Determining baseline information for sea turtles overlapping the proposed wind energy areas in waters off the New Jersey coastline

Application for New Jersey Research and Monitoring Initiative Sea Turtle Priority

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1. **Title:** Determining baseline information for sea turtles overlapping the proposed wind farm lease areas in waters off the New Jersey coastline
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3. **Motivation/Objective**

This project will address the sea turtle priority, along with several other priorities, within the New Jersey (NJ) research and monitoring initiative (RMI) for studying marine and coastal resources prior to and during offshore wind development. Based on the Biological Assessment of the Ocean Wind lease area, there is a substantial lack of data on the presence of sea turtles overall within the NJ coastal and offshore region, along with a very limited understanding of the response of turtles and their prey to an increased exposure to impulsive sounds (BOEM 2022). Although for loggerheads, CFF and partners have documented that there is likely an overlap between these sea turtles and the offshore NJ Wind Energy Areas (WEAs; **Figure 1;** Patel et al. 2021). We plan to take a broad approach to establishing the baseline conditions for sea turtles within the region using a range of biological and ecological metrics. This project will fulfill the RMI objectives in several ways (**Table 1**).

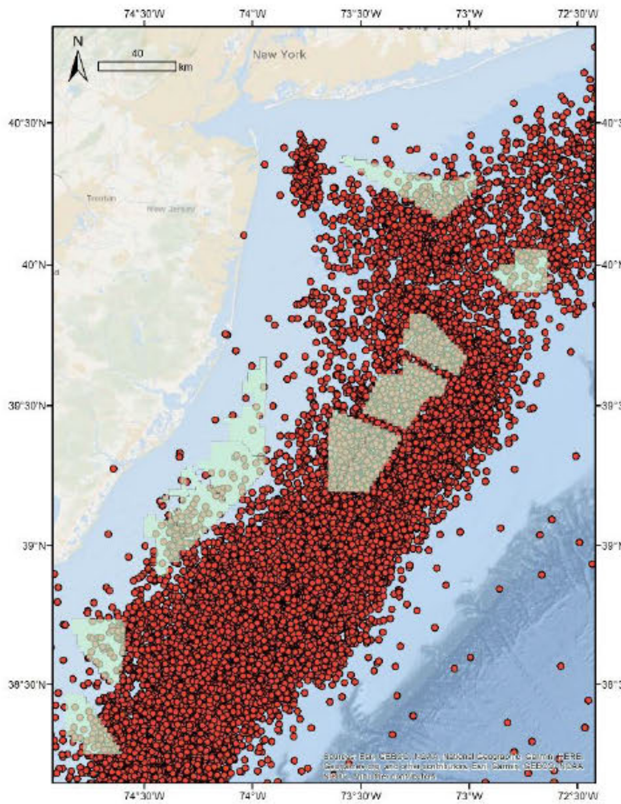

Figure 1: Interpolated locations for 196 loggerheads tagged by CFF and NEFSC between 2009 – 2018 overlayed with WEAs in the MAB (Patel et al. 2021).

Table 1: Project plans that will address the relevant RMI objectives.

RMI OBJECTIVE	PROJECT PLANS
Establish Adaptable Framework	**Several baseline metrics will be established for turtles in the MAB to make it easy to identify an impact from offshore wind through a change in any of these metrics over time.**
Consult, Partner, Maintain Communication	**We will be working with NEFSC, RWU, and local fishermen to accomplish this project. PI Samir Patel is already on the RWSC Sea Turtle Subcommittee and will contribute accordingly.**
Maintain Communication and Coordination	**This project includes collaboration with NEFSC.**
Contribute to greater regional research	**We will combine results from this project with existing data on sea turtles in the region already collected by CFF+NEFSC.**
Identify future offshore wind research needs	**We will both fill and identify data gaps for sea turtles within the region**
Make products readily available	**We plan to publish results and present findings at relevant conferences and meetings.**

Table 2: Overview of project plan including expected results, potential WEA impact to turtles each data product will address, and relevance to NJ RMIs. Green rows are data collected during all turtle trips, orange rows are data collected during videography cruise in WEAs, and purple row is data collected from satellite telemetry deployments in NC and MAB.

Potential data/samples per turtle	Analysis/Products	Potential WEA Impact	RMI Priority + Sea Turtles
Species Type	Context for all analysis	Regional shift in species composition	Fisheries
Interaction/Capture Locaton and Time	Context for all analysis	Regional shift in phenology	
Acoustic telemetry detections	Presence/absence of turtles within the NJ WEAs or other regions with receiver arrays	Within WEA shift in presence/absence	Fisheries, NJ DEP Acoustic Array
Carapace Size	Demographic information on study population and body condition index	Regional shift in demographics and health indices	Fisheries
Body Depth	Demographic information on study population	Regional shift in demographics	
Tail Size	Demographic information on study population	Regional shift in demographics	
Weight	Demographic information on study population and body condition index	Regional shift in demographics and health indices	
Blood	Blood chemistry, stable isotopes, hormone levels	Shifts in health indices, stress levels, and foraging preferences	
Skin	Stable isotope	Shifts in foraging preferences over larger time scale.	
Cloacal lavage	Nematode presence, gut microbiome community, prey determination through genetic markers	Shifts in parasite load and foraging preferences over varying time scales	Environmental Change, Benthos, Fishes and Inverts, Fisheries
Body Temperature	Health status while captured		
Photographs	Turtle identification	Regional population estimates	
Passive Tag Info	Turtle identification	Regional population estimates	
Sea Surface Temp	Context for all analysis	Shifts in oceanographic conditions	Environmental Change
Bottom Temp	Context for all analysis	Shifts in oceanographic conditions	Environmental Change, Benthos
Other species present	Context for all analysis	Regional shift in sympatric species	Environmental Change, Benthos, Fishes and Inverts, Fisheries
In-water footage from ROV	Turtle behavior within the NJ WEAs, Sympatric Species	Within WEA shifts in sympatric species, prey items, foraging preferences, environmentall conditions, and soundscape	Environmental Change, Benthos, Fishes and Inverts, Fisheries
In-water footage from Camera-Tags	Turtle behavior within the NJ WEAs, Sympatric Species	Within WEA shifts in sympatric species, prey items, foraging preferences, environmental conditions, diving behavior, and soundscape	Environmental Change, Benthos, Fishes and Inverts, Fisheries
Satellite telemetry locations and dive information	Seasonal distribution through the NW Atlantic; Dive behavior analysis, full water column temperature-depth profiles	Changes to phenology, movement and diving patterns, oceanographic conditions	Environmental Change, Benthos, Fisheries

In addition to focusing on sea turtles directly, this project will also address broader topics including documenting relevant sympatric species, sea turtle prey resources, and oceanographic conditions. Combined, these results will have value for several RMI priorities including environmental change, benthos, fishes and invertebrates, and fisheries (**Table 2**). Regarding environmental change, the use of satellite tags on turtles will provide one of the most robust datasets on temperature through depth within the region (Patel et al. 2018). Previously, we have identified that turtles provide good platforms for oceanographic sampling and transmit more temperature-depth profiles than are typically acquired for the MAB using traditional surveys (Patel et al. 2018). From this we have identified the clear signature of the cold pool and the annual fall turnover event that significantly shifts the oceanographic conditions in the region. Furthermore, tagged sea turtles are also able to document more short-term and stochastic changes to the environment, including passing tropical storms and hurricanes (Crowe et al. 2020).

In terms of the benthos and fishes and invertebrates priorities, we plan to use videography to study sea turtles specifically within the proposed WEAs. We expect this technique to provide information on sea turtle foraging, which is primarily on invertebrates, and on the sympatric species that are associated with turtles. From previous footage, we have identified a range of species that tend to associate with sea turtles in the MAB, including juvenile fish and higher value recreational species like *Mahi mahi* (Smolowitz et al. 2015). In addition, turtles typically forage within the benthic environment, and this region will also get filmed as we follow them while searching for and consuming prey. This footage can provide a general overview of the benthos and provide insight into how species are interacting with one another.

For the fisheries priority, all sea turtles are protected, and shifts in their habitat usage could substantially impact bycatch rates. In the MAB, historically, there is a significant overlap between sea turtles and Atlantic sea scallop fishing (Hatch et al. 2023), and this has correlated with the pattern of observed interactions. If wind farms displace or concentrate sea turtles and fisheries to regions with higher levels of overlap, interactions between turtles and fisheries can be expected to change. Furthermore, turtles forage on a range of commercially valuable species including sea scallops and crabs. Within this study, we plan to document the parasite load found in sea turtles, and this could be an indicator of parasite presence within these fisheries species (Rudders et al. 2023). The nematode *Sulcascaris sulcata* is a known parasite to scallops that resides within the adductor muscle causing discoloration and a reduced marketability of the resource (Rudders et al. 2023). Sea turtles provide a likely vector for transmission by eating the scallops, or other infected benthic invertebrates, retain the nematode, and pass along the eggs in their feces. From past sampling, we have identified the presence of nematode eggs in loggerhead fecal material and plan to continue this research to determine if a large ecosystem change, like offshore wind development, will alter parasite load in the region and affect high value fisheries in the region.

Overall, this project should be considered a high priority for NJ, due to the large population of sea turtles that enter the MAB annually, their protected status under the Endangered Species

Act, and the breadth of this project to both meet the sea turtle priority of the RMI plus benefit several of the other objectives and projects. Ocean development is expected to occur within many areas of the MAB, both inshore and farther offshore, in sites with known sea turtle presence. Previous research has identified large scale region trends for loggerheads (Winton et al. 2018); however, work needs to be focused in the specific wind lease areas to establish the appropriate baseline levels prior to turbine construction. The MAB is a globally important seasonal foraging ground for 60,000 – 80,000 loggerheads annually (Barco et al. 2018), and slightly fewer green turtles, Kemp's ridleys, and leatherback sea turtles (Kot et al. 2021). As the climate warms and nesting beach conservation efforts continue to be successful, it is expected that the region will see an increase in the seasonal range for sea turtles (**Figure 2**; Griffin et al. 2019; Patel et al. 2021) and likely more individuals entering the MAB annually.

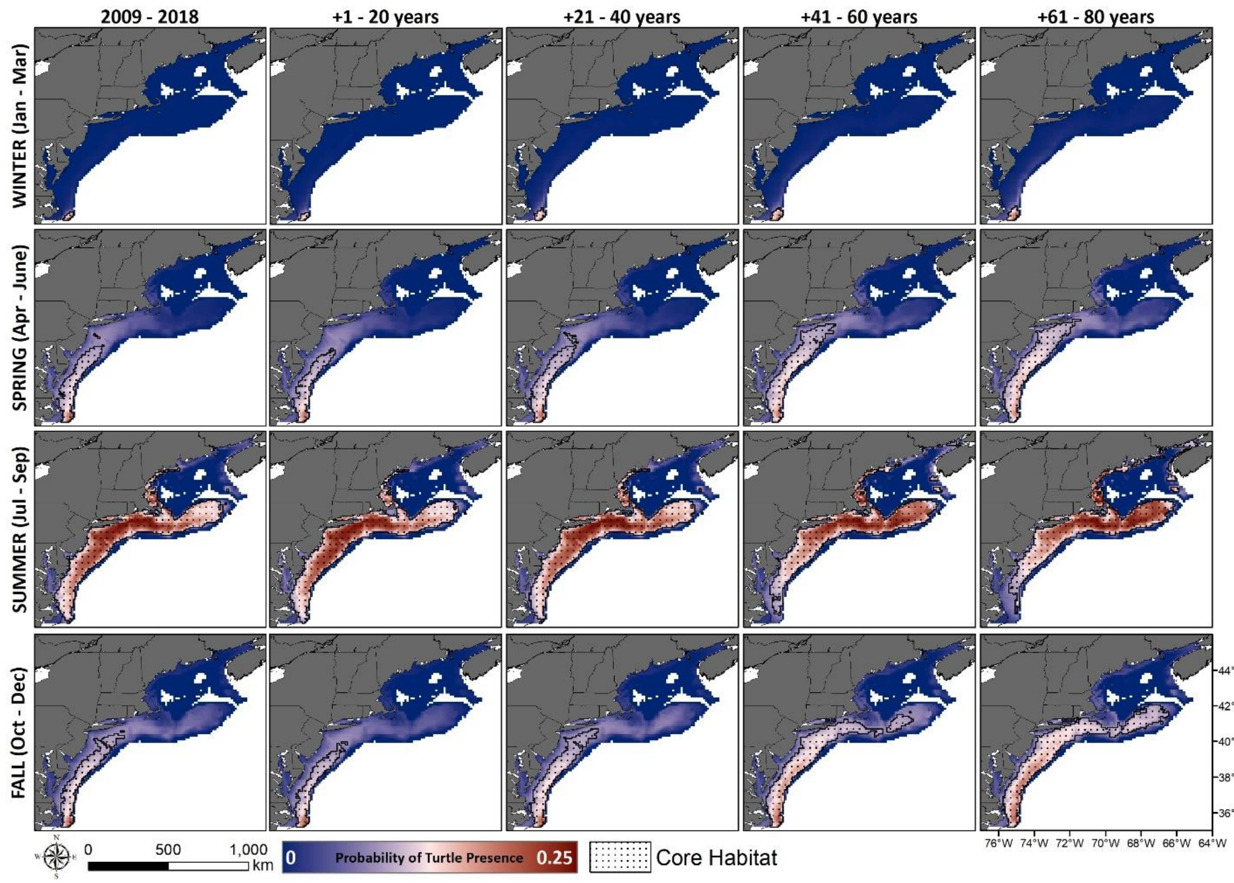

Figure 2: Seasonal maps of probability of turtle presence and core habitat based on observed and projected sea surface temperatures (SST) using the CM2.6 model (Patel et al. 2021).

