Understanding the Impacts of the Atlantic Sea Scallop Fishery on Loggerhead Sea Turtles

Prepared by

Samir Patel, PhD. and Liese Siemann, PhD.

Coonamessett Farm Foundation, Inc.

277 Hatchville Road
East Falmouth, Massachusetts, USA 02536
508-356-3601 FAX 508-356-3603
contact@cfarm.org
www.coonamessettfarmfoundation.org

2017 Sea Scallop Research Set-Aside Grant No. NA17NMFGC0031

May 13, 2019

1.0 EXECUTIVE SUMMARY

Project Title: **Understanding the Impacts of the Atlantic Sea Scallop Fishery on Loggerhead Sea Turtles**
Year Awarded: **2017/18**
RSA Priorities Addressed By This Research: **This proposal addresses 2017/2018 Scallop RSA Research Priority #5 of investigating loggerhead turtle behavior in the Mid-Atlantic.**
Industry Partners: **Viking Village Fisheries**

During the 2017 season we deployed 25 tags. Three tags were deployed in late February near Cape Hatteras. Of these turtles, one stayed adjacent to Cape Hatteras, while the other two migrated north. Sixteen more tags were deployed in mid-May, five were deployed in mid-July and one was deployed in late August. This year we deployed two tags substantially farther south than previous May trips in an attempt to capture turtles traveling within the Gulf Stream. These turtles ended up staying within shelf waters, and did not travel out of the southern MAB like other turtles that were tagged farther north. We deployed a new satellite tag, Wildlife Computers SPOT 375B, on the turtle caught during the August cruise. This turtle did not travel farther north after tagging; however continued to meander through the southern MAB during the summer and fall months, before settling near Cape Hatteras during the winter.

A total of five turtles tagged during 2017 tested positive for nematode eggs. These five turtles seemed to stay within a narrow band in the MAB, close to the 100 m bathymetry line and the scallop access areas. Additionally, we collected samples from 37 stranded sea turtles during the annual necropsies in partnership with the MA Audubon Society Wellfleet Bay Wildlife Sanctuary. This included nine loggerheads, five green turtles, two hybrid turtles and twenty-one Kemp's ridley turtles. We did not find nematode eggs in any of these turtles; however we did find worms in the digestive systems of five Kemp's ridley turtles.

Several projects and analyses that began during FY17/18 have been completed. First, collaborators from UNC Wilmington finalized and published analyses of the blood work from our sampled turtles (Yang et al. 2019 *Conservation Physiology*). This paper established clinical reference intervals for loggerheads foraging within the Mid-Atlantic Bight. This is critically important for veterinary care of this population, as it defines the baseline blood chemistry levels which are used for determining the health status of any future sampled turtle. Additionally, last year CFF and NEFSC took the first steps at analyzing the large temperature dataset acquired from the satellite tags (Patel et al. 2018 *Estuarine, Coastal and Shelf Science*). This was the first step in understanding the potential of this dataset in improving regional oceanographic models (ROMS) used by researchers, fishers and fisheries managers. This also started the process of understanding the thermal preferences for this cohort of turtles, which will be used to project how this population will shift under a changing climate. Finally, NEFSC developed a tool, based on the model built by Winton et al. 2018, to filter our tag location data and recalculate turtle tracks at equal time intervals. This is a critical first step in conducting any geospatial analyses with these tag data, including determining the overlap between loggerheads and scallop fishing effort.

