A Preliminary Home-Range Analysis of Loggerhead Sea Turtles Released in Virginia & North Carolina

Gwen G. Lockhart
GIS Research Specialist
Virginia Aquarium & Marine Science Center

&

Susan G. Barco
Research Coordinator
Virginia Aquarium & Marine Science Center

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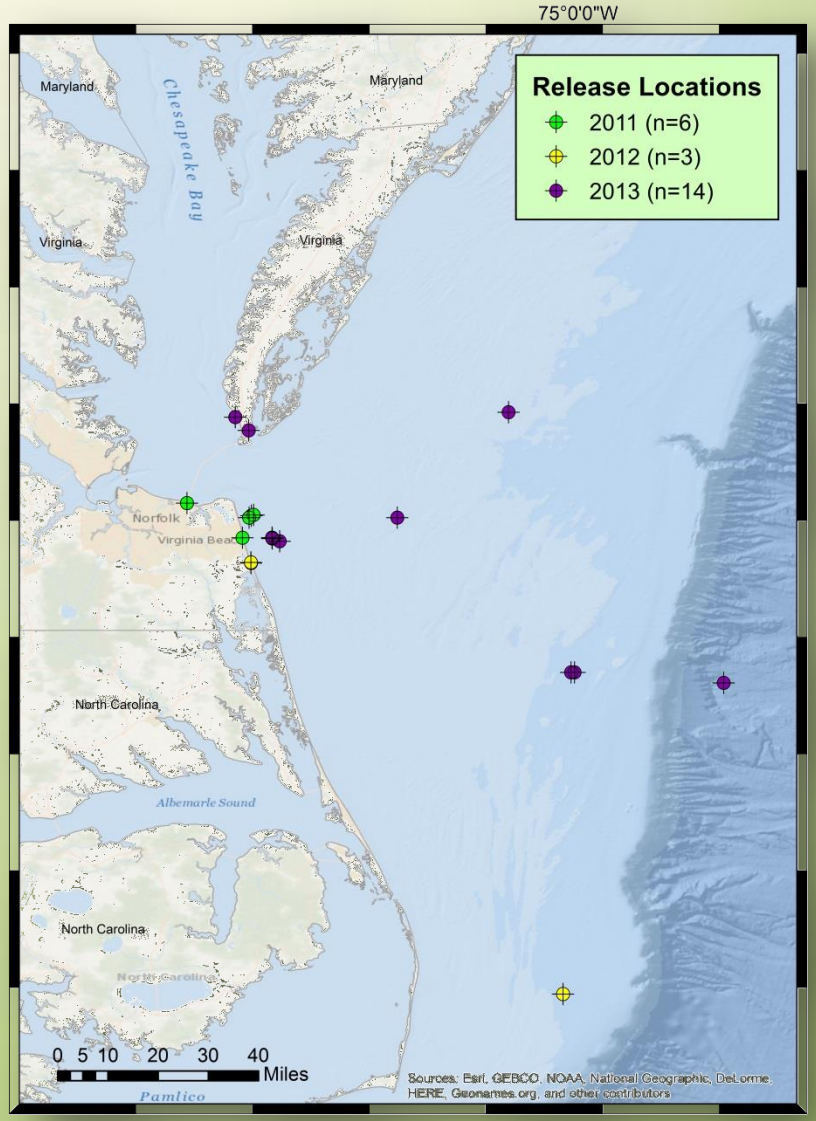
Acknowledgements

- NMFS Species Recovery Grants to State
- Virginia Aquarium Staff and Volunteers
- SeaTurtle.org
- Movebank.org

Primary Study Area Virginia

- Virginia coastal and estuarine waters are an important foraging habitat for juvenile loggerhead (*Caretta caretta*) sea turtle

(Musick and Limpus 1997; Mansfield et al. 2009; Shoop and Kenney 1992; Epperly et al. 1995; Keinath 1993; Keinath et al. 1996; Mansfield 2006; TEWG 2009; NMFS 2011; NMFSa 2012; Virginia Aquarium 2011a, 2011b, 2012a, 2012b)



Loggerhead Critical Habitat Determination

Given the wide-spread nature of foraging loggerheads in the Northwest Atlantic Ocean, and the lack of clear habitat features of foraging areas, we were unsuccessful in identifying specific high value sites as foraging critical habitat for loggerheads.

50 CFR Part 226

DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration

50 CFR Part 226

[Docket No. 130513467–4401–02]

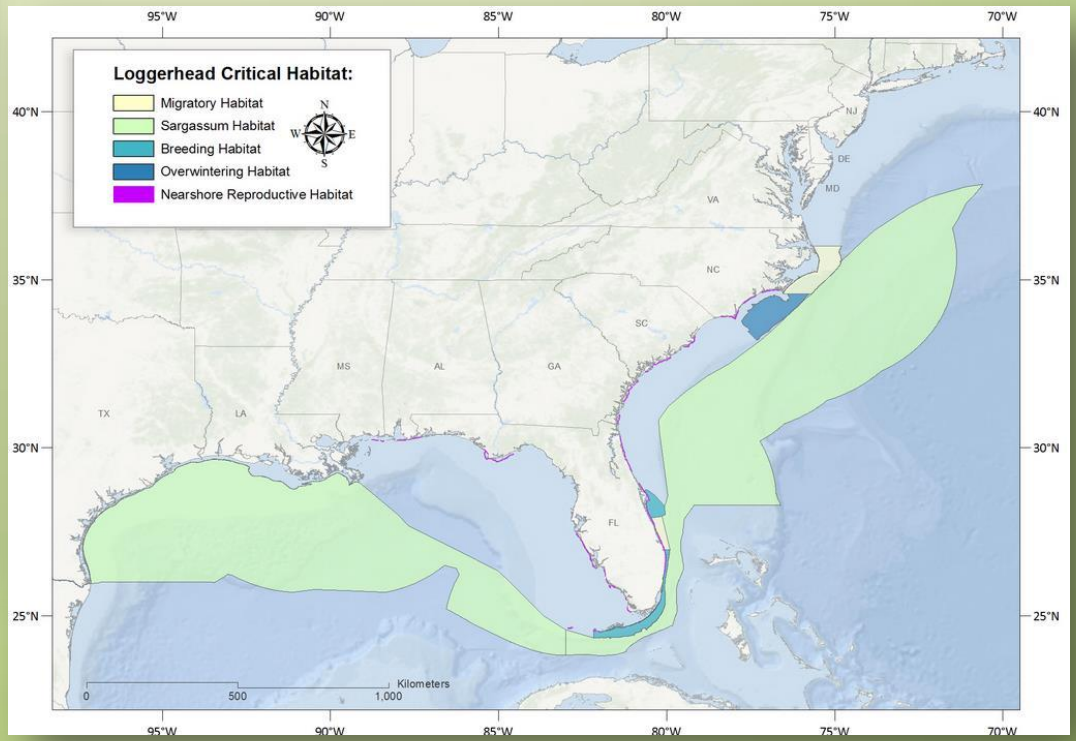
RIN 0648–BD27

Endangered and Threatened Species: Critical Habitat for the Northwest Atlantic Ocean Loggerhead Sea Turtle Distinct Population Segment (DPS) and Determination Regarding Critical Habitat for the North Pacific Ocean Loggerhead DPS

AGENCY: National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA), Commerce.

ACTION: Final rule.

