Ongoing Project Updates and New Project Summaries by Members of the Atlantic Marine Bird Cooperative - 2022

February 2023

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At-Sea Surveys

Metocean Buoy Survey of Marine Wildlife in the New York Offshore Planning Area

Contact: Julia Robinson Willmott, Normandeau Associates, Inc., jwillmott@normandeau.com
Collaborators: Greg Forcey, Normandeau Associates, Inc.

One floating LiDAR (light detection and ranging) buoys remains deployed in the New York Bight in the summer of 2022 and is collecting wind resource data for a period of two-years. The buoy is deployed in the vicinity of OCS-A 0537. On behalf of NYSERDA, Normandeau Associates worked with Ocean Tech to add wildlife sensors to the deployed buoy and are analyzing and making wildlife data collected from the buoys available through the ReMOTe (https://remote.normandeau.com) data management system. These data include passive acoustic microphone data of detected vocalizations by birds and bats, hydrophone data of detected vocalizations by marine mammals, and MOTUS and VEMCO receiver data of detected NanoTagged birds and fishes.

Aerial Digital Surveys Off the Coast of Delaware

Contact: Julia Robinson Willmott, Normandeau Associates, Inc., jwillmott@normandeau.com
Collaborator: APEM Inc.

US Wind is planning an offshore wind project in lease area OCS-A0490 off the coast of Delaware. They have implemented two years of aerial digital surveys to study the impacts of traffic separation and vessel traffic on birds and other species. Information on the project can be found on https://remote.normandeau.com/uswind_home.php

2 Years of Buoy-based Acoustic Studies for Birds and Bats in Delaware

Contact: Julia Robinson Willmott, Normandeau Associates, Inc., jwillmott@normandeau.com
Collaborator: Ocean Tech, Inc.

US Wind is planning an offshore wind project in lease area OCS-A0490 off the coast of Delaware. Deployed within the lease area, they have implemented two years of buoy-based bird, bat, and marine mammal acoustic studies and deployed floating MOTUS receivers. Information on the project can be found on https://remote.normandeau.com/uswind_home.php

Acoustic and Thermographic Offshore Monitoring at the Coastal Virginia Offshore Wind Pilot Project, Virginia

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Collaborator: Dominion Energy

Normandeau updated and deployed the latest version of ATOM™ (Acoustic and Thermographic Offshore Monitoring) on 2 turbines at the Dominion Coastal Virginia Offshore Wind Pilot Project. The ATOM system is a remote bird and bat detection system designed for the harsh offshore environment and be operated remotely via a satellite modem. The upgraded ATOM system includes bird and bat acoustic detectors, 2 thermographic cameras operating in stereo to permit flight high calculations, a fisheye or telephoto visible light camera, and a MOTUS antenna for detecting birds fitted with a nanotag. The system records birds and bats 24-hours/day during the detection period and data will be downloaded to hard drives monthly. Data from this system are used to assess behavior and temporal variation in bird and bat species composition and abundance throughout the year. This information is useful for understanding exposure and collision risk to birds and bats observed at the project.

Anticipating Shifts in Marine Bird Distributions for Planning, Leasing, and Assessment of Energy Development on the US Atlantic Outer Continental Shelf

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The US Bureau of Ocean Energy Management (BOEM) previously partnered with the National Oceanic and Atmospheric Administration (NOAA) National Centers for Coastal Ocean Science (NCCOS) to apply habitat-based species distribution modeling to at-sea survey data to describe the spatial distributions of marine bird species on the Atlantic Outer Continental Shelf (Winship et al. 2018. OCS Study BOEM 2018-010). The results of that study represented average long-term spatial distributions of marine birds from the late 1970s through the mid-2010s. However, spatial distributions can change over time in response to changes in environmental conditions and prey distributions. Furthermore, BOEM is required to consider potential impacts of future activities in their planning, leasing, and assessments. To address changes in distributions over time, BOEM and NOAA NCCOS have continued their partnership in this study (Interagency Agreement M20PG00009) to describe the past, current, and future spatial distributions of marine bird species on the Atlantic OCS. Habitat-based species distribution modeling is again being employed to relate at-sea counts of birds to environmental data matched in space and time, and those relationships are then being used to predict past, current, and future spatial distributions of bird density. At-sea counts of marine birds from surveys during the past 30 years were compiled from the Northwest Atlantic Seabird Catalog and Eastern Canada Seabirds at Sea databases. Environmental data from the same time period were acquired from a global ocean reanalysis (GLORYS12V1) and a global remotely sensed wind field product (CERSAT). Projected changes in the same environmental variables during the next 30 years were acquired from a simulation experiment that used a high-resolution global climate model (GFDL CM2.6). Study results will

provide updated estimates of the current distributions of marine bird species in US Atlantic waters as well as potential changes in bird distributions under an idealized climate change scenario. Study results are expected in 2023.

In-flight Machine Learning for Automated Detection and Classification of Wildlife from Digital Aerial Imagery

Contact: Bradley Pickens, U.S. Fish and Wildlife Service, bradley_pickens@fws.gov
Collaborators: Mark Koneff (USFWS); Timothy White (BOEM); Kyle Landolt (USGS Upper Midwest Environmental Sciences Center); Jennifer Dieck (USGS Upper Midwest Environmental Sciences Center)

In a collaborative effort, the U.S. Fish and Wildlife Service, Bureau of Ocean Energy Management, and U.S. Geological Survey are combining aerial remote sensing with deep learning methodology to support the Atlantic Marine Assessment Program for Protected Species (AMAPPS). Since 2021, we have collected >2.5M very-high resolution digital images from aerial surveys over the Atlantic Ocean. The 'Wildlife Annotation Tool' software is distributing this imagery to experts across federal agencies and associated partners. A seabird imagery guide to species of the Atlantic Ocean has been drafted to facilitate species labeling. This labeled imagery is the foundation for training deep learning algorithms to detect seabirds and predict species classifications. An exploration of algorithms to detect and classify seabirds has been initiated using pilot datasets. An in-flight detection algorithm has been tested and has proven useful. Convolutional neural networks and cutting-edge vision transformer models show high accuracy of species classifications can be achieved with modest sample sizes. Future work will need to encompass more diverse wildlife species to understand realistic scenarios of model performance. The results will improve our knowledge of seabird distribution and abundance to inform environmental assessments and impact analyses of offshore energy development and other population assessments.

