Understanding the Impacts of the Atlantic Sea Scallop Fishery on Loggerhead Sea Turtles: Why Sea Turtles Continue to be Relevant.

FY21/22

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Viking Fresh Viking Village, Inc.

Roger Williams University

Mass Audubon

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RSA Share Day
May 6, 2022

Required RPMs to Minimize the Impacts of the Sea Scallop Fishery on Sea Turtles

- Identify where interactions with scallop fishing gear occur
  - Geographic areas or conditions (RPM #2)
  - On the bottom versus within the water column (RPM #2)
- Quantify the reduction of serious injuries/deaths with chain mats and TDDs (RPM #4 and 5)
- Minimize stress and improve survival rate of turtles that are taken by the scallop fishery (RPM #4 and 5)
- Determine if anticipated impacts have occurred or been exceeded (RPM #4 and 5)
- Continue developing tools for population assessments (RPS #7)

Sea Turtle Ecology Research

Methods to address RPMs

- **Satellite telemetry deployments during the migratory phase of the North Atlantic foraging population (RPMs #2 and #7)**
- **In-water videography through ROVs and GoPros (RPMs #2 and 7)**
- **Biological and morphometric sampling (RPMs #4 and 5)**
- **Habitat assessments – *Sargassum,* jellyfish and plankton sampling (RPM #2)**

Sea Turtle Ecology Research

Fulfill RPMs

Fulfill Nematode Priority

Annual Goals:

1. Collect samples from a minimum of 20 loggerhead turtles caught at-sea.
2. Document seasonal distribution of loggerhead turtles within the MAB for transmitters functioning during the funding year.
3. Identify presence/absence of nematode parasite in lavage samples.
4. Use videography to document potential prey species.
5. Expand database of loggerhead turtle biology and ecology to be used by management.

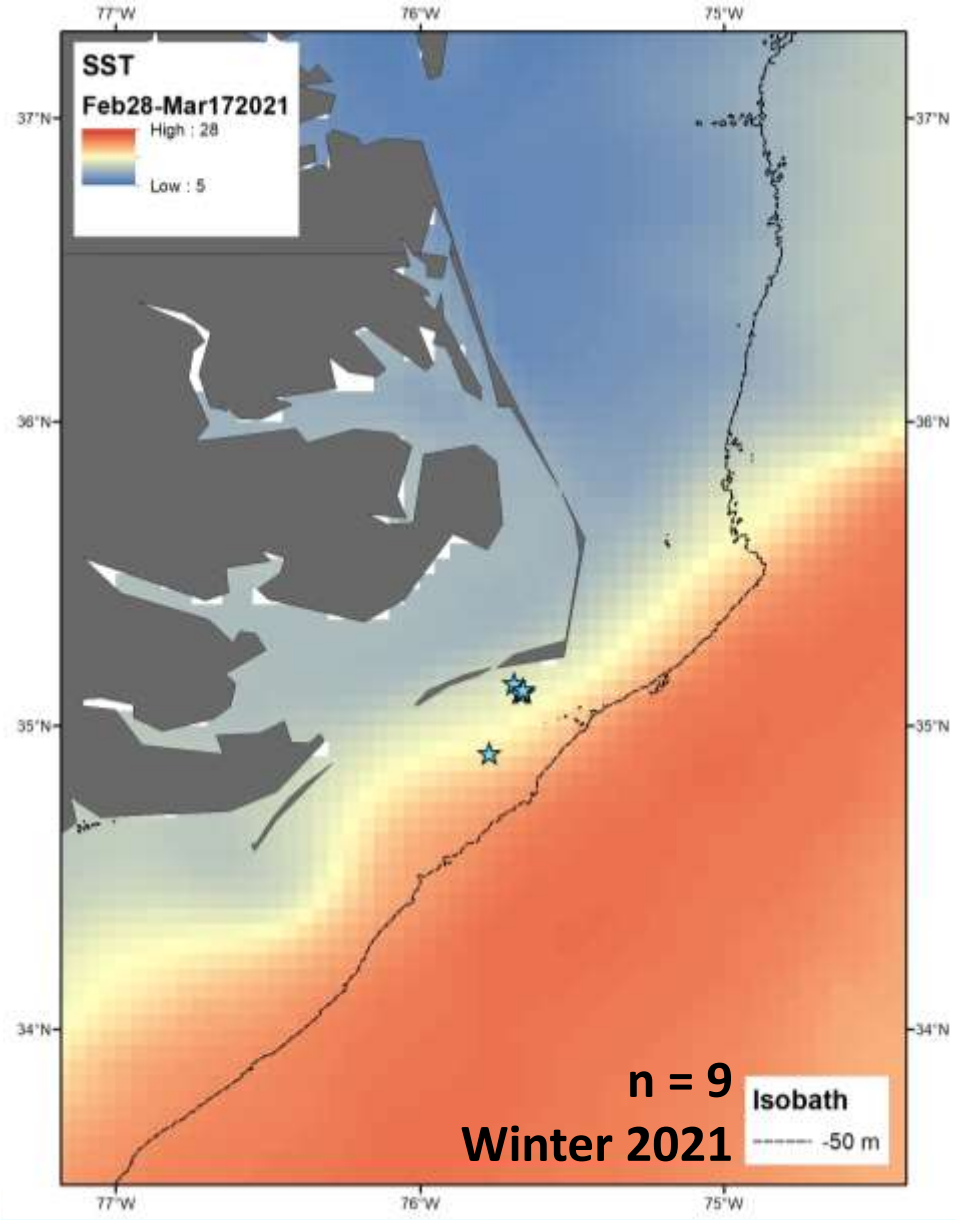
Programmatic goals: (long term, require multiple years of funding)

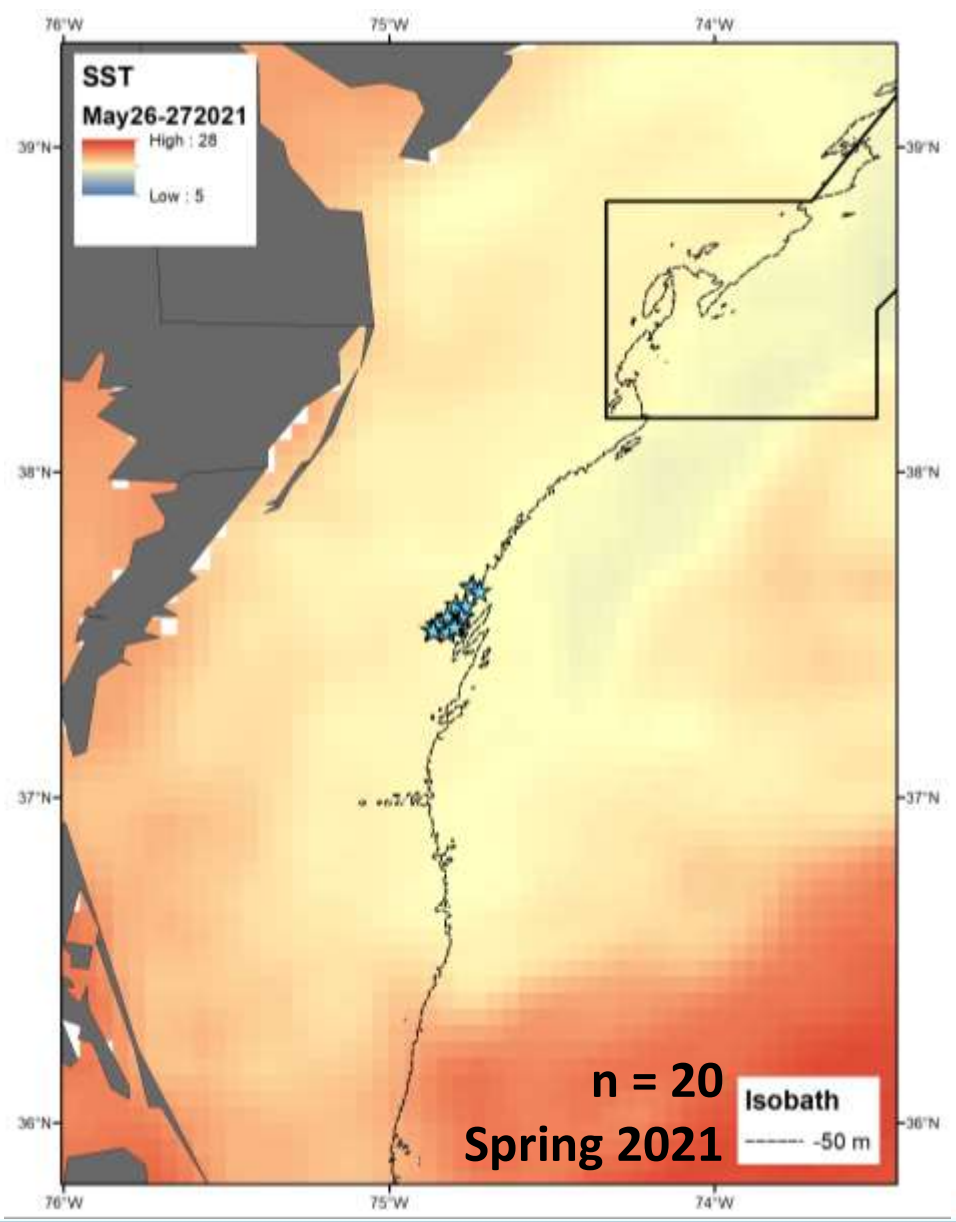
1. How do latitudinal distributions change seasonally? Interannually?
2. How much time do they spend on bottom compared to time spent on the surface?
3. Is there a difference in spatiotemporal distributions based on demographics or morphometrics?
4. Do turtles display site fidelity to foraging areas?
5. How is behavior changed by water temperature?
6. What are the primary prey species and does this impact parasite load?
7. Do oceanographic features impact migratory patterns?
8. How will climate change alter the environmental parameters (temperature, chlorophyll concentration and oceanic currents) impacting loggerheads in this region?