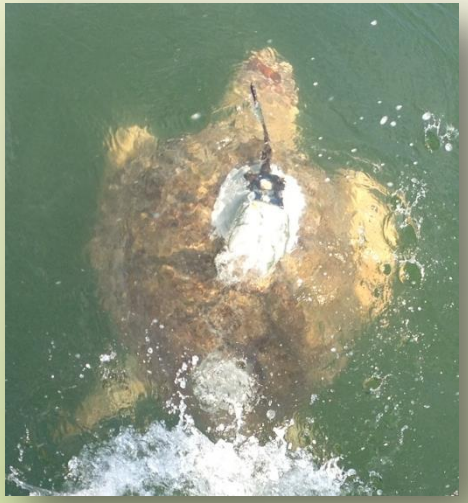
50 CFR Part 226

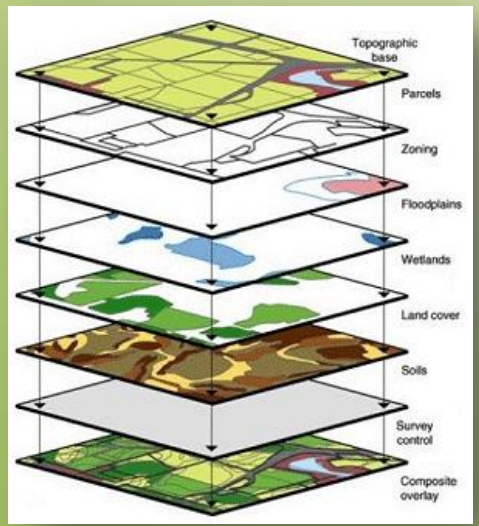


http://www.nmfs.noaa.gov/pr/species/turtles/criticalhabitat_loggerhead.htm

Home-Range Project Goals

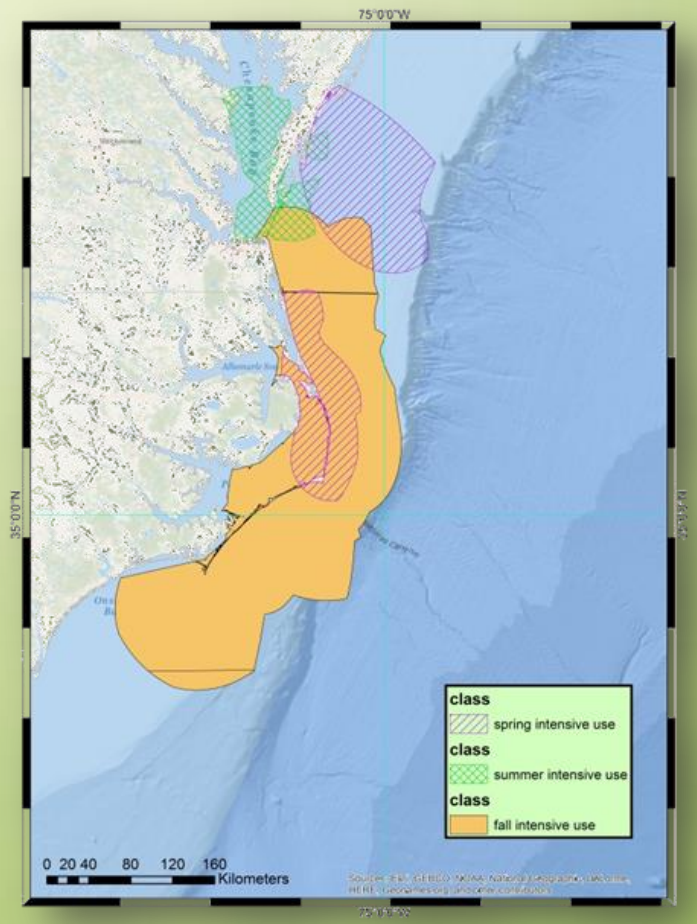
- Collect location data



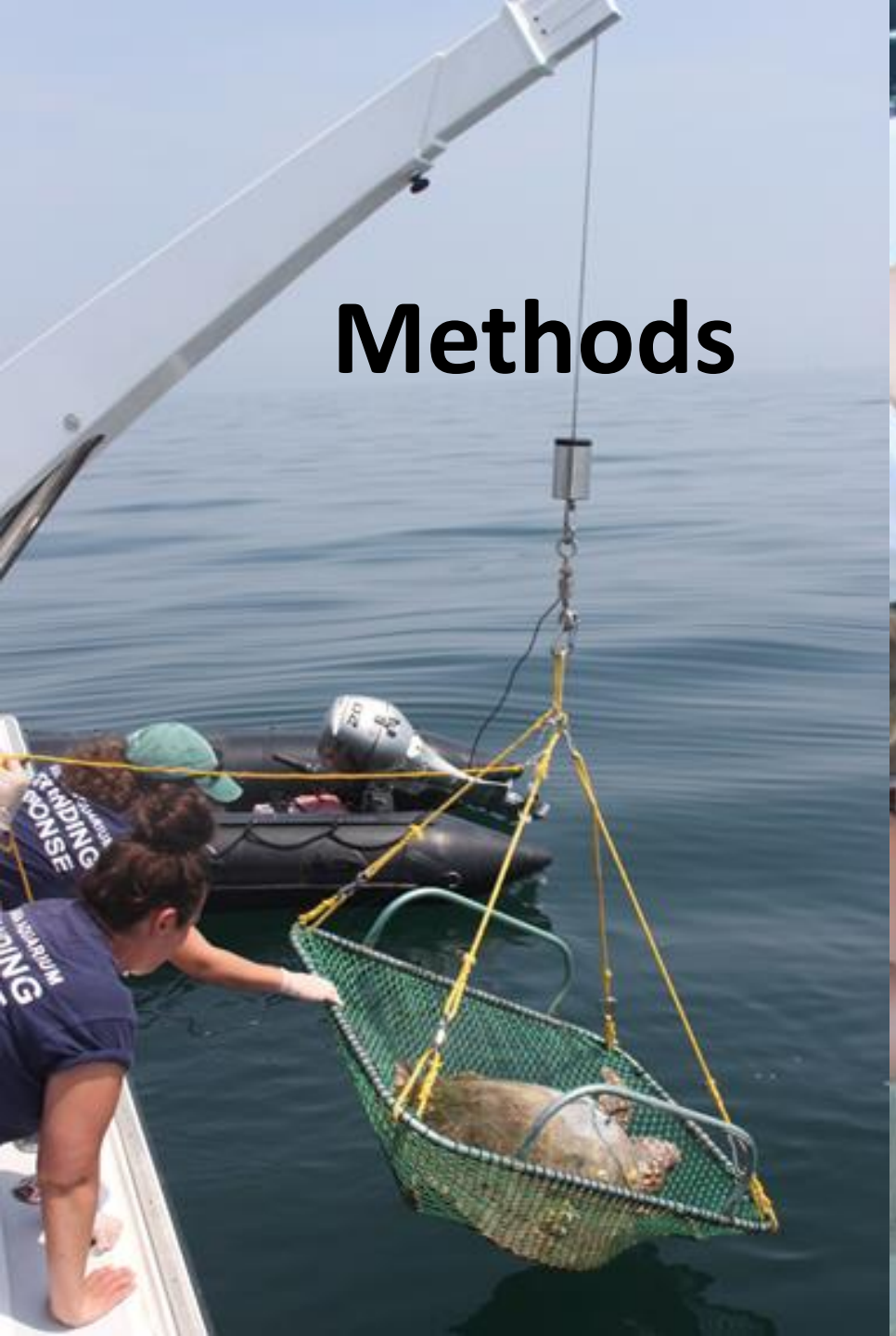


- Develop a GIS analysis

- Create GIS features, representing intensive use areas, to inform management decisions



Methods

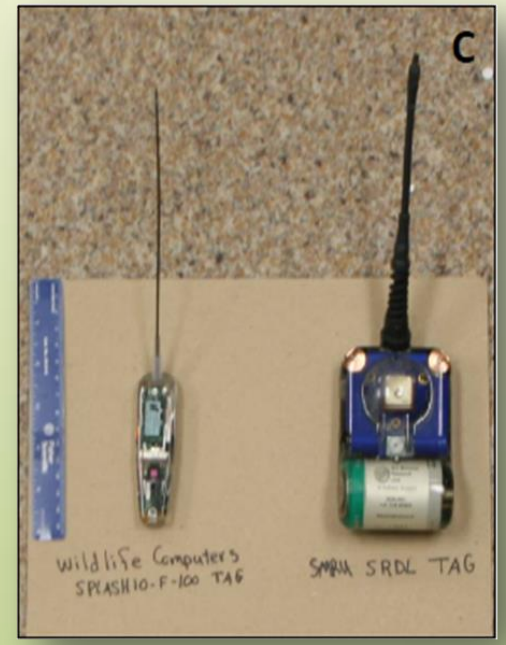


Species

Released	Days at Large	SCL-NT
6/27/11 11:00	22	62.7
6/27/11 15:00	92	72.0
6/29/11 14:30	221	67.7
8/1/11 14:30	176	79.0
10/18/11 14:30	171	99.4
11/21/11 9:00	295	62.0
7/27/12 14:00	52	58.0
9/7/12 13:00	160	76.6
10/5/12 13:00	264	64.4
5/22/13 13:25	126	60.4
5/22/13 15:05	278	71.0
5/22/13 15:05	329	64.3
6/5/13 15:16	189	68.3
6/5/13 15:16	369	66.6
6/6/13 11:10	219	58
6/12/13 9:35	60	59.0
6/13/13 15:00	108	47.5
6/26/13 10:25	182	55.0
7/5/13 17:17	69	64.0
7/21/13 15:15	179	62.7
8/27/13 16:27	375	66.5
9/7/13 10:15	347	79.6
10/20/13 12:36	211	66.5