2022 AMAPPS Shipboard Surveys – Seabirds

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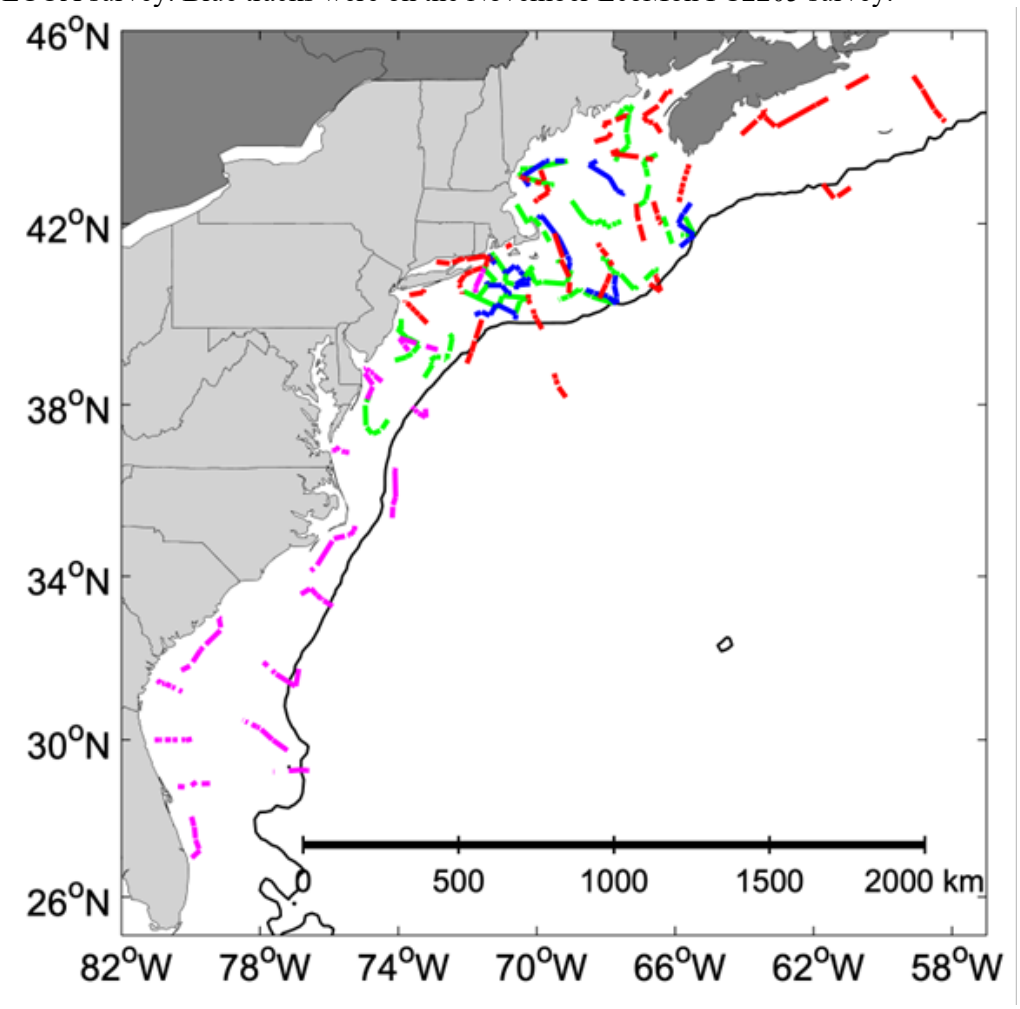
Three shipboard surveys were completed in 2022 as part of the NEFSC Atlantic Marine Assessment Program for Protected Species. Two were conducted during Ecosystem Monitoring (EcoMon) surveys and one was aboard an East Coast Ocean Acidification (ECOA) survey (Table 1). Cruises sampled regions from the Scotian Shelf to the Florida east coast (Figure 1). Over 7000 kilometers of visual transect lines were completed during the three surveys. A total of 21,016 sightings of birds, marine mammals, sea turtles, fishing gear, and marine debris were recorded. Most sightings were sea bird species, and varied by survey season and region. Wilson's Storm-Petrels (*Oceanites oceanicus*) and Great Shearwaters (*Puffinus gravis*) were most frequently sighted birds on all three surveys. Common Dolphin (*Delphinus delphis*), Bottlenose Dolphin (*Tursiops truncates*), and Humpback Whales (*Megaptera novaeangliae*) were the dominate marine mammals.

Table 1. A summary of 2022 NEFSC AMAPPS Shipboard Surveys on which observers sailed with the primary goal of conducting seabird surveys to collect abundance and distribution data and the secondary goal to collect abundance and distribution data for other marine megafauna including marine mammals, sea turtles, sharks, and other large pelagic fishes. Total sightings were inside and outside the 300-m survey zone and total include birds and megafauna.

Cruise	Program	Start Date	End Date	Duration (days)	Total Transect Distance (km)	Total sightings
HB2204	EcoMon	1-Jun	16-Jun	16	2341	4157
RB2203	ECOA	6-Aug	22-Sep	38	3706	12973
PC2205	EcoMon	1-Nov	10-Nov	10	1122	3886

Figure 1. A summary of 2022 NEFSC AMAPPS Shipboard visual survey tracks. Green tracks were on the June HB2204 EcoMon survey. Red (August) and magenta (September) tracks were on the RB2203 ECOA survey. Blue tracks were on the November EcoMon PC2205 survey.



Gulf of Mexico Marine Assessment Program for Protected Species

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Collaborators: Aerial surveys: Randy Wilson, USFWS; Jim Lyons, USGS; Emily Silverman, USFWS; Allison Sussman, USGS; Elise Zipkin, Michigan State Univ.; Kayla Davis, Michigan State Univ.. Vessel-based surveys: Jeff Gleason, USFWS; Patrick Jodice, USGS-SC CFWRU; J. Chris Haney, Terra Mar Applied Sciences LLC; Pamela Michael, SC CFWRU-Clemson Univ.; Yvan Satgé, SC CFWRU-Clemson Univ.; Kathy Hixson, SC CFWRU-Clemson Univ.