Sea Turtle Sampling

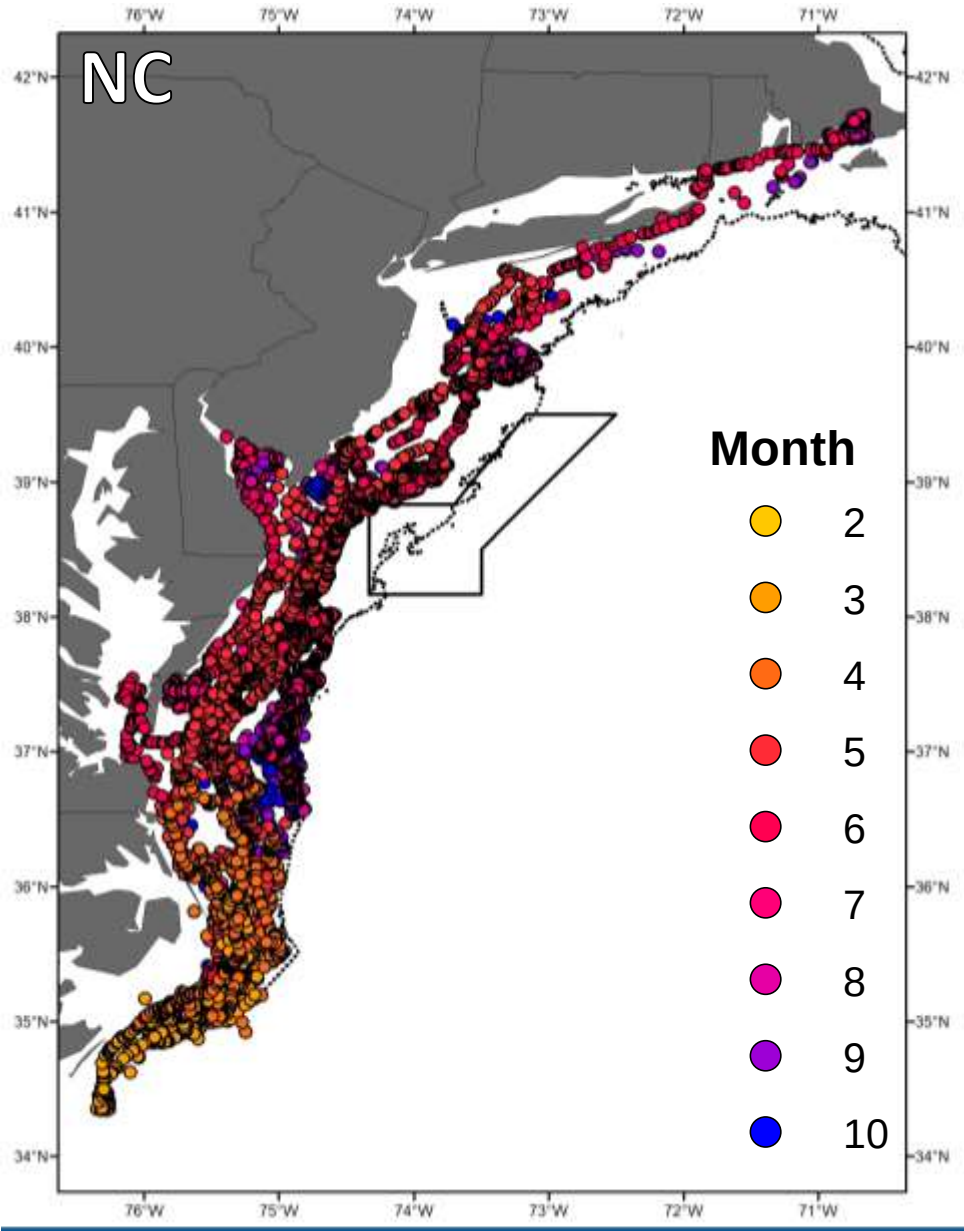
Samples Taken Per Turtle	Purpose	Relevance to Scallop Fishery
Morphometric Measurements (shell size and tail length)	To determine size and life stage of each turtle	TDD and turtle chain specifications, correst size for turtles within the region? (RPM#1) Demographic information for population estimates (RPM#7) Calculating Body Condition Index (BCI) (RPM#2)
Blood Sample (12 ml)	Health status, hormone levels (gender), stable istotope values, genetics	Are turtles eating scallops? (RPM#2) Population health and stress levels (RPM#3, 4 and 5)
Skin Sample	Genetics, stable isotope values	Have turtles been eating scallops? (RPM#2) Population health and structure (RPM#4 and 7)
Cloacal Lavage	Identify nematode presence gut microbiome	Nematodes and foraging preferences (RPM#2)
Physical Health Assessment	Check for injuries, both new and healed	Sources of injury, including from fisheries interactions (RPM#4 and 5) Relationship with calculated BCI (RPM#2)
Passive Tagging	For population estimates	Population size and distribution -> likelihood of interactions (RPM#7)
Body Temperature	Health status	Baseline for healthy turtles to improve survival of incidentally taken turtles (RPM#4 and 5)