2.0 PRELIMINARY RESULTS AND DISCUSSION

- 25 live turtles sampled offshore and 37 dead turtles sampled (**Table 1**).
- Accrued ~6,600 days of telemetry data (**Figure 1**).
- Five live turtles positive for nematodes and zero dead turtles positive for eggs, but worms found in five dead Kemp's ridley turtles (**Figure 2**).
- Turtles showed clear seasonal trend of remaining in the MAB during the summer months, and retreating south during the winter months (**Figure 3**).
- From the 2016 tagged turtles, we had 14 transmitters continue functioning into May 2017 or later (**Figure 4**). As a cohort, these turtles seemed to heavily overlap between years in terms of summer foraging locations. Turtles reached similar latitudes north and seemed to congregate in the northwestern section of the Megatron. Understanding foraging fidelity is an important step in predicting when and where sea turtles will be overlapping with fisheries within the MAB. We expect to improve upon these results as we deploy more long-term tags.
- Turtles overlap with areas of high scallop presence, indicating a continuing high chance of interactions with scallop dredging (**Figure 5**). Additionally, turtles are overlapping scallop grounds outside of the TDD management area and time period (**Figure 6**). This is likely to increase as ocean temperatures rise expanding available habitat for sea turtles.
- Completed assessment of tag-derived temperature data within the Mid-Atlantic Bight (~19,000 temperature-depth profiles) (Patel et al. 2018).
- Completed assessment of blood work from 4 years of collection from 81 turtles, establishing baseline reference intervals for the NW Atlantic population (Yang et al. 2019).
- This project is critically important for scallop management, as interactions and takes of sea turtles can immediately shut down the fishery. Data from this project can be used to improve management actions that could pre-empt interactions and takes. For example, this project could likely identify shifts in distribution of the loggerhead population prior to any documented takes that would yield expansion to the turtle deflector dredge regulations.

Table 1: Summary table for tags deployed during 2017.

Turtle ID	Date Deployed	Deployment Latitude	Deployment Longitude	Curved Carapace Length (Notch -Tip)	Nematode Presence
2017.01	2/23/2017	35.120	-75.660	76	Negative
2017.02	2/28/2017	35.650	-75.400	N/A	Negative
2017.03	2/28/2017	35.650	-75.400	N/A	Negative
2017.04	5/16/2017	37.520	-74.702	70	Negative
2017.05	5/16/2017	37.502	-74.722	60.5	Negative
2017.06	5/16/2017	37.502	-74.728	69	Negative
2017.07	5/16/2017	37.490	-74.735	79.4	Negative
2017.08	5/16/2017	37.453	-74.773	67	Negative
2017.09	5/16/2017	37.382	-74.838	79.25	Negative
2017.10	5/16/2017	37.382	-74.833	86	Negative
2017.11	5/16/2017	37.352	-74.855	74.5	Negative
2017.12	5/16/2017	37.350	-74.850	80	Positive
2017.13	5/16/2017	37.348	-74.872	73	Negative
2017.14	5/16/2017	37.333	-74.867	85.4	Negative
2017.15	5/16/2017	37.347	-74.882	75	Negative
2017.16	5/16/2017	37.342	-74.883	95.5	Positive
2017.17	5/17/2017	35.993	-75.000	90	Negative
2017.18	5/17/2017	35.970	-74.903	58	Negative
2017.19	5/18/2017	37.240	-74.857	73	Positive
2017.20	7/13/2017	39.611	-72.859	98.5	Negative
2017.21	7/13/2017	39.637	-72.903	102.5	Positive
2017.22	7/13/2017	39.652	-72.888	94.1	Negative
2017.23	7/13/2017	39.669	-72.904	77.2	Negative
2017.24	7/15/2017	39.289	-73.326	71.3	Positive
2017.25	8/22/2017	38.733	-73.827	65.5	Negative