- 23 loggerhead sea turtles
- Released from 2011–2013
- Release SCL-NT cm
  - min=55.0; max=99.0; mean=66.6
- 22-375 days tracked (mean=195)

Tag Types



17 Sea Mammal Research Unit 9000x SDRL tags

6 Wildlife Computers SPLASH tags

Capture Methods (n=23)

2 dip net

1 swimming enclosure

3 pound net

17 rehabilitated

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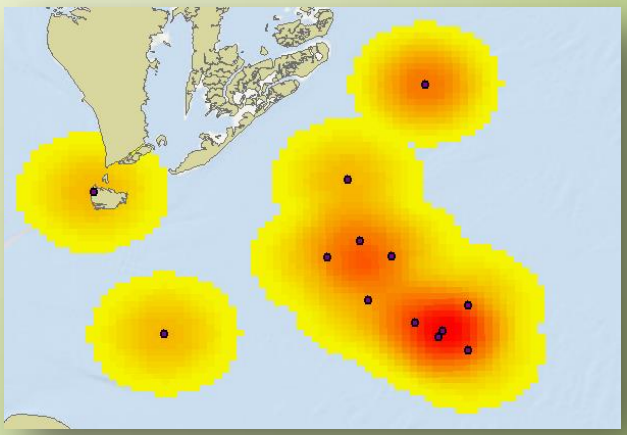
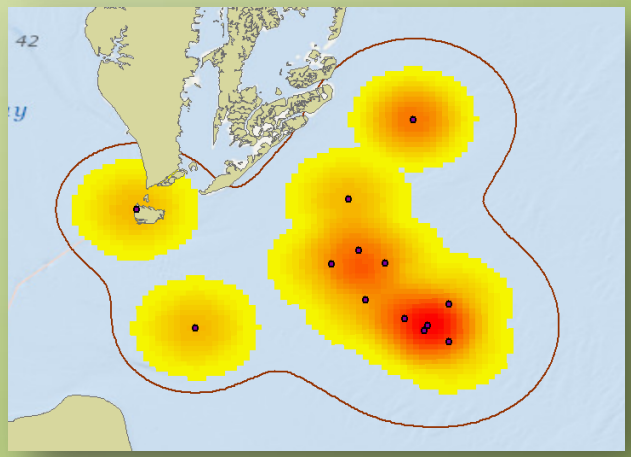
What is Home-Range?

- **Home-range:**
  - Area traversed by an animal during its normal activities of foraging, mating, and migrating *(Burt 1943)*
- **Utilization distribution (UD):**
  - Quantifies the "area traversed" and the "normal activity" of an animal's home-range *(Van Winkle 1975)*
  - Relative density function that reports the probability that an animal will relocate at any place according to the coordinate (x, y) of the place *(Silverman 1986; Wand and Jones 1995)*



- **Isopleths (contour lines):**
  - Based on the summed values of each grid intersection in the UD
  - 95% isopleth = home-range *(Worton 1989)*

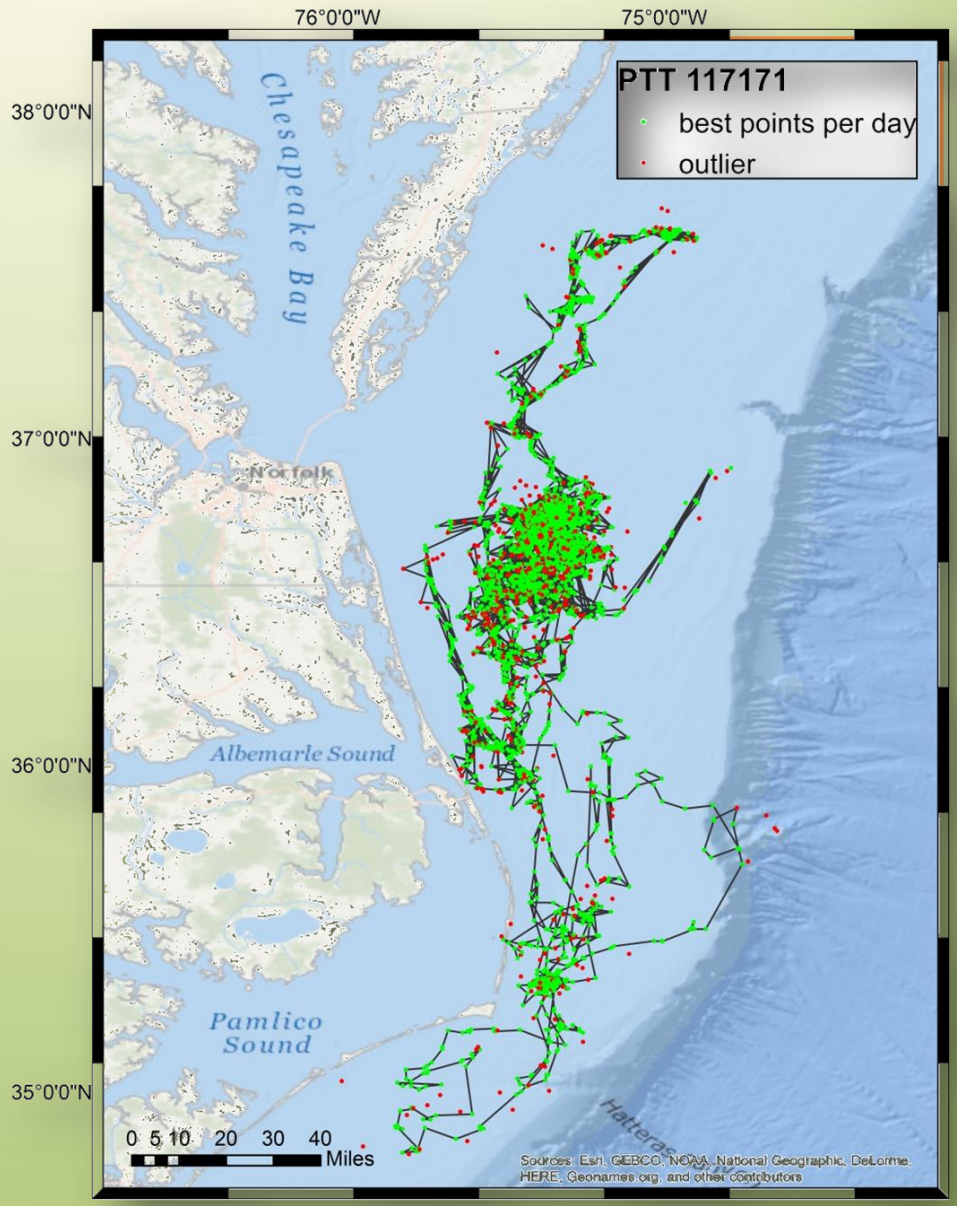


- **Cumulative home-range:**
  - Intersection of 95% isopleths
  - Identify relative cumulative use (RCU) classes

Methods – Point Filtering

- Combined all GPS and ARGOS points
- Calculated proxy ARGOS attributes to for GPS data
- Used Douglas filter identify the “best point per day”

  (Douglas et al. 2012; TEWG 2009)