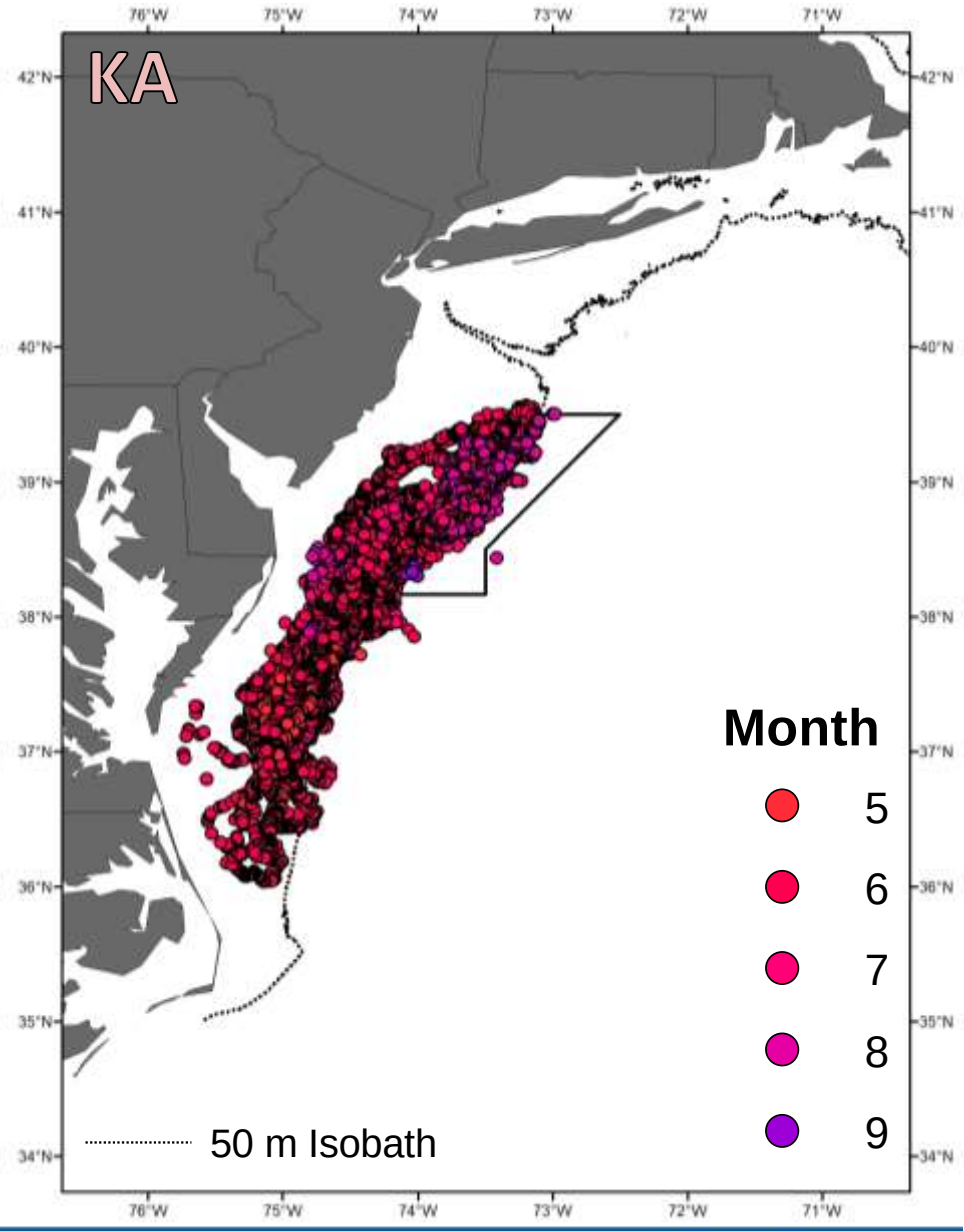
2021 Sat Tag Deployments



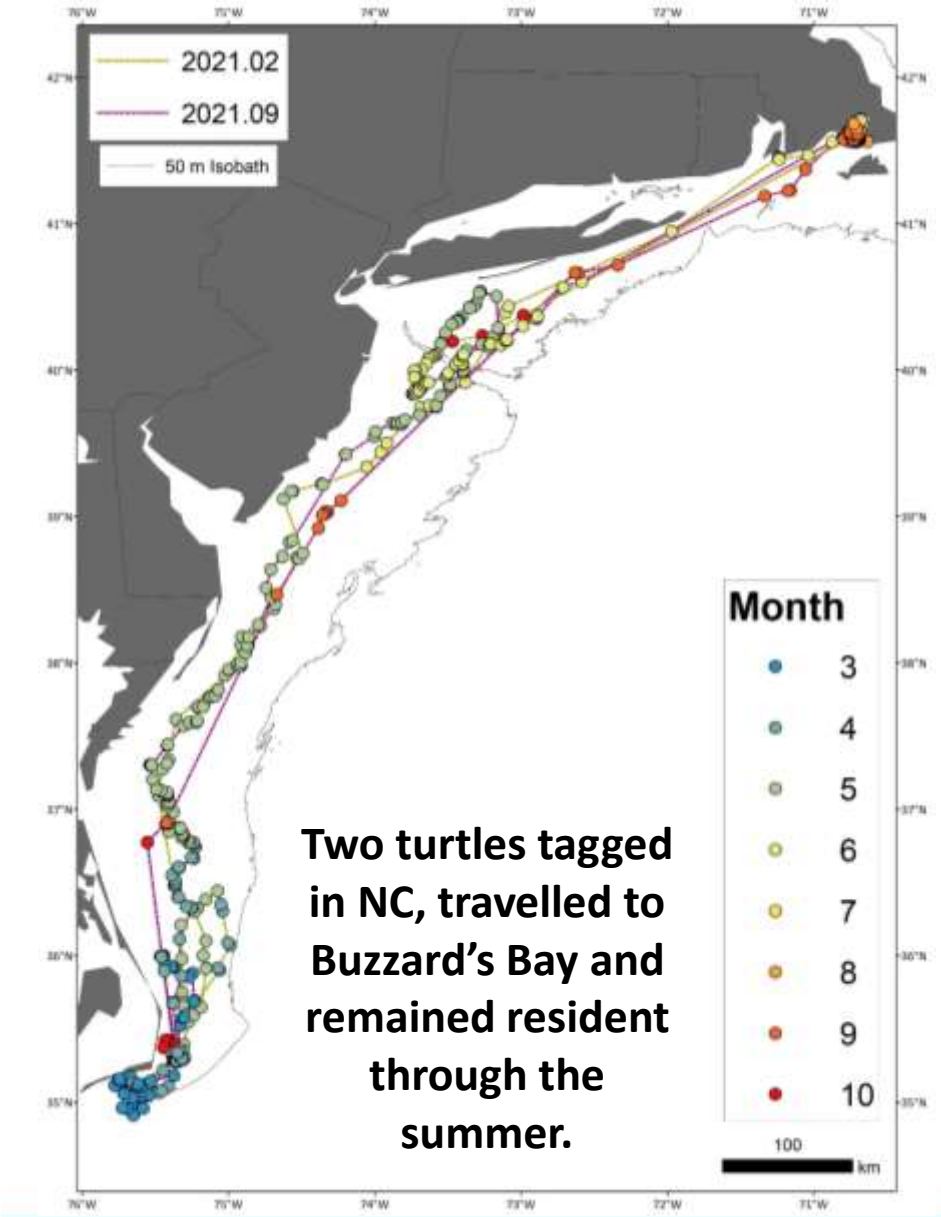


2021 Tag Locations



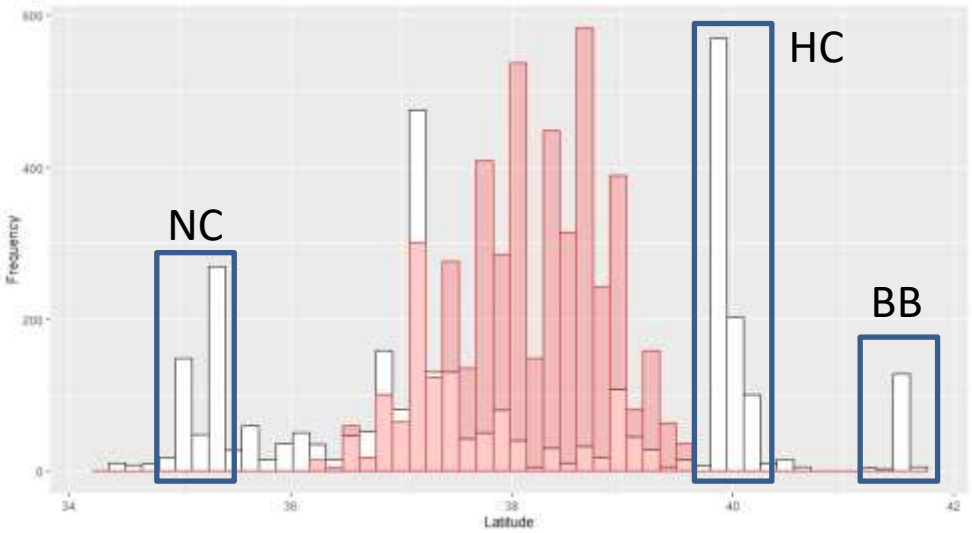