Impacts from Offshore Wind Development: With the novelty of wind farm construction in the NW Atlantic, it is currently difficult to be certain of the specific impacts to the sea turtle population; however, based on previous research there are several potential consequences to ocean development (**Figure 3**). In pre-construction and during construction, the soundscape of the region is expected to significantly change. Impulsive sounds from seismic surveys can travel several miles before blending into the background noise. Turtle hearing is focused within the low frequency range, and these sounds travel the farthest underwater. Furthermore, with the

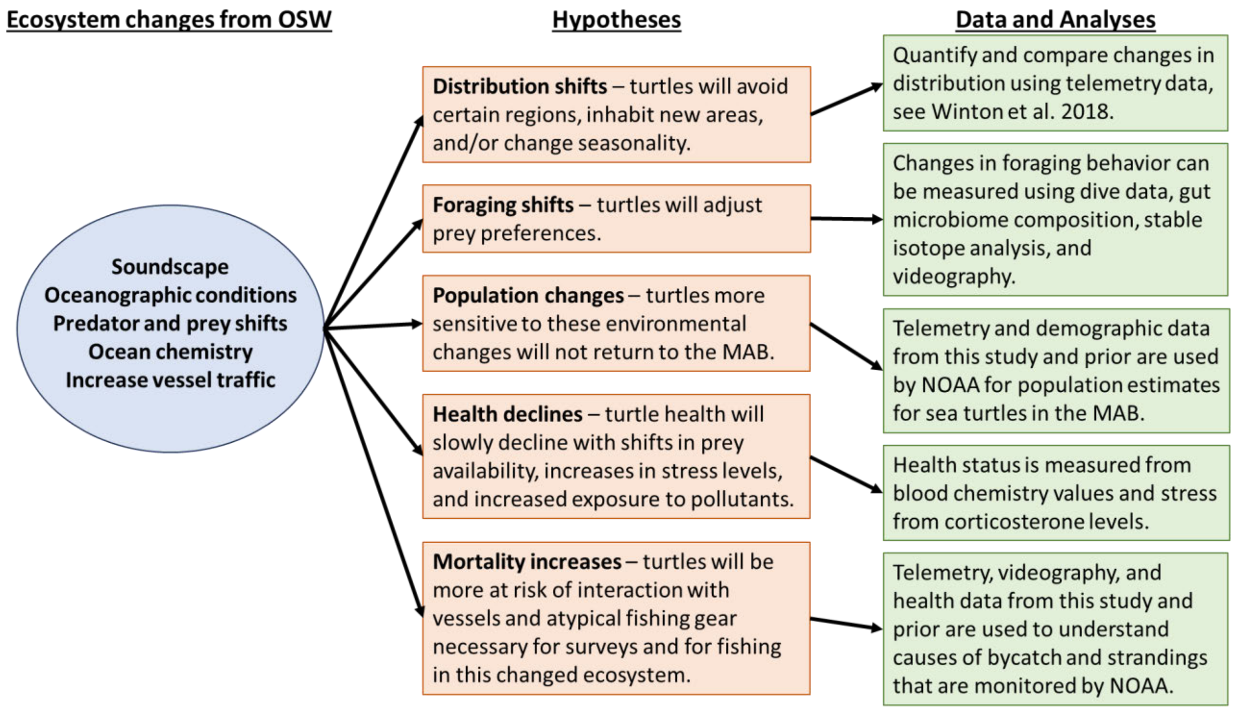

Figure 3: Conceptual framework linking potential offshore wind effects with sea turtle responses and the relevant data required to test each hypothesis.

intensity of activities like pile driving that can create 7,000 impulsive hammer strikes per piling, this has the potential to cause substantial disturbance to animals in the region (Bailey et al. 2010). During post-construction, it is currently unclear how the infrasound from the movement of the turbines will impact sea turtles, but considering the low frequencies of these sounds, it is possible this could be an additional nuisance for marine species. CFF currently has funding from the Bureau of Ocean Energy Management to study the behavioral response of leatherback turtles to impulsive sound. We completed field work in Autumn 2023. This is the first study to test the effects of impulsive sounds on sea turtles *in situ*. Results are pending, but we can use them to help inform our understanding of changes to underwater soundscape associated with wind farm development and sea turtle behavior.

Ecologically, the pilings themselves may create artificial reefs that generate an increase in biodiversity that can both generate new prey options or increase predator presence (Degraer et al. 2020). Oceanographic alterations, like surface turbulence and wakes caused by turbine foundations (Schultze et al. 2020), may not be suitable for turtles dependent on pelagic foraging and logging at the surface for breathing and temperature regulation (Huang 2022). During decommissioning phase, consideration must be taken in how the turbines are safely removed. Past attempts at removing oil platforms have resulted in substantial impacts, including mortality to sea turtle species (Viada et al. 2008). These attempts included underwater explosions that led to an increase in turtle strandings and injuries (Viada et al. 2008). Additionally, this ocean development will release a range of industrial chemicals into the ecosystem, and it’s unclear how these substances could change turtle biology with indications that shifts in bacterial composition correspond to increased stress and gut dysbiosis (Beale et al. 2022).

Sea turtles do noticeably respond to substantial environmental change. For example, in 2011 as Hurricane Irene passed through the MAB causing a significant change to ocean conditions, loggerheads took longer dives and moved away from their sites of residency leading up to and as the storm travelled directly over them (Crowe et al. 2020). Then several turtles completely abandoned the region after Irene passed moving south much earlier than what is typically observed for loggerheads in the region. Hurricane Irene, a storm that lasted less than 24 hours in the MAB, potentially disrupted the seasonal foraging behavior of loggerheads for several weeks after. With ocean development it is possible we could see a similar response from turtles, and the satellite telemetry data will help document these changes. We hypothesize that turtles could exhibit a phenological shift of entering and leaving the MAB at different times of the year and changing their dive patterns while in the region. We may also notice a shift in the composition of marine turtle species inhabiting the region depending on the sensitivity of each turtle to wind turbines, along with their preferred prey preferences. Furthermore, we expect both the telemetry data and the direct footage within the WEAs to provide key baseline information on turtle behavior and the overlapping species, which we can be added and compared to previous footage of loggerheads in the MAB (Smolowitz et al. 2015, Patel et al. 2016). Satellite telemetry and biological samples provide some insight on foraging behavior, but without direct observation it's not always clear how turtles use their environment. The videography techniques will provide high resolution data on turtle movement and data within the WEAs otherwise inaccessible using other techniques.

Loggerheads are known to forage both on benthic and pelagic prey at varying ratios, and we plan to collect biological samples to help provide insight on baseline foraging preferences in the region. We may see a shift in prey signatures and parasite load through stable isotope analysis, gut microbiome characterization, and fecal samples as the ecosystem changes, or perhaps a shift in demographics, as smaller turtles tend to be more pelagic foragers compared to larger turtles (Hawkes et al. 2006). Furthermore, we can compare blood chemistry (Yang et al. 2019), stable isotope signatures (Ceriani et al. 2014), and gut microbiome composition (Forbes et al. 2023) with previously published data collected by NEFSC and CFF from loggerheads in the MAB to help establish a baseline across several years of sampling.

The most dramatic impact from wind farms could be a reduction in the population of turtles entering and inhabiting the region. Population estimates in the region are highly dependent on telemetry data to calculate the availability bias used to convert aerial survey sightings into total counts (Hatch et al. 2022). Through our collaboration with NEFSC, we plan to provide the relevant telemetry data to improve sea turtle population estimates based on their annual aerial surveys. Furthermore, flipper tagging and photography can help provide identification to individual turtles to improve population estimates based on nesting and reproductive metrics used on nesting beaches. All of this baseline information will be critical for determining if turtle behavior, distribution, species composition, or general presence changes within the MAB after turbines are constructed. See table 1 for a full list of the expected data from this project and the relevance to the potential impacts from offshore wind development.

The value of having these baseline data, plus the over 10 years of additional collected data, is we can ideally separate the impacts to turtle behavior and biology between ocean development and general ecosystem shifts caused by broader impacts like climate change. With the expediency of wind farm construction, we expect turtles to respond similarly as quickly. As a result, we may see changes in behavior, foraging preferences, and biological indicators, like blood chemistry, stable isotopes, and microbiome, occur immediately after construction has begun.

4. Proposed Research

We propose six objectives to address the following hypotheses. Our hypotheses are written with the expectation that turtle characteristics will change during construction and while the turbines are active in the region (post-construction) as this provides a logical path to determining if the WEAs will in fact impact sea turtles. For this study, however, due to the time limitations (two-year project) we only expect to establish the baseline information for loggerheads in the region. We do not expect to reach a conclusion for these hypotheses within the duration of this project and would likely need several years of sampling throughout a large portion of the lifespan of the turbines to accurately address each one. For example, Vander Zanden et al. (2014a), based on isotopic signatures, suggests that loggerhead prey preferences don’t substantially vary for up to 12 years, as a result to truly see change could require over a decade of sampling when testing for certain criteria of foraging behavior. Furthermore, some of these hypotheses will be resolved with analyses not conducted as part of this study, like population estimates and mortality risk, as these are metrics managed by NEFSC. However, this project will help provide context to those metrics by providing demographic information, surface availability, dive behavior information from telemetry and videography data, and the health status of loggerheads in the MAB.

Hypotheses:

1) Turtles will shift their seasonal distribution patterns during and post-construction of turbines.
2) Turtles will adjust their prey preferences near WEAs.
3) Turtle population structure will shift in the MAB.
4) Turtle blood chemistry characteristics and stress levels will be different during and post-construction of turbines.

Plan: This project will be comprised of six objectives to begin the first steps of testing the above hypothesis. We plan to fulfill the overarching goal of establishing baseline data on sea turtles overlapping proposed NJ WEAs:

1) Conduct a literature review of sea turtle biology and ecology relevant to the MAB.
2) Annually tag and collect samples from 20 sea turtles (primarily loggerheads) caught at-sea.
3) Collect videography data on sea turtle at-sea behavior in the proposed Wind Energy Areas.
4) Document seasonal distribution of turtles within the Mid-Atlantic Bight using data collected during this study and existing telemetry data collected by CFF and partners.

5) Establish baseline health status and stress levels for turtles in the MAB using samples collected during this study and samples collected during previous years.
6) Identify foraging preferences for turtles in the MAB using samples collected during this study and samples collected during previous years.

Species and Sample Size Considerations: With the range of potential ecosystem impacts caused by wind turbines combined with the available resources, logistics, and data available to be collected from sea turtles in the NW Atlantic, we propose the above research goals and annual sample size. Establishing baseline data, similar to fisheries management, requires annual surveys, and these proposed samples combined with the previous year's efforts by CFF and NEFSC will help ensure the most up-to-date knowledge is being applied to determining the impacts of WEAs on sea turtles. We primarily focused this project on loggerhead turtles and other overlapping hard-shelled species (Kemp's ridleys and green turtles when available) due to the ubiquity of these animals within the MAB specifically overlapping the WEAs, the high likelihood of capturing and sampling these species, and the 10+ years of existing data collected by CFF and NEFSC on loggerheads within the NW Atlantic. Loggerheads are perhaps the most common sea turtle species in the region with individuals ranging from juveniles through adults entering the MAB annually for summer foraging. Furthermore, with their broad spatial range within the region from coastal waters to far offshore, they are good species for ecosystem monitoring (Patel et al. 2018). Although, we also expect leatherbacks to be impacted by wind turbines, studying them requires a totally different research platform at sea, more personnel for veterinary care, aerial spotting, and handling the larger animals, and sightings and captures are not as predictable as with loggerheads.

In terms of samples size, we propose to capture and deploy satellite tags on 20 turtles per year. Although we expect to most likely capture loggerheads, we also will attempt to capture and tag Kemp's ridleys and green turtles when spotted. Although, we may only capture one to five Kemp's or green turtles, this will still provide more information about these species in the MAB than previously documented from satellite telemetry over the last 20 years. For the videography work, we hope to capture and deploy camera tags on 10 turtles annually in the WEA, and film as many more as possible using the ROV. Due to the timing of the trip in July, when turtles are most likely to be overlapping the WEAs and are the most active in the region, they tend to be more difficult to catch. As a result, we plan to use a combined videography approach to increase chances of successfully documenting turtle behavior at-sea. Furthermore, we are keeping the sample size at 20 satellite tag deployments and 10 camera tag deployments per year to remain consistent with the previous year's tagging of loggerheads in the MAB, and to ensure costs remain within a reasonable range. With each satellite tag and day at-sea costing over $5,000 each, attempting to capture and tag more turtles would result in an over-inflated budget. However, considering the logistical complication of capturing a turtle, we want to ensure the largest possible breadth of samples are collected from each individual and that some sort of telemetry device, ideally a satellite tag, is deployed to obtain data beyond the capture event.

We plan to maximize the sample size by using data and samples already collected by CFF/NEFSC to establish baseline metrics of sea turtle habitat usage, health characteristics, and foraging preferences in the MAB (Objectives 4, 5 and 6). Since 2009, CFF/NEFSC have been capturing, sampling, and tagging loggerhead turtles in the MAB. This has led to several publications already characterizing trends for loggerhead seasonal distribution and associated environmental covariates (Winton et al. 2018; Patel et al. 2018, 2021), blood chemistry reference intervals (Yang et al. 2019), stress hormone levels (Allen et al. 2018), foraging preferences (Ceriani et al. 2014, Smolowitz et al. 2015, Patel et al., 2016), and response to other regional conditions like storms (Crowe et al. 2020) and fisheries (Hatch et al. 2023) to help differentiate impacts from offshore wind.

For this study, we will analyze the inventory of blood samples from 2017 – 2023 to update the blood chemistry reference intervals established in Yang et al. (2019). This will expand the range of what is considered a healthy turtle based on blood characteristics and will include samples from turtles captured near NC. This is important for determining how blood chemistry changes seasonally and during times when turtles are foraging less and resting more. Also, this increases the range of demographics for informing understanding of healthy blood chemistry levels, as those caught near NC tend to be smaller. In addition, we will use these blood samples to characterize corticosterone levels as an indicator of stress in captured turtles and testosterone levels to determine sex of turtles considered juvenile.

We will use the inventory of skin samples from 2012 – 2023 to update information on stable isotope values for loggerheads foraging in the MAB (Ceriani et al. 2014). Again, this will be combined with samples collected from NC, so we will have isotopic signatures from two different seasons, foraging behaviors, and smaller turtles. Conveniently, loggerheads seem to exhibit high isotopic consistency over time such that collecting samples at any point of the year still allows for direct comparison between individuals (Vander Zanden et al. 2014a). Concurrently, we have collected fecal swabs since 2021 on all captured loggerheads to establish the baseline of their gut microbiome. This is both an indicator of health status and foraging preferences. Gut microbiome is likely to change much faster than isotopic values and provides context for more immediate foraging activity (Forbes et al. 2023). We will also compare gut microbiome with blood chemistry to help improve understanding of turtle health.

