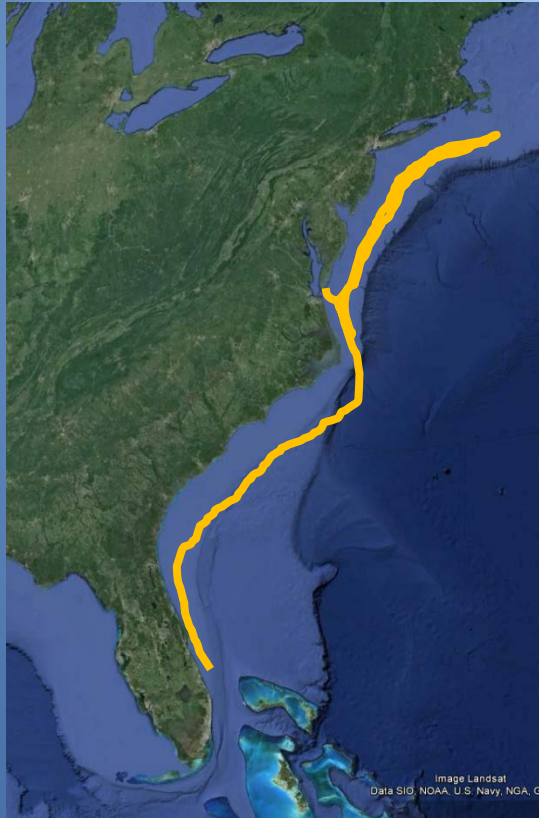


# Tracking Cownose Rays (*Rhinoptera bonasus*) Movement Using Pop-up Satellite Archival Tags

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# Cownose Rays (*Rhinoptera bonasus*)



- **Western Atlantic Population of Cownose Ray**
- **Summer inhabitants of Chesapeake Bay**
- **K-selected traits**



- **Opportunistic benthic feeders (e.g., shellfish)**





# Cownose Rays

Problems with shellfish industry &  
decline of bivalves



Blame placed on cownose rays



Call to regulate cownose rays



# Fishery for Cownose Rays



➤ Population

➤ Habitat use



➤ Movement & migration patterns

# Fishery for Cownose Rays



➤ Population

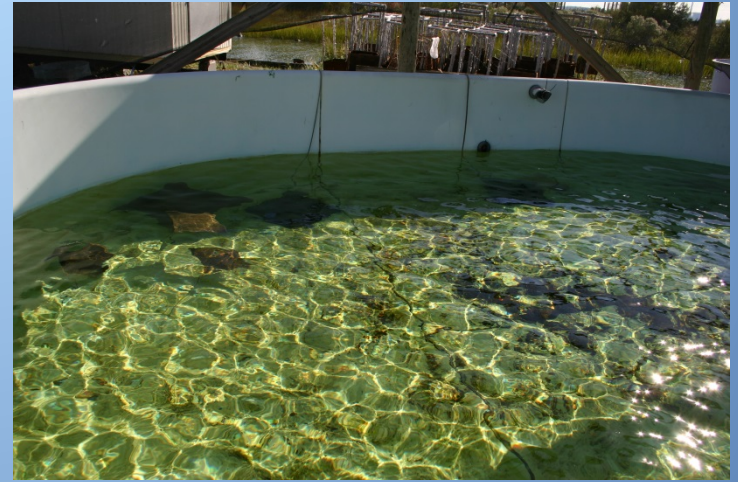
➤ Habitat use

➤ **Movement & migration patterns**





# Methods: Tagging



# Pop-up satellite archival tags (PSATs)



Wildlife Computers MiniPAT

- Programmed release:
  - 90-180 days
  - Constant depth for 72 hrs
  - > 4000 m (2011)
  - > 1700 m (2013)
- Measure:
  - Temperature
  - Pressure (depth)
  - Light-levels (geolocation)

# Tag Summary



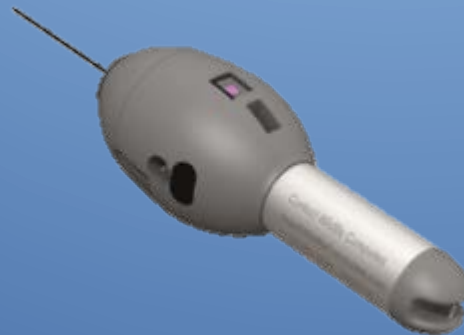
Early release: 9 tags  
(56.25%)

*Musyl et al. 2011: 64.5 %*



Non-reporting: 2 tags  
(12.5%)

*Musyl et al. 2011: 21 %*



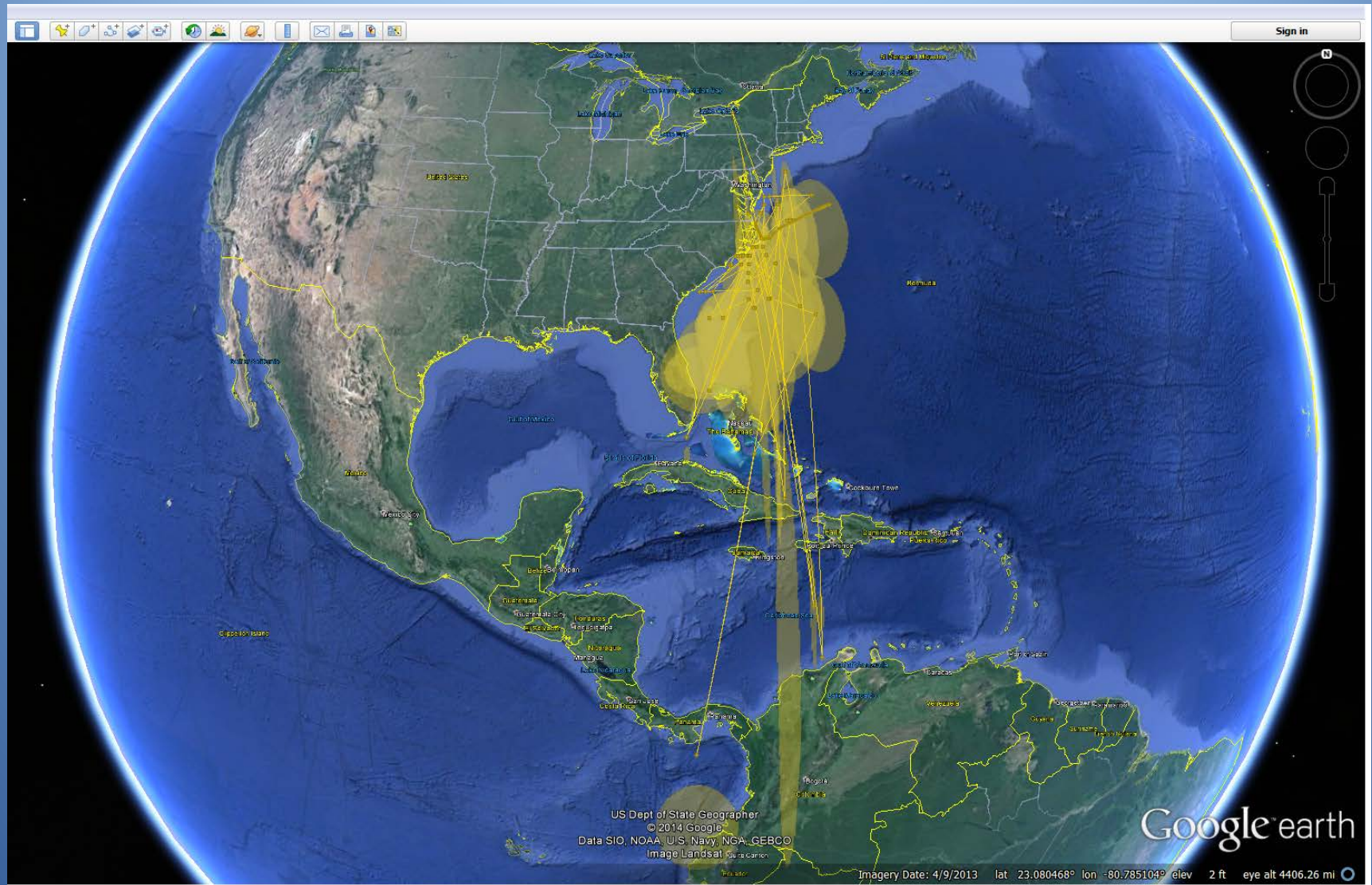
Successful: 5 tags  
(90-150 days)  
(31.25%)

