ($t_{stat}=2.01, p=0.54$), number of days detected ($t_{stat}=2.01, p=0.79$), and deployment duration ($t_{stat}=2.06, p=0.30$).
- 2 loggerheads were detected in two consecutive years (turtles migrate south of the study area after Fall of each year)
 - [VAQS20132102](#): first detected in October 2013 and then again from May-June 2014
 - [VAQS20152063](#): first detected from July-October 2015 and then again from May-June 2016

REFERENCES

- Barco, S., and G.G. Lockhart. (2016). *Turtle Tagging and Tracking in Chesapeake Bay and Coastal Waters of Virginia: 2015 Annual Progress Report. Final Report.* U.S. Fleet Forces Command. Submitted to Naval Facilities Engineering Command Atlantic, Norfolk, VA, under Contract No. N62470-10-D-3011, Task Orders 41 and 50, issued to HDR Inc., Virginia Beach, VA. February 2016.
- Barco, S.G., S.A. Rose, G.G. Lockhart, and A. DiMatteo. 2018. *Sea Turtle Tagging and Tracking in Chesapeake Bay and Coastal Waters of Virginia: 2017 Annual Progress Report.* U.S. Fleet Forces Command. Submitted to Naval Facilities Engineering Command Atlantic, Norfolk, VA, under Contract No. N62470-15-8006, Task Order F4031, issued to HDR, Inc., Virginia Beach, VA. April 2018.
- Mansfield, K. L. (2006). *Sources of mortality, movements and behavior of sea turtles in Virginia.* (PhD Dissertation). College of William and Mary.
- Swingle, W.M., Barco, S.G., Costidis, A.M., Bates, E.B., Mallette, S.D., Rose, S.A., and Epple, A.L., 2018. *Virginia Sea Turtle and Marine Mammal Stranding Network 2017 Grant Report.* Final Report to the Virginia Coastal Zone Management Program, NOAA CZM Grant #NA16NOS4190171, Task 49. VAQF Scientific Report 2018-01. Virginia Beach, VA. 52 pp.

RESULTS (CONTINUED)

- Both species were initially detected in Spring, with detections recorded until Fall (Table 2).
 - Kemp's ridleys were detected more (58% detections) during Summer.
 - 91% of loggerhead detections were in Summer and Fall.
- Habitat use patterns by season (Figure 3):
 - Spring**- Both species displayed movement from the VA coast into the mouth of the Bay.
 - Kemp's ridleys were detected more between Little Creek and Elizabeth River
 - Summer**- Loggerheads detected more in southern part of the Bay and around James River.
 - Kemp's ridleys mainly detected in rivers, near and within Naval Station Norfolk (NSN) zone.
 - Fall**- Both species displayed movement out of the Bay, but were still detected within the NSN zone.

Table 2. Number of tagged turtles released by season and percent detections by species and season for turtles detected between 2013-2017

| Season | Number Released | Kemp's ridley | Loggerhead |
|--------|-----------------|---------------|------------|
| Winter | 0 | 0.0% | 0.0% |
| Spring | 25 | 25.2% | 8.7% |
| Summer | 33 | 58.3% | 44.9% |
| Fall | 8 | 16.5% | 46.4% |