Research Cruise Plans: To fulfill these objectives, we plan to have three research trips per year (**Figure 4**). The first trip will occur in early March to satellite and acoustic tag primarily loggerheads, but other species as available, in coastal waters of Cape Hatteras, North Carolina. We expect this trip to require six days at sea (DAS), all day trips departing from Hatteras aboard the F/V Salvation. For this trip we will live on the island of Hatteras for two weeks and conduct at-sea field work during the six best weather days. The second trip will occur in late May within offshore waters of the southern MAB to also satellite and acoustic tag loggerheads as they are migrating north. We plan for seven DAS to capture and tag 10 sea turtles. For this trip, we will live offshore aboard a large fishing vessel (F/V Kathy Ann) that is not actively fishing. During both tagging trips, we will also collect demographic information, skin biopsies, blood samples, and cloacal lavage samples from each turtle to measure baseline biological information. The third trip will occur in July specifically in the NJ WEAs and use videography techniques to

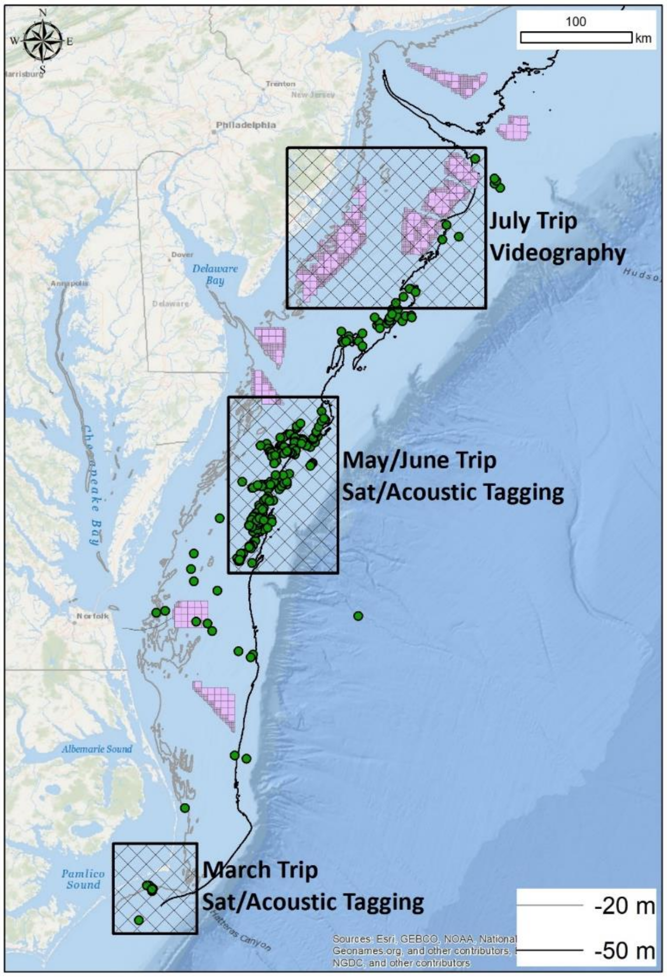

Figure 4: Map representing previous capture locations by CFF/NEFSC for loggerheads in the MAB, along with the proposed research locations for this project.

document both turtles and the habitat characteristics of these sites that are relevant to sea turtle ecology. For this trip, we are planning for another seven DAS aboard the F/V Kathy Ann.

Within the nearshore NC waters, sea turtles congregate during the late-fall through early-spring months, making catching them at-sea less difficult. From previous research, we tend to catch turtles that are slightly smaller than those caught during the offshore MAB trip. We also are likely to encounter both loggerheads and Kemp's ridley turtles of sizes large enough to be equipped with satellite tags. From three years of data, we have noticed turtles tagged in NC tend to migrate north following an inshore path, with some passing through the MAB and entering Southern New England (SNE; **Figure 5**). These turtles are very likely to be part of a cohort that would inhabit and pass through the coastal NJ WEAs. Tagging at this location also provides the best chance for interacting with hard-shelled species other than loggerheads. This is critical because there is far less information on Kemp's and green turtles in the MAB than on loggerheads (Kot et al. 2021). Here we will also take biological and morphometric data to establish baseline information on these turtles prior to entering the MAB because the exposure to impulsive sounds could be occurring immediately upon entering the region and far south of the NJ WEAs.

During the second trip we will tag and sample turtles in offshore waters of the southern MAB. Here turtles also tend to congregate as they migrate north into the region. Also, with the colder water temperatures in late-May, turtles tend to linger at the surface making them easier to both spot and capture. From previous sampling, these turtles migrate north during the summer, with many maintaining residency within the offshore NJ WEAs. Again, we will collect demographic and biological samples to help establish baseline information for these turtles more likely to remain offshore. From previous work, this cohort tends to have larger morphometric measurements than the inshore group. As a result, the combined two separate tagging trips can provide data on a broader range of demographics for loggerheads likely to seasonally inhabit both the inshore and offshore NJ WEAs.

The third trip will occur within the NJ WEAs, in July, when we expect loggerheads to be inhabiting those areas. During this trip we will focus on videography as a method of studying both the turtles and the sites themselves. We will employ two videography methods. The first will be a remotely operated vehicle (ROV) to follow turtles from a distance as they swim and forage throughout the water column (Smolowitz et al. 2015, Patel et al. 2016).

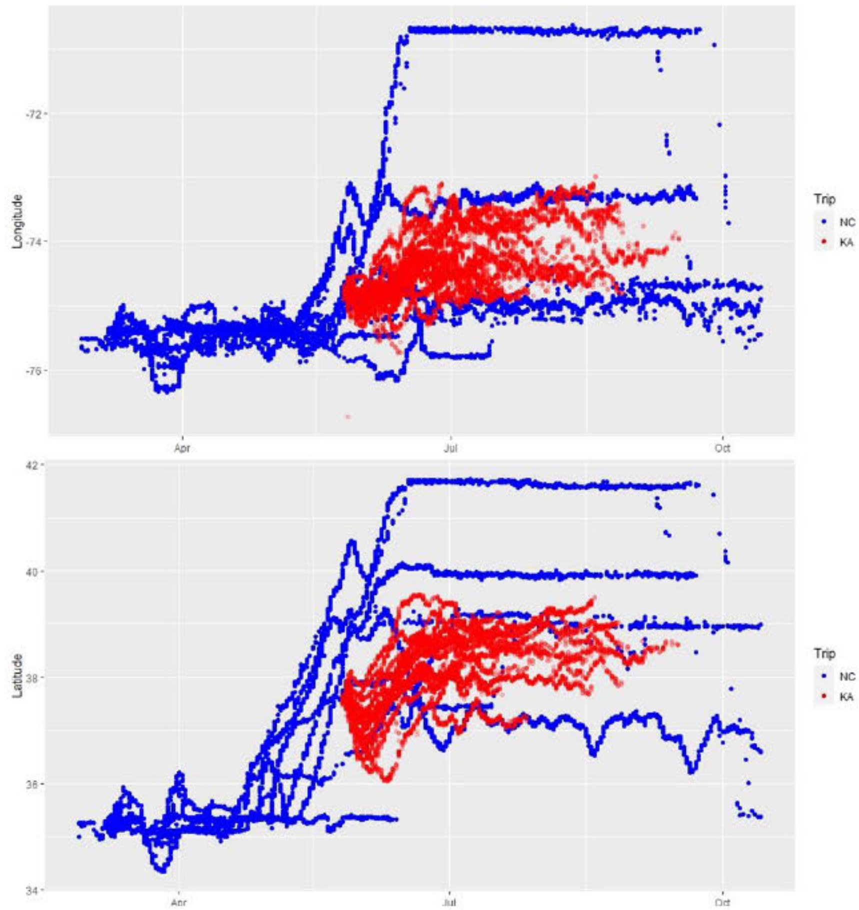

Figure 5: Longitudinal (top) and latitudinal (bottom) range of NC (blue) vs MAB (red) tagged turtles throughout their deployments in 2021 (unpublished CFF and NEFSC data).

CFF has several years of experience following loggerheads in the MAB using an ROV, and we have documented pelagic and benthic foraging, inter- and intra-species interactions, dive patterns, and surrounding environmental conditions. This method provides a high-resolution dataset of sea turtle behavior that complements the data transmitted from the satellite tags. In general, we have noticed that the ROV is not a disturbance to the animal, and they continue swimming, diving, foraging, defecating, and socializing with other turtles. From previous analyses, we used footage ranging in duration from 30 seconds to 418.8 minutes (Patel et al. 2016). With the combined data previously published, we can compare ROV footage from directly within the WEAs to outside of them to determine any obvious differences in turtle behavior when establishing the baseline dataset. The second videography technique will be the deployment of camera-tags mounted to the turtles. These data will differ from the ROV due to the continuous perspective of looking forward from the carapace. The ROV typically ends up following turtle from behind making breathing and foraging events sometimes difficult to accurately document. With the perspective of the face and head of the turtle, we can more effectively film these events and particularly film the prey species turtles are foraging. CFF and NEFSC have designed tags specifically for mounting on leatherbacks that record video, temperature, depth, and GPS and Argos quality locations. We plan to modify these tags to be mounted to hard-shelled turtles to document their habitat usage from their perspective.

Modifications will include changing the suction cup with an epoxy attachment technique similar to Thomson and Heithaus (2014), while retaining the same combination of sensors. Retention of the tag on hard-shelled turtles is dependent on the galvanic release used. We plan to have the camera tags release within 2-4 hours to ensure recovery within the same day. From previous data on green turtles, we expect loggerheads to return to 'natural behavior' within 30 minutes of deployment (Seminoff et al. 2006). Ideally, we will document movement through the water column, including foraging. Due to the potential increased stress caused by capture, we will limit handling time of the turtles to only as long as necessary for equipping the camera tags. As a result, we will likely not always collect the complete suite of biological samples from these camera-tagged individuals. We will collect morphometric measurements and attach passive tags (flipper tags and/or Passive Integrated Transponders [PIT]) to mark individuals.

Expected Data and Samples: From these trips we expect to collect a broad range of data on turtle in-water ecology and biology including demographics on turtles residing or passing through the NJ WEAs, baseline biological metrics, foraging preferences, available prey species, horizontal and vertical movement patterns, seasonal distributions, and overlapping oceanographic conditions. We plan to deploy Wildlife Computers Splash tags due to their reliability and high data output when deployed on hard-shelled turtles (Hays and Hawkes 2018). We will purchase two sizes of SPLASH tags to accommodate for the range in sizes of turtles we expect to capture in NC and the MAB. All satellite tags are expected to transmit for one year providing dive behavior, temperature through depth, and location data throughout the

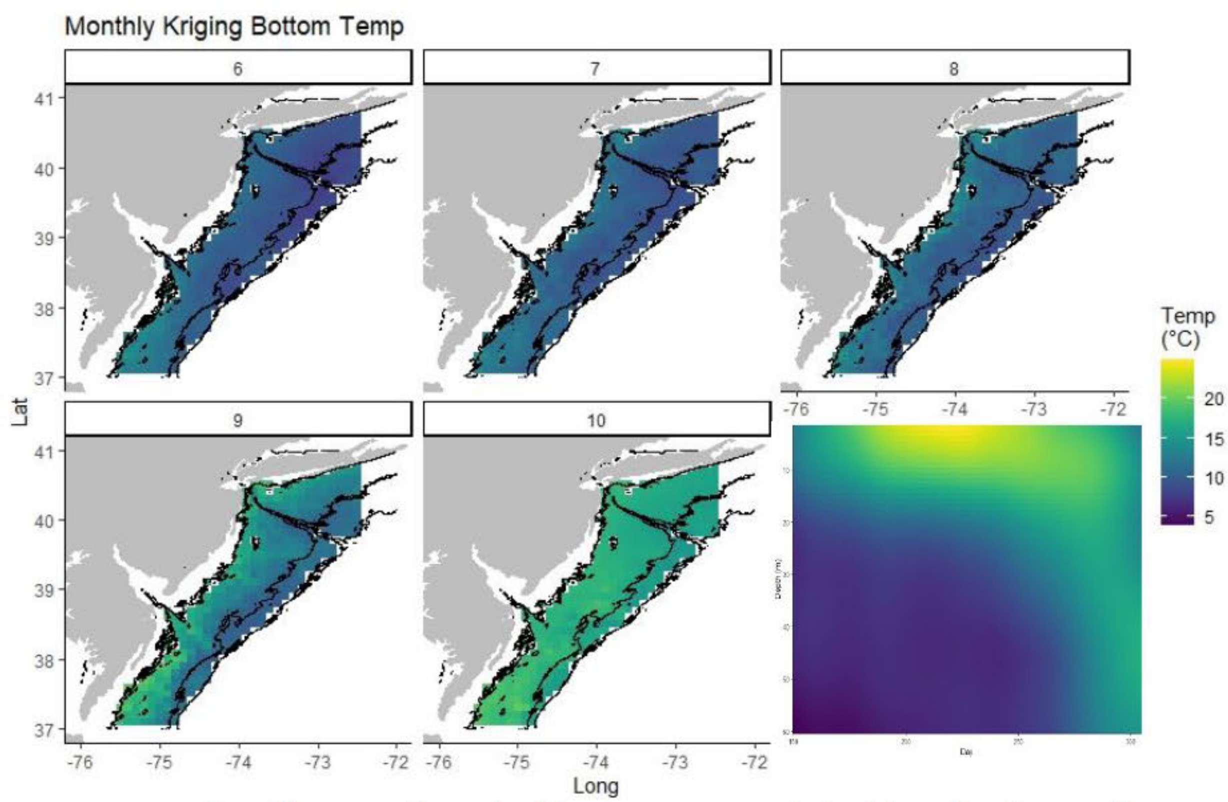

Figure 6: Maps of monthly averaged interpolated bottom temperature calculated from all turtles tagged between 2009 – 2021 while in the MAB. Bottom left image is the averaged interpolated full water column temp-depth profiles across the same months and region. (Unpublished CFF and NEFSC data.)

deployment. With the long-term deployment, we may also identify foraging site fidelity and determine if the same turtles are using or passing through the NJ WEAs annually. Furthermore, these tags provide high quality oceanographic data during a time of year that is typically difficult to model because of the nuances of the seasonal cold pool water mass in the MAB (**Figure 6**; Patel et al. 2018). The acoustic tags will help increase resolution of location data while in the NJ WEAs, as these sites are expected to have a network of acoustic receivers. We plan to deploy Innovasea V13T due to the combination of size, battery life, and additional environmental data. These tags are only 3.4 cm long, making them suitable for the entire size range of captured turtles during this study while also having an expected battery life of well over a year even with high transmission rates.

From the biological samples we plan to establish several baselines for loggerheads, and perhaps other hard-shelled species that utilize the MAB. From the blood samples, we will measure stress hormones to determine the baseline and compare with existing literature to interpret the level of stress. We will also measure blood chemistry levels to characterize turtle health status (Yang et al. 2019). Blood, along with the skin samples, will also be used to calculate stable isotope values to determine trophic position and foraging preferences for turtles in the region (Ceriani et al. 2014). From the cloacal lavage we will determine nematode parasite presence, gut microbiome, and prey preferences. The nematode *Sulcascaris sulcata* is a known parasite to the Atlantic sea scallop, and sea turtles provide a vector for transmission through the consumption of scallops and subsequent defecation of eggs. From previous work, the presence of nematodes in sea turtles and scallops has fluctuated since 2016, with matching highs and lows. With sea scallops being a high valued managed species in the region, we expect this study to be indicative of a shift in regional ecology that could lead to a deterioration of a critical fishery. *S. sulcata* is also known to infect other invertebrate species, and an increase in its presence may be indicative of a more general uptick in parasite load within loggerhead prey (Marcer et al. 2020).

The gut microbiome study will be used to determine foraging habits and health status within the region. Previous research has indicated that gut microbiome can have varying characteristics depending on diet and foraging activity (Forbes et al. 2022). Establishing a gut microbiome baseline will allow us to determine if turtle foraging activity and diet change once construction begins. From the lavages, we will also attempt to determine prey species directly using molecular techniques. We will test for higher taxonomic levels to obtain a broad perspective on foraging preferences, and 1 – 3 species-specific genetic markers based on relevance to the region. These will be determined after identifying, during the July 2024 videography cruise, prey species turtles are most likely to encounter in the WEAs.