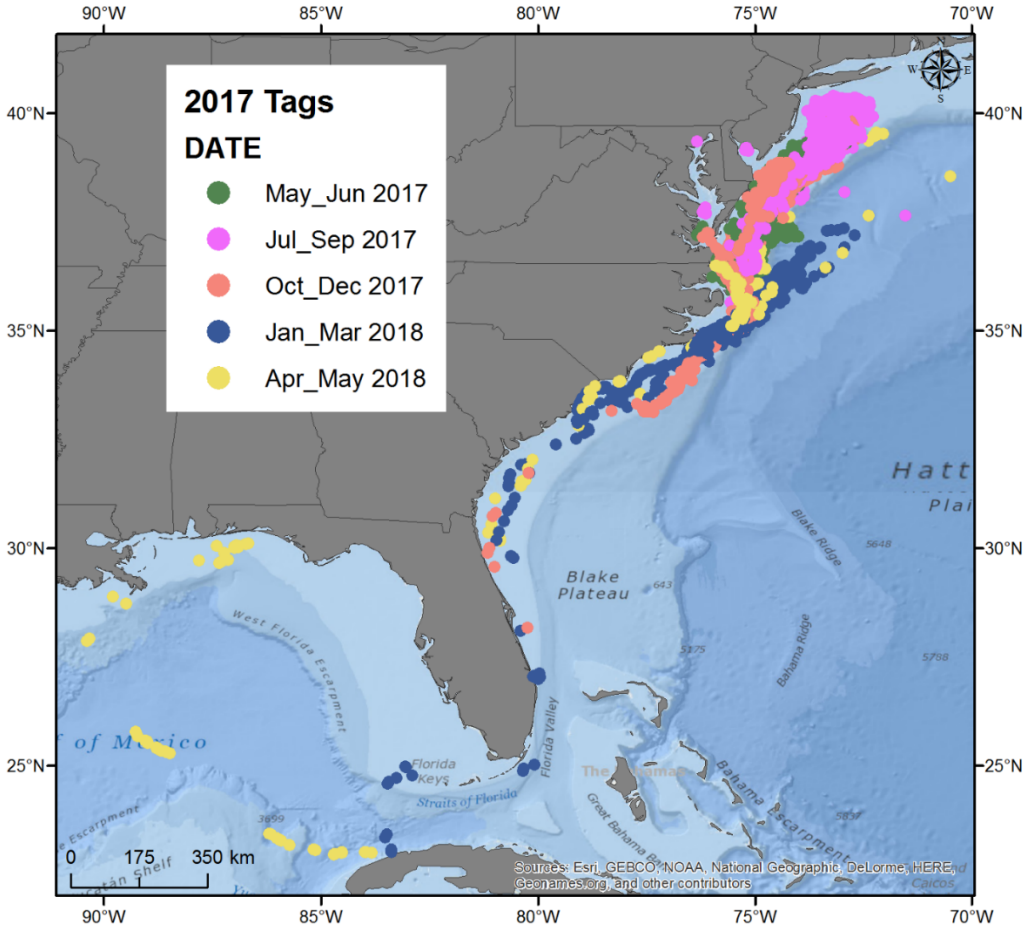

Figure 1: All locations for turtles tagged in 2017 as of May 15, 2018.

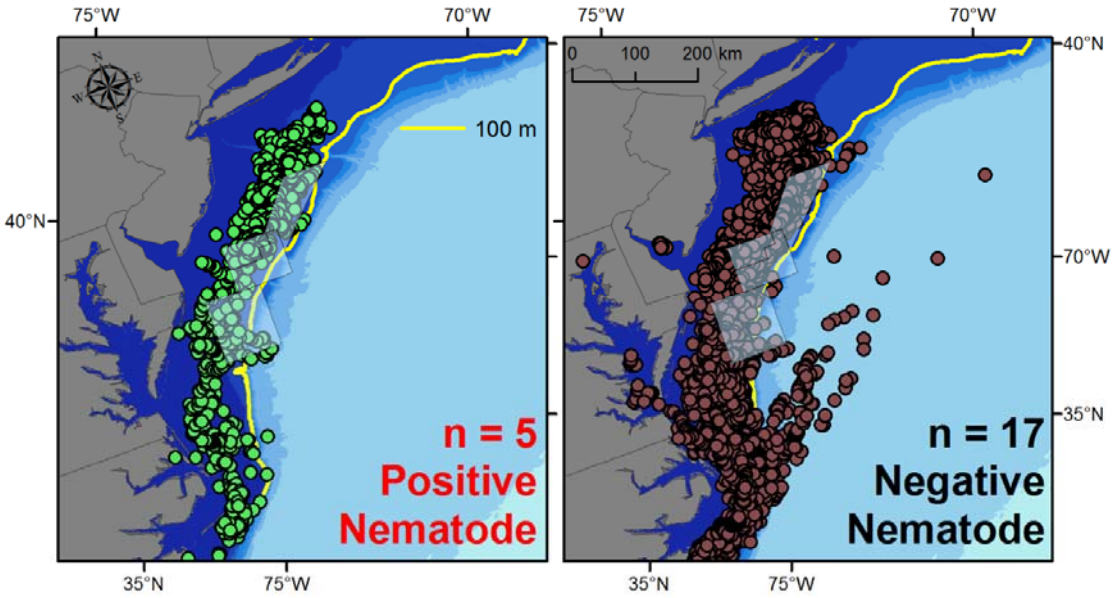

Figure 2: Locations of loggerheads within the MAB positive and negative for nematode presence in cloacal lavage samples.