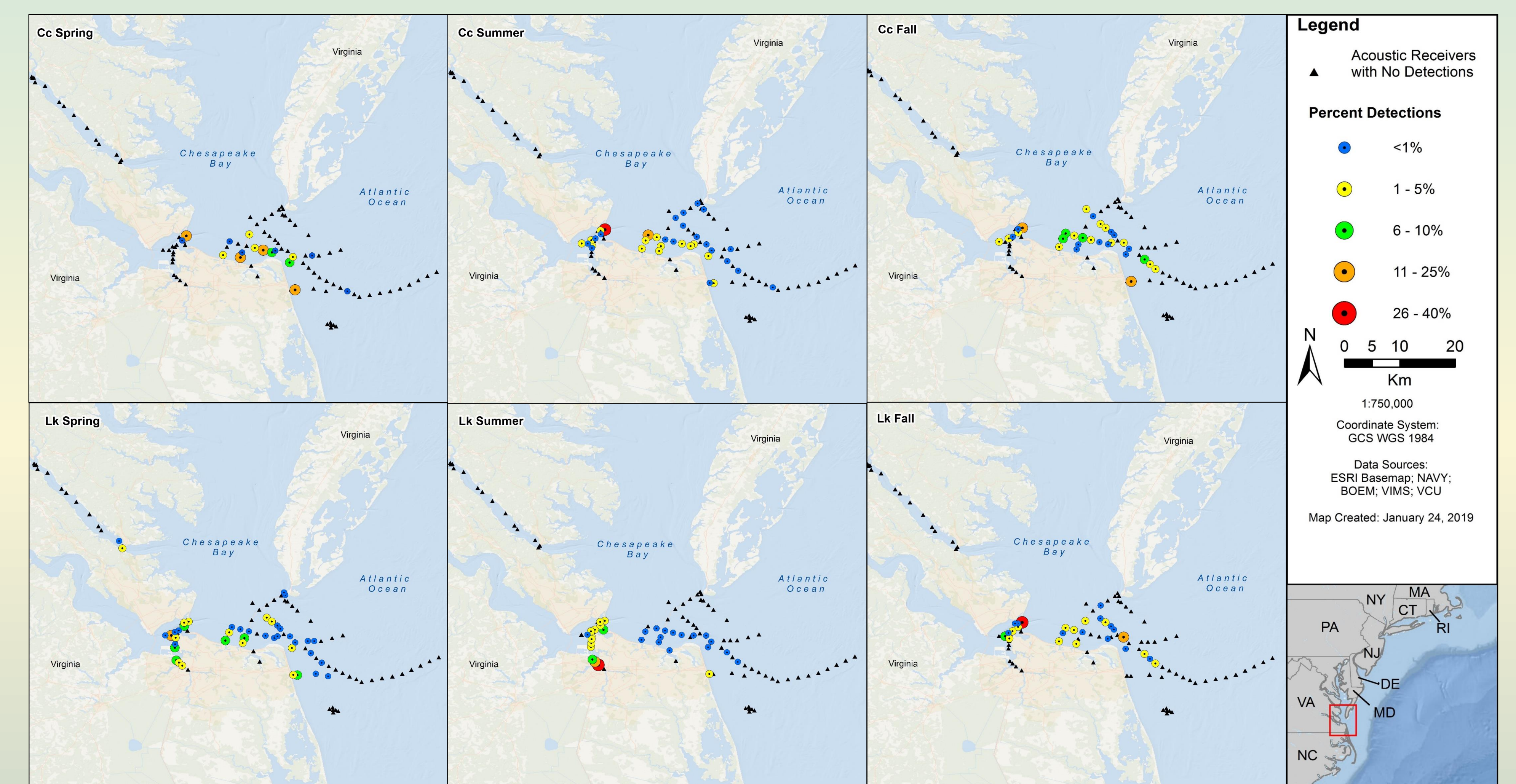


Figure 3. Percent detections of loggerhead (Cc- top row) and Kemp's ridley (Lk- bottom row) turtles by season at receivers in the Lower Chesapeake Bay and coastal VA waters for 2013-2017

- Loggerheads and Kemp's ridleys were detected on 46 and 54 acoustic receivers, respectively, with most being within military zones (Figure 4).
 - Loggerheads: Percent detections were highest for the NSN (39.5%) and Little Creek (30.5%) zones.
 - Kemp's ridleys: Percent detections were highest for the NSN (40.5%) and Elizabeth River (37.5%) zones.