In addition to the field work, we will conduct a thorough literature review to centralize the information on sea turtle biology and ecology within the MAB. Sea turtles have been tagged and tracked in the region since the 1990s, and aggregating this published information will be critical to understanding how they will be affected by wide scale ocean development.

Methodology: All objectives will follow methods previously established and implemented by CFF and collaborators for studying turtles in the NW Atlantic. At-sea we will implement several techniques that have all been authorized under ESA Permits #23639 and #22218 granted to CFF and NEFSC respectively.

Literature Review: For the literature review, we will conduct an exhaustive search of all relevant information on sea turtles within the MAB. We will consolidate these results into a report identifying known baseline information regarding the various biological and ecological characteristics for turtles versus the unknown/lacking data. This literature review will also provide research recommendations for future projects, including feasibility based on our experience with direct in-water capture and sampling for sea turtles in the region. CFF/NEFSC will also incorporate the historical data collected from loggerheads within the MAB that have not yet been published. This includes results on gut microbiome, parasite load, and updated information on turtle dive and movement patterns. Due to much of these data being unpublished, we will need to remain cautious of the format and how much data are presented.

At-Sea Methods: While at-sea, we will first spend time spotting for turtles. Once a turtle is spotted, we will prepare gear for capture. While in NC, we will employ two capture techniques. The first will be to use an entanglement net to collect sea turtles residing at the nearshore reefs. Then if turtles are also spotted lingering at the surface, we will capture them using a dip net. Due to the non-selective nature of the entanglement net and the high density of turtles in NC, we may catch different species of hard-shelled turtles. In the MAB, we will capture turtles exclusively using the dip net, a technique we have used successfully since 2009 to capture over 250 loggerheads in this region. While in NC, turtles will be processed on the same boat used for capture (F/V Salvation), while in the MAB, we will deploy a small inflatable boat for the capture and process the turtles aboard a larger commercial fishing vessel (F/V Kathy Ann) that will not be actively fishing.

Once a turtle, likely a loggerhead, is brought aboard, we will first take blood to attempt to capture hormone and chemical levels most closely associated with natural conditions. Allen et al. (2018) found that blood collected from our previous loggerhead captures within 20 minutes of the harassment does not show a clear increase in corticosterone concentrations indicative of stress. As a result, we will make sure to take blood within this timeframe to ensure that if corticosterone concentrations are elevated, they are likely not associated with the capture. We will collect a minimum of 6 ml from this first draw or the complete 12 ml if the blood draw is easy and successful. Blood will be spun and separated into red blood cells and plasma either after completing turtle processing, or at the end of that day. A few drops of the blood will be tested using an iSTAT blood analyzer while in the field. We will use cartridges Chem8+ and CG4+ to follow standards previously designed for analyzing turtle blood samples to determine health status (Yang et al. 2019). The remaining separated blood will be frozen and stored for later analyses. After the blood draw, we will weigh the turtle and measure the carapace and tail. Then we will collect the lavage sample by doing a cloacal flush using 30 ml of sterile saline. Internal body temperature will be taken twice to ensure the turtle has not overheated while on board. The first time will be soon after capture using a thermocouple inserted into the cloaca and the second time will be immediately prior to release. We will collect the skin biopsies from the rear flippers using a 6 mm sterile punch. One biopsy will be frozen, while the other will be preserved in a hypersaline solution. Then we will attach flipper tags on the rear flippers and inject a PIT in the triceps muscle complex between the front flipper and the carapace. While some of these sampling techniques are occurring, a researcher will clean the carapace to remove epibionts that may have hindered measuring and to prepare the shell for the tag attachments. Once prepped, the tags will be attached using a two-part epoxy. We will place the satellite tag on the vertebral scute at the highest and flattest section of the carapace, usually the second scute from the head. We will attach the acoustic tag on a posterior marginal scute. Once the epoxy has dried, we will release the turtle to the sea by lowering it down using a hoisting net while on the larger vessel in the MAB and by gently releasing it to the sea by hand aboard the smaller vessel in NC.

Figure 7: Turtle filmed by the ROV basking near the boat.

During the July videography cruise in the MAB, we will capture turtles when available, but primarily focus on filming spotted turtles using the ROV (**Figure 7**). To accomplish this, once a turtle is spotted, the ROV will be deployed and driven close enough to the turtle to visualize it in the camera. Then the ROV driver will attempt to continue following the turtle for as long as possible throughout the entire water column. Typically, visibility in offshore waters is good, and turtles can be followed from 2 – 3 meters away. If the turtle is lost, the ROV will be sent to the bottom to film the benthic environment and document prey species until another turtle is spotted. In July, we notice turtles are slightly more difficult to catch, however, we have had success in the past. If turtles are seen lingering at the surface, we will make a capture attempt so that we can attach a camera tag. To reduce handling time and increase the chances of the turtle returning to natural behavior as soon as possible, we will not always take the full suite of biological samples. We will first draw blood to collect some baseline health data, and then measure the turtle. We will then immediately prepare the carapace for the tag attachment. This will require three small spots to be prepped so that one end of the galvanic releases can be epoxied to the carapace. The other ends of the releases will be attached to the camera tag that will be equipped with a dive camera, a radio transmitter, and a pop-up satellite tag. While the epoxy is curing, we will attempt to take the remaining biological samples, particularly the cloacal lavage, due to the extent of analyses that can be accomplished from this sample. Skin biopsies will be last if possible. Turtles will also be equipped with flipper tags and a PIT upon release. Ideally, this will take half as long (20 min) as processing a turtle during the previous trips.

Biological Sample Analysis: At the end of each research trip, biological samples will be sent to the appropriate labs for analysis. Skin and blood samples will be dried, ground, and packaged for shipment to UC Davis for stable isotope analyses (SIA). We plan to run the blood and skin for bulk 13C and 15N and for compound specific amino acid 15N. This combined SIA of bulk and amino acid will provide a more detailed understanding of the trophic position of turtles in this region, and by assessing blood and skin we can determine foraging preferences at different time scales due to the varying turnover rates of each tissue (Vander Zanden et al. 2014a). We will use discrimination function analysis to help distinguish SIA values to categorize turtles based on foraging preferences. This is a common statistical method for analyzing SIA (e.g. Bean and Logan 2019 and Robinson et al 2016). Blood will also be sent to veterinary processing labs to test for hormone levels and characteristics used to assess overall health. Combined with Yang et al. (2019), blood results will be aggregated and summary statistics (range, mean, median, etc..) will be calculated to update reference intervals making these results easy to compare with future sampling. Cloacal lavage samples will be sent to Roger Williams University (RWU) Aquatic Diagnostics Labs (ADL) for nematode, gut microbiome (**Figure 8**), and prey determination studies. CFF has been working with the ADL for several years on these analyses, and protocols have already been established for these processes. Nematodes will be assessed using a visual scan of the lavage samples through a compound microscope. While genetic material from the lavage samples will be amplified and sequenced to determine bacterial and prey compositions. These results will also be aggregated into a consistent format for future comparisons.

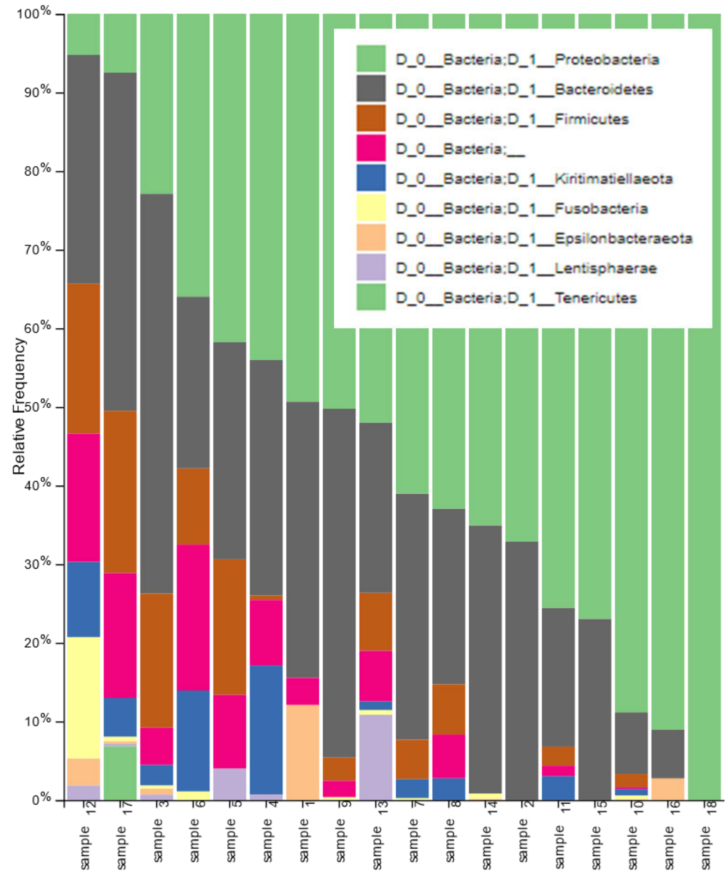

Figure 8: Composition of the gut bacteria from 18 loggerheads sampled in the MAB in 2021 (unpublished CFF and NEFSC data).

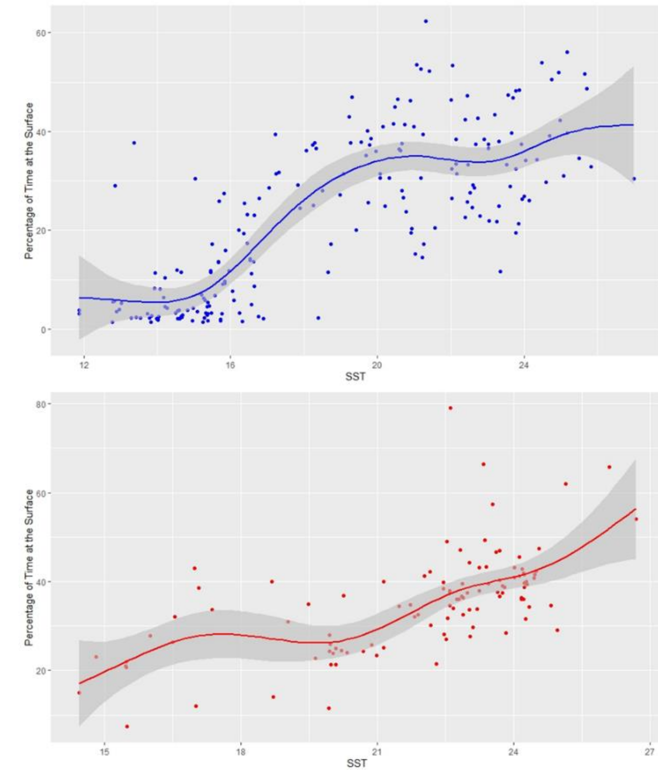

Figure 9: Percent of time at the surface as related to SST for NC (top, blue) vs MAB (bottom, red) tagged turtles in 2021. GAM fit line applied to both figures, with shaded region representing the 95% confidence interval (unpublished CFF and NEFSC data).

Telemetry Data Analysis: The satellite tag data will be analyzed in several ways. First, we will use the location data to determine the seasonal distribution of sea turtles in the MAB specifically overlapping the NJ WEAs. With the frequency of data transmissions and the various analytical tools to interpolate locations, we will generate daily position estimates using state space models common for interpolating telemetry data to obtain better temporal resolution for distribution data and allow for comparison with remotely sensed oceanographic data that is typically aggregated into daily averages. These data will be used to updated loggerhead distribution models developed by Winton et al. (2018) and modified by Hatch et al. (2023) that included data collected by CFF/NEFSC from 2009 - 2016. Winton et al. used a geostatistical mixed effects model to estimate the density of loggerheads within the Northwest Atlantic on a monthly timescale. Hatch et al. (2023) upscaled the results to increase the spatial resolution. We will update this model using 10 more years of data once all tags are deployed for this project, including the many tags deployed from NC after 2016. The dive data from the tags can also be interpolated using common regression models into a consistent temporal pattern making analyses easier (Hatch et al. 2022). We plan to establish trends in diving behavior between foraging in the greater MAB compared with the NJ WEAs to determine if there are fine scale regional differences. We expect diving behavior to be different between NC and the MAB, and likely between inshore and offshore foraging (**Figure 9**). We will establish several metrics that encompass movement patterns and dive behavior, for example swim speed, turn angle, dive duration, number of dives per sample period, and time at depth interval, and calculate summary information for each to establish a baseline that is easily compared to any future sampling (Patel et al. 2015). Each metric will be compared by season and region and with overlapping environmental variables when accessible, like SST, bottom temperature, and air temperature, using generalized additive models. This will allow us to establish the current predictors of turtle behavior, again as a baseline that can be easily compared with future data. Furthermore, it will be important to establish behavior characteristics both within, around, and relatively far from the WEAs to determine if the turbines are in fact causing any changes. We will also examine the temperature through depth data to develop products representing the full water column depth within the regions turtles overlap. Interpolated oceanographic products will be generated using kriging and generalized additive models. For the MAB, these products will provide high resolution full water column temperature data during the late-spring, summer, and early-fall months while the cold pool water mass forms, intensifies, and then degrades (Patel et al. 2018). The cold pool water mass is a unique seasonal feature of the MAB and is associated with processes required for high fisheries productivity (Miles et al. 2021). There are already recent indications that the cold pool is warming and shrinking in area (Friedland et al. 2022) and this could be exacerbated by the construction of turbines in the region (Miles et al. 2021). Combined with our data from 2009, this will provide a nearly 15-year time series on the oceanographic conditions within the MAB during the late-spring through early-fall. This provides a strong baseline of information regarding the environmental conditions of the region. Lastly, the acoustic tag data will be analyzed based on returns acquired through the planned network of receivers deployed by other organizations.

Videography Analysis: The videography data will be analyzed using animal behavior annotation programs called Observer XT and BORIS. CFF has used these programs to analyze a range of video footage including previous ROV footage of sea turtles (Patel et al. 2016). In BORIS, we can also incorporate the sound data from the camera tags to understand how turtles may be reacting or contributing to the soundscape within the region. We will develop an ethogram based on Patel et al. (2016) to document turtle flipper beats, breathing events, dive patterns, foraging events, prey species, sympatric species, intra/inter-species interactions, sound pressure levels, and other noteworthy events. The camera tags and ROV will also be equipped with temperature-depth loggers to provide additional details on the oceanographic conditions within the WEA sites.

Dissemination of Results and Deliverables: All results will be provided through progress and final reports as specified in the reporting requirements. If preferred, we will also hold regular meetings with NJ DEP to provide updates on the project. We will also provide project updates, if requested by NJ DEP, at relevant meetings with offshore wind regional coordination entities like RWSC, ROSA, and project WOW. All telemetry, demographics, and most biological samples will be stored and managed by the NEFSC. Lavage samples are stored and managed by Roger Williams University. With NEFSC managing these data, access is granted based on requests made through NOAA. These data also become shared with NEFSC for fisheries management and broader ocean development research. Products created from the telemetry data may be added to online portals like Northeast Ocean Data (www.northeastoceandata.org; Winton et al. 2018) and acoustic detections will be monitored through the Mid-Atlantic Acoustic Telemetry Observations System (MATOS).