*Musyl et al. 2011: 14.5 %*

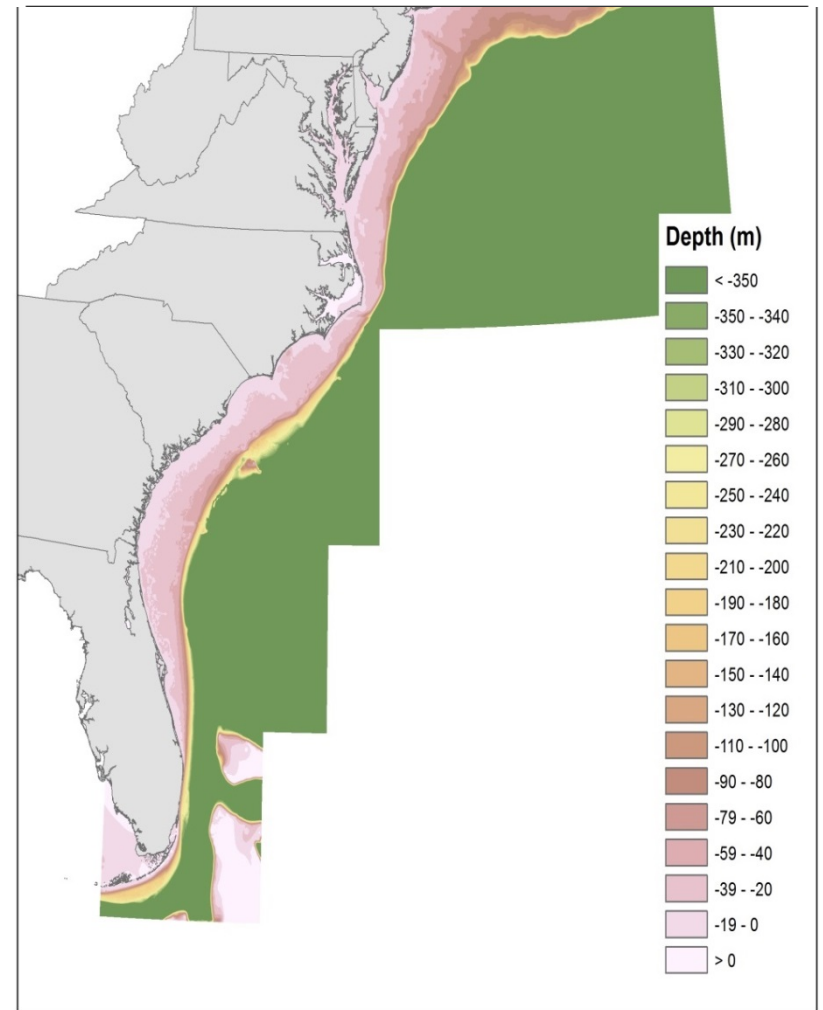
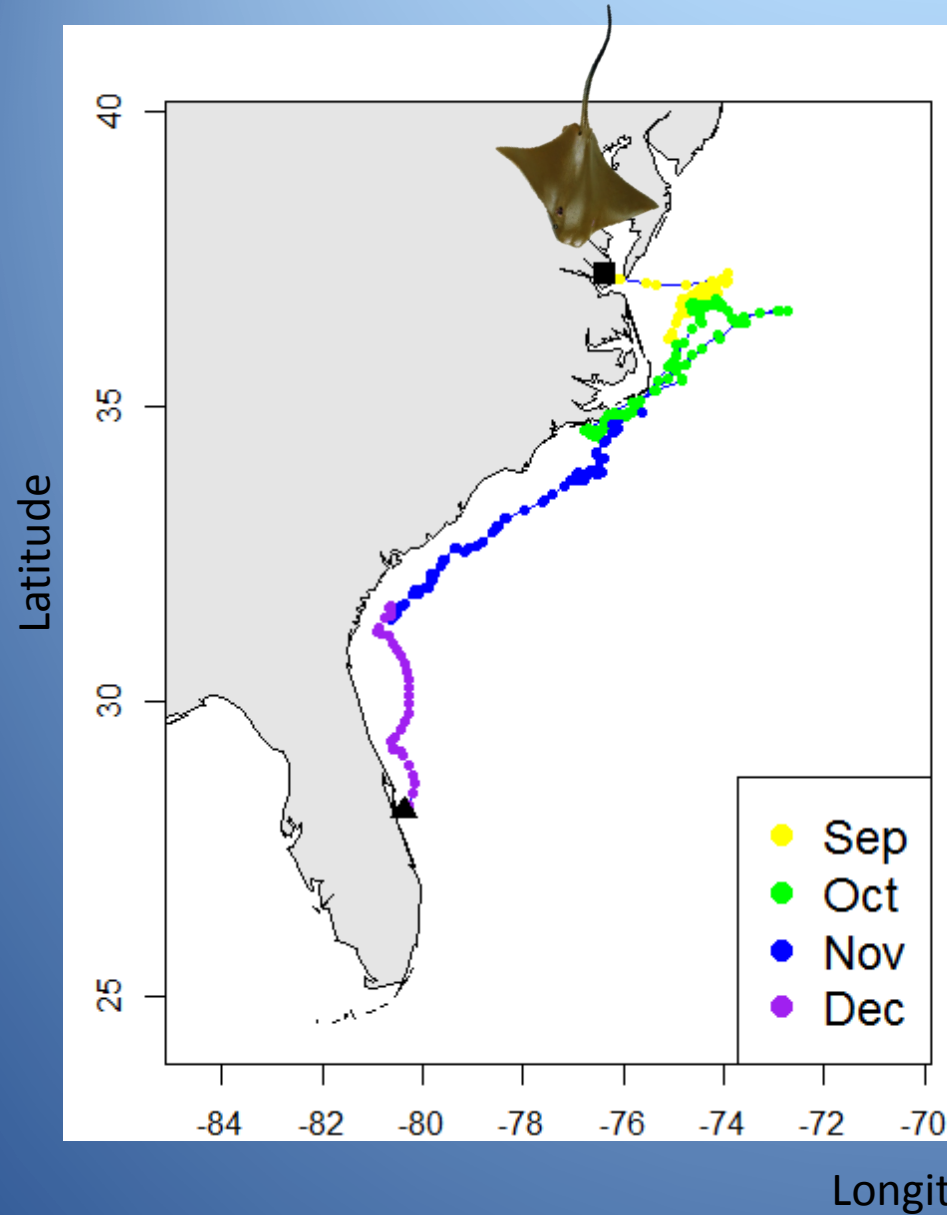


# Tag: 11P0486

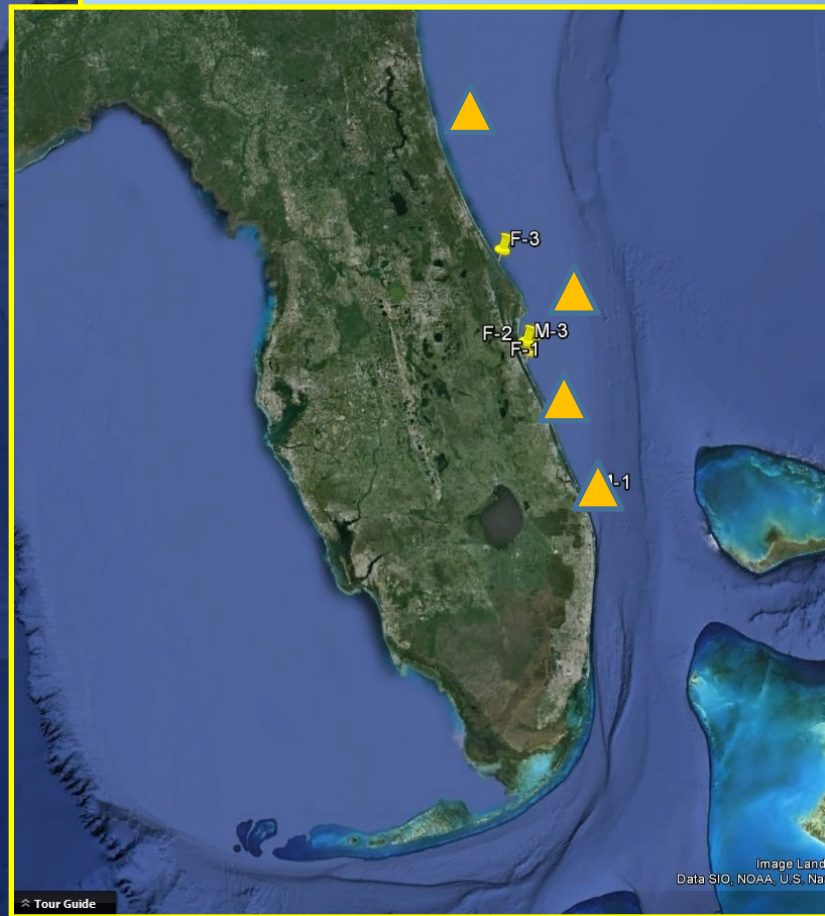
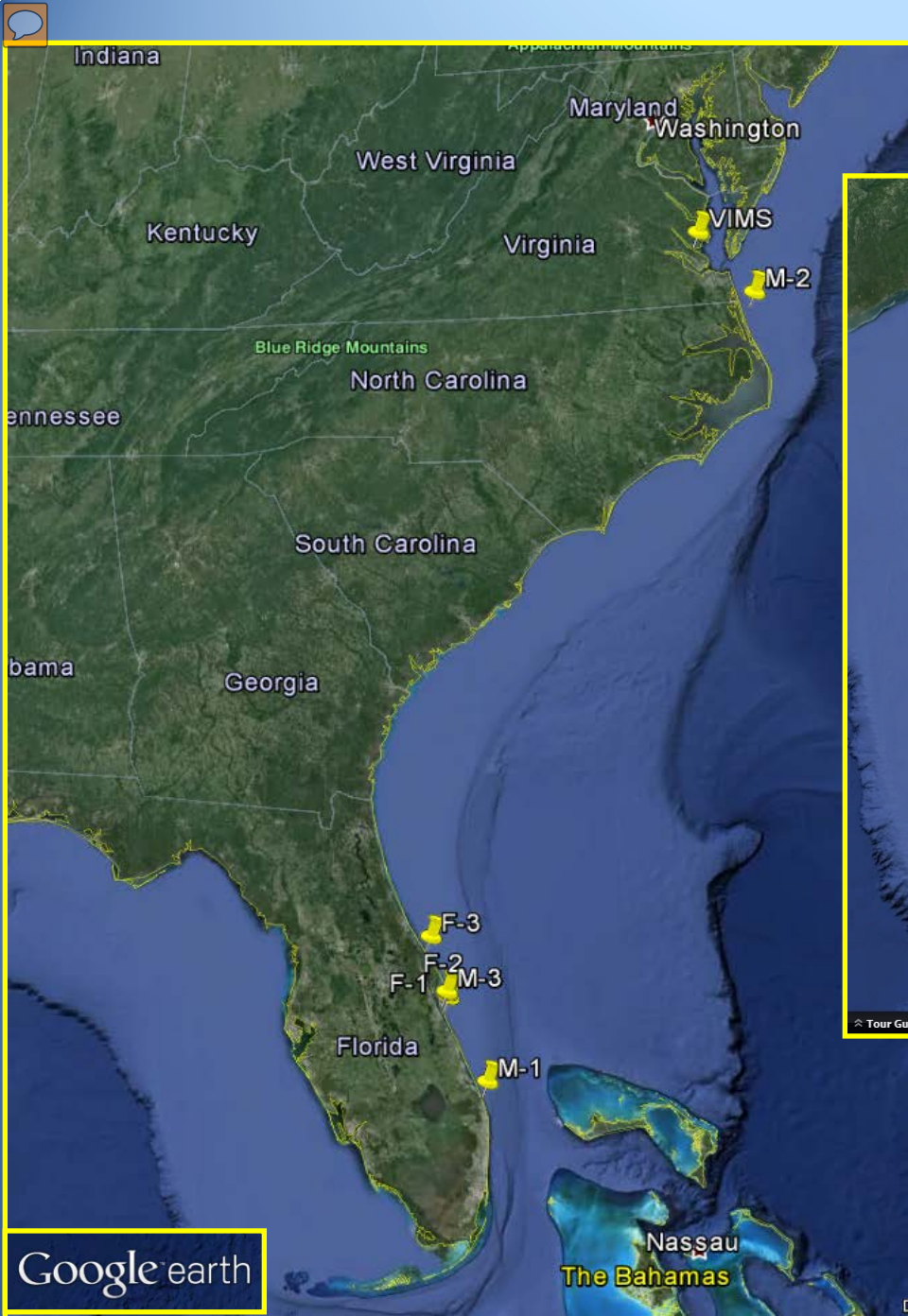
## Geolocation with WC DAP Processor Kalman filter