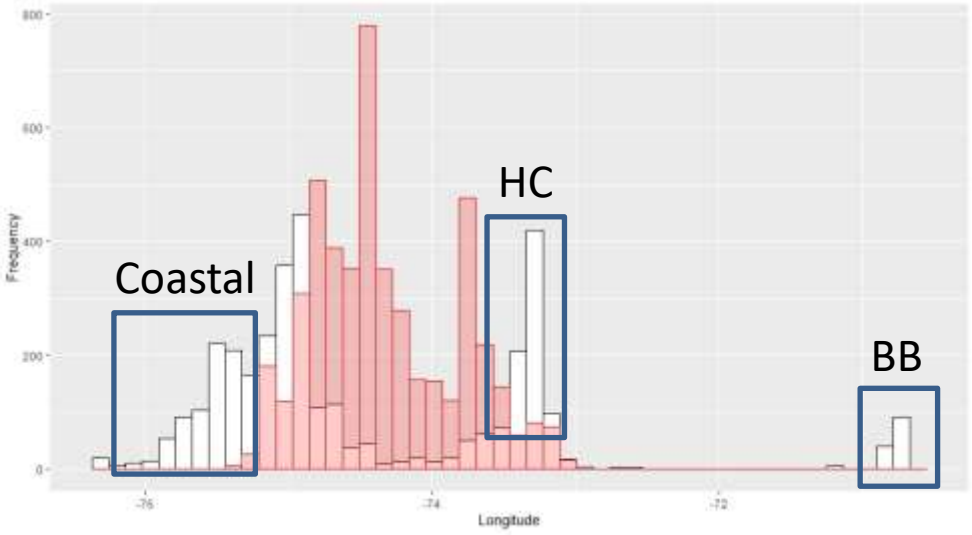
Movement Patterns



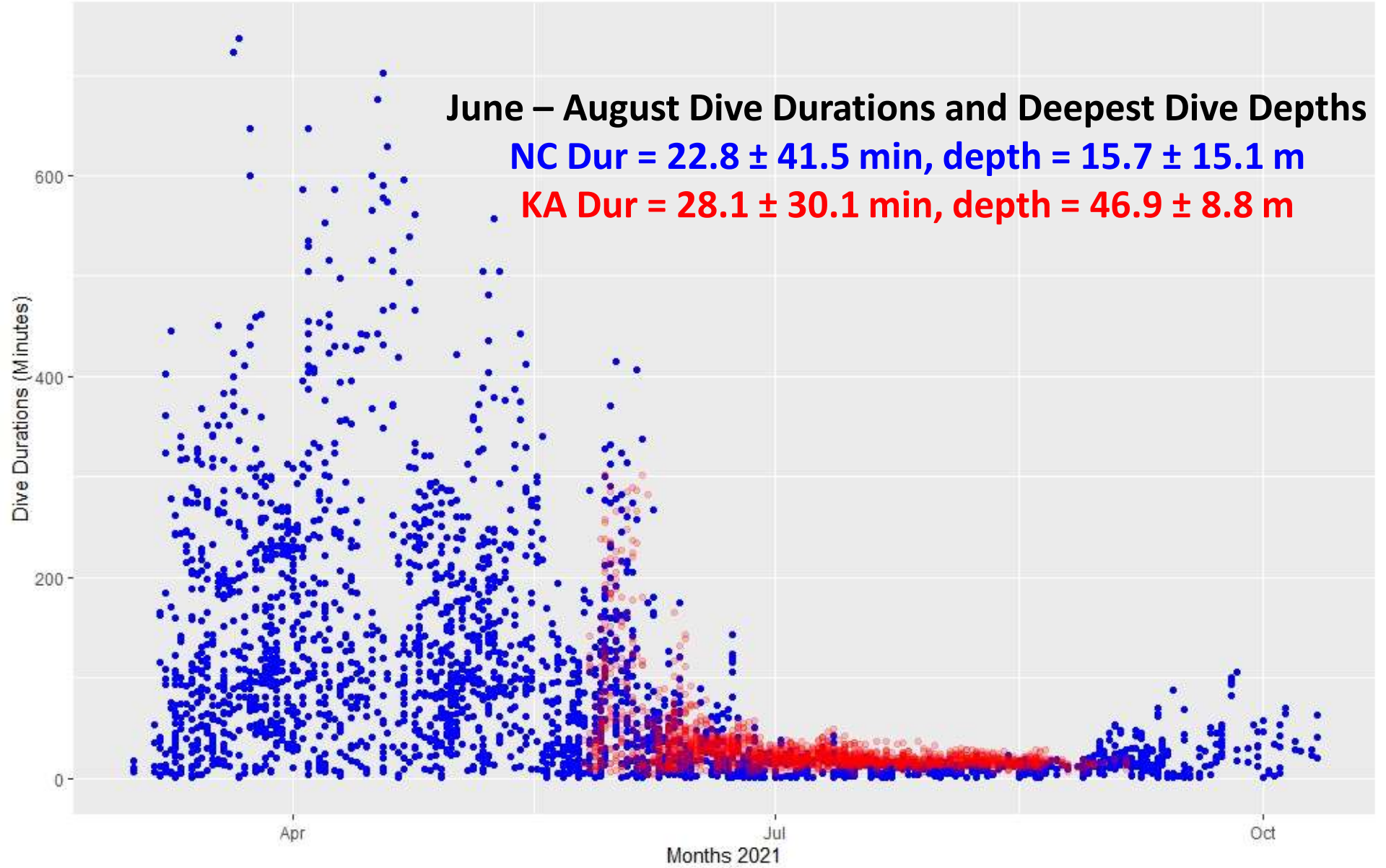
Two turtles tagged in NC, travelled to Buzzard's Bay and remained resident through the summer.