The deliverables from the project will include the complete movement and dive information from 40 hard-shelled sea turtles seasonally inhabiting the MAB. These will be presented through both cumulative maps of their movements along with summary figures detailing dive behavior throughout the tag deployments. Satellite tags will also transmit oceanographic data and we plan to generate temperature-depth profiles for the region. Biological data will also be organized and summarized with relevant figures. We will combine the data collected during this project with previous data collected by NEFSC and CFF to characterize the baseline for loggerheads across several metrics that can then be used as indicators of change caused by ocean development. This will include seasonality within the MAB, dive preferences associated with ocean characteristics, blood chemistry reference intervals, gut microbiome composition, stable isotope signatures, parasite load, prey species, demographics, and oceanographic conditions.

Currently, NEFSC/CFF have already published baseline information for sea turtle seasonal movement within the MAB (Winton et al. 2018), high resolution behavior information through videography (Smolowitz et al. 2015, Patel et al. 2016), stable isotope signatures (Ceriani et al. 2014), blood chemistry reference intervals (Yang et al. 2019), MAB oceanographic conditions captured by loggerhead satellite tags (Patel et al. 2018), temperature and depth habitat envelope for loggerheads in the MAB (Patel et al. 2021), and updated estimates of loggerhead availability bias for aerial surveys (Hatch et al. 2022). Currently, updating these existing publications may not seem worthy for development into new manuscripts due to limited additional data and available time. Within the two-year time frame of this project, we plan to present updates to these studies within project reports and intend to publish the baseline data on loggerhead gut microbiome for the region and the demographic information based on a combination of NEFSC/CFF at-sea captures, plus bycatch information and strandings data from local collaborators. Both publications will provide novel insight on loggerheads that inhabit the region, increasing the portfolio of baseline information. For the gut microbiome study, we plan to establish the range of bacterial species quantity and diversity likely to exist in healthy sea turtles at different times of year, while they exhibit unique behaviors (overwintering vs migrating vs forging), and from a range of age classes (juvenile through adult). This will be the first study of its kind for this species in this region and gives context to both the health status of the population and its foraging preferences. Gut microbiome can quickly change (Forbes et al. 2023), and so knowing the range of bacterial load and diversity that occurs in healthy turtles is useful for determining more recent aspects of their life history. The second manuscript will focus on the demographics of the captured turtles which is essential for population modelling to determine the value of this cohort on the larger group of loggerheads inhabiting US Atlantic coastal waters. Studies indicate turtles that forage in the MAB make up the largest percent of nesters in certain beaches along the US east coast (Vander Zanden et al. 2014b). Knowing the demographics and population structure of these MAB turtles is essential for developing conservation priorities for the region and may help in determining the consequences to future nesting success from changes to their foraging behavior and/or health status caused by WEA.

Schedule of Activities: Below is the proposed schedule of activities. Most activities are organized around research cruises when most data are collected. The satellite tag data will continue to be transmitted for many months, and so that data analysis will be ongoing through most of the project. The lab-based analyses will also be ongoing through most of the project as samples will be coming in at various times and labs will have other projects to accomplish alongside this one. The videography analysis will be undertaken immediately after that research cruise and should become more streamlined after the first round of footage is processed. We will attempt to complete the literature review within the first 14 months of the project.

2024	1 Jan	2 Feb	3 Mar	4 Apr	5 May	6 Jun	7 Jul	8 Aug	9 Sep	10 Oct	11 Nov	12 Dec
Order tagging and sampling supplies	■	■		■		■					■	■
Research Cruises			■		■	■	■					
Lab based analysis (lavage, blood, skin)				■	■			■	■	■	■	■
Tag data analysis				■	■	■	■	■	■	■	■	■
Literature Review		■	■	■	■	■	■	■	■	■	■	■
Videography analysis								■	■	■	■	■
Report Writing			■			■			■			■
2025	**13 Jan**	**14 Feb**	**15 Mar**	**16 Apr**	**17 May**	**18 Jun**	**19 Jul**	**20 Aug**	**21 Sep**	**22 Oct**	**23 Nov**	**24 Dec**
Order tagging and sampling supplies	■	■		■		■						
Research Cruises			■		■	■	■					
Lab based analysis (lavage, blood, skin)	■	■		■	■			■	■	■		
Tag data analysis	■	■	■	■	■	■	■	■	■	■	■	
Literature Review	■	■										
Videography analysis								■	■	■		
Report Writing			■			■			■		■	■

Expected outcomes: During this project we expect to apply telemetry tags on 20 hard-shelled turtles per year and collect the full suite of biological samples and morphometric information from each turtle. Due to the nature of satellite tags, we don't expect all of them to function for the full planned deployment duration; however, we do expect to receive data from most of the tags while in the MAB. Based on previous tagging in the region, we do expect some turtles to either forage or at least transit through the NJ WEAs, providing data while in those sites. Regarding the biological samples, we expect to receive the relevant results (SIA, blood chemistry, hormones, nematode presence, microbiome, prey determination) from all collected samples, as these analyses are based on well-established protocols performed regularly by the collaborating labs. Cloacal lavage is the only biological sample we may not obtain from all turtles simply based on how well turtles cooperate with the cloacal flush. During the videography trip, we expect to film ~10 turtles either while using the ROV or through the video tags. This trip is the most weather dependent, and poor weather conditions will make it hard to both spot and catch turtles and drive the ROV even if turtles are spotted. Furthermore, recovery of the camera tags may be difficult if turtles quickly move far away, released floating tags become hard to spot, or if tags are picked up by nearby vessels.

Success will be evaluated based on several metrics. The first will be based on the number of turtles captured and tagged during the first two trips of each year. This set of turtles provides the majority of data for this project and ensuring we tag and sample 20 turtles will be critical. However, with multiple tagging trips, if are unable to catch our planned number of turtles, we can use those tags in future cruises. The second metric will be based on the number of turtles we document while conducting videography work in WEAs. Ideally, we will interact with several turtles but at a minimum we will be able to film the region to provide insight on the relevant prey species and overall environmental conditions within the sites during a time when turtles are very likely to be present. Other outcomes include the literature review and reports, and we are confident those will be completed appropriately based on our previous history of completing grants and publishing manuscripts.

5. **Budget**

In total, we are requesting $1,030,863 [redacted]

Personnel costs support the principal investigator, Samir Patel, for a total of 1000 hours, 40 DAS, and fringe benefits. More hours are allocated for funding year 2 to account for additional time required for data analysis and report writing. This will cover project management, data analyses, report writing, equipment purchasing and maintenance, and all fieldwork. Funding also covers 80 total hours for Justin Potter, CFF research coordinator, to handle all administrative tasks related to the project. The budget also includes funding for 40 total DAS for two CFF at-sea technicians to accompany during all fieldwork.

Travel costs will cover the roundtrip mileage to drive to Barnegat, NJ twice per year and Hatteras, NC once per year. Rates are based on GSA prices for each area. In Barnegat, we will stay on the boat, and food and lodging are covered in the charter rate. For the research trip to Hatteras, 18 days of funding are required for lodging and meals. We expect to stay in Hatteras for 14 days, with four days required for roundtrip travel from Massachusetts.

Supply costs include the following:

- 20 Wildlife Computers SPLASH-10-F 344/385 tags per year
- 20 Innovasea V13T acoustic tags per year
- Due to the fluctuating costs of fuel, we have budgeted this separately from the charter fees. We anticipate requiring [redacted] for the F/V Kathy Ann and [redacted] for the F/V Salvation to cover fuel during the research cruises.
- iSTAT cartridges are [redacted] and we plan to have enough to test 25 turtles each year.
- Lotek LAT 1800 temp-depth recorders will be attached to the ROV. We plan to order one in year 1 and have budgeted to order a replacement in year 2 in case of loss or malfunction.
- Paralenz dive cameras will be used as part of the camera tags, we plan to build three tags. We budgeted for the purchase of a camera in year 2 in case of loss or malfunction.
- Wildlife Computers MK10 satellite tags will be used on the camera tags to collect depth, temperature, and location data. They will also be used for recovery. We budgeted for the purchase of three in year 1 and one in year 2 in case of loss or malfunction.
- Consumable biological sampling supplies: needles, biopsy punches, vials, vacutainers, sterile saline, catheter tubes, syringes, betadine.
- Consumable tagging supplies: epoxy, gloves, tongue depressors, paper towels, acetone, rubbing alcohol, passive metal and PIT tags.
- Videography supplies: SD cards, storage hard drives, galvanic releases, syntactic foam, zip ties, fishing line, camera mounts, action cameras

- Turtle capture supplies: building or repair of dip nets and encircle nets, replacement of lost or broken radios for communications, and replacement of broken binoculars and chairs used for spotting.

Contractual costs include the following:

- Samples will be sent to UC Davis to be processed for SIA. Sample prep will be done in house prior to sending.
- Microbiome and prey genetic sequencing will be performed by the University of Rhode Island as part of an in-state partnership with RWU ADL.
- Nematode analysis will be completed by RWU ADL, and RWU ADL will conduct all amplification and extraction of genetic material for the microbiome and prey determinations prior to sequencing. RWU ADL will also interpret sequencing results.
- Blood hormone levels will be determined by commercial veterinary labs, like Antech Diagnostics.
- Vessel charter rates are based on size of the vessel and provided services. During the MAB research cruises, we will be living on the vessel and provided food. We have budgeted for 14 DAS/year. In NC, we will be taking day trips on a smaller gillnet vessel and have budgeted for 6 DAS/year.
- Argos monitoring fees are required to receive transmission from the satellite tags.
- New Jersey Sea Grant Consortium Management Fees for administering the contract from NJDEP.
- Subcontract to Coonamessett Farm includes gear storage and maintenance, along with payroll and human resources services. Coonamessett Farm is a separate entity to CFF that provides these additional services.

Indirect costs are calculated as follows:

- CFF uses a Modified Total Direct Cost (MTDC) based on federal guidelines for grants [redacted]. The MTDC is calculated the same way as the Total Direct Costs (TDC) except each contractual cost is capped at [redacted]. As a result, the total contractual costs added to the remaining categories is equal to [redacted] in year 1 and [redacted] in year 2.

Item	Rate	Units	Year 1	Units	Year 2	TOTAL
Personnel						
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
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Travel						
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Supplies						
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Contractual						
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[redacted]			[redacted]		[redacted]	[redacted]
[redacted]			[redacted]		[redacted]	[redacted]
Total Research Cost			[redacted]		[redacted]	**$1,030,863.00**

Budget breakdown for lab support from RWU ADL

[redacted]

on top of this Seq/target by invoice

6. **Expertise**

CFF in collaboration with NEFSC, RWU, Viking Village Fisheries, and F/V Salvation have all of the necessary resources to complete this project. This collaborative group has been working together for capturing and tagging hard shelled turtles for nearly 10 years. As a result, the reusable gear including ROVs, nets, and sampling equipment have generally all been purchased through previous years of funding resulting in a more streamlined budget that does not require large equipment expenses. Furthermore, by using the same vessels and crew to capture sea turtles at sea, we do not need to retrain staff and have more confidence in our abilities to achieve the sampling goals. We also have all the appropriate computer hardware and software to manage telemetry data and the appropriate storage capabilities for all of the biological samples. All listed methods have been previously accomplished by CFF/NEFSC on sea turtles, and so we expect similar positive results through this funding.

Principal Investigator: Dr. Samir Patel will be responsible for project management, data analyses, report writing, equipment purchasing and maintenance, sample distributions, and all fieldwork. Samir has been the PI on a loggerhead tagging project within the MAB since 2014, and has sampled over 150 turtles in the region, all caught at sea using either a dip net or entanglement net aboard the same boats being used in this proposal. This includes catching the turtles, completing all turtle processing steps as specified above, transporting samples, filming turtles using the ROV, deploying camera tags, deploying and recovering oceanographic sampling tools, analyzing telemetry, morphometric, oceanographic, and video data, and authoring reports and manuscripts.

The funded projects run by Dr. Patel at CFF include a loggerhead tagging project supported by the Atlantic Sea Scallop Research Set-Aside Program (RSA; FY23-24). This is an annually funded project that has contributed to the 10+ years of data on sea turtles within the MAB. Dr. Patel also has funding from the Bureau of Ocean Management (BOEM) to test the impacts of impulsive sounds on leatherback behavior (FY21-24). The field work for this project will be completed in the fall of 2023. Both projects will be finished in 2024 and will not conflict with the requirements of this funding, but rather will likely add additional information to help inform the results of this research.

The below collaborators are all associated with the loggerhead tagging research scheduled to be concluded in 2024, and Dr. Haas is also associated with the BOEM leatherback tagging project, again, scheduled to be completed in 2024.

Collaborators: Ron Smolowitz of Coonamessett Farm (CF) will provide expert technical advice and manage all aspects of the project specified above for CF (gear storage and maintenance, along with payroll and human resources services). Ron has been managing these aspects of CF and CFF since their inception and is the founder and treasurer of CFF. Ron also helped develop the sea turtle research program at CFF, including the capture, sampling, and filming of loggerheads in offshore waters of the MAB.

Dr. Heather Haas, of the Northeast Fisheries Science Center, has been a long-time collaborator with CFF on sea turtle projects, and was part of the team to help develop the methods for catching, tagging, and filming loggerheads in offshore MAB. Heather will provide technical expertise in all aspects of the project, will assist with fieldwork or preparation for fieldwork, will share Turtle Ecology Program resources, will store tissue samples prior to laboratory analysis, and will store resulting data in the Turtle Ecology database.

Dr. Galit Sharon, of RWU ADL, has been collaborating with CFF to conduct the nematode and microbiome analysis using the cloacal lavage samples. Galit will continue this analysis and develop the assay for prey determination based on existing genetic extraction and sequencing techniques. Galit will provide technical advice on sample collection, storage, processing, and analysis.

Jim Gutowksi, of Viking Village Fisheries, is a long-time collaborator of CFF and NEFSC, and was also part of the team to develop the process for capturing, tagging, and filming loggerheads in offshore MAB. Jim manages the F/V Kathy Ann, which CFF has been using for sea turtle research since the program's inception. The captain and crew of the F/V Kathy Ann are very familiar with this research, and provide expert advice on when, where, and how to capture sea turtles at sea.

Charlie Locke, captain of the F/V Salvation, has been working with CFF and NEFSC for several years to capture and tag sea turtles in NC nearshore waters. Charlie is an experienced gillnetter and provides expertise in deploying and retrieving the entanglement net, along with safely removing caught turtles. Charlie also provides expert advice on when, where, and how to catch turtles at sea.