# Female Cownose Rays



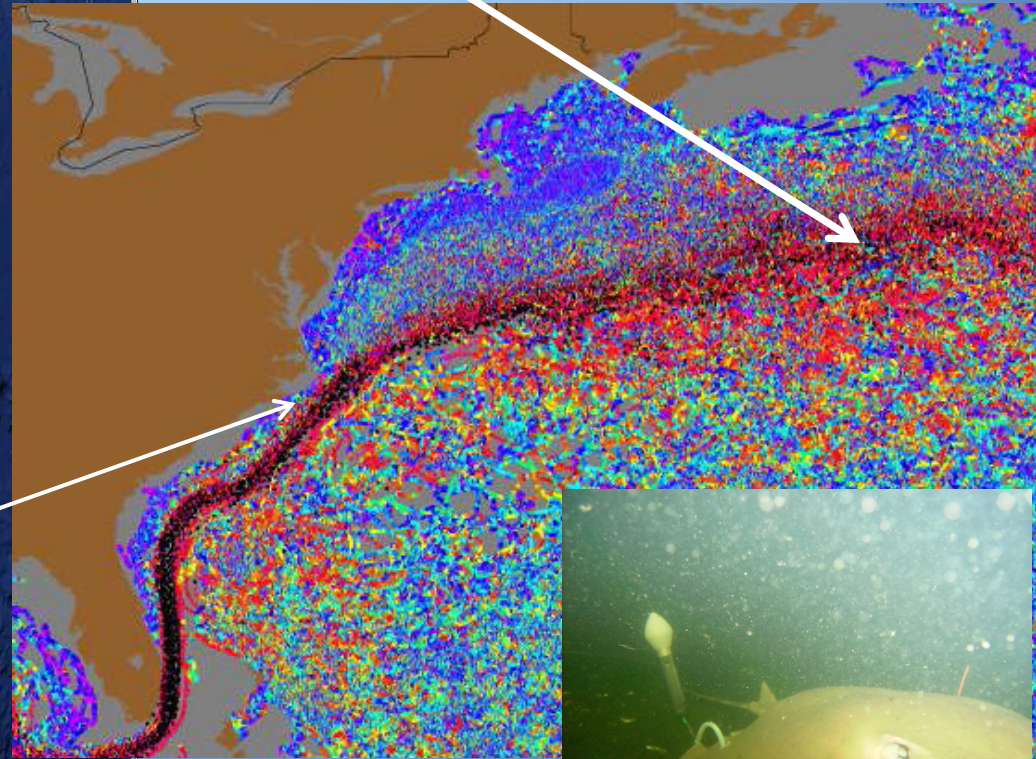
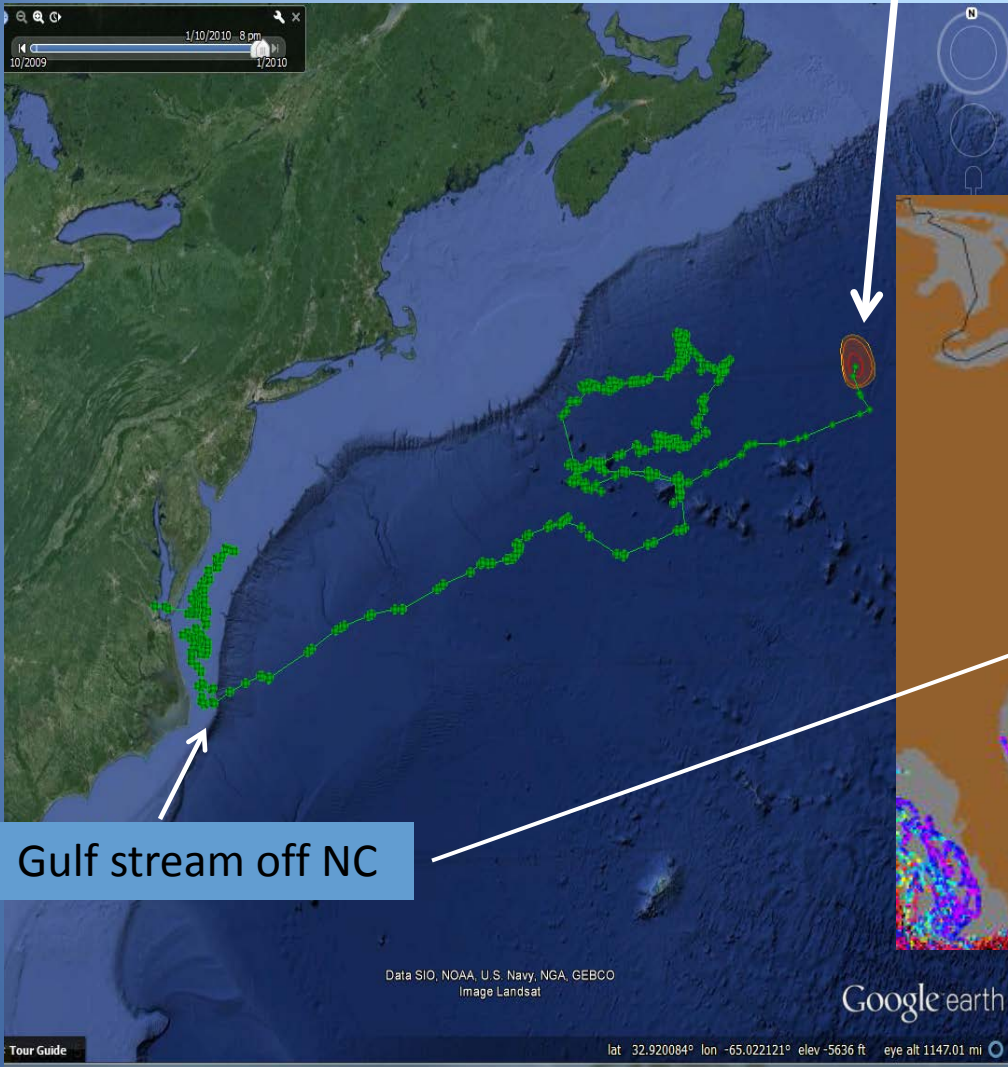