Despite the importance of the Gulf of Mexico for marine species, there is limited information available to quantify species-use in the region (but see DWH Bird Study #6; e.g., Haney et al. 2019). To bridge this gap, the Gulf of Mexico Marine Assessment Program for Protected Species (GoMMAPPS), was developed as a federal partnership between the Bureau of Ocean Energy Management, U.S. Fish and Wildlife Service, U.S. Geological Survey, and National Oceanic and Atmospheric Administration. For seabirds, a combination of vessel-based (NOAA Vessels of Opportunity) and aerial surveys (USFWS Kodiak amphibious aircraft) were employed. Seabird vessel surveys were initiated in April 2017 and the last vessel survey was completed in September 2019. In total, ~40,000kms, ~2,200hr of observation effort over ~265 DAS were conducted on 20 pelagic cruises in the northern Gulf of Mexico. Using standard, transect-based methodology ~10,700 detections representing ~51,000 individuals of 121 species (n = 44 seabird species) were amassed. Results indicated the Top 10 seabird species, based on # of individuals observed, were: Black Tern (*Chlidonias niger*; n = 12,109), Sooty Tern (*Onychoprion fuscatus*; n = 7,855), Laughing Gull (*Leucophaeus atricilla*; n = 2,569), Royal Tern (*Thalasseus maximus*; n = 1,869), Audubon's Shearwater (*Puffinus iherminieri*; n = 1,766), Northern Gannet (*Morus bassanus*; n = 1,658), Herring Gull (*Larus argentatus*; n = 1,636), Sandwich Tern (*Thalasseus sandvicensis*; n = 1,445), Bonaparte's Gull (*Chroicocephalus Philadelphia*; n = 1,356), and Magnificent Frigatebird (*Fregata magnificens*; n = 940). Black terns were observed in all Gulf BOEM Planning Areas. Approximately 78% of Black Terns were observed in the fall, 19% in summer, 3% in spring, and none in winter; though survey effort in winter was limited. Black Terns were observed primarily within the 200m isobath near the Mississippi River Delta and along the coast of TX from Galveston Bay south through Corpus Christi. There was a widespread presence of Brown Booby (*Sula leucogaster*), a tropical species commonly associated with coastal environments, occurred broadly in pelagic waters. There was an extended presence of European breeding Band-rumped Storm-petrel (*Oceanodroma castro*) in U.S. offshore waters of the northern Gulf from March to September, and the regular occurrence of Black-capped Petrel (*Pterodroma hasitata*; see Jodice et al. 2021). Low-level (200'ASL) aerial surveys covering the coastal waters out to 50nm were conducted from the U.S.-Mexico border to Key West, FL (including the Dry Tortugas) from February 2018 to February 2020. 180 EPA 40km^2 hexagons were randomly selected by generalized random tessellation stratified sampling (GRTS). For each hexagon, a random flight direction was selected, thus defining two additional, adjacent hexagons and creating a three-hexagon sampling unit. Using a double-observer protocol, three observers collected data along 3 parallel 10nm transects spaced 1nm apart representing 30nm of transects/sample unit. Preliminary results indicated no apparent detection bias based on observer or seat location, though flock size estimation differed between observers in the front v. rear seats (see Davis et al. 2022). The final aerial survey was completed in Feb

2020. Over 3 years (2018-2020), 600 hexagons were surveyed representing 1,800 transect segments and >36,000km of effort. Aerial survey crews detected and identified 52 species of birds (n = 23 seabird species). In winter, detections were dominated by gulls (Larus sp.), Northern Gannets offshore, waterfowl (e.g., mergansers) and Common Loons (*Gavia immer*). In summer, several pelagic species were observed near the outer continental shelf break (e.g., shearwaters and storm-petrels) while gulls, terns, and Brown Pelicans (*Pelecanus occidentalis*) dominated the nearshore environment. Detection probability estimated from our preliminary models was 0.91. We submitted a DRAFT of the BOEM Final Report entitled, "Gulf of Mexico Marine Assessment Program for Protected Species (GOMMAPPS): Seabird Surveys in the Northern Gulf of Mexico, 2017-2020" to BOEM in October 2022.

Peer-reviewed Publications

Davis, K. L., E. D. Silverman, A. L. Sussman, R. R. Wilson, and E. F. Zipkin EF. 2022. Errors in aerial survey count data: identifying pitfalls and solutions. Ecology and Evolution 12(3): https://doi.org/10.1002/ece3.8733

Jodice, P. G. R., P. E. Michael, J. S. Gleason, J. C. Haney, and Y. G. Satgé YG. 2021a. Expanding the marine range of the endangered black-capped petrel *Pterodroma hasitata*: occurrence in the northern Gulf of Mexico and conservation implications. BioRxiv: https://doi.org/10.1101/2021.01.19.427288

Jodice, P. G. R., P. E. Michael, J. S. Gleason, J. C. Haney, and Y. G. Satgé. 2021b. Revising the marine range of the endangered black-capped petrel *Pterodroma hasitata*: occurrence in the northern Gulf of Mexico and exposure to conservation threats. Endangered Species Research 46:49-65. DOI https://doi.org/10.3354/esr01143

Michael, P. E., K. M. Hixson, J. C. Haney, Y. G. Satgé, J. S. Gleason, and P. G. R. Jodice. 2022. Seabird vulnerability to oil: exposure potential, sensitivity, and uncertainty in the northern Gulf of Mexico. Frontiers in Marine Science: https://doi.org/10.3389/fmars.2022.880750

Data Releases

NOAA NCEI

Aerial survey, NCEI Accession 0247205:

https://www.ncei.noaa.gov/archive/accession/0247205

DOI Minted: https://doi.org/10.25921/vyg0-tv44

Citation: Wilson, R. R., J. S. Gleason, J. E. Lyons, E. D. Silverman, A. L. Sussman, E. F. Zipkin, and K. L. Davis. 2022. Seabird visual surveys using line-transect methods collected from USFWS aircraft in the Gulf of Mexico for the Gulf of Mexico Marine Assessment Program for Protected Species (GoMMAPPS) project from 2018-01-31 to 2020-02-12 (NCEI Accession 0247205). U.S. Department of the Interior, Bureau of Ocean Energy Management. NOAA National Centers for Environmental Information. Unpublished Dataset. https://doi.org/10.25921/vyg0-tv44 [Date Accessed]

Vessel survey, NCEI Accession 0247206:

https://www.ncei.noaa.gov/archive/accession/0247206

DOI Minted: https://doi.org/10.25921/afrq-h385

Citation: Gleason, J. S., R. R. Wilson, P. G. R. Jodice, Y. G. Satgé, P. E. Michael, K. M. Hixson, A. L. Sussman, and J. C. Haney. 2022. Seabird visual surveys using line-transect methods collected from NOAA vessels in the northern Gulf of Mexico for the Gulf of Mexico Marine

Assessment Program for Protected Species (GoMMAPPS) project from 2017-07-21 to 2019-09-25 (NCEI Accession 0247206). U.S. Department of the Interior, Bureau of Ocean Energy Management. NOAA National Centers for Environmental Information. Unpublished Dataset. https://doi.org/10.25921/afrq-h385 [Date Accessed]

Colony Management and Monitoring

Successful Tern Nesting Platform in Maryland Coastal Bays

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Collaborators: Roman Jesien, Maryland Coastal Bays Program; Archer Larned, Maryland Coastal Bays Program; Kim Abplanalp, Maryland Coastal Bays Program.