Methods – UD Calculation

- **UDs are calculated using the reference bandwidth input** *(Wortan 1995)*

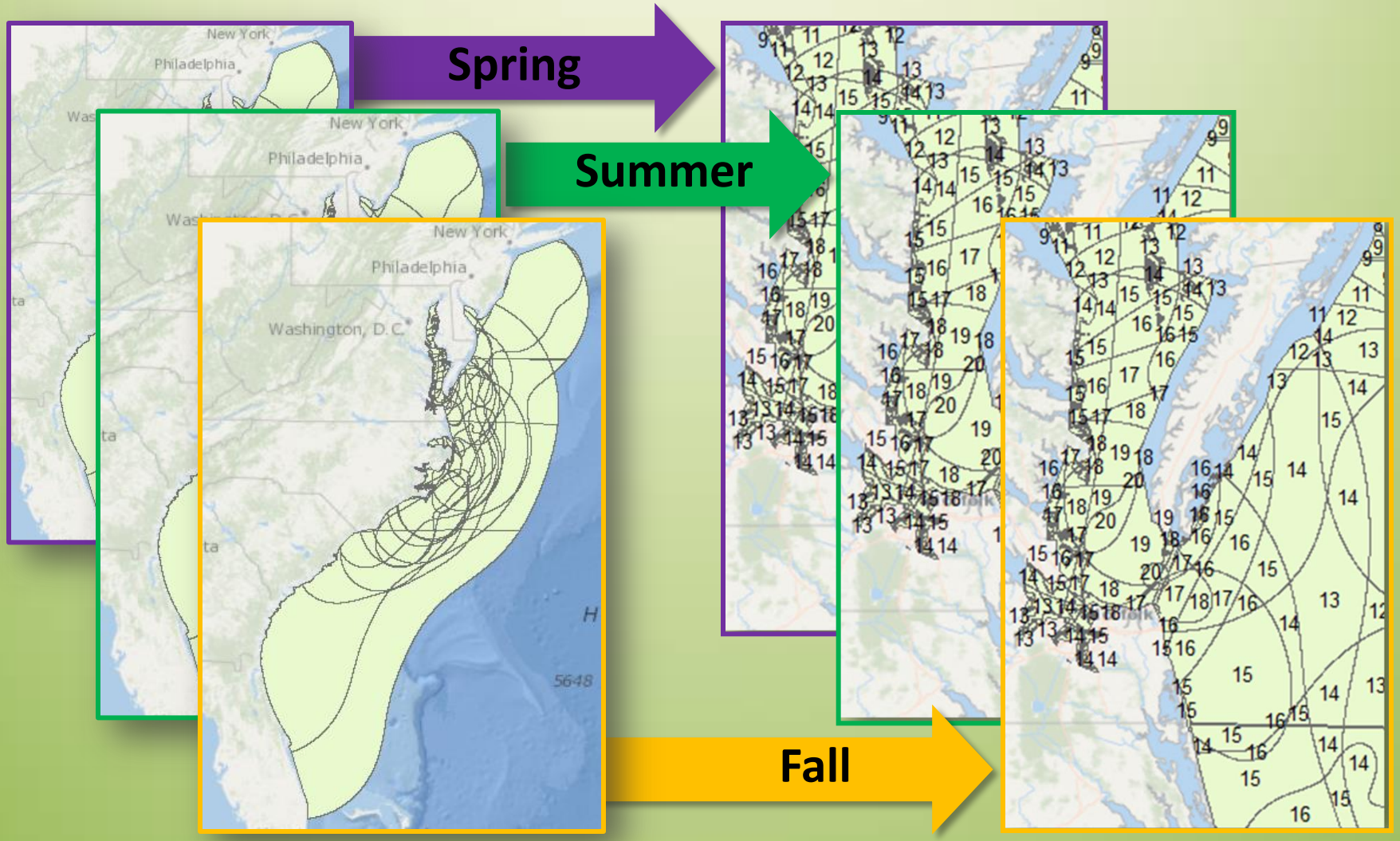
$$h_{ref} = n^{-1/6} \sqrt{\frac{var_x + var_y}{2}}$$

- h_{ref} **is based on the standard deviation** (*Silverman 1986)*
  - To compare variances the ratio between Std(x) and Std(y) for each dataset data set was calculated
  - Spatial variance was too great between each turtle's dataset to create one UD for all turtles

- **Calculated UD and 95% isopleth for each animal - in each season** *(Seaman and Powell 1996)*
  - Spring: April-June
  - Summer: July-September
  - Fall: October-December

Methods – Isopleth Intersection

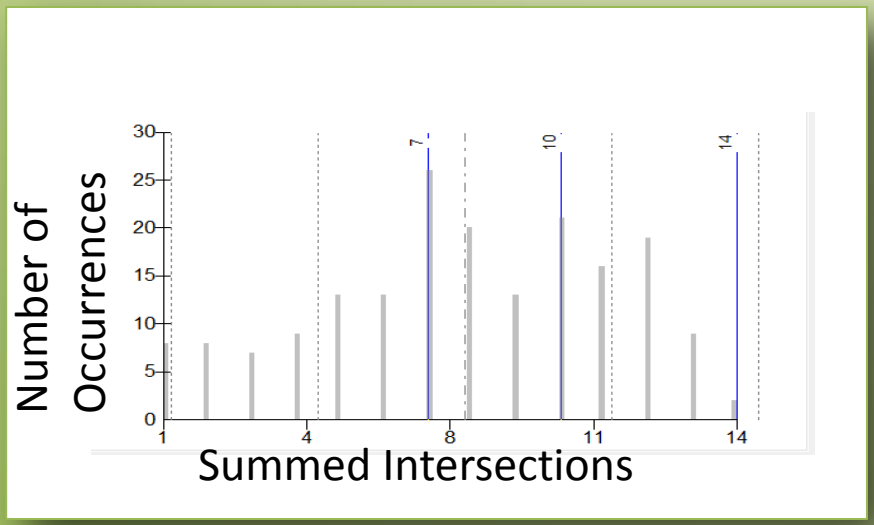
- Merge and intersect all isopleths – for each season
- Sum all home-ranges in each intersection for each season

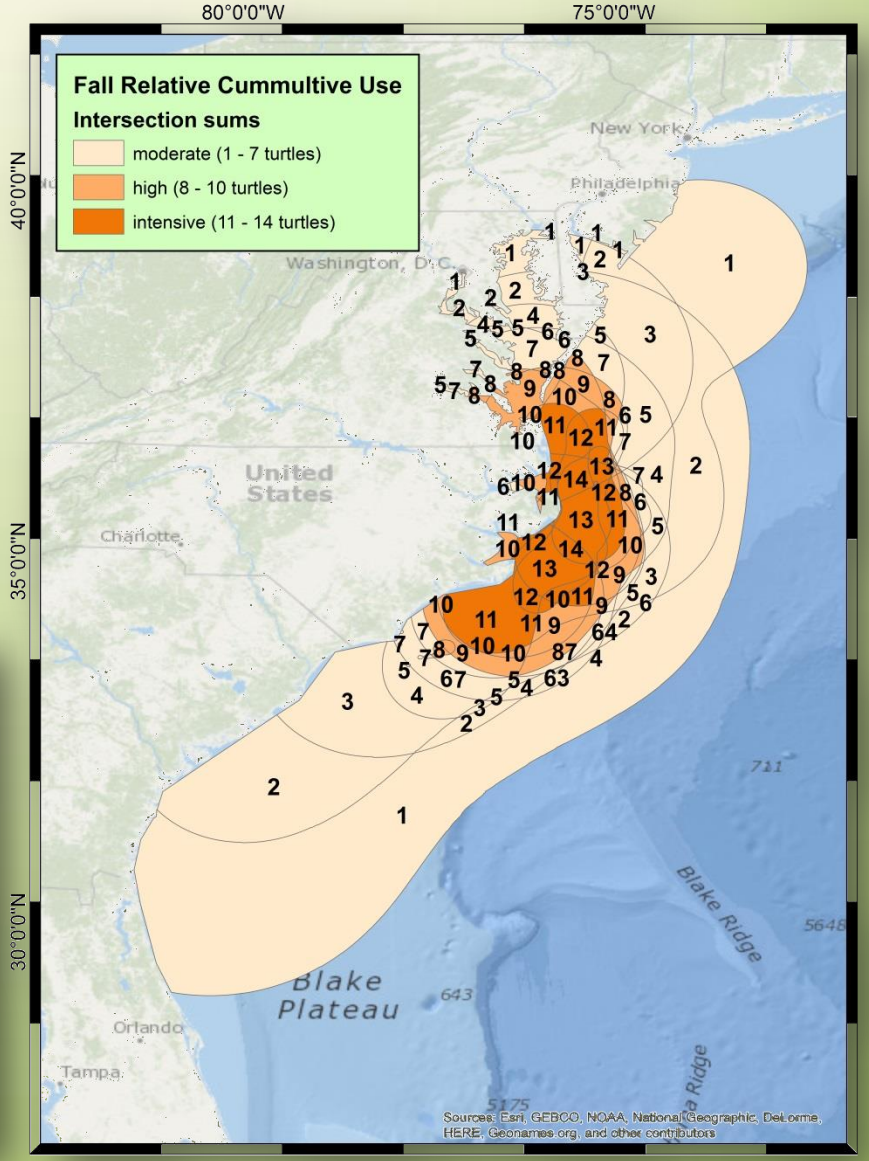


Methods – Relative Cumulative Use (RCU)