**End Locations →  
Wintering Grounds**



Pop-off location



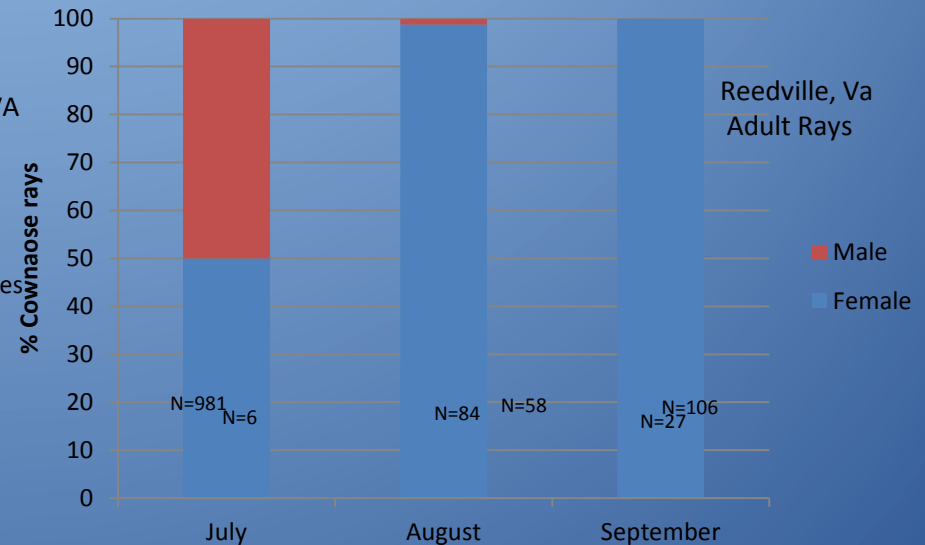
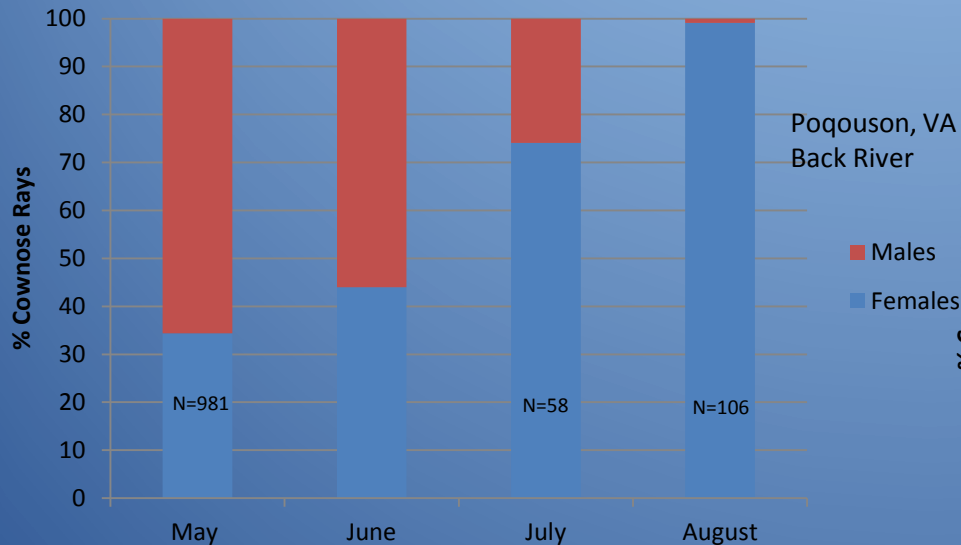
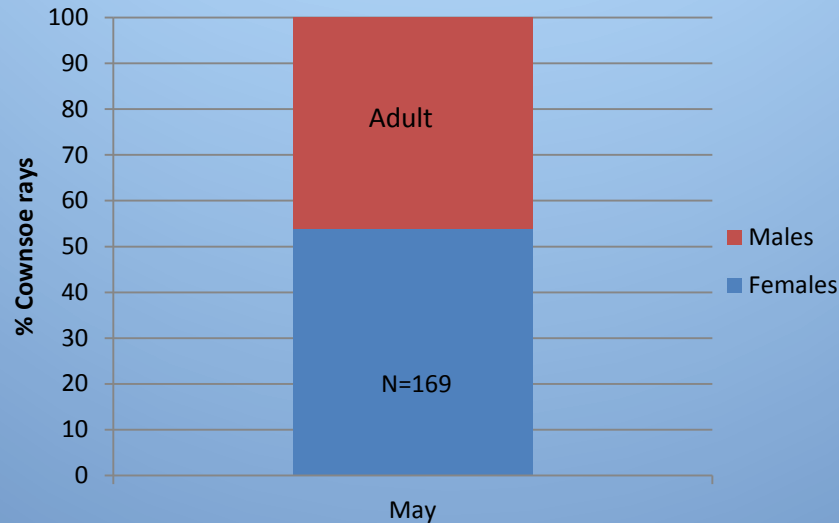
Female cnr track coming out of Chesapeake Bay in October heading south but quickly moves off-shore north-east, tag popped-off when programmed in December. Explanation? Thought is ray was compromised by tagging (large MK10 tag loop through pectoral fin), ventured too far off-shore rounding NC outer banks and was caught in Gulf Stream?

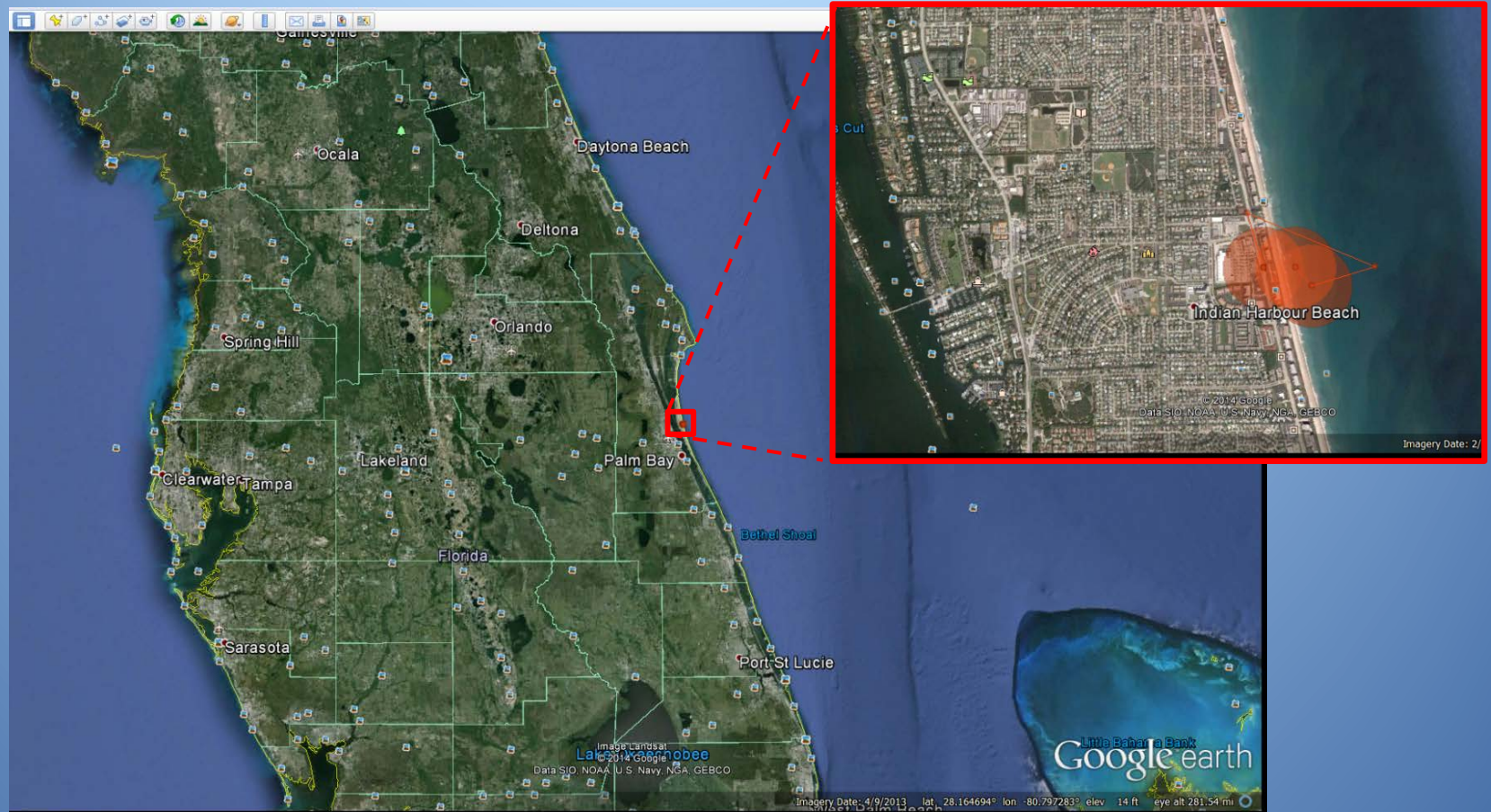


# Where have all the males gone?

A proposal to determine male cownose ray movement after mating in Chesapeake Bay: a potential fishery management concern (VMRC funding)

Cownose Rays enter the bay in May in equal sex proportions, but males separate from females after mating in early July and are not found in near-shore environments throughout the bay