NC v KA lat/lon range





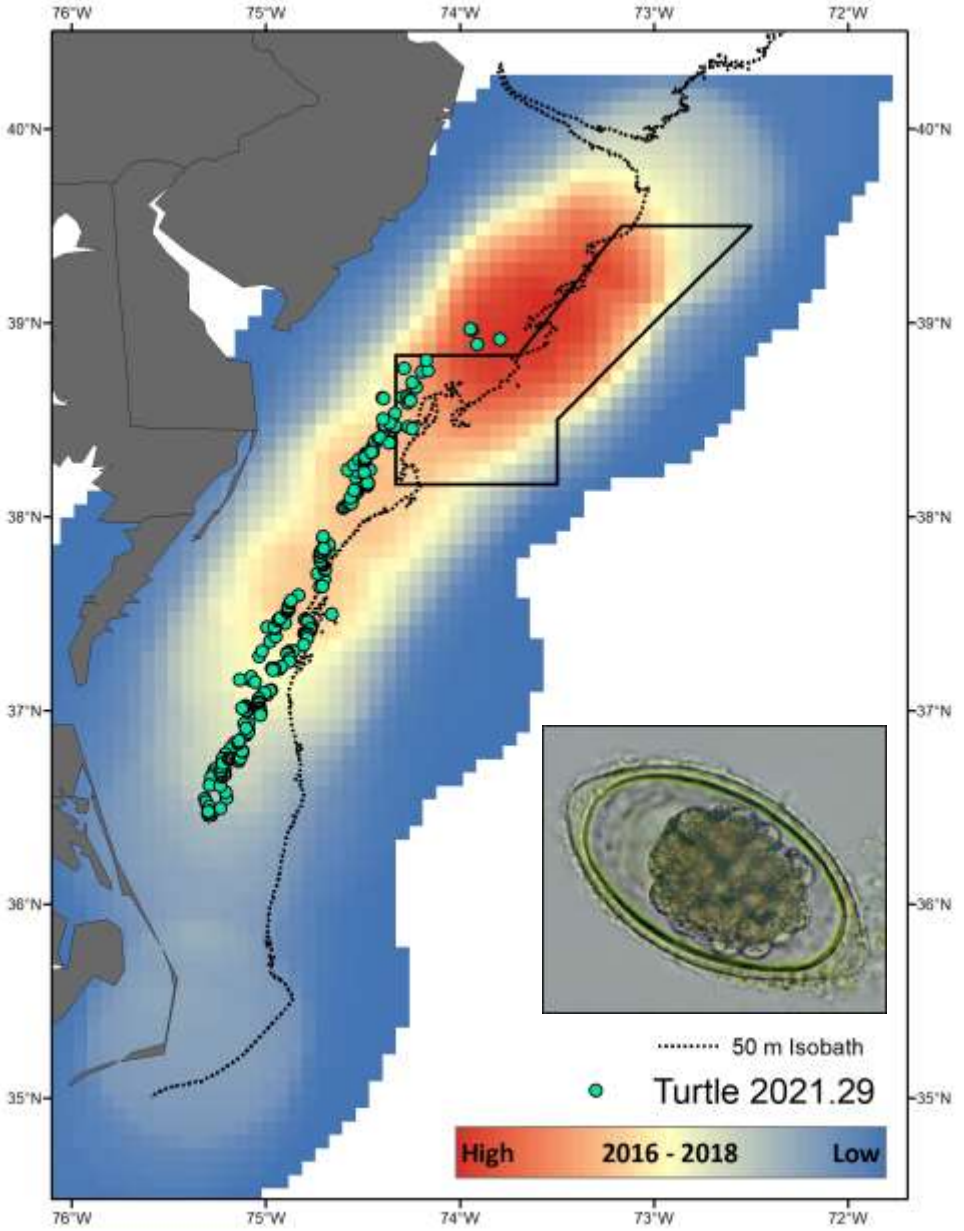
Dive Comparisons



Nematodes

Year	Total Turtles		Positive Nematode		Negative Nematode	
	Tagged	Dead	Tagged	Dead	Tagged	Dead
2016	22	28	6	1	15	27
2017	22	10	5	1	17	9
2018	35	33	7	7	28	26
2019	13	95	0	3	13	92
2021	22	25	1	0	17	38
Total	114	191	19	12	90	192
CCL mean ± SD (cm)	81.1 ± 10.0		82.2 ± 9.7		80.9 ± 10.1	

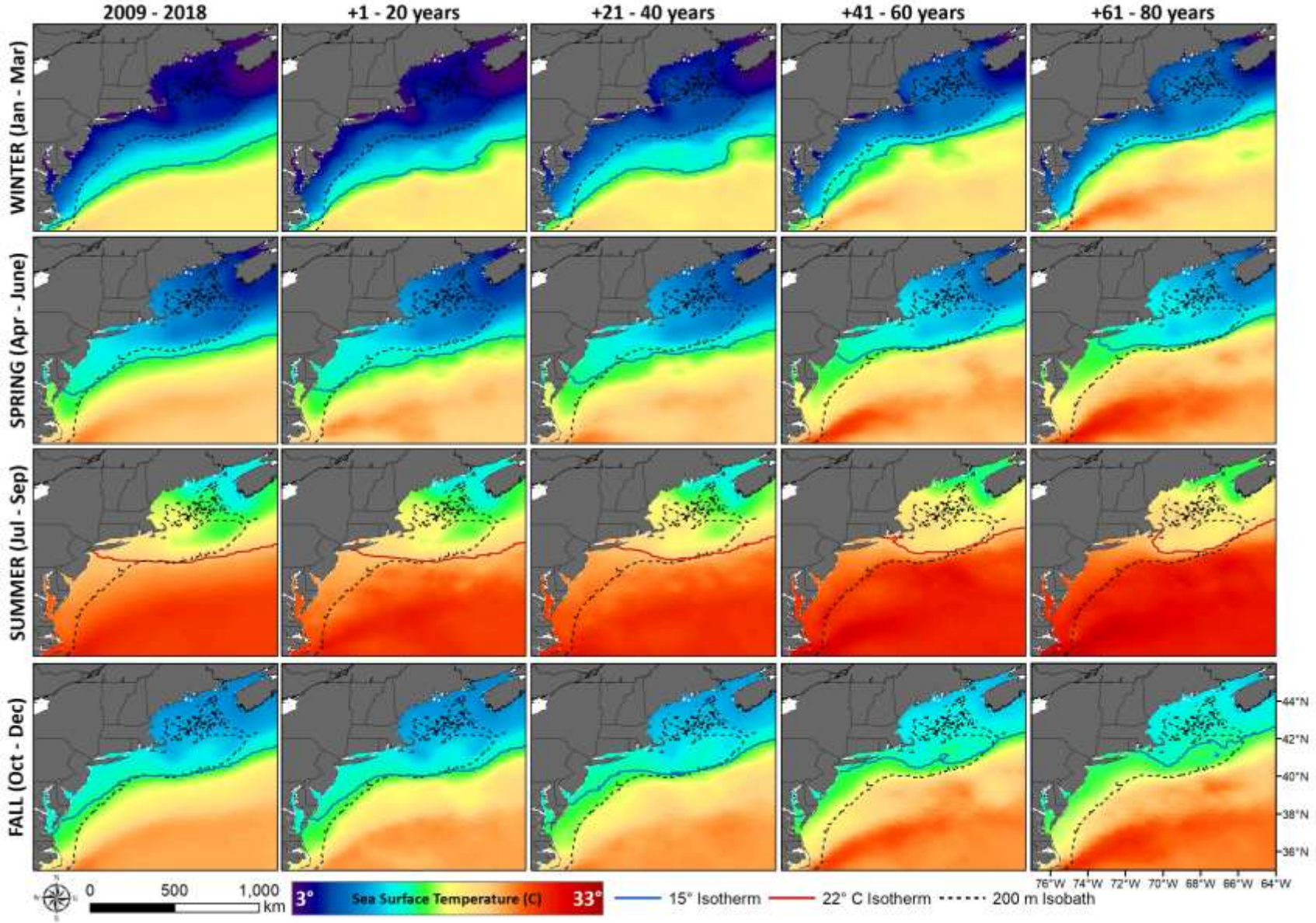
- 17% of tagged loggerheads positive (~8,500 turtles).
- 5% of necropsied turtles positive.
- Kemp's ridleys and green turtles also carry nematode.



Climate Change

scientific reports

OPEN Projected shifts in loggerhead sea turtle thermal habitat in the Northwest Atlantic Ocean due to climate change