In 2021, a collaborative effort between Maryland Department of Natural Resources, Audubon Mid-Atlantic, and Maryland Coastal Bays Program led to the installation of a nesting platform in Chincoteague Bay to address the lack of suitable nesting habitat in Maryland coastal bays. The platform successfully hosted 23 Common Terns nests, making it the largest breeding colony of this species in the Coastal Bays in 2021. In 2022, the nesting platform was enlarged from 1,024 ft2 to 2,304 ft2 and placed in the bay earlier in the spring. The larger size and earlier installation date led to an increase in nesting attempts by Common Terns to a total of 155 nests.

In 2022, the raft consisted of 18 wooden raft units, each 16’ x 8’. These units were put into the water using a boat ramp on April 12. Once in the water units were connected into pairs with steel plates to create nine 16’ x 16’ sections. These sections were then covered with crushed clam shell to provide nesting substrate for terns. The nine sections were towed by boats to the project location and connected via locking dock hinges into a single floating platform. Once the platform was fully assembled, it was anchored into position with four 22 lb. anchors, one attached to each corner of the platform. The platform design performed well and sustained no damage during a tropical storm in July 2021 and during a week-long nor’easter in May 2022.

To facilitate colony establishment Common Tern decoys were placed on the platform. An audio-lure that broadcasts the sounds of Common Terns during daylight hours was added to the platform to increase the social attraction of the decoys. Small wooden shelters were placed on the platform to offer shade and protection to chicks from weather and predators. The corners and centers of each side of the raft had built-in wooden shelters for the same purpose. During 2022, we added artificial plants to provide shade for chicks, and protection from avian predators. These plants also break up sight lines on the raft and are presumed to have helped increase nest density on the raft.

The first nest on the platform was a pair of American Oystercatchers, which successfully fledged one chick. We banded both adults and the chick with USGS and field readable bands.

Common Terns first showed up on the platform April 23, with nest initiation beginning May 21. Nest establishment by terns continued until late July. A total of 155 nests were established with 308 eggs laid, a substantial increase from 2021 when there were 23 nests and 48 eggs. In 2022, 153 chicks fledged and 126 nests hatched at least one chick. Of the 19 Common Tern adults that were banded on the platform in 2021, 15 of them were on the platform in 2022. In 2022, we banded 91 adult terns and 159 chicks with USGS and field readable bands (white band with black lettering). The nesting platform will be returned to the bay in April 2023.

An Atlas and Registry for Seabird Colonies in the Northern Gulf of Mexico

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Collaborators: Yvan Satgé, Clemson University, South Carolina Cooperative Fish and Wildlife Research Unit; Jeffrey Gleason, U.S. Fish and Wildlife Service; Patrick Jodice, U.S. Geological Survey South Carolina Cooperative Fish and Wildlife Research Unit, Clemson University

The coastal zone of the northern Gulf of Mexico supports a diverse array of breeding nearshore seabirds that nest colonially on islands, in marshes, on mainland beaches, and human-made structures. Although nest-site fidelity is common among seabirds, the dynamic nature of the coastal zone can result in inter-annual shifts in the locations of colonies and in the existence, size, or stability of the islands or habitats that support them.

Overlaid on this dynamic system is a stakeholder network responsible for management of these species and their breeding habitats that includes natural resource agencies from five states,

multiple federal agencies, and numerous private organizations. There is no single source of information for seabird nesting sites in the northern Gulf of Mexico that is current or readily accessible. Information and data regarding the location and status of seabird colonies is scattered among the stakeholder network and difficult to source. The strategic monitoring guidelines recently released by the Gulf of Mexico Avian Monitoring Network (GoMAMN) highlighted the need for a spatial inventory of breeding sites to support energy development and marine spatial planning, oil spill response, restoration planning, habitat management, and monitoring and research.

We seek to address this information gap by creating an atlas and registry for seabird colonies in the northern Gulf of Mexico that will integrate existing data from the stakeholder network. The development process is being guided by a technical advisory team with stakeholder input. The development of these products is a critical step in understanding the distribution and status of breeding seabirds in the region.

Evaluating the Effectiveness of Gull Control as a Management Tool for Increasing Common Eider Duckling Survival

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Duckling survival has been identified as a significant limiting factor for a sustainable population of the American common eider. Although periodic boom/bust cycles in duckling survival and breeding success of females have helped maintain common eider populations in the past, evidence suggests that fewer and/or less frequent years of increased production have occurred within the Gulf of Maine which is necessary for maintaining the eider population. In 2016, a collaborative project among Biodiversity Research Institute, U.S. Fish and Wildlife Service, Maine Department of Inland Fisheries and Wildlife, and the U.S. Geological Survey, initiated a pilot-study to test the feasibility of marking with nasal tags and VHF radios and tracking individual eider broods to determine duckling survival at an important eider nesting colony located in Casco Bay, Maine. The effort was successful and we determined that duckling survival could be measured effectively through both marked and potentially un-marked broods. Through the support of the Waterfowl Research Foundation, U.S. Fish and Wildlife Service, Maine Department of Inland Fisheries and Wildlife, and the U.S. Geological Survey, we continued to nasal mark and VHF radio tag hens during the 2017-22 seasons and collected additional duckling survival rates during the 2018-22 seasons.