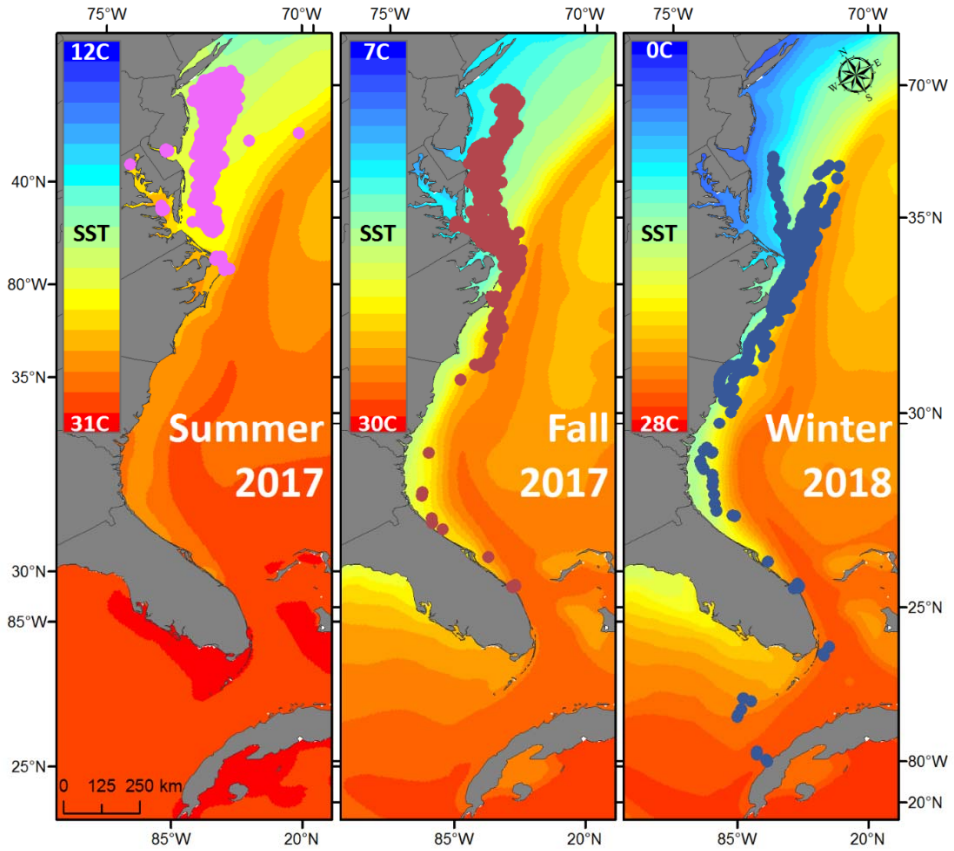

Figure 3: Mean SST during the summer, fall and winter months overlaid with corresponding turtle locations from tags deployed during 2017 offshore MAB trips. Note the SST scale bars differ in each panel.