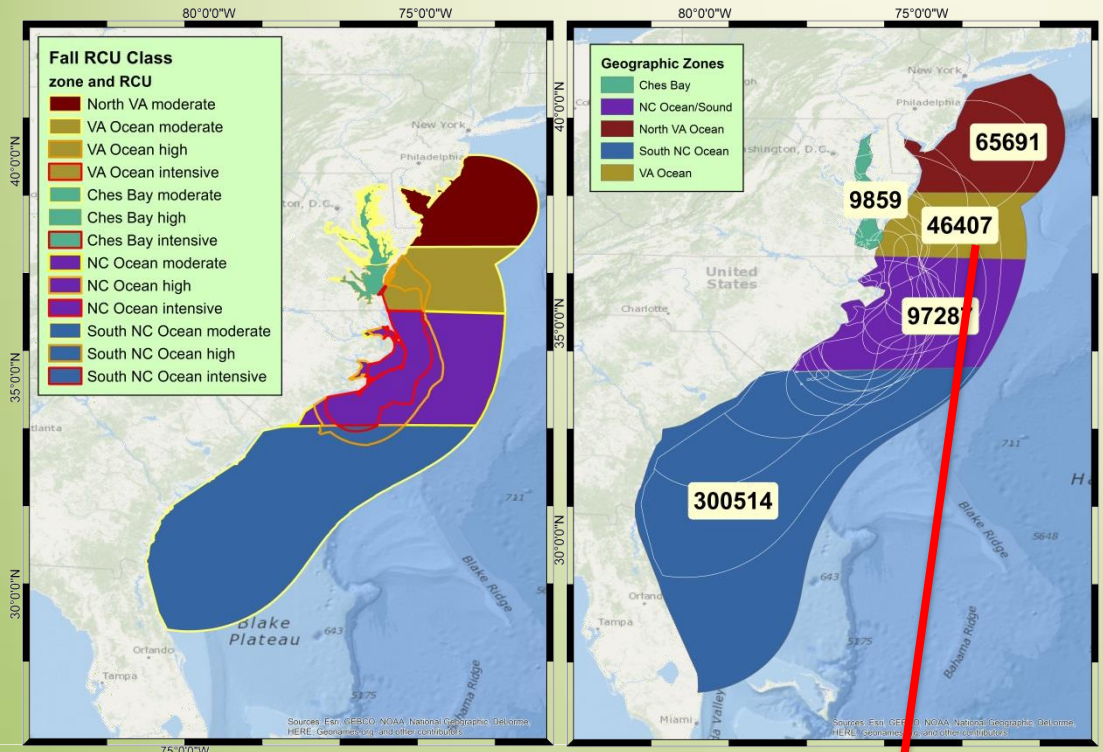
- Reclassify sums into three RCU classes for each season
  - moderate
  - high
  - intensive

- ArcGIS10™ quantile classification





Methods – %RCU by Geographic Zone



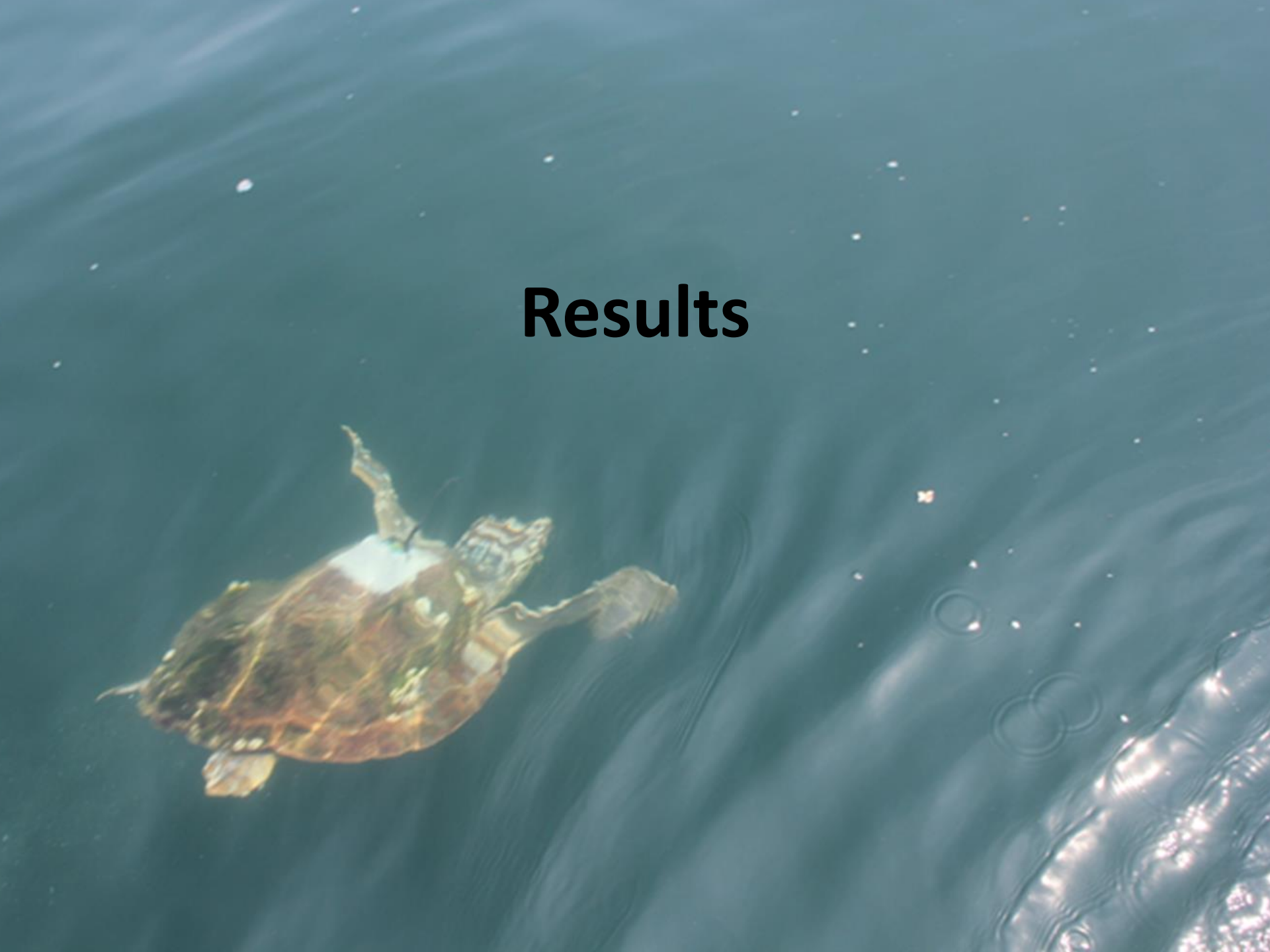
$$\frac{4,400\ sq\ km}{46,407\ sq\ km}$$

$$\frac{4{,}400}{46{,}407} = 9.5\%\ RCU$$

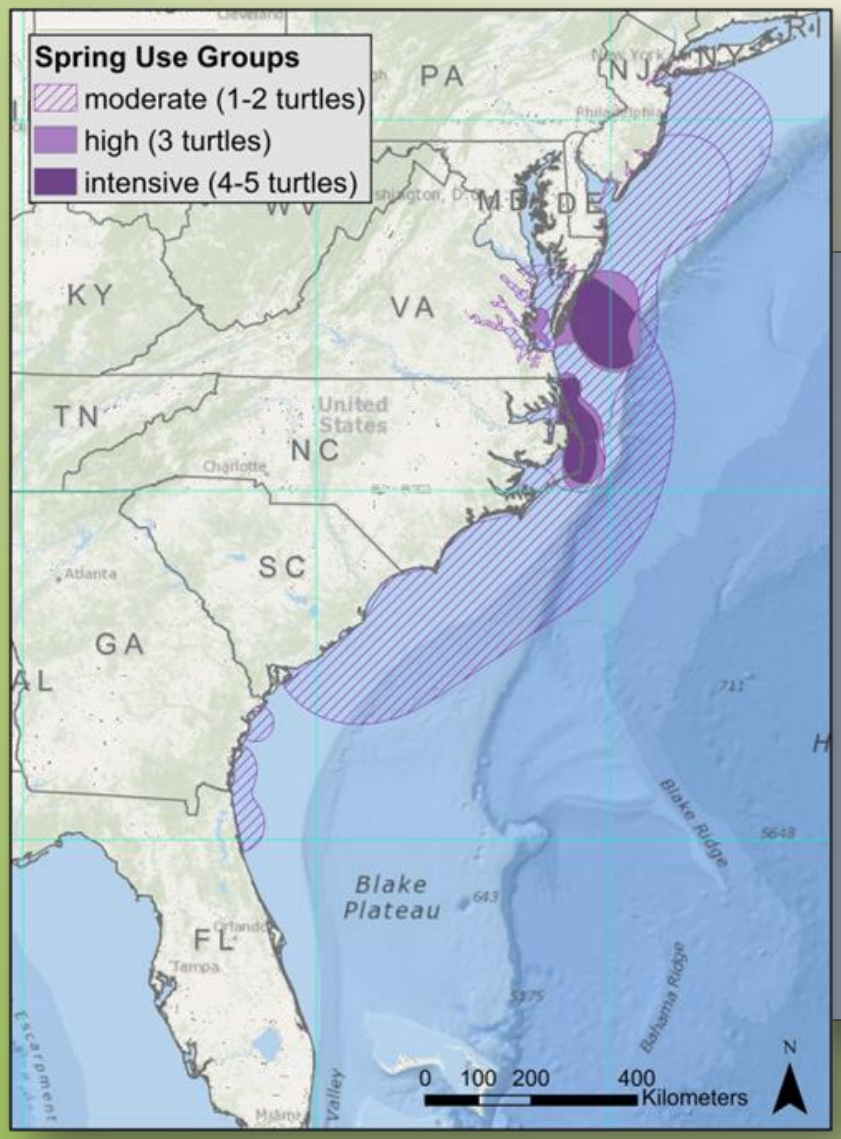
- Separated all RCU layer into geographic zones for each season
- Calculated the area of total home-range in each zone
- Calculate the area of each RCU class in all seasons and in all zones
- Calculated **%RCU area** for each class in each geographic zone