In summer 2021 we began implementing active gull control efforts at the focal eider nesting colony, targeting great black-backed gulls, to evaluate the effectiveness of gull control as a management tool to increase common eider duckling survival. During the 2021 season, we baited 131 great black-backed gull nests and subsequently recovered 19 great black-backed gulls

and 97 herring gulls. During the 2022 season, we baited an additional 48 great black-backed gull nests and 167 herring gull nests and recovered 112 carcasses, comprised of 10 great black-backed gulls and 102 herring gulls. Between 2021-22, we tagged an additional 30 adult hen eiders with VHF radio transmitters to track them throughout the summer and record duckling counts. Through these counts we documented a marked increase in eider ducklings surviving to fledge in 2021 compared to previous seasons (42% survival compared to a previous high of 22%). These preliminary results were encouraging, and suggested that localized gull control efforts appeared to have boosted eider duckling survival at our study site. However, the 2022 season was marred by extremely low survival (1%), potentially related to especially high rates of HPAI circulating in the environment. To better assess the efficacy of active gull management on increasing eider duckling survival, these efforts will continue in 2023.

Tern and Skimmer Colony Management in North Carolina

Contact: Lindsay Addison, Audubon North Carolina, laddison@audubon.org
Collaborators: Other agencies that do this work in NC at their managed sites include NC Wildlife Resources Commission, NC Coastal Reserve (Masonboro Island), Cape Lookout National Seashore, Cape Hatteras National Seashore, U.S. Marine Corps (Camp Lejune), Hammocks Beach State Park, Pea Island NWR

Agencies and NGOs around the state post signs and, where needed, symbolic fencing at tern and skimmer colonies across the state annually. The majority of nesting terns and skimmers are within these protected areas. Level of monitoring varies by site, with Least Terns counted annually statewide and several partners counting pairs or nests of other species annually as well. Two of the sites also have volunteer bird steward groups that conduct onsite outreach to the public.

Successful Tern Nesting Platform in Maryland Coastal Bays

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In 2021, a collaborative effort between Maryland Department of Natural Resources, Audubon Mid-Atlantic, and Maryland Coastal Bays Program led to the installation of a nesting platform in Chincoteague Bay to address the lack of suitable island nesting habitat in the Maryland coastal bays. The platform was successfully used for nesting by 23 pairs of Common Terns, making it the largest breeding colony of this species in the Coastal Bays in 2021. In 2022, the size of the nesting platform was enlarged from 1,024 sq. ft. to 2,304 sq. ft. and placed in the bay earlier in the spring. The larger size and earlier installation date led to an increase in the number of nesting attempts by Common Terns to a total of 155 nests for the season.

In 2022, the raft consisted of 18 wooden-framed raft units, each 16’ x 8’. These units were put into the water at South Point boat ramp on April 12, 2022, from a rollback flatbed truck used to

transport them from a nearby storage site. Once in the water project staff and volunteers connected the units into pairs with steel plates to create nine 16' x 16' sections. These sections were then covered with crushed clam shell to provide nesting substrate for terns. The nine raft sections were then towed by boats to the project location and connected via locking dock hinges into a single floating platform. Once the platform was fully assembled, it was anchored into position with four 22 lb. anchors, one attached to each corner of the platform. The platform design performed well during a tropical storm in July 2021 and during a week-long nor'easter in May 2022. Both times the platform rocked and flexed during the storm as designed but did not sustain any damage.

To facilitate colony establishment plastic (polyethylene) decoys painted to resemble Common Terns were placed on the platform. An audio-lure sound system that broadcasts the sounds of an active Common Tern colony during daylight hours was added to the platform to increase the social attraction impact of the decoys. Small wooden shelters were placed on the platform to offer shade and protection to tern chicks from weather and predators. The corners and centers of each side of the raft had built-in wooden shelters for the same purpose. During 2022, we added artificial plants in small clumps to provide shade for chicks and adults, and to provide protection from avian predators. These plants also break up sight lines on the raft surface and are presumed to have helped increase nest density on the raft.

The first nest on the platform was a pair of American Oystercatchers, which successfully fledged one chick. We banded both adults and the chick with USGS and field readable bands.

Common Terns first showed up on the platform April 23, with nest initiation beginning about May 21. Nest establishment by terns continued until late July with the last two nests initiated by July 28. A total of 155 nests were established with a total of 308 eggs laid, a substantial increase from 2021 when there were 23 nests and 48 eggs. In 2022, 153 chicks fledged and 126 nests hatched at least one chick. Of the 19 Common Tern adults that were banded on the platform in 2021, 15 of them were present on the platform in 2022, for a return rate of 78%. In 2022, we banded 91 adult terns and 159 chicks with USGS metal bands and plastic field readable bands (white band with black lettering). The nesting platform will be returned to the bay in April 2023 for another nesting season.

Seabird Tracking Studies

Post-breeding Distribution of Common Eiders in the Grand Manan Archipelago, Bay of Fundy, NB

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The southern portion of the Common Eider breeding population (dresseri) is exhibiting considerable population declines, including the lower Bay of Fundy, which historically supported large numbers of breeding and overwintering eiders. Within the lower Bay of Fundy, eiders are exposed to a suite of anthropogenic and environmental stressors including aquaculture

development, high vessel traffic, declining food resources, contaminants and disease. The goal of our study is to identify important post-breeding foraging areas for female eiders and their young when they are most vulnerable to oiling and disturbance to inform conservation management strategies. We deployed 21 GPS-GSM tags on late-incubating females among five island within the Grand Manan and the Wolves Archipelagoes. Total number of tracking days ranged from 12-73 (mean = 41). Preliminary results show high use of coastal waters around colonies before dispersion to others areas within the Archipelagoes, particularly some areas with finfish aquaculture. Habitat selection models will be developed to better understand key drivers of post-breeding eider distribution.

Understanding the Year-round Movements of Seabirds Breeding in Nunatsiavut Waters

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The waters of Nunatsiavut, NL support large numbers of breeding seabirds and provide an important food resource for Inuit beneficiaries. Eggs of gulls, eiders and Black Guillemot are harvested at their colonies and Black Guillemots and ducks are harvested in the fall. Many of these migratory marine bird species overwinter great distances from where they breed and face increased pressures from anthropogenic activities and climate change. "Is it safe to eat?" is a pressing question in Nunatsiavut. Identifying where valued seabirds breeding in Nunatsiavut overwinter would provide a more comprehensive answer to this question and a greater understanding of potential risks to these birds outside of Nunatsiavut. The objective of our study was to examine the year-round movements of Glaucous Gulls and Black Guillemots breeding on colonies off Nain, Labrador. The work also provided an opportunity for shared learning. The team, composed of federal and Nunatsiavut government employees, worked together to identify appropriate colonies, develop capture techniques and learn banding, sampling and tagging techniques. In July 2021, geolocator (GLS) tags were deployed on 33 breeding Black Guillemots. In 2022, team members attempted to deploy 15 solar-powered GPS-PTT tags on breeding Glaucous Gulls. Due to the steep declines in numbers of breeding Glaucous Gulls, complicated by late laying, tagging attempts were unsuccessful for Glaucous Gulls. 2022 was a late ice year, resulting in later laying dates and presence of foxes on islands, causing birds to abandon. However, GLS tags were retrieved from seven Black Guillemots, providing preliminary insights into their year-round movements.