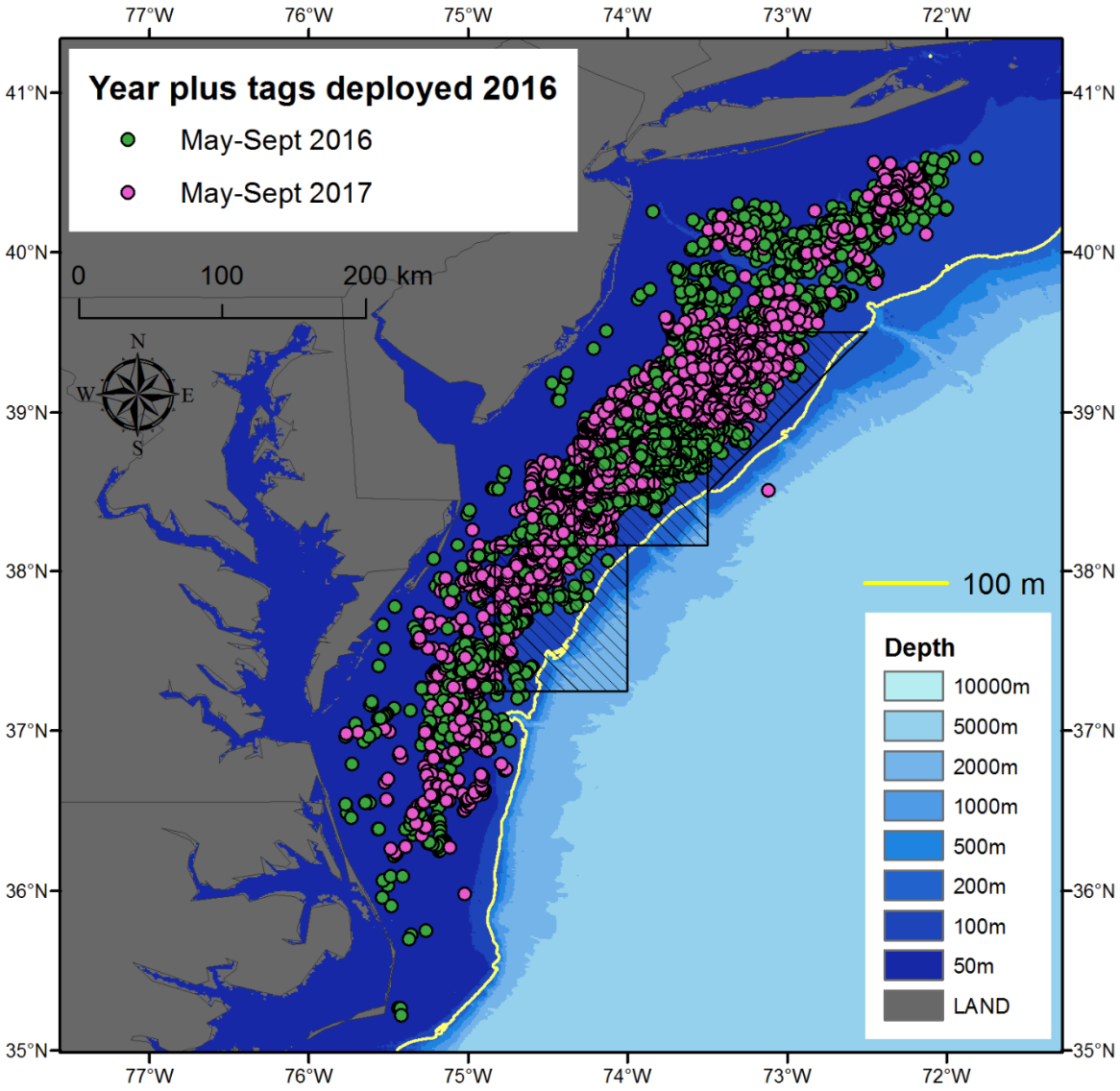

Figure 4: 2016 and 2017 summer locations for turtles tagged in 2016. Fourteen tags deployed in 2016 continued to transmit until May 2017 or beyond.