scientific reports

Climate Change

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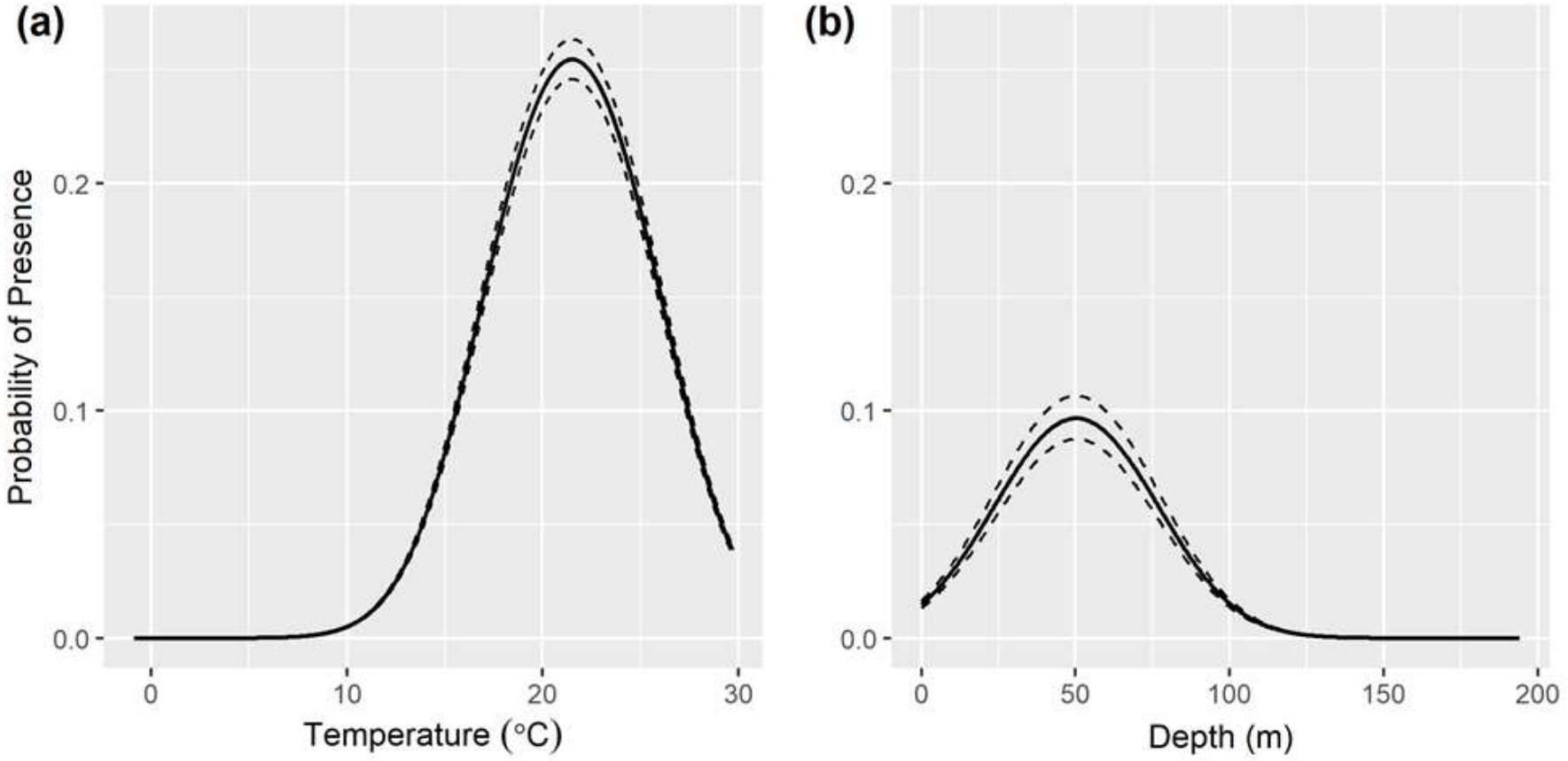
The habitat envelope for tagged loggerheads is SST ranging from 15° – 27° C and depths ranging from 25 – 75 m.



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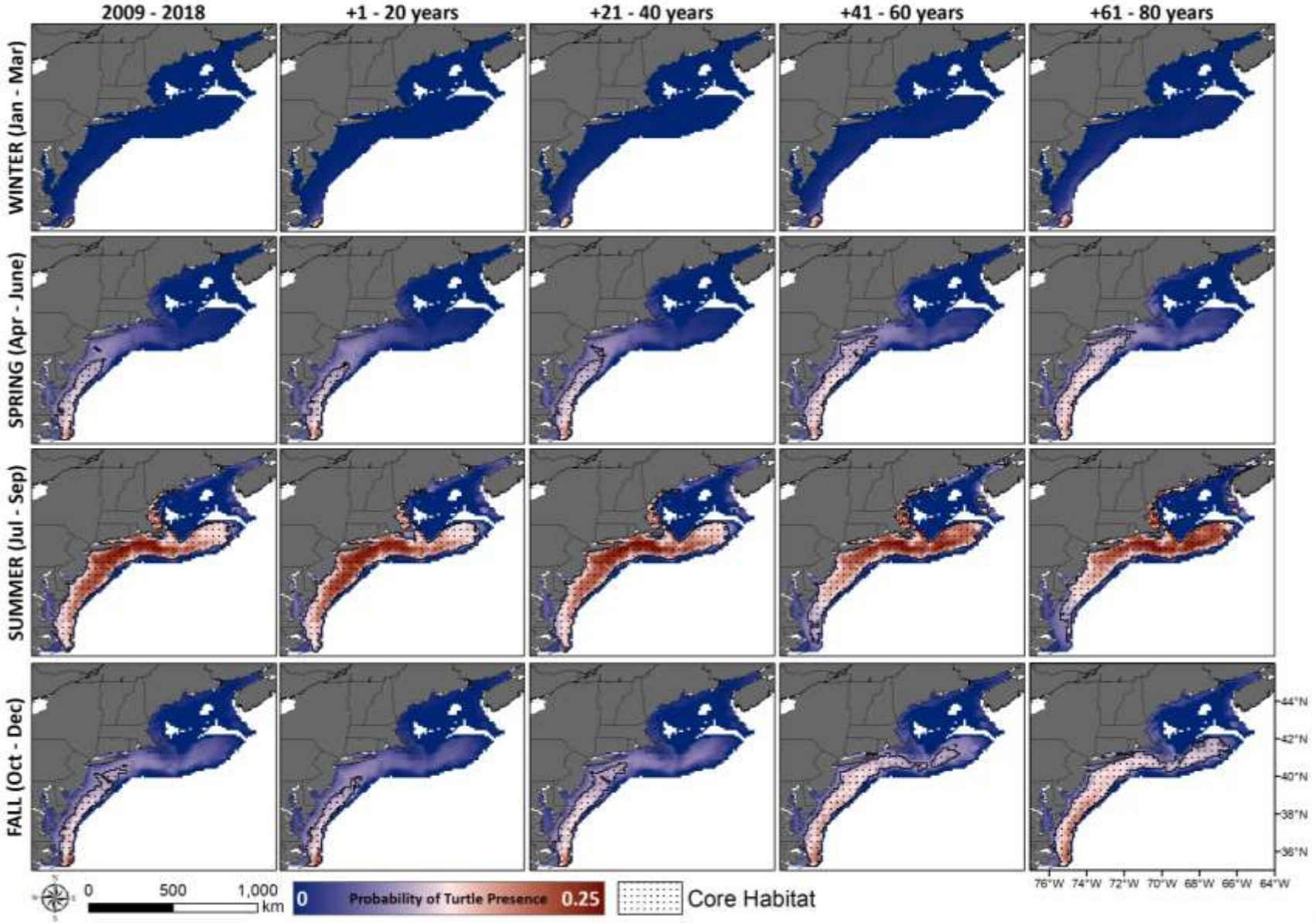
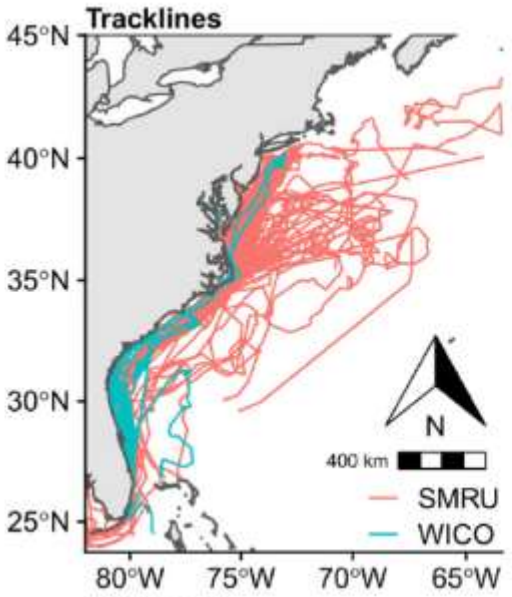
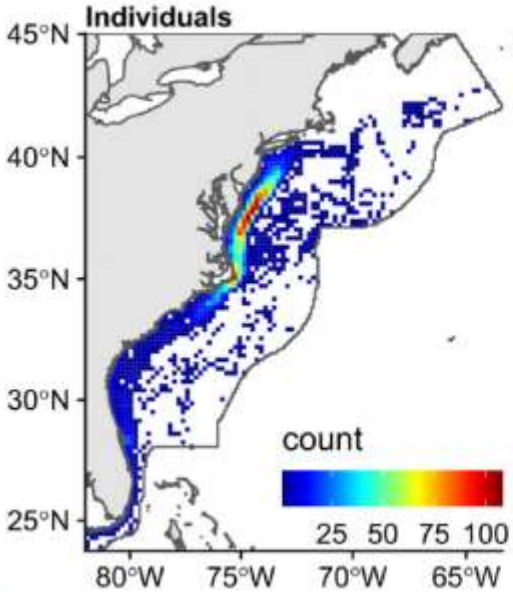
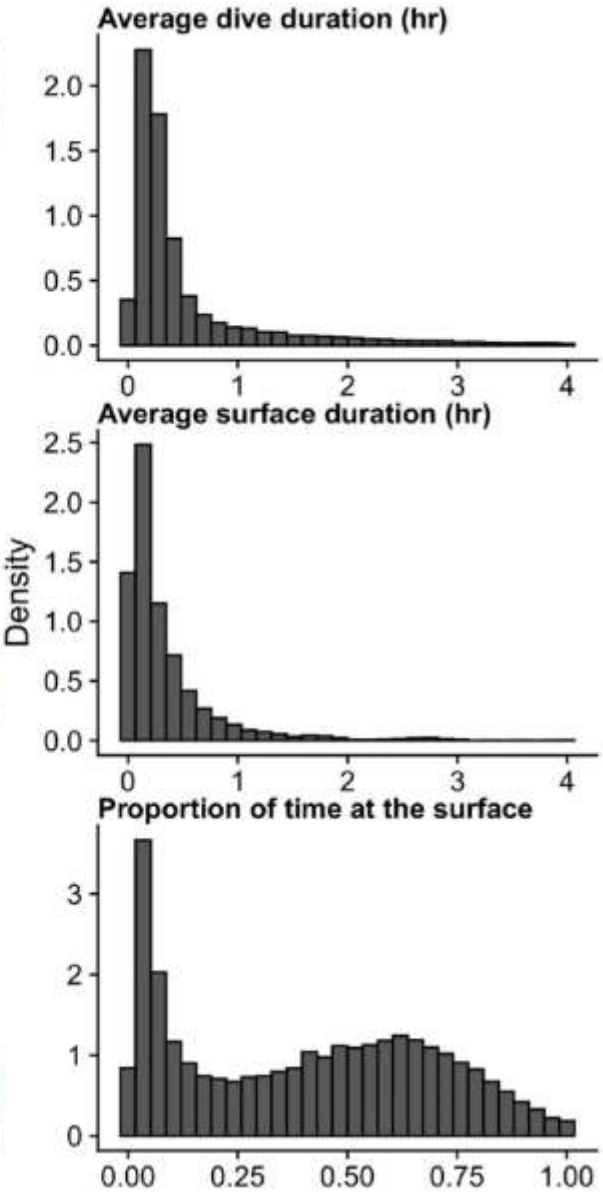