Advanced Technologies for Waterbird Research

Contact: Diann Prosser, U.S. Geological Survey, Eastern Ecological Science Center, dprosser@usgs.gov

Collaborators: U.S. Fish and Wildlife Service, U.S. Army Corps of Engineers, Maryland Environmental Service, Maryland Department of Natural Resources

Our team continues to explore opportunities to incorporate emerging technologies into waterbird research and management. Our recent work has focused on developing a method that would allow tracking of juvenile Common Terns across dependency periods and first migration, while minimizing impacts to tagged individuals. We monitored the reproductive success and behavior of adult Common Terns (Sterna hirundo) and the growth and behavior of juvenile Common Terns after attaching small solar powered transmitters to adults and juveniles with leg-loop harnesses made of elastic cord. We found that transmittered adults had similar reproductive success and behaviors to untransmittered controls. Transmittered juveniles had similar fledging success and growth rates to untransmittered control juveniles, despite exhibiting slight increased rates of preening. Finally, monitoring efforts during the breeding season following transmitter deployment found no difference in the return rate, nesting attempt rate, or hatching success rate based on treatment. However, despite evidence of an individual retaining its transmitter into fall migration, no returning adults retained their transmitters when resighted the following breeding season. While our results show that leg-loop harnesses made of elastic cord present a potential option for transmitter attachment to both adult and juvenile Common Terns, additional testing could provide further insight into potential long-term impacts and tag retention. Full results from this effort can be found in our manuscript entitled "An evaluation of transmitter effects on adult and juvenile Common Terns using leg-loop harness attachments" published in the Journal of Field Ornithology URL: https://doi.org/10.5751/JFO-00136-930403

Marine Debris

Identifying and Addressing Impacts of Marine Debris on Birds in the Gulf of Maine Region – Released!

Contact: Caleb Spiegel, USFWS Migratory Birds Program, caleb_spiegel@fws.gov
Project Leads and Collaborators: Michael Andranovich - University of Rhode Island; Meg Harrington, USFWS Ecological Services; Pam Loring, USFWS Migratory Birds; Demi Fox - NOAA Marine Debris Program; Helen Manning, USFWS Marine Debris Project Coordinator

In February 2022 the U.S. Fish & Wildlife Service (USFWS), in coordination with the NOAA Marine Debris Program and other partners, released the document: *Identifying and Addressing the Impacts of Marine Debris on Birds in the Gulf of Maine Region.* This report compiles what is currently known about the impacts of marine debris on birds in the Gulf of Maine region, identifies information gaps for understanding impacts of marine debris on birds, and elucidates strategies for addressing these impacts. The implementation framework section of this document aims to step down priority information gaps and strategies to address debris impacts into actionable first steps for meeting specific measurable objectives.

Since the framework's release, multiple efforts are underway to fill information gaps, build partnerships, and take the first steps towards addressing debris impacts. One of these efforts is a

multi-program effort within the Northeast Region of the USFWS including Refuges, Ecological Services, Law Enforcement, and the Migratory Birds Program to bring to light the rising concerns over aquaculture operations in close proximity to refuge lands. In December 2022 this group held a briefing presentation for the Refuges Senior Leadership Team where they highlighted the significance of the subject, the potential impacts on birds and refuge lands, and what the recommendations and needs are for addressing impacts. This group is planning to hold another briefing presentation for the Ecological Services Senior Leadership Team in early 2023. Another project underway is the creation of a Gulf of Maine Region fishing gear and wildlife impacts data collection form. The purpose of this form is to collect and organize sightings of fishing gear (with a focus on abandoned, lost, or discarded gear) and the impacts of this gear on wildlife across the Gulf of Maine region. The form is currently in beta testing and is aimed to be released in 2023. Other ongoing efforts include holding meetings/discussions with partners from multiple agencies and NGO's working on research aimed to fill information gaps on debris ingestion in birds, and working with NOAA to revamp the Northeast Marine Debris Collaborative Portal to encourage use and contributions.

Disease & Contaminants

Fifty Years of Changes in Concentrations of Mercury and Organohalogenated Contaminants in the Northern Gannet of the Gulf of the St. Lawrence

Contacts: Raphael A. Lavoie and Louise Champoux, Science and Technology Branch, Environment and Climate Change Canada

The St. Lawrence is a vast and complex ecosystem where biological productivity is high. It is subjected to many stressors including acidification, hypoxia, ship traffic, fisheries, invasive species, warming of the sea surface temperature, and pollution. The Northern Gannet was selected as a sentinel species to monitor the state of the Gulf of the St. Lawrence half a century ago after organochlorine pesticides were found to impact reproductive output and eventually, population size. In the last decade, their reproductive success was once more challenged, but by reductions in prey distribution and abundance. This study aims to determine the latest trends of contaminants in eggs of gannets between 1969 and 2019. Eggs were collected every five years to measure concentrations of mercury, legacy organochlorine contaminants (e.g., DDT and PCBs), and brominated flame retardants. In addition, stable isotopes were measured to indicate possible diet shifts. Most contaminants decreased in the last decades, but recently the rate of decline decelerated, with contaminant concentrations increasing in some cases. Foraging ecology tracers such as stable isotopes revealed trophic shifts that partially explained these fluctuations of contaminants concentrations. Recent studies showed that climate change affected prey availability and shifted diet composition, which could in turn affect trophic transfer of contaminants up to gannets.