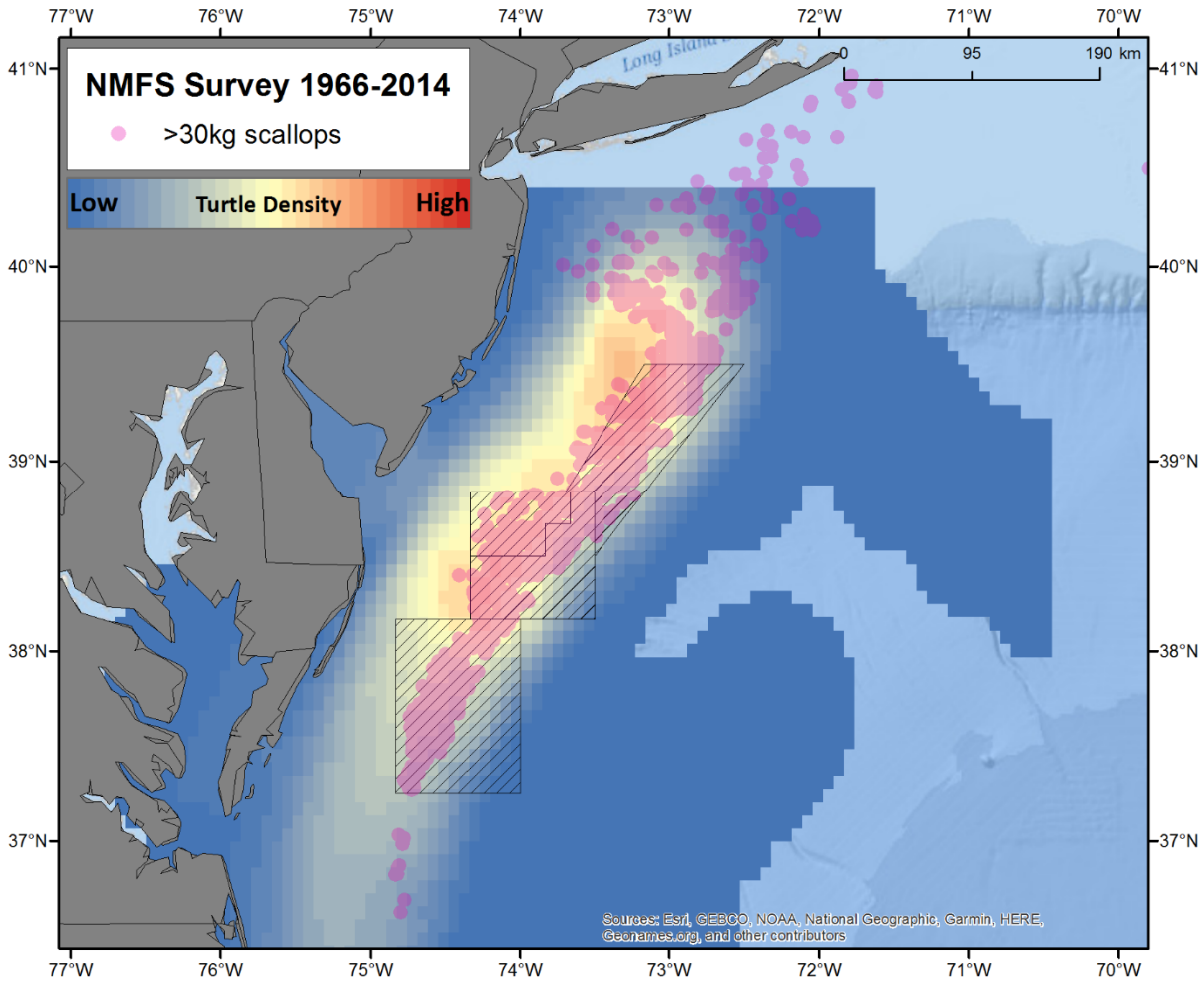

Figure 5: Density of turtle locations from those tagged in 2017 overlaid with scallop catch data from the NOAA scallop survey from 1966 – 2014.