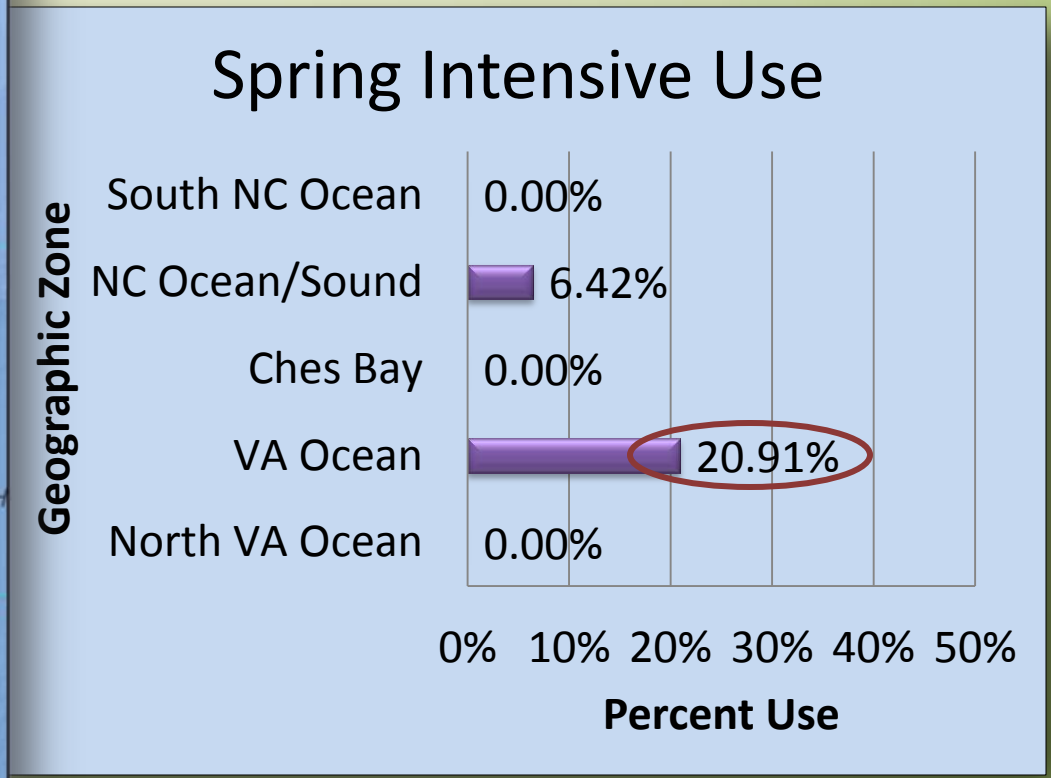
$$\frac{area\ of\ seasonal\ use\ class}{area\ of\ total\ home\ range} = \%RCU$$