Multi-topic and Miscellaneous Updates

Sea Duck Key Habitat Sites Atlas

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Collaborators: Tim Bowman, USFWS (retired); James Churchill, ACCDC; Christine Lepage, CWS; Shannon Badzinski, CWS; Scott Gilliland, CWS; Nic McLellan, Ducks Unlimited Canada; Emily Silverman, USFWS

Sea ducks are a unique group of waterfowl that inhabit coastal marine habitats throughout arctic and subarctic North America. Since 2001, the Sea Duck Joint Venture (SDJV) partnership has completed surveys and studies of sea ducks that provide information on distribution and abundance throughout the annual cycle. Using this information and other available sources, the SDJV developed the Sea Duck Key Habitat Sites Atlas describing 85 sites throughout North America that constitute important sea duck habitats, including many sites on the Atlantic coast. Criteria for inclusion in this atlas were strict, relative to criteria used for other bird habitat designations, to highlight those habitats most critical to sea ducks during at least one season. Key site descriptions include a synopsis of sea duck abundance and temporal importance of the site to sea ducks, as well as sensitivities or potential conflicts that may impact sea ducks or their habitats. The Atlas is intended to heighten awareness of valuable sea duck habitats, aid in prioritizing habitat conservation and protection efforts such as oil spill prevention and response, and provide information for environmental assessments. The Atlas and associated data products can be found at seaduckjv.org.

Transparent Modeling of Collision Risk for Three Federally-listed Bird Species in Relation to Offshore Wind Energy Development

Contacts: Pam Loring, USFWS Migratory Birds, pamela_loring@fws.gov; Evan Adams, Biodiversity Research Institute, evan.adams@briwildlife.org; Andrew Gilbert, Biodiversity Research Institute, andrew.gilbert@briwildlife.org; Kate Williams, Biodiversity Research Institute, kate.williams@briwildlife.org

Collision risk models are often used to estimate risk of avian collisions with offshore wind turbines. Such models typically use avian density data derived from observational survey datasets along with a suite of behavioral and site-specific variables that are thought to predict collision risk. However, very limited survey data are available for the Roseate Tern, Piping Plover, and Red Knot, three species of conservation interest that could interact with offshore wind energy development in the Northeastern Continental Shelf Ecosystem (NES). With funding from the Bureau of Ocean Energy Management, the U.S. Fish and Wildlife Service and Biodiversity Research Institute adapted a previous stochastic collision risk model to use individual tracking data for these species from the Motus Wildlife Tracking System. An online web application of the model, called Stochastic Collision Risk Assessment for Movement (SCRAM), and accompanying user manual will be made publicly available. A report is in review that documents the current published model, presents several case studies for its use in evaluating collision risk of Roseate Tern, Piping Plover, and Red Knot at offshore wind energy

areas in the NES, and includes a preliminary framework for estimating cumulative collision risk across spatiotemporal scales. SCRAM will continue to be updated in the coming years. Please contact the above project leads for more information.

Framework for Assessing and Mitigating the Impacts of Offshore Wind Energy Development on Marine Birds

Contacts: Aspen Ellis, University of California, Santa Cruz, aaellis@ucsc.edu; Don Croll, University of California, Santa Cruz, dcroll@ucsc.edu
Collaborators: See list of coauthors on the referenced paper

Offshore wind energy development (OWED) is rapidly expanding globally and has the potential to contribute significantly to renewable energy portfolios. However, development of infrastructure in the marine environment presents risks to wildlife. Marine birds in particular have life history traits that amplify population impacts from displacement and collision with offshore wind infrastructure. Here, we present a broadly applicable framework to assess and mitigate the impacts of OWED on marine birds. We outline existing techniques to quantify impact via monitoring and modeling (e.g., collision risk models, population viability analysis), and present a robust mitigation framework to avoid, minimize, or compensate for OWED impacts. Our framework addresses impacts within the context of multiple stressors across multiple wind energy developments. We also present technological and methodological approaches that can improve impact estimation and mitigation. We highlight compensatory mitigation as a tool that can be incorporated into regulatory frameworks to mitigate impacts that cannot be avoided or minimized via siting decisions or alterations to OWED infrastructure or operation. Our framework is intended as a globally-relevant approach for assessing and mitigating OWED impacts on marine birds that may be adapted to existing regulatory frameworks in regions with existing or planned OWED. The paper is publicly available at https://www.sciencedirect.com/science/article/pii/S0006320722003482

Informing Avian Research and Monitoring at Offshore Wind Farms

Contact: Kate Williams, Biodiversity Research Institute, kate.williams@briwildlife.org
Collaborators: Julia Gulka, Biodiversity Research Institute; Julia Stepanuk, Biodiversity Research Institute; Evan Adams, Biodiversity Research Institute; Andrew Gilbert, Biodiversity Research Institute; Pam Loring, USFWS; Caleb Spiegel, USFWS

There are several ongoing or recently completed efforts that are informing avian monitoring and research in relation to offshore wind energy development. AMBC members are involved in all of these efforts and are making important contributions to this field as the offshore wind industry develops. This includes:

- An effort to synthesize already-identified research needs and data gaps for offshore wind-wildlife research and develop interim guidance for regional-scale research and monitoring efforts. A database of data gaps and research needs for the U.S. Atlantic and other information is available at nyetwg.com/regional-synthesis-workgroup.

- Ongoing development of recommendations for conducting avian pre- and post-construction monitoring to detect displacement/attraction at offshore wind farms (nyetwg.com/avian-displacement-guidance).
- Recently completed guidance for using automated radio telemetry technology to monitor wildlife in relation to offshore wind energy development. Five main end products inform coordination, study design, and deployment of offshore Motus stations and make recommendations for future work (will be available shortly via https://briwildlife.org/offshore-motus-guidance/).
- Ongoing effort to identify limitations of available avian monitoring technologies for monitoring birds at offshore wind farms and recommend targeted research and development to improve technology capabilities. Identified limitations of available technologies include the ability to provide information on small-bodied bird movements and distributions, access data remotely, and operate in the offshore environment without stable platforms (e.g., in the pre-construction period). Contact Kate for more information about this effort, which is funded by the National Offshore Wind Research and Development Consortium and will be completed in 2023.