Survey Availability







RESEARCH ARTICLE

WILDLIFE

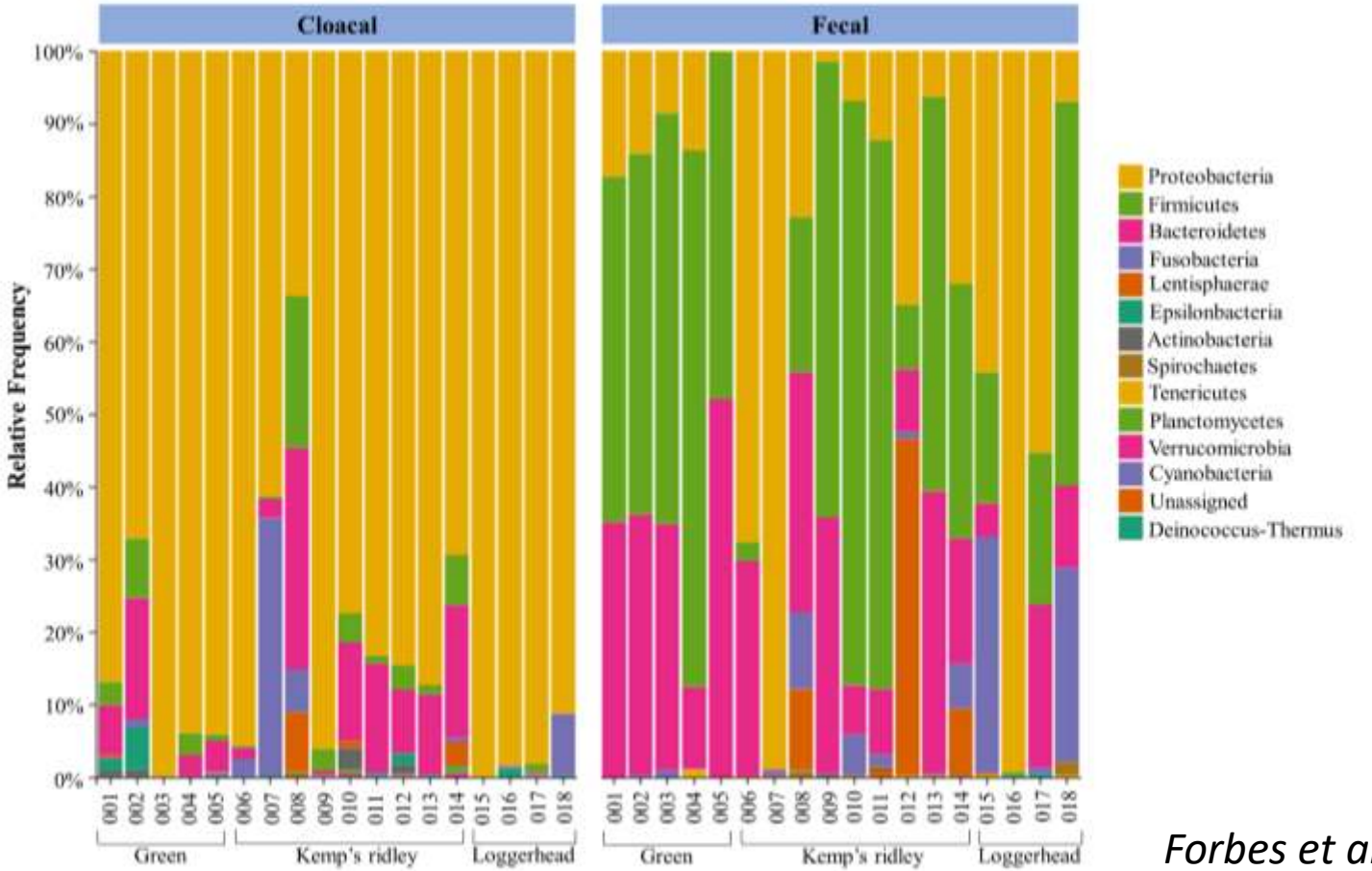
Estimating the complex patterns of survey availability for loggerhead turtles

Joshua M. Hatch[1] | Heather L. Haas[1] | Christopher R. Sasso[2] | Samir H. Patel[3] | Ronald J. Smolowitz[3]

- Need to improve estimates of loggerhead population in Atlantic.
- To do this, need to better understand likelihood of spotting turtle from aerial survey.