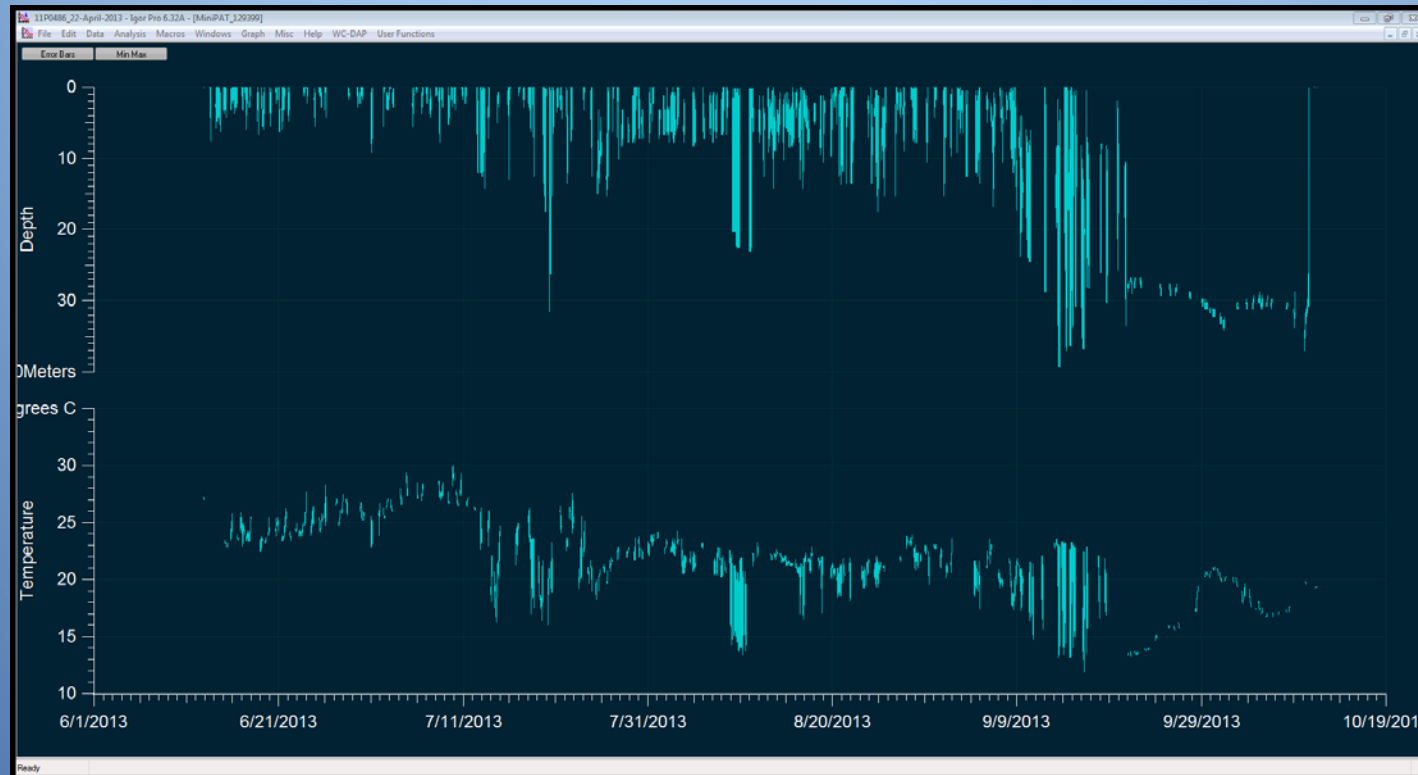




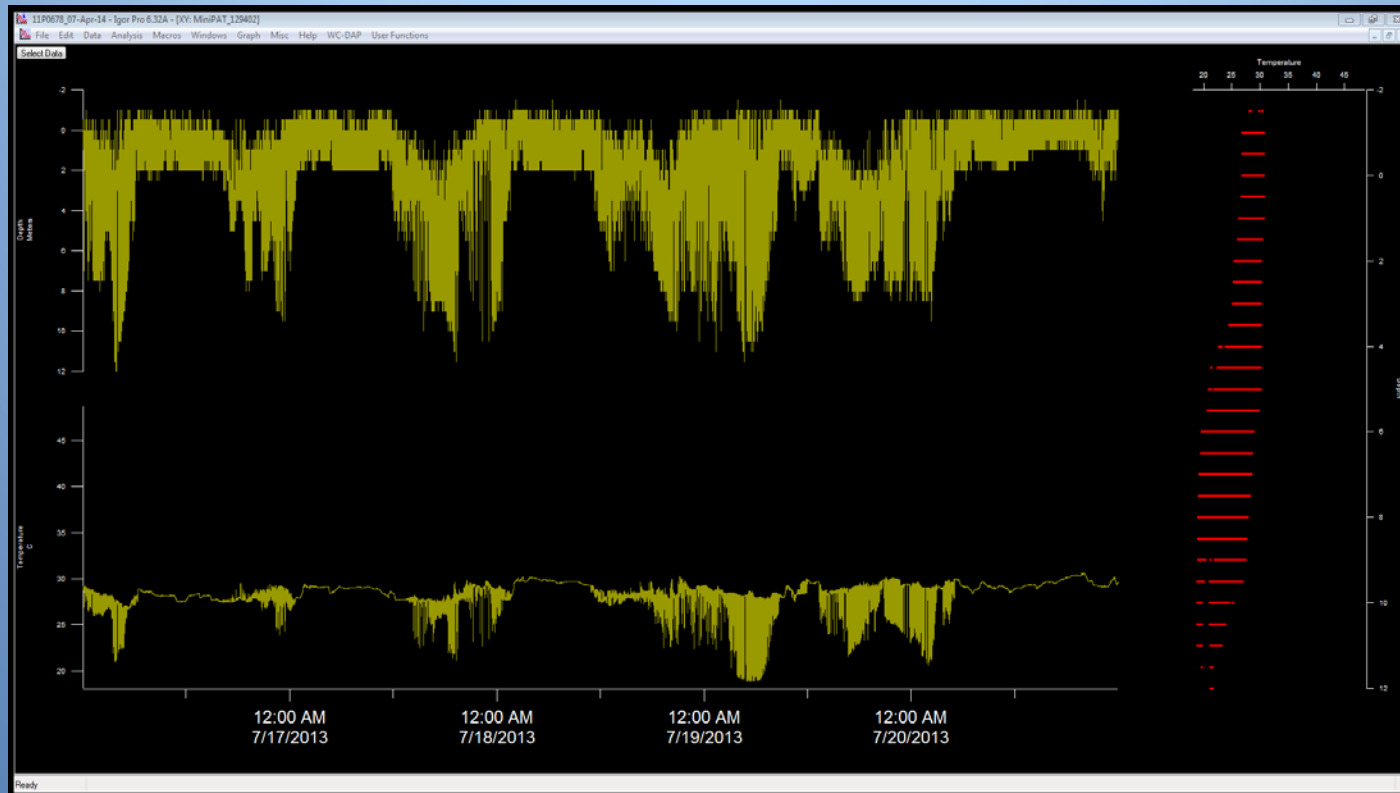
Pop-off location of Tag 11P0827 after 145 days of deployment showing tag located close to shore off Indian Harbour Beach, Florida. Male cnr

First successful tag deployment for male cownose ray (popped-off as programmed) demonstrating same location off central Florida as recorded for females in previous efforts



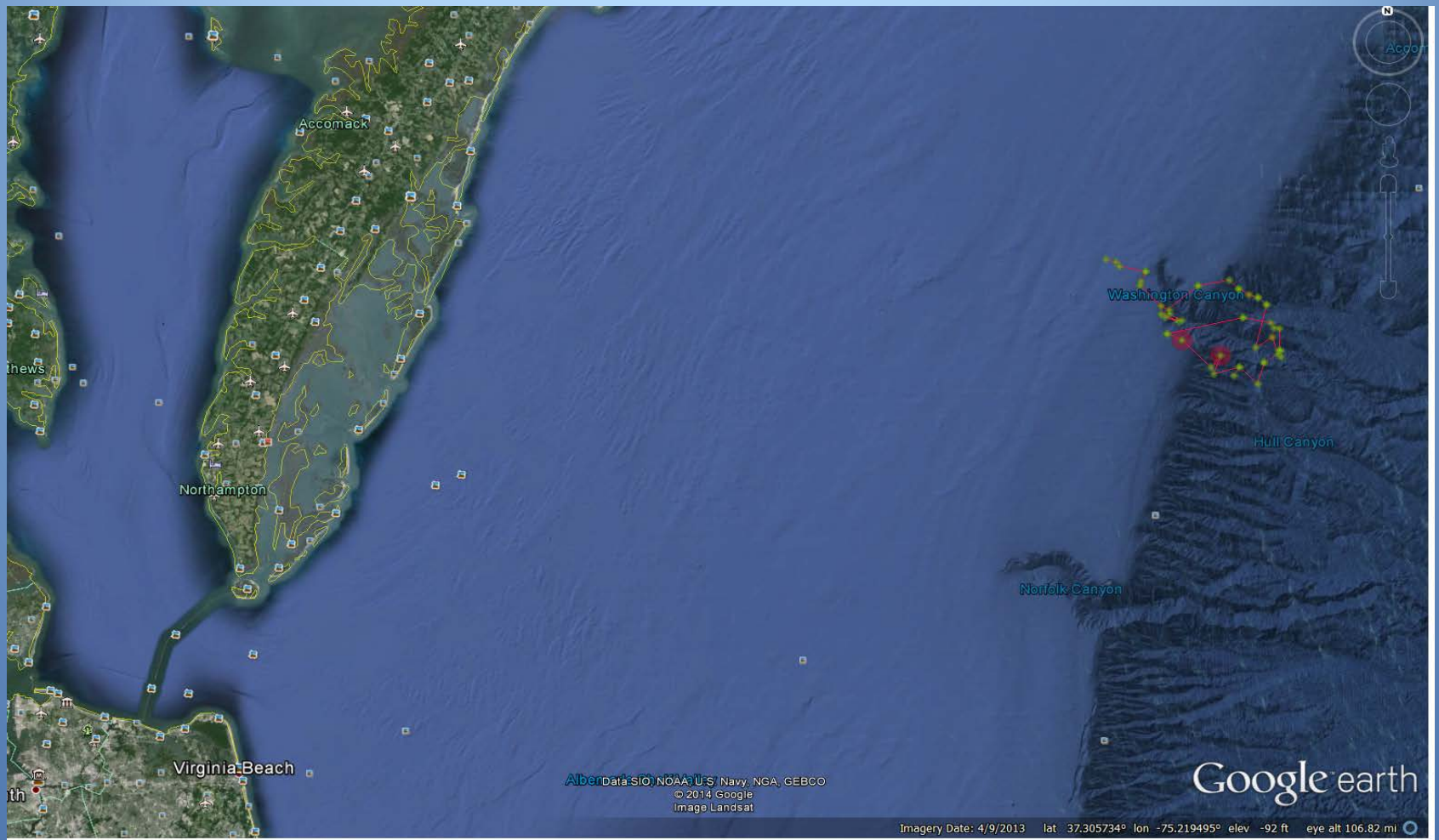


Depth and Temperature data for tag 11P0486 showing 119 days of male cownose ray activity pre (June) and post (early July–September) mating. Note habitat use shift post-mating .