Multi-scale Relationships Between Marine Predators and Forage Fish

Contact: Evan Adams, Biodiversity Research Institute, evan.adams@briwildlife.org
Collaborators: Julia Gulka, BRI; Chandra Goetsch, BRI; Andrew Gilbert, BRI; Iain Stenhouse, BRI; Kate Williams, BRI; Arliss Winship, NOAA NCCOS; Holly Goyert, AECOM; Kevin Friedland, NOAA

Studying trophic relationships in the marine environment is particularly difficult due to the remote and variable natures of these ecosystems. Different tools are often needed to describe patterns in predators and prey. In order to better understand how prey availability influences predator behavior, distributions, and long-term trends, this study includes:

1. Compiling digital aerial survey data of forage fish shoals in the Mid-Atlantic and New York Bight to understand the oceanographic factors that lead to forage fish shoals;
2. Using satellite telemetry data to describe the movements of Northern Gannets, Red-throated Loons, and Long-tailed Ducks and determine how forage fish availability influences movement behavior;
3. Combining aerial survey data for forage fish and seabirds to determine how shifts in forage fish distributions contribute to predator distributions; and
4. Quantifying decadal trends in forage fish distribution and predator distributions to determine how climate and other habitat changes have affected long-term trophic relationships.

While the project is still ongoing, we have two papers in review and two in preparation. From the work we have done, we have preliminary findings that we can share. Using survey and satellite telemetry data from the Northeastern United States Continental Shelf (NEUS), we quantified the environmental drivers of forage fish distributions and forage fish aggregations, and, in turn, the drivers of seabird movements over this seascape. Using joint species distribution modeling techniques, we found forage fish distributions were strongly influenced by surface submesoscale

eddies, temperature, and depth. In contrast, fish aggregation models found that the number of aggregations was most strongly related to mixed layer depth, surface salinity and eddies, and sediment. Using hidden Markov modeling approaches, we found that seabirds were more likely to switch to area-restricted movements in shallow areas with high chlorophyll a concentrations. Area-restricted movements were often strongly correlated with a subset of forage fish species distributions. These results suggest that both surface and subsurface drivers influence forage fish distributions and area-restricted seabird movements on the NEUS. The next steps in this work are to identify the environmental drivers that are consistently important to predator-prey interactions and that mediate species interactions over space and time.

Cooperative Roseate Tern Metapopulation Project (CRTMP)

Contact: Dr. Jeff Spendelow, Emeritus Research Wildlife Biologist, USGS, JSpendelow@usgs.gov

I have been coordinating the Cooperative Roseate Tern Metapopulation Project (CRTMP), a research program on the metapopulation dynamics and ecology of the endangered NW Atlantic breeding population of Roseate Terns (ROSTs, *Sterna dougallii*) for 35+ years. The primary goal of the CRTMP is to determine the major factors that are limiting the recovery and growth of this population. I rely on many cooperators to band and identify individual terns at their breeding colony sites, and since 2011 have focused my personal fieldwork on staging site studies, mainly in the Cape Cod area of southeastern Massachusetts (CCMA). This research involves sighting colorbanded individuals with 3-character plastic field-readable (PFR) bands for the purpose of examining temporal and geographic variation in the use of staging sites by ROSTs of different ages and breeding status (e.g., Hatch Year [HY] birds; nonbreeding [mainly 1-, 2-, and 3-yr-old] adults; failed and successful breeders that are not caring for an HY; and successful breeders that are giving postfledging care to HYs) coming from about a dozen colony sites spanning the entire breeding range.

In contrast to prior years, covid-related events had relatively little direct impact on colony-site fieldwork, but as a result of several of other factors only 4, 100, and 0 ROST chicks were colorbanded, respectively, in CT, NY & MA, and 436 ROST chicks were colorbanded in the NH-NS area, so overall 540 ROST chicks received PFRs in 2022. For the first time ever at Great Gull Island (GGNY), 100 Common Tern (COTE, *S. hirundo*) chicks also got PFR bands. Although extensive observations were made by the new crew working at GGNY, as of when this report was written I had not received a complete list of resights made there and so I do not know how many PFR-banded ROSTs from Brazil in 2020 were seen at GGNY in 2022.

In 2022, I started 9 days later than I did in 2021 and so spent 50 days from 29 July to 27 September doing fieldwork on CCMA. Despite the fact that "fewer-than-normal" ROST chicks got PFRs in 2020-2022, high numbers of PFRs read/day were recorded for late July and most of August in 2022 compared to all prior years including 2021. Overall, 115 COTEs of all ages and for ROSTs 328 HYs, 868 known-age adults, and 90 birds first banded as adults for a total of just over 1400 tern PFRs identified on CCMA in 2022. Only 30 (29%) of 104 ROST chicks from the CT-NY area, but 298 (68%) of 436 ROST chicks from the NH-NS area were seen as HYs on CCMA. By comparison, only one COTE chick from GGNY was seen as an HY. No ROSTs from Ireland were seen, but 33 ROSTs given PFRs in Brazil in prior years were seen on CCMA

in 2022. The 28-yr-old ROST from 2021 was not seen this year, but on 16 September I saw an HY COTE with a PFR that had been banded as a chick in July at the Hampton Roads Tunnel colony site in Virginia near the mouth of the Chesapeake Bay.

	Week Number and Starting Date (6-20 = 20 June; 9-19 = 19 September)													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14
Year	6-20	6-27	7-04	7-11	7-18	7-25	8-01	8-08	8-15	8-22	8-29	9-05	9-12	9-19
2014	3.7	1.4	1.3	1.6	3.3	2.5	41	27	32	59	64	19	10	6
2015	0.3	0	0.4	0.9	1.7	6.9	25	nd	43	36	55	66	49	15
2016	nd	4	4.7	6.1	14	34	58	77	50	40	50	49	38	nd
2017	nd	nd	nd	5.5	20	55	44	44	50	16	15	15	22	8.4
2018	nd	nd	nd	nd	nd	26	41	49	54	61	72	89	36	12
2019	nd	0	3.3	5	19	52	59	69	67	77	120	134	44	32
2020*	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.5*	76	38	4.4
2021	nd	nd	nd	nd	38	76	84	60	99	144	136	7	14	1
2022	nd	nd	nd	nd	nd	102	86	86	134	131	53	15	18	0.25
Color Key:		0-5		6-15		16-40		41-75		76-150				

Table 1. Weekly average observation statistics of staging terns with PFR bands on Cape Cod, MA. Shown are the weekly average number of Roseate Terns and Common Terns (combined) with plastic field-readable (PFR) bands identified/day by Jeff Spendelow over a 14-week period starting as early as 20 June each year. Note the relatively low values (highlighted in yellow) for periods 10-13 in 2017 compared to the values from 2015-16, and 2018-22. nd = no data. Also note the drop in PFRs identified in periods 12-14 in 2021-2022 compared to 2018-2019. *Note: In 2020 weekly periods began 3 days earlier & Week 11 was done in Rhode Island, not CCMA.