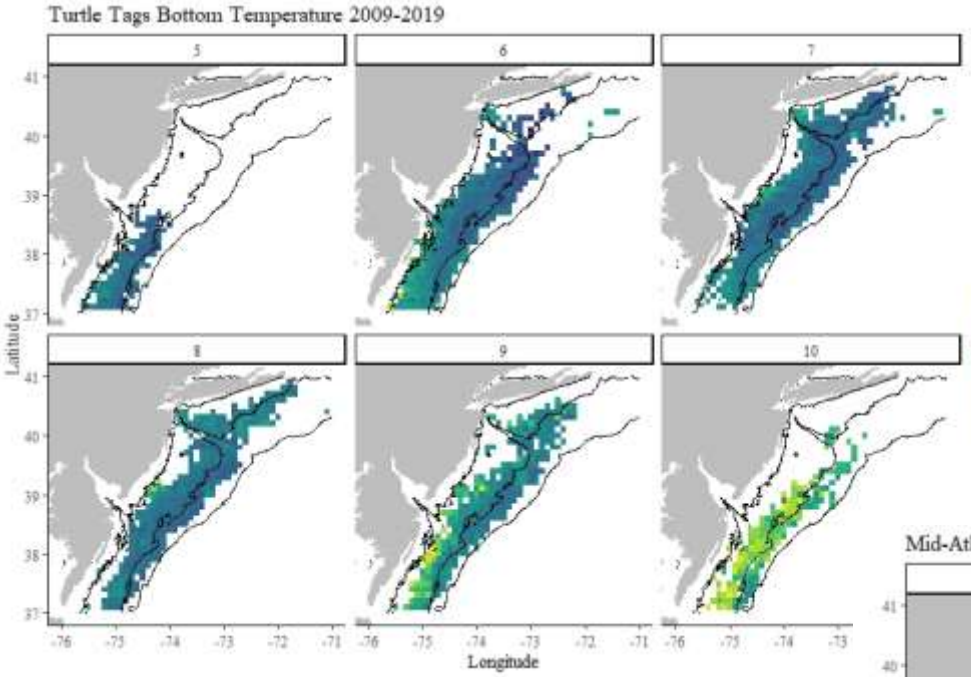
Foraging Ecology

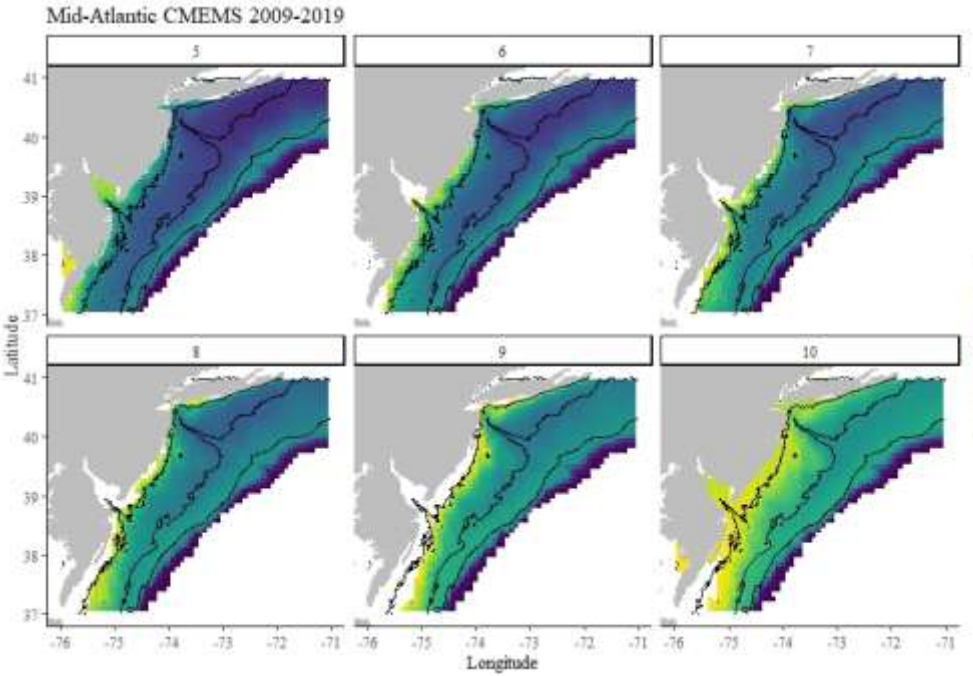
- Collected samples (live and dead turtles) for gut microbiome analyses (RWU) and heavy metal contamination levels (PFW).
- Gut microbiome can be used to determine foraging habits and preferences for sea turtles.



Forbes et al. in review

Turtles as Ocean Observers





- Compared bottom temperature data from turtle tags to NOAA GLORYS model.

Figure credits: Nathan Shivers

Turtles as Ocean Observers

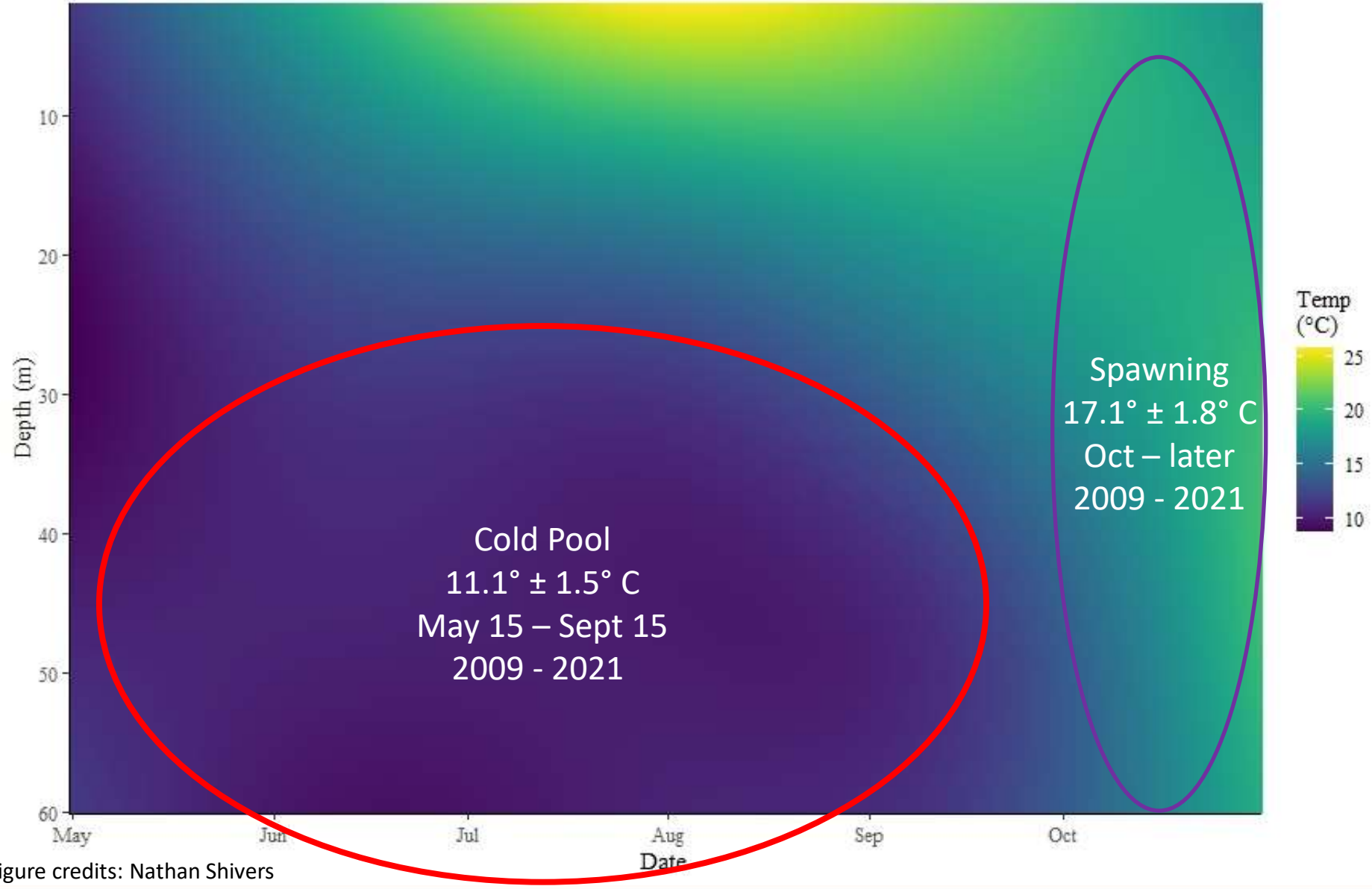


Figure credits: Nathan Shivers

Turtles - Tether

Importance of Continued Sea Turtle Research

- If the RPMs are not met, stricter requirements may be forced upon the scallop industry to protect turtles
- We have not recaptured any of our tagged turtles (n = 248) –> population size may be larger than estimated, skewing estimates of interaction rates with the scallop fishery
- Sampling occurring during tagging efforts helps to determine if the population is continuing to thrive in the presence of scallop fishing

Importance of Continued Sea Turtle Research

- Alternative tagging strategies could help us identify the pathways and proportions of loggerheads that reach northern waters.
- Nematodes infect ~17% of loggerheads in MAB including other hard-shelled turtles that travel farther north.
- Climate change projected to shift loggerhead habitat envelope, and continued turtle research is required to monitor if this yields shifts in distribution.