7. **Resources**

CFF has been conducting research on sea turtles within the offshore and nearshore waters of the NW Atlantic since 2007. In collaboration with NEFSC, SEFSC, DFO Canada, North Carolina State University, Virginia Aquarium, New England Aquarium, several commercial fishing partners, this includes ~275 loggerhead captures with satellite tag deployments, ~50 leatherback captures with satellite tag deployments and non-capture camera-tag deployments, and 5 captures of Kemp's ridleys with one satellite tag deployment. From these turtles, we have also collected the same biological samples we plan to collect for this project. Through this CFF has developed close collaborations with fishing vessels and captains that are well trained in the at-sea methods and scientists who can contribute to both ensuring biological samples are effectively collected and follow through on the analysis providing results with relevant contextual information.

In terms of equipment, CFF will provide two ROVs for this project. Each ROV will also be equipped with a temperature-depth logger to record basic oceanographic conditions and high-definition action cameras to record footage. The first is the Benthos MiniROVER that we have used to film and follow over 73 turtles (**Table 2**; Smolowitz et al. 2015, Patel et al. 2016). This ROV will be used in the videography cruise in July. We will also use a Deep Trekker DTG2 that is meant for use on smaller vessels and in regions with less current. The Deep Trekker is easier to set up and will be used more opportunistically to film regions quickly or to provide pre-survey information prior to deploying the MiniROVER. However, unlike the MiniROVER, it only has 2 thrusters, instead of 3, and can fly at fastest 2.5 knots instead of 4 knots for the MiniROVER.

CFF also has all of the turtle capture gear, including entanglement nets, dips nets, and hoisting nets for obtaining turtles in-water and bringing them aboard. The F/V Kathy Ann will provide the small inflatable boat for in-water captures in offshore waters. CFF and collaborators also have all of the non-consumable tools necessary for measuring turtle morphometrics, body temperature, photography, attaching telemetry tags, and processing and storing samples for SIA, blood work, and lavage analysis.

Table 2: Technical Specifications of the MiniROVER.

Specification	Description	Details
Performance	Maneuverability	3-axis translation and yaw rotation
	Horizontal Speed	4 knots on surface, 2 knots at sea floor
	Operating Depth	300 m of seawater
Characteristics	Size	29.8 cm x 40.6 cm x 68.6 cm
	Weight	23.5 kg
Thrusters	Horizontal	Two 2 HP magnetically coupled brushless DC motors
	Vertical	One 1/3 HP magnetically coupled brushless DC motors
	Propeller	Stainless steel
Viewing	Camera 1	Color, Resolution: 470 lines, Sensitivity: 1.0 lux, Tilt: 180º
	Camera 2	B&W, Resolution: 600 lines, Sensitivity: 0.003 lux.
	Lights	2 LED arrays, one port and one starboard
Sensors	Heading	0-360º, 1º resolution
	Depth	±1° of operating depth

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Education
Ph.D., Environmental Science, Drexel University 2008 - 2013
B.A., Biological Sciences, George Washington University 2001 - 2005
Relevant Employment
Coonamessett Farm Foundation, Inc, Senior Research Biologist, East Falmouth, MA Since Aug 2014
Fisheries and Oceans Canada, Data Analyst, Saint Andrews, New Brunswick Feb – Apr 2016
The Leatherback Trust, Post-Doctoral Researcher, Monterey Bay, CA Jan – Jun 2014
Publications

Hatch JM, Murray KM, **Patel SH**, Smolowitz RJ, Haas HL. 2023. Evaluating simple measures of spatial-temporal overlap as a proxy for encounter risk between a protected species and commercial fishery. Frontiers in Conservation Science. 10.3389/fcosc.2023.1118418.

Forbes ZR, Scro AK, **Patel SH**, Dourdeville KM, Prescott RL, Smolowitz RM. 2023. Fecal and cloacal microbiomes of cold-stunned loggerhead *Caretta caretta*, Kemp's ridley *Lepidochelys kempii*, and green sea turtles *Chelonia mydas*. Endangered Species Research. 10.3354/esr01220

Hatch JM, Haas HL, Sasso CR, **Patel SH**, Smolowitz RJ. 2022. Estimating the complex patterns of survey availability for loggerhead turtles. The Journal of Wildlife Management. 86(4):e22208.

Kot CY, **et al**. 2022. Network analysis of sea turtle movements and connectivity: A tool for conservation prioritization. Diversity and Distributions 28.4: 810-829.

Robinson NJ, García-Párraga D, Stacy BA, Costidis AM, Blanco GS, Clyde-Brockway CE, Haas HL, Harms CA, **Patel SH**, Stacy NI, Fahlman A. 2021. A Baseline Model for Estimating the Risk of Gas Embolism in Sea Turtles During Routine Dives. Frontiers in Physiology, 12.

Patel SH, Winton MV, Hatch JM, Haas HL, Saba VS, Fay G, Smolowitz RJ. 2021. Projected shifts in loggerhead sea turtle thermal habitat in the Northwest Atlantic Ocean due to climate change. Scientific Reports, 11(1).

Crowe LM, Hatch JM, **Patel SH**, Smolowitz RJ, Haas HL. 2020. Riders on the storm: loggerhead sea turtles detect and respond to a major hurricane in the Northwest Atlantic Ocean. Movement Ecology. 8(1):1-3.

Yang T, Haas HL, **Patel SH**, 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).

Patel SH, Barco SG, Crowe, LH, 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 – 136.

Patel SH, Dodge KL, Haas HL, Smolowitz RJ. 2016 Videography reveals in-water behavior of loggerhead turtles (*Caretta caretta*) at a foraging ground. Front Mar Sci 3, 254.

Patel SH, Morreale SJ, Saba VS, Panagopoulou A, Margaritoulis D, Spotila JR. 2016. Climate Impacts on Sea Turtle Breeding Phenology in Greece and Associated Foraging Habitats in the Wider Mediterranean Region. PLoS ONE 11: e0157170.

Patel SH, Morreale SJ, Panagopoulou A, Bailey H, Robinson NJ, Paladino FV, Margaritoulis D, Spotila JR. 2015. Changepoint analysis: a new approach for understanding animal movements and behaviors from satellite telemetry data. Ecosphere 6: 1-13.

Patel SH, Panagopoulou A, Morreale SJ, Kilham SS, Riggall T, Margaritoulis D, Spotila JR. 2015. Fitness differences between postnesting loggerhead sea turtles (*Caretta caretta*) from Rethymno, Crete, Greece. Mar Eco Prog Ser 535: 231-241.

Smolowitz RJ, **Patel SH,** Haas HL, Miller SA. 2015. Using a remotely operated vehicle (ROV) to observe loggerhead sea turtle (*Caretta caretta*) behavior on foraging grounds off the mid-Atlantic United States. Jour Exp Mar Bio Eco 471: 84-91.

Spotila JR, Saba VS, **Patel SH,** Santidrián Tomillo P. 2015. Warming Climate: A New Threat to Leatherback Turtles. In: Leatherback Turtles: Biology and Conservation (eds. Spotila JR and Santidrián Tomillo P) John Hopkins Press, USA.

<u>Grants and Contracts (Total: ~$10.4 million)</u>

Patel SH, Smolowitz RJ and Siemann L. NOAA Atlantic Sea Scallop Research Set-Aside Program. Understanding the Impacts of the Atlantic Sea Scallop Fishery on Loggerhead Sea Turtles. **2015:** $861,672; **2016:** $797,040; **2017:** $899,000; **2018:** $762,395; **2019:** $584,415; **2021:** $798,908; **2022:** $983,004. 2023: $1,048,211

L. Siemann and **Patel SH.** 2022. NOAA Atlantic Sea Scallop Research Set-Aside Program. Using Sedimentary eDNA to Track the Presence of Scallop Spat and Predators. $399,422.

Patel SH, Komoroske L, Logan, J, Mils S, Robinson N, Dourdeville K, Prescott B, Haas H, Rogers R. 2022. MA Environmental Trust. Understanding the health and distribution of sea turtles within Massachusetts waters. $29,732.

Siemann L and **Patel SH**. 2021. NOAA Atlantic Sea Scallop Research Set-Aside Program. Developing a tool to quantify the impact of the scallop fishery on loggerhead sea turtles. $456,024.

O'Hara T, Jennings N, Davis F, **Patel S**, Garcia L, Siemann L. 2021-2022. Atlantic States Marine Fisheries Commission. Developing a hybrid learning curriculum for supplemental at-sea monitor training. $981,739.

Patel SH and Siemann L. 2020. BOEM Contract 140M0120P0032. Behavioral response of sea turtles from controlled exposures to a mobile impulsive sound. $206,474.

Patel SH and Clermont J. 2018. Saltonstall-Kennedy Fund. Improving oceanographic models of bottom temperature within the Mid-Atlantic Bight through novel data assimilation and stakeholder input. $257,534.

Patel SH. 2018. Saltonstall-Kennedy Fund. Using climate change scenarios to project loggerhead turtle distributions in the US Mid-Atlantic. $35,770.

Carlson A and **Patel SH.** 2018. Chesapeake Bay Fisheries Research Program. Examining the movement ecology and habitat utilization of black sea bass (*Centropristis striata*) in Chesapeake Bay using telemetry techniques. $149,442.71.

Patel SH. 2018. MA Environmental Trust. Nearshore habitat utilization by sea turtles within Massachusetts waters. $17,060.

Patel SH and Siemann L. 2017. Bycatch Reduction Engineering Program. Improving the Understanding of Sea Turtle Entanglement in Vertical Lines. $168,802.50.

Siemann L, **Patel SH**, Davis F. 2017. Saltonstall-Kennedy Fund. Developing a method for assessing blueline (*Caulolatilus microps*) and golden (*Lopholatilus chamaeleonticeps*) tilefish stocks using a baited underwater video system. $247,750.

Clermont J, Alexander R, **Patel SH**. 2017. Bycatch Reduction Engineering Program. Testing selectivity and raised webbing gillnets on target and non-target species in the northeast haddock fishery. $177,798.

Siemann L, **Patel SH**, Davis F. 2017. Marine Mammal Commission. Development and testing of an inexpensive GPS radio buoy system for early notification of whale entanglements. $19,960.

Huntsberger C, Siemann L, **Patel SH**, Smolowitz RJ. 2015. Saltonstall-Kennedy Fund. Investigating Offshore Essential Fish Habitat of Southern New England Winter Flounder. $259,532.

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WORK EXPERIENCE

October 1989 - Present	President, Coonamessett Farm, Inc
January 1, 2006 – Present	Treasurer, Coonamessett Farm Foundation, Inc
January 1985 - October 1989	Director, Special Projects, NERO, NMFS
July 1982 - January 1985	Commanding Officer, NOAA Ship **ALBATROSS IV**
August 1979 - January 1982	OIC, Northeast Marine Support Facility, NOS
August 1977 - June 1982	Technical Projects Coordinator, NEFSC, NMFS
February 1975 - August 1977	CO, NOAA Ship **TOWNSEND CROMWELL**

EDUCATION

College:	State University of New York Maritime College
Degree conferred:	Bachelor of Engineering/Marine (1969)

EXPERTISE

Exploratory fishing and gear development; marine living resource surveys; scallop fishery management; marine protected species gear and behavioral research; small fruit and vegetable farming; oyster aquaculture.

PUBLISHED PAPERS:

Smolowitz, R. J. 1972. Shipboard procedures to decrease lobster mortality. Comm. Fish. Rev. 34 (5-6):44-48
Smolowitz, R. J. 1978. Trap design and ghost fishing: An overview. Mar. Fish. Rev. 40 (5-6):2-8
Smolowitz, R. J. 1978. Trap design and ghost fishing: Discussion. Mar. Fish. Rev. 40 (5-6):59-67
Smolowitz, R. J. 1978. Annotated bibliography on lobster trapping and related subjects. M. Fish. Rev. 40 (5-6):68-77
Pecci, K. J., R. A. Cooper, C. D. Newell, R. A. Clifford, and **R. J. Smolowitz** 1978. Ghost fishing of vented and unvented lobster, Homarus Americanus, traps. Mar. Fish. Rev. 40 (5-6):9-43
Smolowitz, R. J. and F. M. Serchuk 1980. Recent USA lobster-trap gear research: Applications and implications. Canadian Technical Report Fish Aquat. Sci. 932 p73-76
Crossen, J. M. and **R. J. Smolowitz** 1980. Power system requirements of an electro-hydraulic clam dredge. Mar. Technology 80. Mar. Tech. Soc. p433-438
Twohig, P. and **R**. **J. Smolowitz** 1980. The application of an underwater color video system to fishing gear research. Proc Symp on Sci and Tech. Applications of Underwater photography
Serchuk, F. M. and **R. J. Smolowitz**. 1980. Size selection of sea scallops by an offshore scallop survey dredge. ICES C.M. 1980/K:24. 38pp.
Smolowitz, R. J. and V. E. Nulk 1982. The design of an electrohydraulic dredge for clam

surveys. Marine Fish Rev 44. 19 pp.
Smolowitz, R. J. 1983. Fisheries engineering and its role in resource management. MTS Jnal Vol 17(1):31-41.
Smolowitz, R. J. 1983. Mesh size and the New England ground fishery Applications and implications. NOAA Tech Rep. NMFS SSRF-77-1. 60pp.
Smolowitz, R. J. and R. L. Edwards 1983. The application of technology to the fishing industry. OCEANS 83 Marine Tech Soc. p853-856.
Smolowitz, R. J. and F. M. Serchuk, J. Nicolas, and S. E. Wigley 1985. Performance of an offshore scallop survey dredge equipped with rock chains. NAFO SCR DOC 85/89 Serial No N1064. 29pp.
Smolowitz, R. J. and F. M. Serchuk, 1987. Current technical concerns with Sea Scallop management. OCEANS 87 Proceedings. P. 639-644.
Smolowitz, R. J. and F. M. Serchuk, 1988. Marine fisheries technology in the United States: Status, trends and future directions. OCEANS 88 Proceedings. 5pp.
Smolowitz, R. J. and F. M. Serchuk, 1988. Developments in sea scallop gear design. Proc World Symposium on Fishing Gear and fishing vessel design. P. 531-540.
Smolowitz, R. J., F. M. Serchuk, and R.J. Reidman. 1989. The use of a volumetric measure for determining sea scallop meat count. J. of Shellfish Research, Vol. 8, No. 1, 151-172.
Serchuk, F. M. and **R. J. Smolowitz.** 1990. Ensuring fisheries management dysfunction: the neglect of science and technology. Fisheries 15:4-7.
Smolowitz, R. J. and D. N. Wiley. 1992. A model for conflict resolution in marine mammal/fisheries interactions: The New England Harbor Porpoise Working Group. MTS 92. pp 354-360.
Smolowitz, R. J. 2006. Sea Scallop Harvest Gear: Engineering for Sustainability. J. Mar. Tech. Soc. Vol. 40; No. 3. P.25-9.
Smolowitz, R. J., H. Haas, H. Milliken, M. Weeks, and E. Matzen. 2010. Using Sea Turtle Carcasses to Assess the Conservation Potential of a Turtle Excluder Dredge. North American Journal of Fisheries Management. 30:993–1000.
Smolowitz, R. J., H.O. Milliken, and M. Weeks. 2012. Design, Evolution, and Assessment of a Sea Turtle Deflector Dredge for the U.S. Northwest Atlantic Sea Scallop Fishery: Impacts on Fish Bycatch. North American Journal of Fisheries Management, 32: 65-76.
Ceriani, S. A., J. D. Roth, C. R. Sasso, C. M. McClellan, M. C. James, H. L. Haas, **R. J. Smolowitz**, D. R. Evans, D. S. Addison, D. A. Bagley, L. M. Ehrhart, and J. F. Weishampel. 2014. Modeling and mapping isotopic patterns in the Northwest Atlantic derived from loggerhead sea turtles. Ecosphere 5: 1-24.
Smolowitz, R. J., S. H. Patel, H. L. Haas, and S. A. Miller. 2015. Using a remotely operated vehicle (ROV) to observe loggerhead sea turtle (*Caretta caretta*) behavior on foraging grounds off the mid-Altantic United States. Journal of Experimental Marine Biology and Ecology 471: 84-91.
Siemann, L. A., C. J. Parkins, and **R. J. Smolowitz.** 2015. Scallops caught in the headlights: swimming escape behavior of the Atlantic sea scallop (*Placopecten magellanicus*) reduced by artificial light. ICES Journal of Marine Science 72: 2700-2706.
Smolowitz, R. J., L. A. Siemann, C. Huntsberger, and D. Boelke. 2016. Application of seasonal closures to reduce flatfish bycatch in the USA Atlantic sea scallop fishery. Journal of Shellfish Research 35: 475-480.