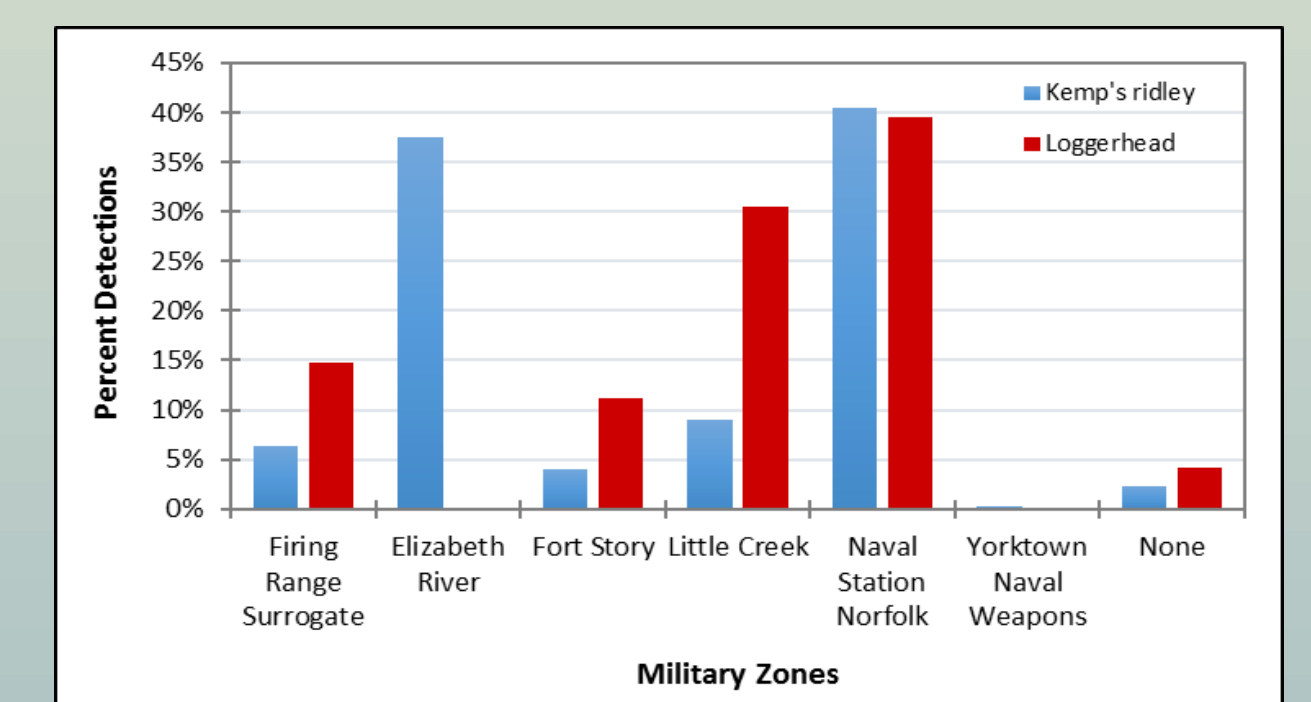


Figure 4. Percent detections of loggerhead (red) and Kemp's ridley (blue) turtles by military zone for all seasons between 2013-2017

DISCUSSION

- This study shows that acoustic tag data can be used to investigate areas of relative habitat use and residency time in and around the Lower Chesapeake Bay for loggerhead and Kemp's ridley sea turtles.
 - Differences in deployment duration indicate loggerheads may occur in VA across seasons and exhibit inter-annual site fidelity.
- Results indicate both species utilize the waters adjacent to U.S. Navy facilities in Virginia from Spring to Fall.
 - High percent detections at certain military zones (e.g., Little Creek and Elizabeth River) compared to other zones could indicate potential hot spot areas. Results from analyses on satellite-tagged loggerheads and Kemp's ridleys show foraging areas in these zones [1], [2].
 - However, detection patterns/habitat use is influenced by turtle release dates and number/location of acoustic receivers. For example, more loggerheads and Kemp's ridleys were released in Summer, which could explain why higher detections were recorded during this season.
- Increased knowledge of the movements, habitat utilization, and seasonality of the sea turtles found in the Lower Chesapeake Bay and nearshore mid-Atlantic will help the Navy with ongoing environmental compliance and conservation efforts.

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