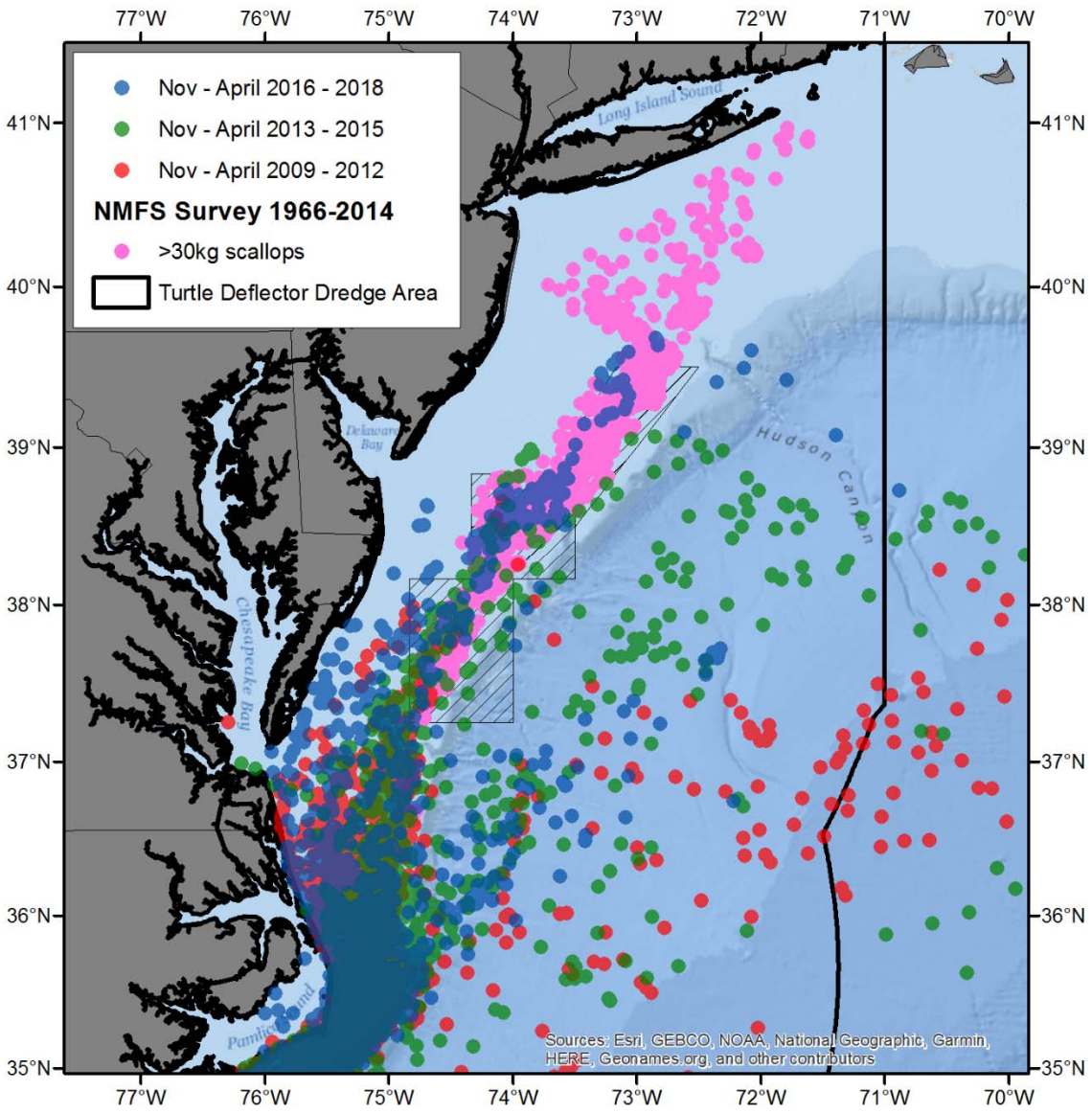

Figure 6: Turtle locations during Nov – April for all years since 2009. This time period is when the TDD is not required.

3.0 SPECIAL COMMENTS

Sea turtle research funded by the program is critically important for ensuring that the scallop fishery remains open and sustainable, despite this priority being designated as lower priority in recent years. Prior to the development and required use of turtle chain mats and turtle deflector dredges (TDDs), sea turtle bycatch was a serious issue for the scallop fishery. Even with the TDD, changes to scallop fishery access areas, particularly in the Mid-Atlantic, requires consideration of potential impacts on turtles. Section 7 Biological Opinions for the Atlantic sea scallop fishery require that Reasonable and Prudent Measures (RPMs) are taken to make certain that changes to fishing effort do not increase the likelihood of interactions with sea turtles. Without observed takes, data from this and previous years' projects provide the only consistent dataset to meet this requirement if an Endangered Species Act (ESA) Section 7 Consultation is triggered. Ongoing court cases exposing the flaws of the takes model demonstrate the value of this active research.

Scallop gear is assumed to catch an estimated average of 140 loggerhead sea turtles each year, with 47% incidental sea turtle mortality (NMFS 2012). Due to the lack of recent observed takes, updates to this model can only be made through data generated by this project. This turtle research directly addresses RPMs #3, and #5; while correlated CFF gear and fisheries-based research address the remaining RPMs. There is a necessity to continually review available data to determine whether there are areas or conditions within the action area where sea turtle interactions with scallop fishing gear are more likely to occur. For the scallop fishery to maintain an exemption from the prohibitions under Section 9 of the ESA these RPMs, which are non-discretionary, must be implemented. Consequently, data from the satellite tagging projects have been used to develop multiple scallop management frameworks.

Data are starting to accumulate that indicate sea turtle populations within the NW Atlantic are increasing (Griffin et al. 2019, McNeill et al. 2018). As a result, continuing the RSA-funded sea turtle research is critical in pre-empting the potential increase in interactions rates that could occur as the turtle population grows and moves because turtle interactions could increase with no changes to current scallop fishing effort or access areas. During the 2017 season we successfully continued our efforts to deploy transmitters and collect biological samples from loggerheads in the MAB. The deployment of 25 transmitters adds to our considerable dataset and ensures that our understanding of the overlap between loggerheads and fisheries is always up-to-date. This is of critical importance to guarantee that any potential future interactions will be identified quickly and managed with the least amount of impact to both the industry and the animals. If changes in turtle behavior or the environment do occur that can impact loggerhead take numbers, it is imperative to have this type of annual survey information to help inform the Section 7 Consultation.