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Current Position:
Research Fisheries Biologist, Sea Turtle Ecology Lead, Northeast Fisheries Science Center, National Marine Fisheries Service, Woods Hole, MA 02543

- Lead research program to study sea turtle ecology and behavior
- Participate on research surveys and field work and collect and analyze data on the abundance, distribution, bycatch, biology, and ecology of marine turtles in NW Atlantic;
- Improve marine turtle population studies and management measures;
- Analyze biological and ecological sea turtle data.
- Serve as a consultant on sea turtle issues to various internal and external groups

Education:
Louisiana State University, Baton Rouge, Louisiana (8/97-12/01; GPA 4.0)
Doctor of Philosophy in Oceanography & Coastal Sciences; Minor in Experimental Statistics
Dissertation: Modeling Shrimp Population Dynamics
University of Massachusetts Dartmouth, South Dartmouth, Massachusetts (8/95-8/97; GPA 4.0)
Master of Science in Marine Biology; Thesis on Bivalve Behavior;
Miami University, Oxford, Ohio (8/87-5/92; GPA 3.6 overall and 4.0 in major)
Bachelor of Philosophy, Major in Interdisciplinary Studies; Biological & Cultural Diversity
Honors Program Graduate, Honors project in non-human primate behavior
Post-graduate courses: Introduction to Distance Sampling, Advanced Techniques in Distance Sampling, Mixed and Hierarchical Linear Models, Application of Akaike's information criterion (AIC) for model selection, Fast rescue boat training

Research Experience:
Postdoctoral Research Ecologist (1/02-12/03), Marine Biological Laboratory, Woods Hole, MA
Research Fellow (08/1997- 08/2001) and Research Assistant (08/2001 - 12/2001), Coastal Fisheries Institute, Department of Oceanography and Coastal Sciences, LSU

Honors and Awards:
United States Department of Commerce Silver Medal Award (2007)
Protected Species Award (2003)
Best Student Presentation (Louisiana Chapter of the American Fisheries Society, 2001)
Dr. Theodore Ford Memorial Endowed Scholarship (Department of Oceanography, LSU, 2001) The Joseph Lipsey Senior Memorial Scholarship (Department of Oceanography, LSU, 2001) Louisiana Coastal Conservation Association / J Pollard Sealy Memorial Scholarship (2000)
Best Oral Presentation (Aquatic & Marine Science Sym. of LA Univ. Marine Consortium, 2000) Best Oral Presentation (Department of Oceanography and Coastal Sciences, LSU, fall 1997) Board of Reagents Graduate Fellowship in Coastal Processes (LSU, 1997-2001)

Selected Papers:
Winton, MV, G Fay, HL Haas, M Arendt, S Barco, M James, C Sasso, R Smolowitz. In Press. Estimating the distribution and relative density of tagged loggerhead sea turtles in the western North Atlantic from satellite telemetry data using geostatistical mixed effects models. Marine Ecology Progress Series.
Warden, ML, HH Haas, PM Richards, KA Rose, J Hatch. 2017. Should observers walk or fly to monitor trends in sea turtle populations? Endangered Species research 34: 323-337.
Patel, SH, Dodge, KL, Haas, HL, & Smolowitz, RJ. 2016. Videography Reveals In-Water Behavior of

Loggerhead Turtles (Caretta caretta) at a Foraging Ground. Front. Mar. Sci, 3, 254.
Warden, M, HL Haas, KA Rose, PM Richards. 2015. A spatially explicit population model of simulated fisheries impact on loggerhead sea turtles (*Caretta caretta*) in the Northwest Atlantic Ocean. Ecological Modelling 299: 23-39.
Seminoff, JA, CD Allen, GH Balazs, PH Dutton, T Eguchi, HL Haas, SA Hargrove, MP Jensen, DL Klemm, AM Lauritsen, SL MacPherson, P Opay, EE Possardt, SL Pultz, EE Seney, KS Van Houtan, RS Waples. 2015. Status Review of the Green Turtle (*Chelonia mydas*) Under the U.S. Endangered Species Act. NOAA Technical Memorandum, NOAANMFS-SWFSC-539.
Smolowitz, RJ, SH Patel, HL Haas, and S Miller. 2015. Using a remotely operated vehicle (ROV) to observe loggerhead sea turtle (*Caretta caretta*) behavior on foraging grounds off the mid-Atlantic United States. Journal of Experimental Marine Biology and Ecology.
Scott-Hayward, L. A. S., Borchers, D. L., Burt, M. L., Barco, S., Haas, H. L., Sasso, C. R., & Smolowitz, R. J. (2014). Use of Zero-and One-Inflated Beta Regression to Model Availability of Loggerhead Turtles off the East Coast of the United States.
Ceriani, S. A., Roth, J. D., Sasso, C. R., McClellan, C. M., James, M. C., Haas, H. L., ... & Weishampel, J. F. (2014). Modeling and mapping isotopic patterns in the Northwest Atlantic derived from loggerhead sea turtles. Ecosphere, 5(9), art122-art122.
Haas, HL 2010. Using observed interactions between sea turtles and commercial bottom trawling vessels to evaluate the conservation value of trawl gear modifications. Marine and Coastal Fisheries: Dynamics, Management, and Ecosystem Science. 2:263–276.
Smolowitz, R, H Haas, M Milliken, M Weeks, E Matzen. 2010. Using sea turtle carcasses to assess the conservation potential of a turtle excluder dredge. North American Journal of Fisheries Management 30:993–1000.
Haas, HL, CJ Freeman, JM Logan, L Deegan, and EF Gaines. 2009. Examining mummichog growth and movement: Are some individuals making intra-season migrations to optimize growth? Journal of Experimental Marine Biology and Ecology 369: 8-16.
Haas, HL, E LaCasella, R LeRoux, H Milliken, and B Hayward. 2008. Characteristics of sea turtles incidentally captured in the U.S. Atlantic sea scallop dredge fishery. Fisheries Research 93: 289–295.
Milliken, HO, L Belskis, W DuPaul, J Gearhart, H Haas, J Mitchell, R Smolowitz, W Teas. 2007. Evaluation of a modified scallop dredge's ability to reduce the likelihood of damage to loggerhead sea turtle carcasses. U.S. Dep. Commer., NEFSC. Ref. Doc. 07-07; 30 p.
Logan, J, H Haas, L Deegan, E Gaines. 2006. Turnover rates of nitrogen stable isotopes in the salt marsh mummichog *Fundulus heteroclitus*, following a laboratory diet switch. Oecologia 147:391-395.
Haas, HL, KA Rose, B Fry, TJ Minello, and LP Rozas. 2004. Linking estuarine habitats to brown shrimp survival: implications of a spatially-explicit individual-based simulation model. Ecological Applications 14(4), pp. 1232-1247.
Fry, B, DM Baltz, MC Benfield, JW Fleeger, A Gace, HL Haas, and ZJ Quinones. 2003. Chemical indicators of movement and residency for brown shrimp (*Farfantepenaeus aztecus*) in coastal Louisiana marshscapes. Estuaries 26:82-97.
Haas, HL, EC Lamon, KA Rose, and RF Shaw. 2001. Environmental and biological parameters associated with stage-specific brown shrimp abundances in Louisiana: applying a new combination of statistical techniques to recruitment data. Canadian J. of Fisheries & Aquatic Sciences 58:2258-2270.
Haas, HL, RF Shaw, KA Rose, MC Benfield, and WR Keithly. 1999. Regression analysis of the relationships among brown shrimp (*Penaeus aztecus*) and environmental variables in southern Louisiana, USA. Proceedings of the Gulf and Caribbean Fish. Institute 52:231-241

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Address: 202 Fairway Dr., Middletown, RI, 02842
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1. University Education and Additional Training

Dates	Description
1992-1998	DVM - Doctor of Veterinary Medicine at the University of Veterinary Medicine, Kosice, Slovakia. Graduation with distinction. Israeli Veterinary license number for practicing: 1513
2008-2010	M.Sc. thesis in the Agriculture and Biotechnology Department, at the Institute of Desert Research, Ben Gurion University, Midreshet Ben-Gurion, Israel. Title of thesis: Immunization of guppies *Poecilia reticulate*, against *Tetrahymena* and the study of their immune response to infection. Supervision by: prof. Dina Zilberg
2010-2015	Ph.D. in Fish Health, Institute of Desert Research, Department of Agriculture and Biotechnology, Ben Gurion University, Israel Title of thesis: Protection of Guppies (Poecilia reticulata) from Infection with Tetrahymena and Study of their Immune Response to the Parasite Supervision by: Prof. Dina Zilberg and Prof. Noah Izakov
April 2018	Certified Aquatic Veterinarian – CertAqV, by the World Aquatic Veterinary medical Association
March 2019	Certified Fish medicine specialist- By the Ministry of Agriculture and Rural Development, Veterinary Services, Israel. Specialist # 561

2. Positions Held and Academic Status

Dates	Description
1998-2001	Veterinary surgeon, Hematological and Pathological Laboratory, diagnosis lab, at the "Center for Animal Medicine", owner and chief, Dr. Zeev Shiner. Five Habonim Street, Ramat-Gan, Israel.
2000-2007	Owner and head of "Animan", a veterinary private clinic, joint partnership with Dr. Ronit Abutbul. Veterinary surgeon and the manager of a small hematological and pathology laboratory for diagnosis. 1 Jabotinsky Street, Tel Aviv, Israel.
2006-2014	Veterinary supervisor for the health and marketing of fish for food, for fish farms in the region. Research and Development (R&D), Center of Ramat Negev district
2008-2014	The Fish Health Laboratory at the Institute of Desert Research, Department of Agriculture and Biotechnology, Ben Gurion University. Diagnosis of fish diseases. Histopathology, parasitological and bacteriological diagnosis. Chief Scientist: Prof. Dina Zilberg.
2015-2022	Research scientist (Assistant professor), Attending veterinarian and Head of the Department of Pathobiology and the Green-Keiser Fish Health Center, Israel Oceanographic & Limnological Research Ltd., National Center for Mariculture, Eilat, Israel
2016-2021	Lecturer at Ben-Gurion University, Eilat campus, Israel.
September 2021- August 2022	Sabbatical leave at Cornell University, Department of Microbiology and Immunology, Veterinary Medical Center, Ithaca, New York, USA. Joining Professor Theodore Clark's laboratory as a visiting scientist.

August 2022- to date	Associate Professor of Marine Biology and Director of the Aquatic Animal Diagnostic Lab (ADL). Department of Biology, Marine Biology & Environmental Science, Feinstein School of Social & Natural Sciences, Roger Williams University, 1 Old Ferry Road, Bristol, RI, USA

3. Articles in Reviewed Journals

Sharon, G., Pimenta Leibowitz, M., Kumar Chettri, J., Isakov N. and Zilberg D. (2013). Comparative study of infection with *Tetrahymena* of different ornamental fish species. *Journal of Comparative Pathology* 150, pp. 316-324.

Sharon, **G.,** Pimenta-Leibowitz, M., Vilchis, M.C.L., Isakov, N. and Zilberg, D. (2014). Controlled infection of *Poecilia reticulata* Peters (guppy) with *Tetrahymena* by immersion and intra-peritoneal injection. *Journal of Fish Diseases* 38 (1), pp. 67-74.

Sharon, **G.,** Benharroch, D., Kachko, L., Reis-Hevlin, N. and Zilberg. D. (2014). Liposarcoma in Clown Fish (*Amphiprion ocellaris*) produced in indoor aquaculture. *Journal of Fish Diseases* 38 (6), pp. 575-580.

Sharon, **G.,** Nath, P.R., Isakov N. and Zilberg D. (2014). Evaluation of Guppy (*Poecilia reticulata* Peters) immunization against *Tetrahymena* sp. using Enzyme-Linked Immunosorbent Assay (ELISA). *Veterinary Parasitology Journal* 205 (1-2), pp. 28-37.

Sharon, **G.,** Fridman, S., Reiss-Hevlin, N., Sinai, T., Boisot P. and Zilberg. D. (2016). Effects of different commercial diets on growth performance, health and resistance to *Teyrahymena* sp. Infection in Guppies (*Poecilia reticulate* Peters). *Aquaculture Research* 47 (7), pp. 2276-2286.