Depth (top histogram) and temperature (bottom histogram) showing male cownose ray daily movement post-mating between water surface and dives to 15 meters.



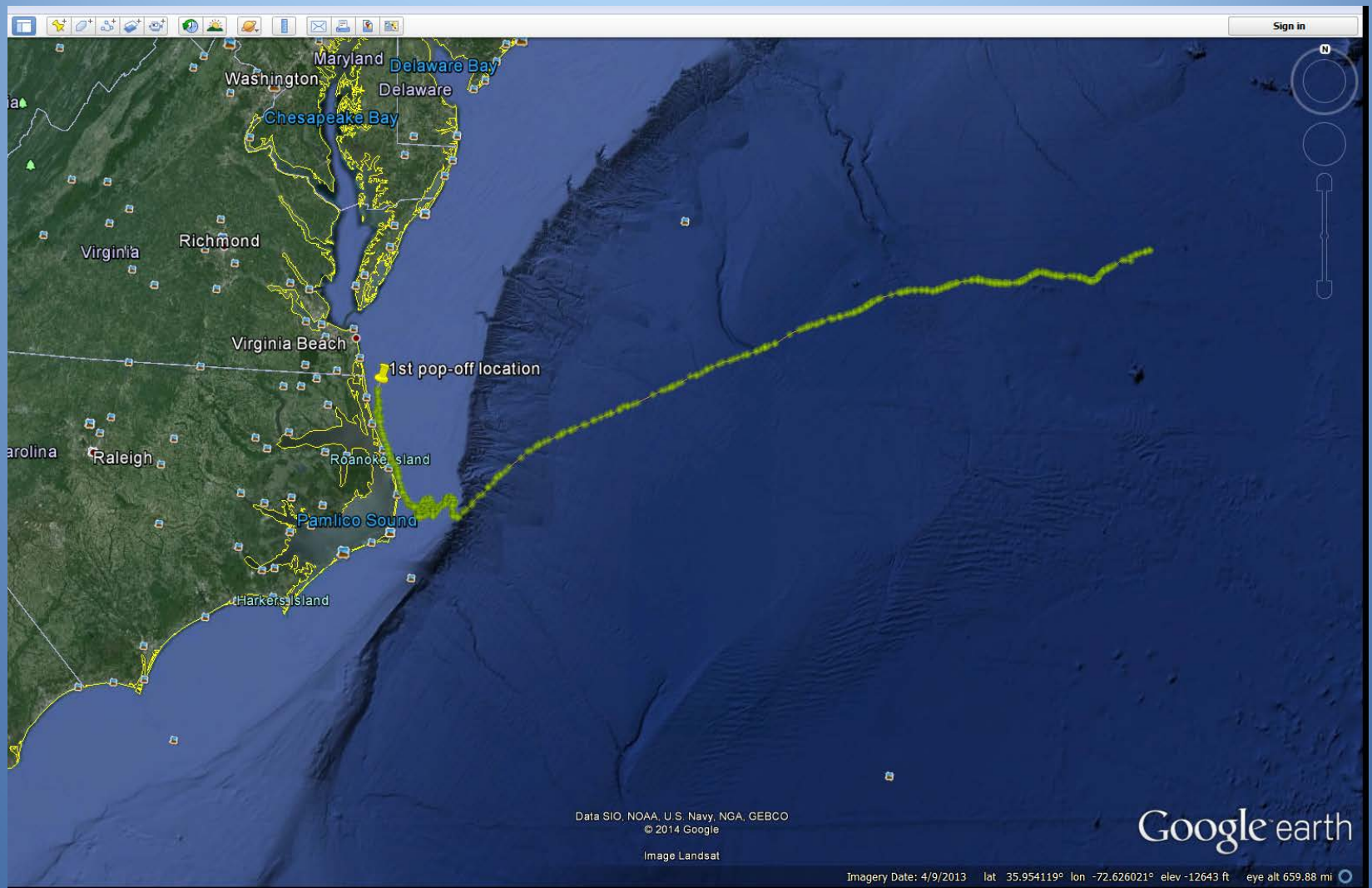


Location of tag 11P0461 July 2013. Male cownose ray when popped-off prematurely; Washington Canyon, ~65 miles off Burton Bay on VA Eastern Shore. Male left Chesapeake Bay after mating.