By capturing and tagging turtles, we are not only determining where they go within the MAB, but also assessing their health condition to determine if the population is continuing to thrive in the presence of associated anthropogenic activities, specifically scallop fishing. If our tag sample size decreases, it becomes much more difficult to extrapolate our biological data to the population as a whole. The collaboration between NEFSC and CFF has yielded an average of 20

tag deployments per year since 2009. This is above what is typical for sea turtle satellite tagging projects, and this relatively high tag number has given us the confidence to extrapolate results to a larger scale. Currently, we have not recaptured a turtle we have tagged (n = 201), and we suspect the population in the region to be substantially higher than previously estimated. Furthermore, each turtle provides an incredible wealth of samples and data. As a result, increasing the number of turtle tags from five to ten translates to not only five more tags deployed, but also five more blood, skin and lavage samples, with each of these samples also having multiple purposes and five additional turtles to add to our demographics dataset (**Table 2**). Similarly, by reducing the number of turtles sampled, we are losing essential data each year that cannot be re-collected. It is rare to have a consistent long-term dataset of this kind and it is important to continue this research at the same, consistent levels into the future. Interactions between fisheries and protected species can result in severe complications for the industry and this project is a method to preempt negative impacts on the scallop industry.

Table 2: Samples taken from each turtle in addition to satellite telemetry data.

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 chains are built to specifications based on sizes of turtles within the region. Additionally, knowing general demographic information is useful in understanding the overall importance of this cohort to the greater population of loggerheads. This information is important for determining the impact takes from this cohort could have on the larger population.
Blood Sample (12 ml)	Health status, hormone levels (gender), stable isotope values, genetics	Stable isotope values are used to determine what loggerheads eat (benthic vs pelagic prey and nearshore vs offshore), this is useful in determining the level of overlap between loggerhead foraging and scallop presence. Hormone levels are used to determine if this is a healthy population and if there are any gender specific differences in behavior. Sex determination is also important for population estimates.
Skin Sample	Genetics, Stable Isotope values	Obtaining stable isotope values from multiple tissue sources provides insight into foraging preference on different time scales. Blood is more recent, but values from skin refer to feeding much longer ago.
Cloacal Lavage	Identify nematode presence	This is important for determining the prevelance of nematodes within this cohort of loggerheads.

Physical Health Assessment	Checked for injuries, both new and healed.	Useful for determining mortality estimates and documenting any sources of injury, including from fisheries interactions.
Passive tagging	For population estimates	Adding and checking for passive tags is important for determining population estimates. So far we have not reencountered a single turtle we have tagged, indicating the population is likely very large.
Body Temperature	Health Status	It is important to know the baseline conditions of healthy turtles to be able to determine if a turtle is unhealthy. This is important for knowing the level of response required for an incidentally impacted turtles.

References

Griffin LP, Griffin CR, Finn JT, Prescott RL, Faherty M, Still BM, Danylchuk AJ. 2019. Warming seas increase cold-stunning events for Kemp's ridley sea turtles in the northwest Atlantic. PloS one. 14(1):e0211503.

McNeill JB, Hall AG, Richards PM. 2018. Trends in fishery-dependent captures of sea turtles in a western North Atlantic foraging region. Endangered Species Research. 36:315-24.

National Marine Fisheries Service (NMFS). 2012. Biological Opinion for the Atlantic Sea Scallop Fishery. http://www.nero.noaa.gov/prot_res/section7/NMFS-signedBOs/2012ScallopBiOp071212.pdf

Patel SH, Barco SG, Crowe LM, Manning JP, Matzen E, Smolowitz RJ, Haas HL. 2018. Loggerhead turtles are good ocean-observers in stratified mid-latitude regions. Estuarine, Coastal and Shelf Science. 213:128-36.

Yang T, Haas HL, Patel S, Smolowitz R, James MC, Williard AS. 2019. Blood biochemistry and haematology of migrating loggerhead turtles (Caretta caretta) in the Northwest Atlantic: reference intervals and intra-population comparisons. Conservation physiology. 7(1):coy079.