Stern, N., Rachmilovitz, E.N., **Sharon, G.** and Diamant, A. (2018). The direct implications of releasing marine ornamental fishes to the wild: first reported case from the Red Sea. *Marine Biodiversity* 48(3)

Sharon, G., Ucko, M., Tamir, B. and Diamant A. (2019) Co-existence of *Myxobolus* spp. (Myxozoa) in grey mullet (*Mugil cephalus*) juveniles from the Mediterranean Sea. *Parasitology research* 118(1)

Ravid-Peretz, S., Colorni, A., **Sharon, G.**, Ucko, M. (2019) Vaccination of European sea bass *Dicentrarchus labrax* with avirulent *Mycobacterium marinum* (iipA::kan mutant). *Fish and Shellfish Immunology* 90, pp. 317–327. IF 3.185 (doi:10.1016/j.fsi.2019.04.057)

Davidovich, N., Pretto, T., **Sharon, G**., Zilberg, D., Blum, S., Baider, Z., Edery, N., Morick, D., Grossman, R., Kaidar-Shwartz, H., Dveyrin, Z., Rorman, E. (2020) Cutaneous appearance of mycobacteriosis caused by *Mycobacterium marinum*, affecting gilthead seabream (*Sparus aurata*) cultured in recirculating aquaculture systems. *Aquaculture*

Genin, A., Levy, L., **Sharon, G.**, Raitsos, D.E., Diamant, A. (2020) Rapid onsets of warming events trigger mass mortality of coral reef fish. *Proceeding of the National Academy of Sciences of the United States of America (PNAS)* 117 (41)

Al-Ashhab, A., Alexander-Shani, R., Avrahami, Y., Ehrlich, R., Strem, R. I., Meshner, S., Shental, N., **Sharon, G.** (2022) *Sparus aurata* and *Lates calcarifer* skin microbiota under healthy and diseased conditions in UV and non-UV treated water. ***Animal Microbiome***

Inés Strem, R., Ehrlich, R., Shashar, N., Sharon, G. (2023) First description of *Vibrio harveyi* as the causative agent of morbidity and mortality in farmed flathead grey mullet (*Mugil cephalus*). Diseases of Aquatic Organisms

Strem, R., et al. (2023) Evaluation of Flathead Grey Mullets (*Mugil cephalus*) Immunization and Long-Term Protection against *Vibrio harveyi* Infection Using Three Different Vaccine Preparations. International Journal of Molecular Sciences (24), 8277.

James Gutowski

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Present Position
James Gutowski presently owns and manages two sea scallop vessels in Barnegat Light New Jersey. He also coordinates daily operations and scheduling for five other vessels at Viking Village Fisheries. He has worked successfully with Coonamessett Farm on several turtle projects.

History
Graduated Seton Hall Prep 1979
University of Rhode Island –Commercial Fisheries and Marine Technology 1979-1980.
Scallop vessel Captain 1981-1995
Scallop vessel Owner 1988(F/V Kathy Ann) Kathy Ann Corp
Scallop vessel Owner 2000(F/V Elizabeth) Thirty Fathom Fish Corp
New Jersey Agricultural Leadership Development Program Class IV graduate 2003
Mid Atlantic Fisheries Council Nominee 2005
A/R Manager/ Sales Manager Viking Village 1996-2007
Mid Atlantic Fisheries Council Nominee 2005
Attended Marine Resource Education Program Fall 2004
Sea Scallop advisory panel February 2008
Fleet manager of operations and coordination at Viking Fisheries 2008-present

Affiliations
Member Barnegat Light Planning Board
Member New Jersey Agricultural Society
Coach Stafford Hockey League Manahawkin New Jersey

P.O. Box 761
Wanchese, NC 27981

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obxlocke@aol.com

fvsalvation

PROFILE

26 years' experience as owner/operator of a commercial fishing business.

12 years' experience as industry collaborator on marine fisheries research.

VISION

To not only provide high-quality seafood to interested consumers but also to assist researchers and fishery managers in obtaining best-available science for managing marine fishery resources for long-term viability and a thriving domestic fishing economy.

SKILLS

Communication ★★★★

Critical Thinking ★★★★

Supervisory ★★★★★

Machine Operation ★★★★

Seamanship ★★★★★

SUMMARY OF QUALIFICATIONS

CHARLIE LOCKE

U.S. Coast Guard Licensed Captain / Commercial Fisherman

OVERVIEW. Full-time, dayboat commercial fisherman harvesting sustainable seafood off the Outer Banks, N.C., using multiple gears including float and anchored gillnet, bottom and surface longline, bandit reel, trolling and fish pot. Harvested species range from inshore net fish, such as sea mullet and Spanish mackerel, to offshore bottom fish which includes black sea bass, tilefish, grouper, and amberjack. One of just roughly a dozen commercial directed shark fishermen in North Carolina.

LICENSES & PERMITS

NOAA Fisheries 2022 Shark Research Fishery Permit (SRF-1-22-A)

NOAA Fisheries South Atlantic King Mackerel (KM-588)

NOAA Fisheries South Atlantic Sea Bass Pot Endorsement (SBPE-16)

NOAA Fisheries South Atlantic Snapper-Group, Unlimited (SG1-28)

NOAA Fisheries South Atlantic Shark Directed (SKD-209)

NOAA Fisheries South Atlantic Open Access Permits:

Dolphin/Wahoo, Smooth-Hound Shark, Spanish Mackerel

NOAA Fisheries Greater Atlantic Federal Permit (150993):

Black Sea Bass, Bluefish, Tilefish

N.C. Standard Commercial Fishing License (140319)

TRAINING & CERTIFICATIONS

Onboard Drill Instructor Course (ALMSEA-334), 2023

NOAA Fisheries Sea Turtle Safe Handling & Release Gear Workshop, 2021

U.S. Coast Guard 50-Ton Master Captain's License, 1995

PADI Open Water Diver, 1989

INDUSTRY SERVICE

NOAA Fisheries Atlantic Large Whale Take Reduction Team

North Carolina Commercial Gillnet Seat 4/06 – present

South Atlantic Fishery Management Council Mackerel Cobia Advisory Panel

North Carolina Commercial Seat 3/20 – present

INDUSTRY SERVICE *(continued)*

Atlantic States Marine Fisheries Commission Bluefish Advisory Panel

Commercial Seat 4/21 – present

N.C. Marine Fisheries Commission Kingfish FMP Advisory Committee

Commercial Seat 4/06 – 11/07

N.C. Marine Fisheries Commission Striped Mullet FMP Advisory Committee

Commercial Seat 3/04 – 4/06

RESEARCH COLLABORATIONS *(select)*

"**Greater Amberjack (*Seriola dumerili*) abundance, distribution and movement in the South Atlantic and Gulf of Mexico regions**," Mississippi-Alabama Sea Grant Consortium, NC State Subaward, PI: Jeffrey Buckel, July 2021 – October 2023.

"**Refinement and testing of a microprocessor-based shark bycatch reduction device (BRD) using an academic-industry partnership**," National Sea Grant Office Highly Migratory Species Competition, PI: Sara Mirabilio (North Carolina Sea Grant), October 2019 – August 2022.

"**Assessing effectiveness of a low-profile gillnet in reducing the bycatch of sea turtles in the commercial large-mesh gillnet fishery for monkfish**," NOAA Fisheries Northeast Fishery Science Center, PI: Henry Milliken, February – March 2017; February 2020 – February 2022.

"**Life history, behavioral ecology, and genetic stock structure of elasmobranchs in the South Atlantic**," S.C. Department of Natural Resources, PI: Bryan Frazier, July 2019 – December 2020.

"**Post-release survivorship, life history traits, and stock characteristics of scalloped and Carolina hammerhead sharks**," NOAA Fisheries Cooperative Research Program, PI: Dean Grubbs (Florida State University), July-August 2019.

REFERENCES

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S.C. Department of Natural Resources
Marine Resources Research Institute
217 Fort Johnson Road
Charleston, SC 29412
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Literature Cited:

Allen CD, Haas HL, Smolowitz RJ, Patel SH, Martin SL, Seminoff JA. 2018 Corticosterone concentrations in migratory loggerhead sea turtles. Oral presentation at International Sea Turtle Symposium, Kobe, Japan.

Bailey H, Senior B, Simmons D, Rusin J, Picken G, Thompson PM. 2010. Assessing underwater noise levels during pile-driving at an offshore windfarm and its potential effects on marine mammals. Marine pollution bulletin. 2010 Jun 1;60(6):888-97.

Beale DJ, Bissett A, Nilsson S, Bose U, Nelis JL, Nahar A, Smith M, Gonzalez-Astudillo V, Braun C, Baddiley B, Vardy S. 2022. Perturbation of the gut microbiome in wild-caught freshwater turtles (*Emydura macquarii macquarii*) exposed to elevated PFAS levels. Science of the Total Environment. 838:156324.

Bean SB, Logan JM. 2019. Stable isotope analyses of cold-stunned Kemp's ridley (*Lepidochelys kempii*) sea turtles at the northern extent of their coastal range. Marine Biology. 166:1-0.

Bureau of Ocean Energy Management. 2022. Ocean Wind 1 Offshore Wind Farm Biological Assessment. Prepared for National Marine Fisheries Service.

Ceriani SA, Roth JD, Sasso CR, McClellan CM, James MC, Haas HL, Smolowitz RJ, Evans DR, Addison DS, Bagley DA, Ehrhart LM. 2014. Modeling and mapping isotopic patterns in the Northwest Atlantic derived from loggerhead sea turtles. Ecosphere. 5(9):1-24.

Crowe LM, Hatch JM, Patel SH, Smolowitz RJ, Haas HL. 2020. Riders on the storm: loggerhead sea turtles detect and respond to a major hurricane in the Northwest Atlantic Ocean. Movement Ecology. 8(1):1-3.

Degraer S, Carey DA, Coolen JW, Hutchison ZL, Kerckhof F, Rumes B, Vanaverbeke J. 2020. Offshore wind farm artificial reefs affect ecosystem structure and functioning. Oceanography. 33(4):48-57.

Forbes ZR, Scro AK, Patel SH, Dourdeville KM, Prescott RL, Smolowitz RM. 2023. Fecal and cloacal microbiomes of cold-stunned loggerhead *Caretta caretta*, Kemp's ridley *Lepidochelys kempii,* and green sea turtles *Chelonia mydas*. Endangered Species Research. 10.3354/esr01220

Friedland KD, Miles T, Goode AG, Powell EN, Brady DC. 2022. The Middle Atlantic Bight Cold Pool is warming and shrinking: Indices from in situ autumn seafloor temperatures. Fisheries Oceanography. 31(2):217-23.

Griffin LP, Griffin CR, Finn JT, Prescott RL, Faherty M, Still BM, Danylchuk AJ. Warming seas increase cold-stunning events for Kemp's ridley sea turtles in the northwest Atlantic. PLoS One. 2019 Jan 29;14(1):e0211503.

Hatch JM, Haas HL, Sasso CR, Patel SH, Smolowitz RJ. 2022. Estimating the complex patterns of survey availability for loggerhead turtles. The Journal of Wildlife Management. 86(4):e22208.

Hatch JM, Murray KM, Patel SH, Smolowitz RJ, Haas HL. 2023. Evaluating simple measures of spatial-temporal overlap as a proxy for encounter risk between a protected species and commercial fishery. Frontiers in Conservation Science. 10.3389/fcosc.2023.1118418.

Hawkes LA, Broderick AC, Coyne MS, Godfrey MH, Lopez-Jurado LF, Lopez-Suarez P, Merino SE, Varo-Cruz N, Godley BJ. 2006. Phenotypically linked dichotomy in sea turtle foraging requires multiple conservation approaches. Current Biology. 16(10):990-5.

Hays GC, Hawkes LA. 2018. Satellite tracking sea turtles: Opportunities and challenges to address key questions. Frontiers in Marine Science. 5:432.

Huang SL. 2022. Unstated impacts of the green energy industry on the habitat of a coastal delphinid: Turbid-turbulent wakes induced by offshore wind turbine foundations. Aquatic Conservation: Marine and Freshwater Ecosystems. 32(11):1787-96.

Kot CY, et al. 2022. Network analysis of sea turtle movements and connectivity: A tool for conservation prioritization. Diversity and Distributions 28.4: 810-829.

Marcer F, Tosi F, Franzo G, Vetri A, Ravagnan S, Santoro M, Marchiori E. 2020. Updates on ecology and life cycle of *Sulcascaris sulcata* (Nematoda: Anisakidae) in Mediterranean grounds: molecular identification of larvae infecting edible scallops. Frontiers in Veterinary Science.

Miles T, Murphy S, Kohut J, Borsetti S, Munroe D. 2021. Offshore wind energy and the Mid-Atlantic Cold Pool: A review of potential interactions. Marine Technology Society Journal. 55(4):72-87.

Patel SH, Morreale SJ, Panagopoulou A, Bailey H, Robinson NJ, Paladino FV, Margaritoulis D, Spotila JR. 2015. Changepoint analysis: a new approach for revealing animal movements and behaviors from satellite telemetry data. Ecosphere. 6(12):1-3.

Patel SH, Dodge KL, Haas HL, Smolowitz RJ. 2016 Videography reveals in-water behavior of loggerhead turtles (*Caretta caretta*) at a foraging ground. Front Mar Sci 3, 254.

Patel SH, Barco SG, Crowe, LH, 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 – 136.

Patel SH, Winton MV, Hatch JM, Haas HL, Saba VS, Fay G, Smolowitz RJ. 2021. Projected shifts in loggerhead sea turtle thermal habitat in the Northwest Atlantic Ocean due to climate change. Scientific Reports, 11(1).

Robinson NJ, Morreale SJ, Nel R, Paladino FV. 2016. Coastal leatherback turtles reveal conservation hotspot. Scientific reports. 6(1):37851.

Rudders DB, Roman SA, Fisher R, McDowell J. 2023. Observations on a Reemerging Epizootic of the Sea Scallop, *Placopecten magellanicus*, Resource. Journal of Shellfish Research. 42(1):51-60.

Schultze LK, Merckelbach LM, Horstmann J, Raasch S, Carpenter JR. 2020. Increased mixing and turbulence in the wake of offshore wind farm foundations. Journal of Geophysical Research: Oceans. 125(8):e2019JC015858.

Seminoff JA, Jones TT, Marshall GJ. 2006. Underwater behaviour of green turtles monitored with video-time-depth recorders: what's missing from dive profiles? Marine Ecology Progress Series. 322:269-80.

Smolowitz RJ, Patel SH, Haas HL, Miller SA. 2015. Using a remotely operated vehicle (ROV) to observe loggerhead sea turtle (*Caretta caretta*) behavior on foraging grounds off the mid-Atlantic United States. Jour Exp Mar Bio Eco 471: 84-91.

Thomson JA, Heithaus MR. 2014. Animal-borne video reveals seasonal activity patterns of green sea turtles and the importance of accounting for capture stress in short-term biologging. Journal of Experimental Marine Biology and Ecology. 450:15-20.

Vander Zanden HB, Tucker AD, Bolten AB, Reich KJ, Bjorndal KA. 2014a. Stable isotopic comparison between loggerhead sea turtle tissues. Rapid Communications in Mass Spectrometry. 28(19):2059-64.

Vander Zanden HB, Pfaller JB, Reich KJ, Pajuelo M, Bolten AB, Williams KL, Frick MG, Shamblin BM, Nairn CJ, Bjorndal KA. 2014b. Foraging areas differentially affect reproductive output and interpretation of trends in abundance of loggerhead turtles. Marine Biology. 161:585-98.

Viada ST, Hammer RM, Racca R, Hannay D, Thompson MJ, Balcom BJ, Phillips NW. 2008. Review of potential impacts to sea turtles from underwater explosive removal of offshore structures. Environmental impact assessment review. 28(4-5):267-85.

Winton MV, Fay G, Haas HL, Arendt M, Barco S, James MC, Sasso C, Smolowitz R. 2018. Estimating the distribution and relative density of satellite-tagged loggerhead sea turtles using geostatistical mixed effects models. Marine Ecology Progress Series. 586:217-32.

Yang T, Haas HL, Patel SH, 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).