# Male CNR

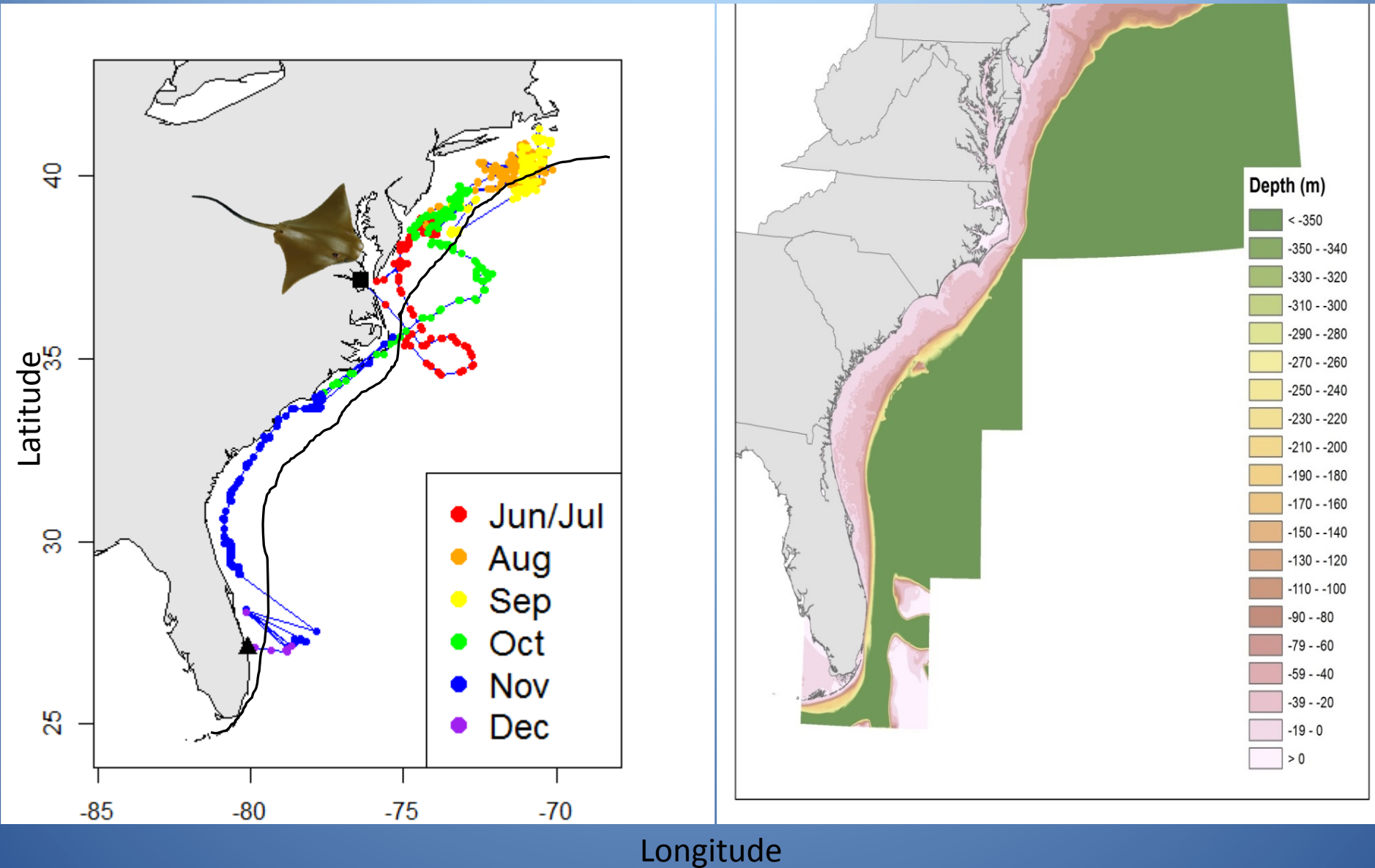
Pop-off Location Oct 15, 2013



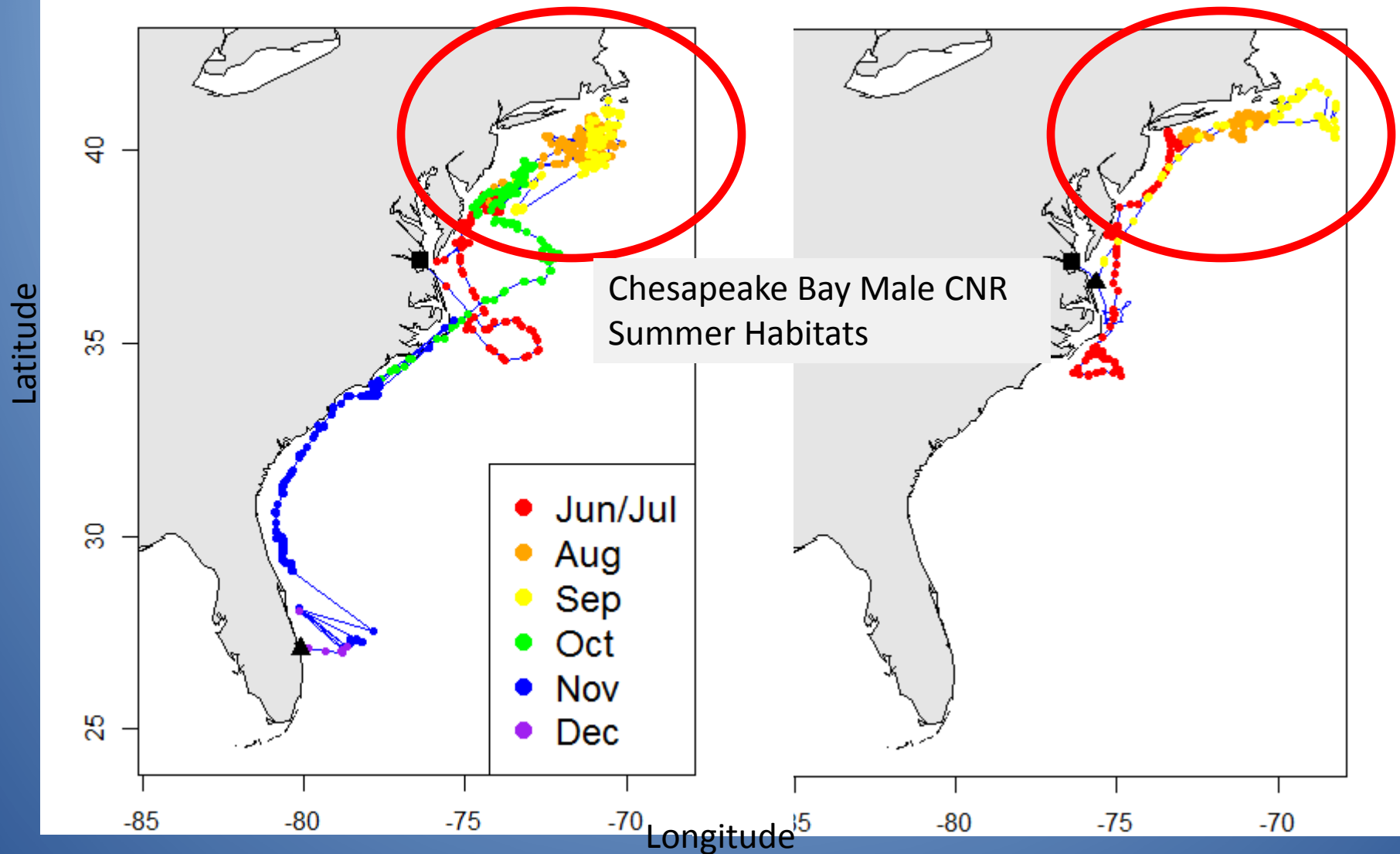
Location tag 11P0486 popped-off (100 day) and drift path along NC coast and then out to sea.