Results

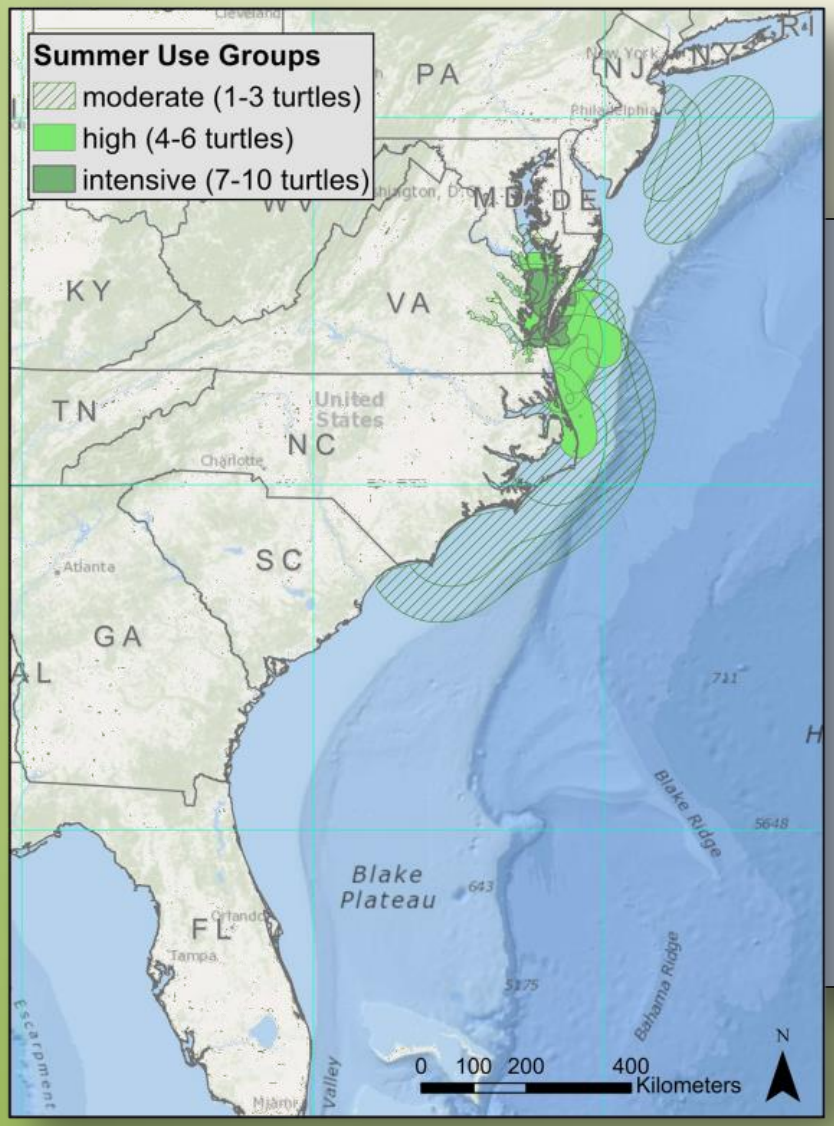


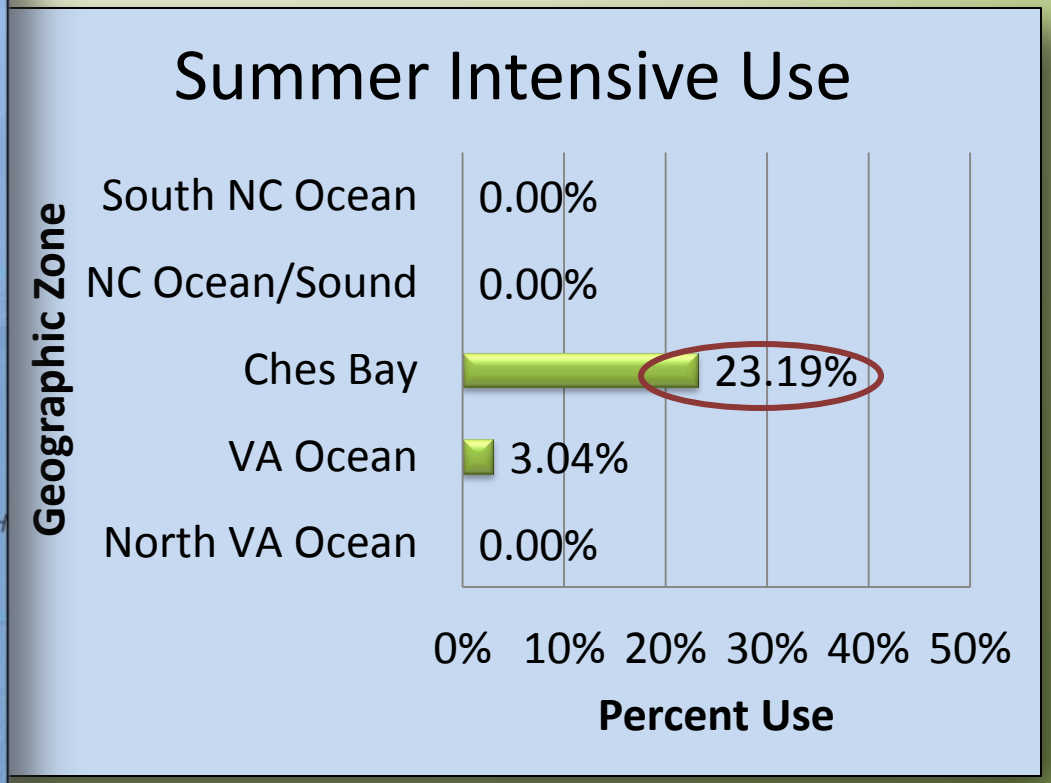
Results - Spring RCU (10 turtles)



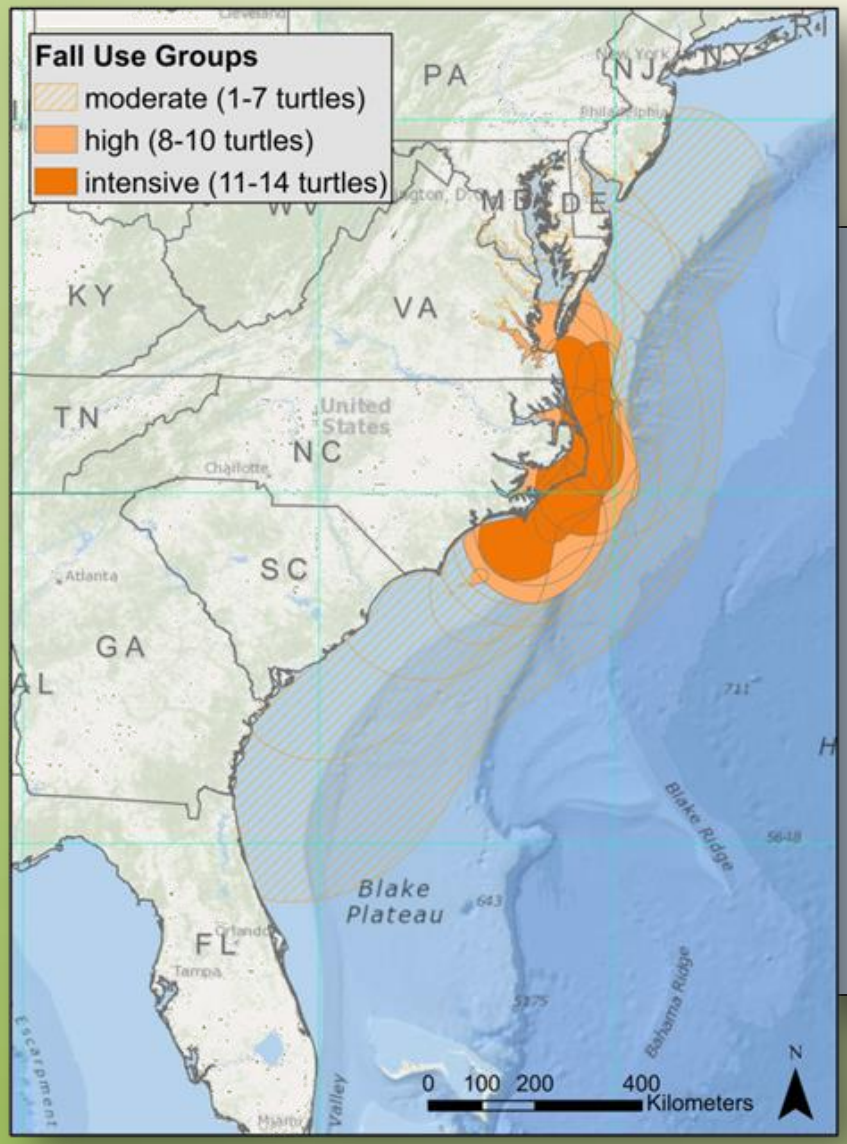


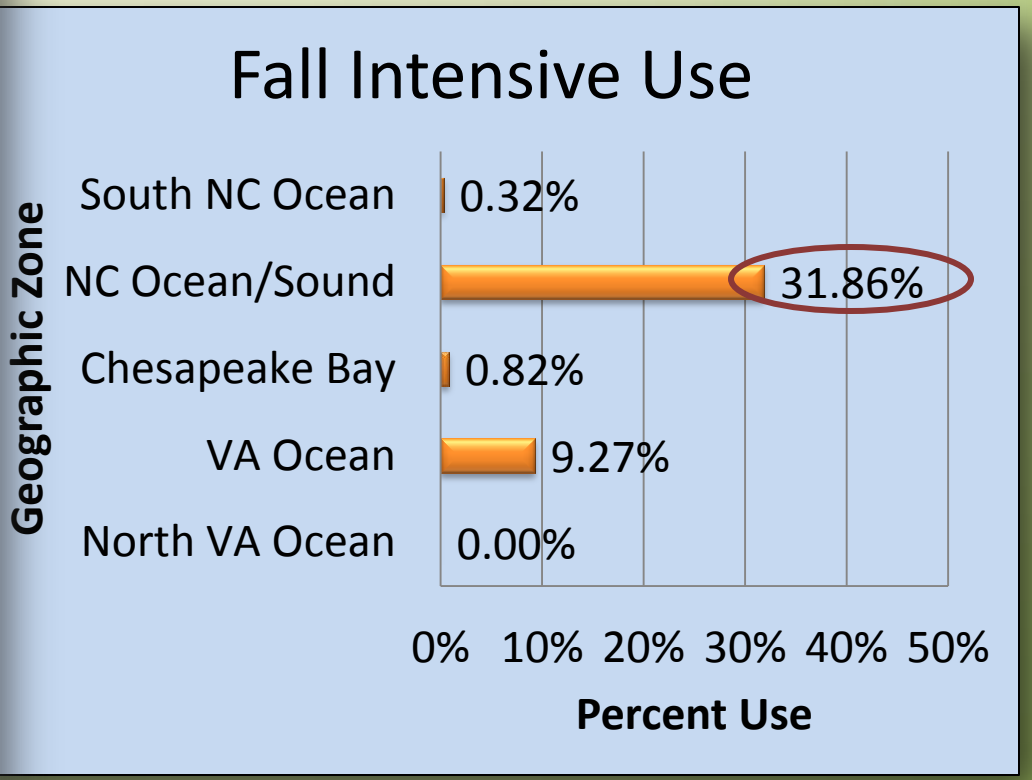
Results - Summer RCU (18 turtles)



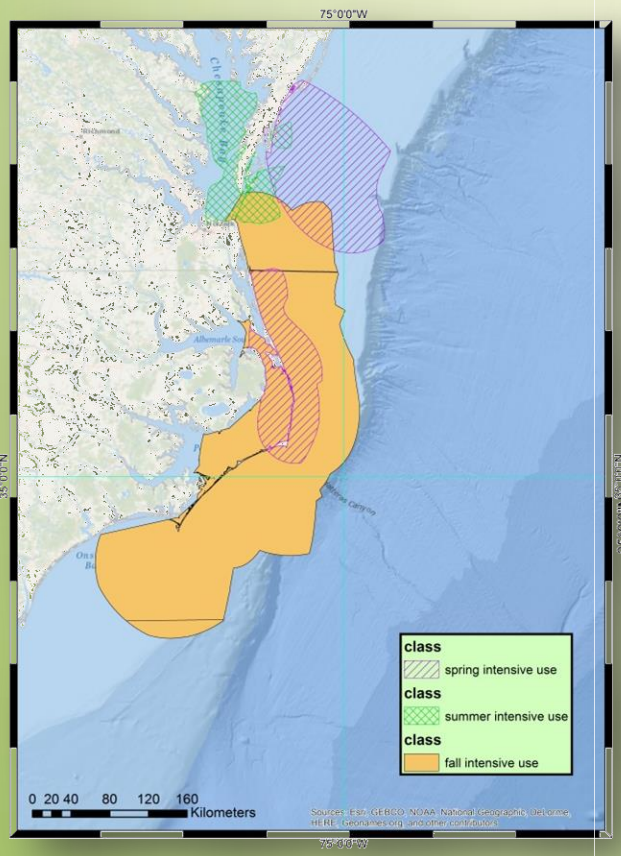


Results - Fall RCU (15 turtles)

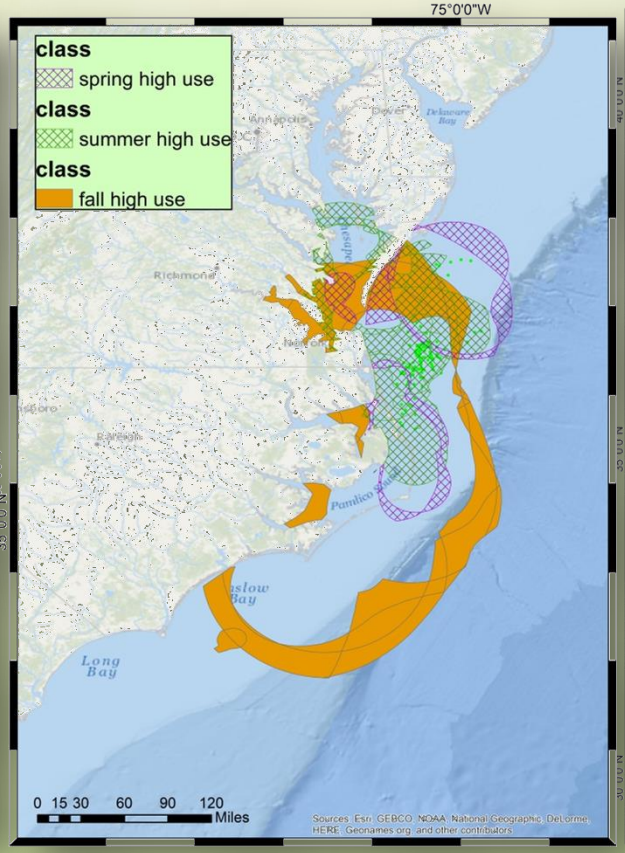




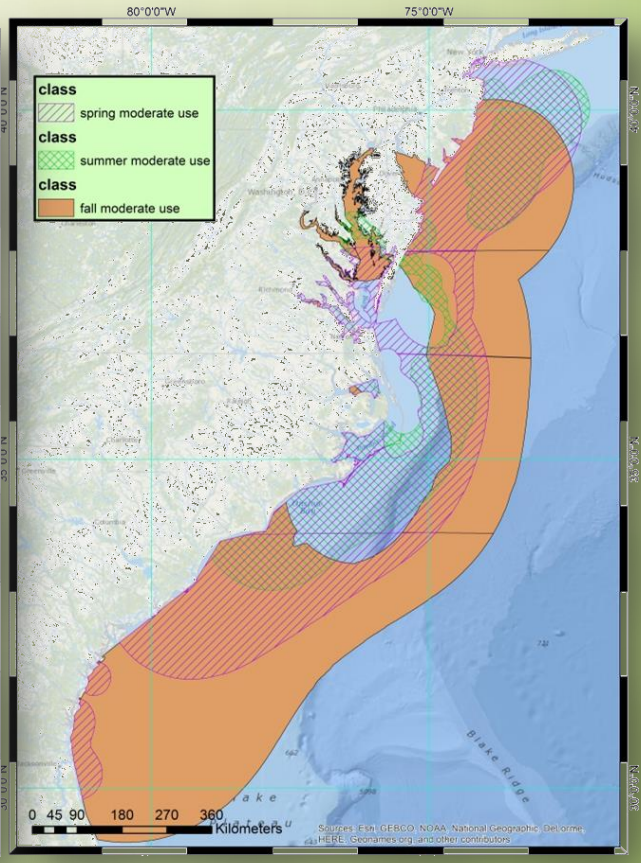
What About Moderate & High RCU Areas?



Intensive RCU Areas



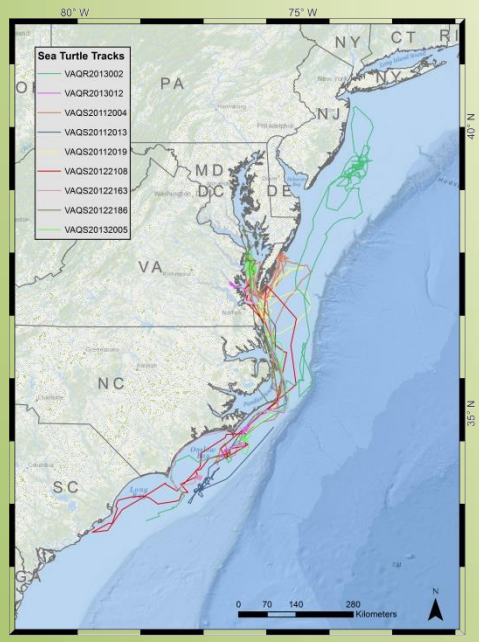
High RCU Areas



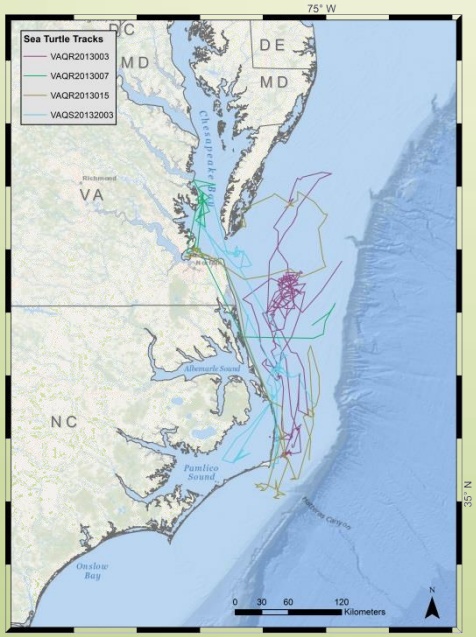
Moderate RCU Areas

Four Overwintering Categories

17 loggerheads

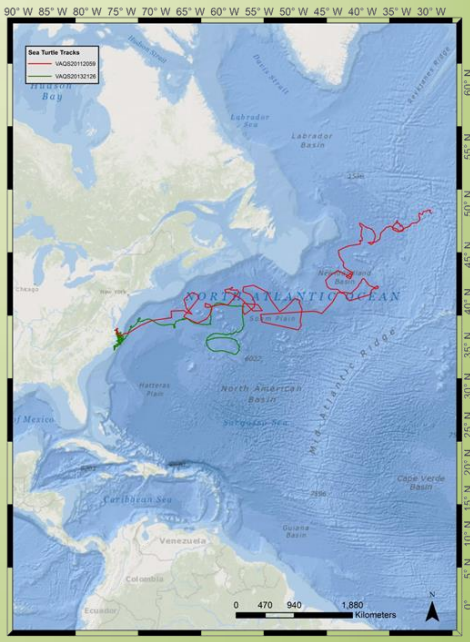


VA to Onslow Bay, NC (n=9)



VA to Offshore, NC (n=4)

VA to Florida (n=2)



VA to Gulf Stream (n=2)

*Overwintering data was defined as data from tags that transmitted at least 45 days past the date a turtle left Virginia waters in the fall.

Conclusions – Cumulative Home-Range

- Geographic zone with highest percent of intensive relative use shifted seasonally
- Chesapeake Bay had moderate use in all three seasons
- Cumulative home-range analysis is a practical tool that identifies intensive use areas using telemetry data
- Cumulative home-range analysis a dynamic tool for leveraging telemetry data
- RCU areas can be used to predict times and places of intensive use
- RCU can inform managers who regulate actions that pose significant risk to sea turtles

Next Steps…

- Fine tune and update the model
- Compare rehabilitated and wild-caught RCU areas
- Conduct state-space modeling to identify foraging and migration behavior *(Jonson et al. 2005)*
- Identify RCU areas for foraging behavior using state-space modeling results
- Develop a resource selection model
- Submit geospatial data to NMFS & VDGIF

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