# Male Cownose Ray

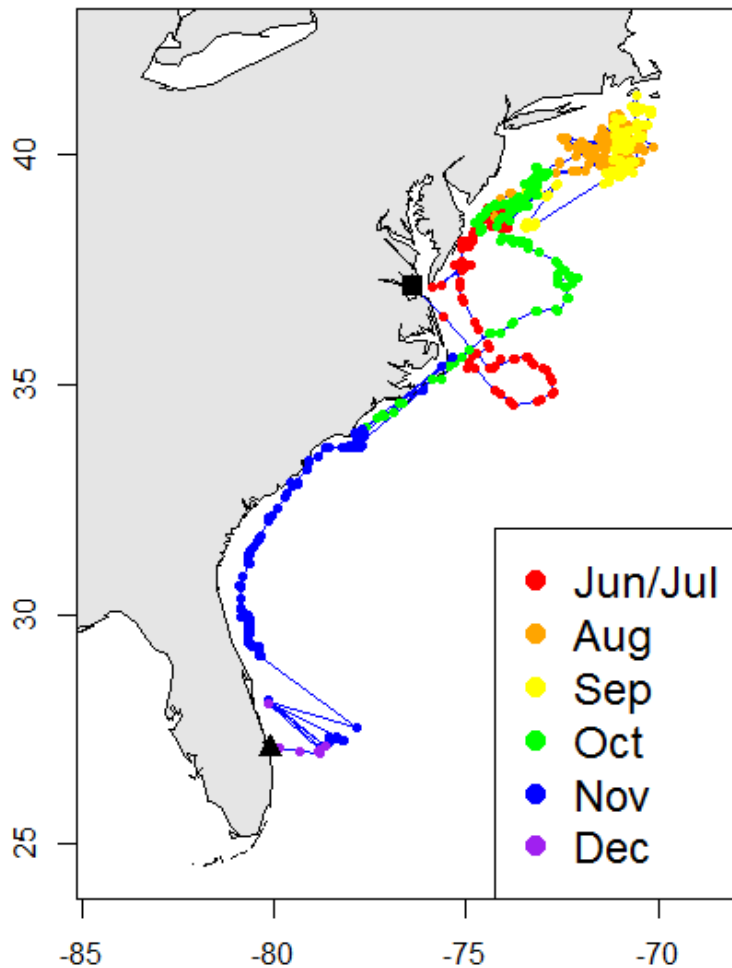


# Male Cownose Rays

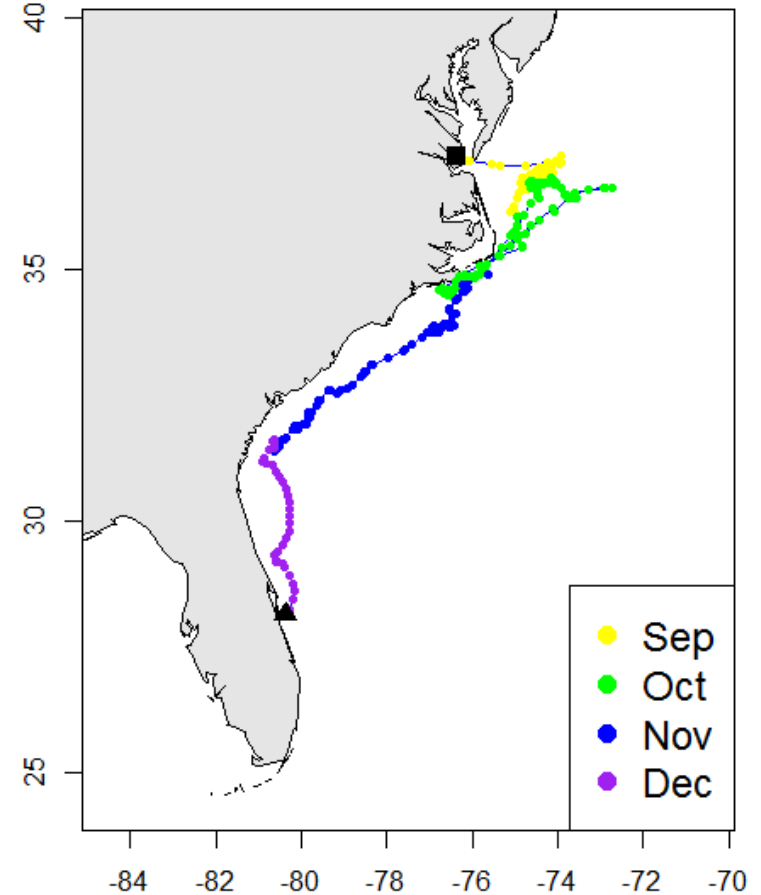




Male CNR

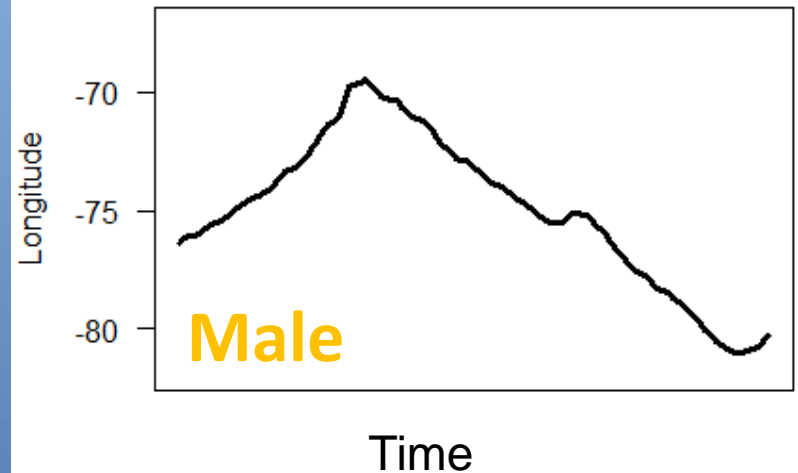
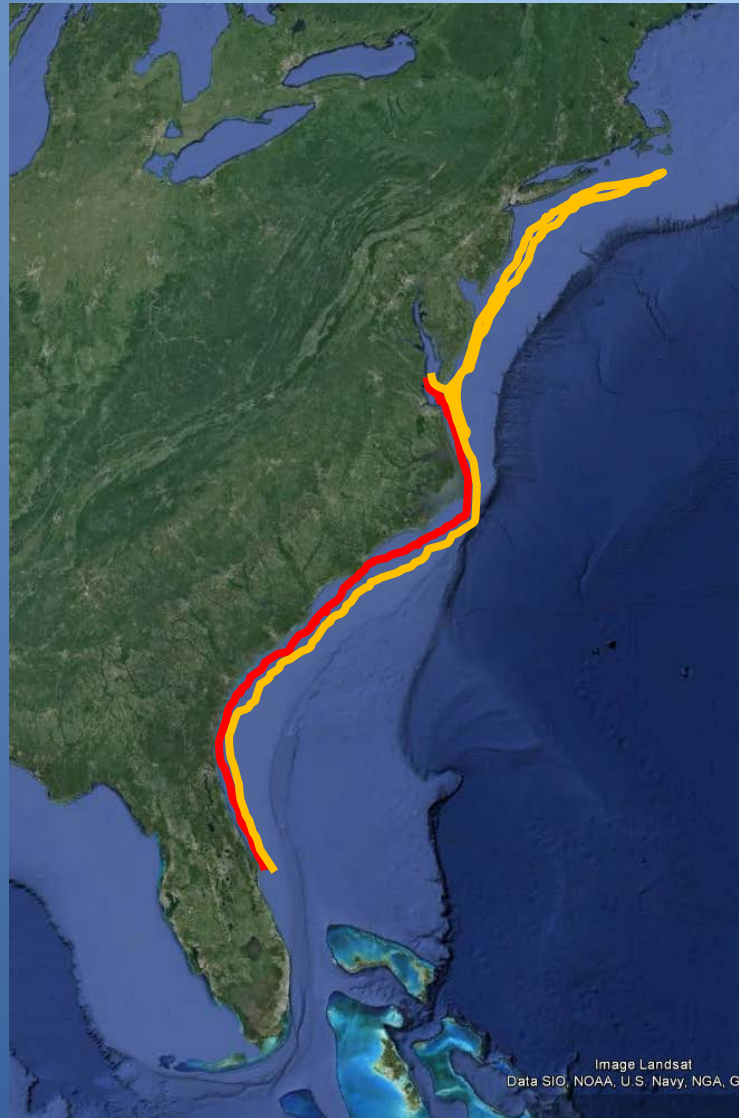


Female CNR



Chesapeake Bay population Re-mix in October outside bay for southern migration together to winter habitat?

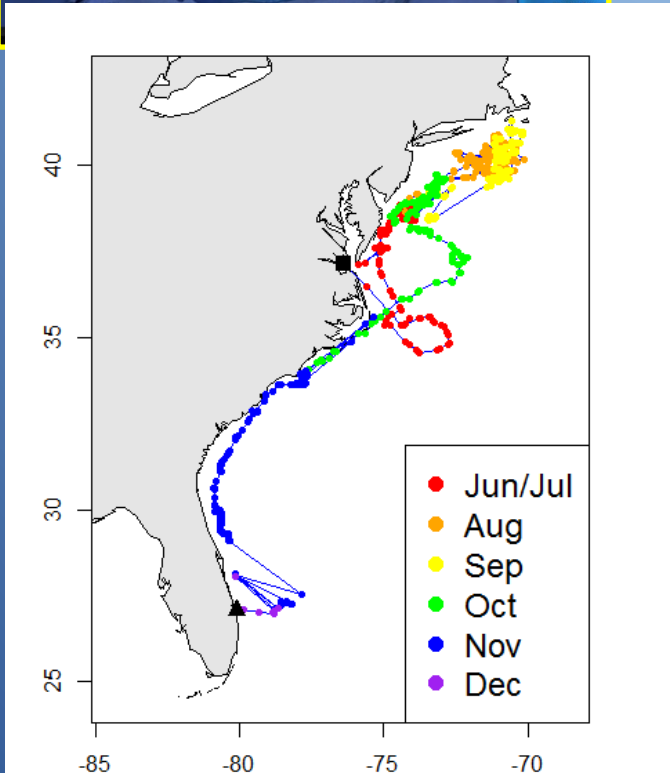
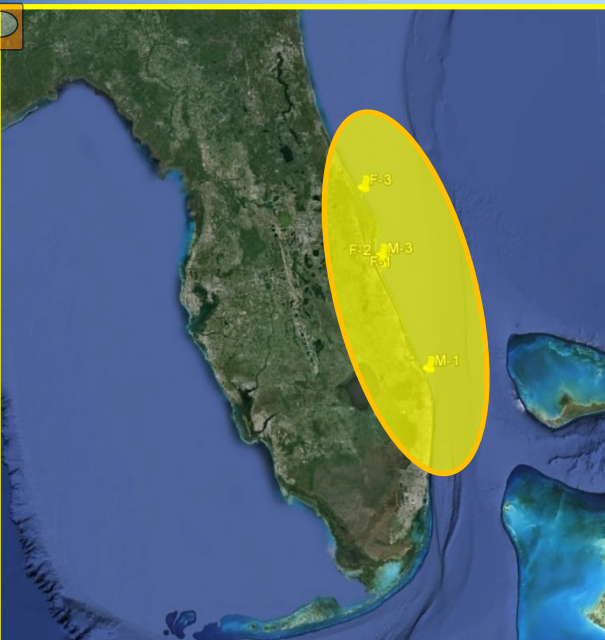
# Longitudinal Analysis





# PSAT CNR Summary

- Wintering grounds for cownose rays that mate in Chesapeake Bay
- Movement patterns for female rays
- Movement patterns for male rays & possible second summer grounds
- PSAT's have not been an effective tool to determine small scale spatial distribution patterns for the cownose rays within the Bay....benefit of acoustic telemetry



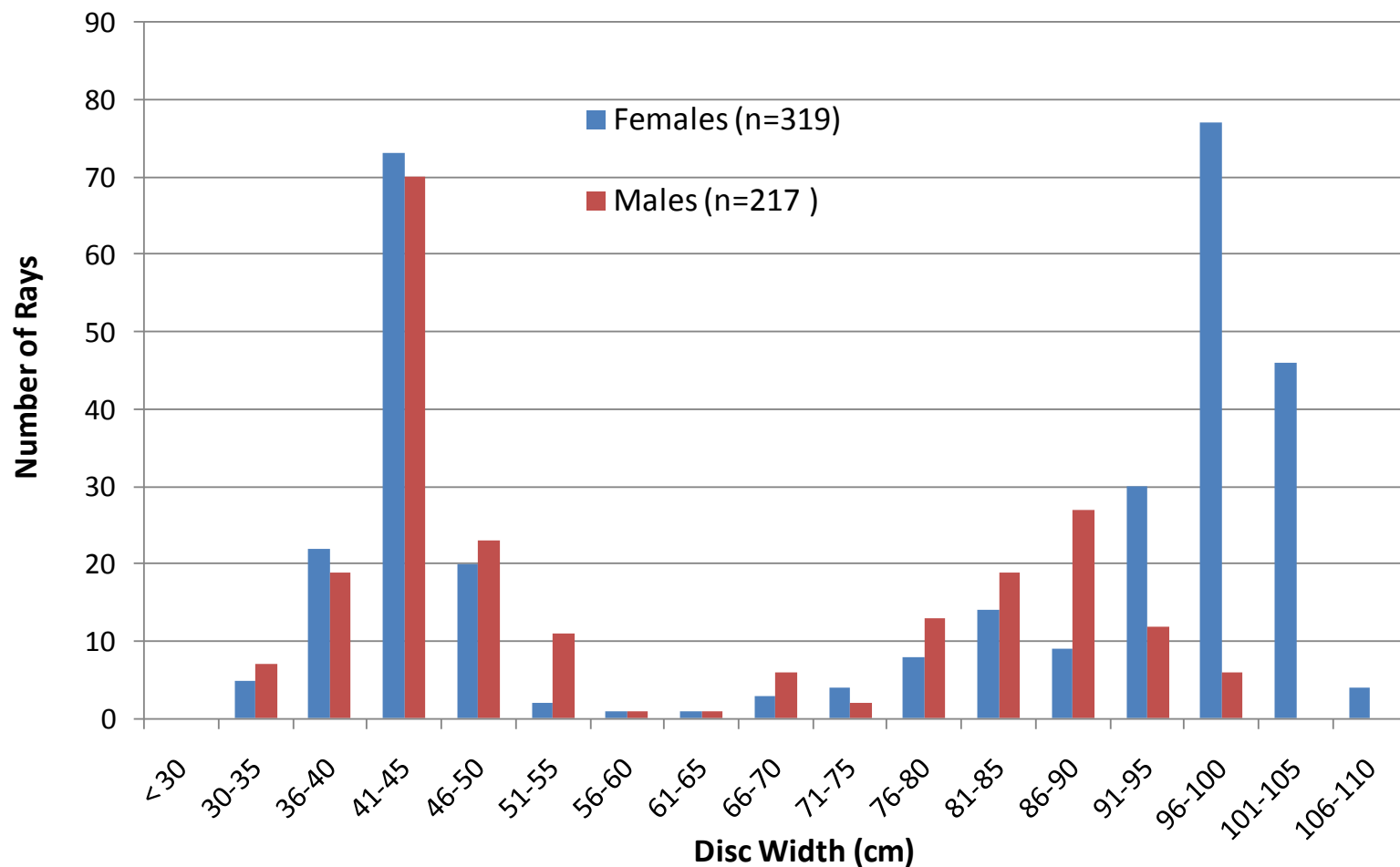


Figure 2. Number and size of cownose rays used for age and growth study.

Where are all the teenagers? If not in Chesapeake Bay,  
what habitat are they using until they mature?  
**Need for telemetry work**