ATLANTIC MARINE BIRD COOPERATIVE

Recent Projects by Members of the Atlantic Marine Bird Cooperative December 2019

TABLE OF CONTENTS

At-Sea Surveys

Pelagic Seabird Surveys in Atlantic Canada

Contact: Carina Gjerdrum, Canadian Wildlife Service, Environment and Climate Change Canada, carina.gjerdrum@canada.ca

The Canadian Wildlife Service (CWS) has been conducting pelagic seabird surveys since 2006 to quantify abundance and distribution of birds at sea in Atlantic Canada. The surveys are conducted from both ships and aircraft, and effort extends from the eastern Canadian Arctic to the Gulf of Maine and east across the North Atlantic. The data are used to help understand the threats faced by birds at sea and help define areas for marine protection. A new student project is underway to quantify the relationship between seabird abundance estimated from two different survey methods (1965-1992 and 2016-2019), and examine changes in abundance through time.

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

Contacts: Timothy White, BOEM Environmental Studies Program, timothy.white@boem.gov
Mark Koneff, USFWS Division of Migratory Bird Management, mark_koneff@fws.gov
Jennifer Dieck, USGS Upper Midwest Environmental Sciences Center, jdieck@usgs.gov

The Bureau of Ocean Energy Management (BOEM), in partnership with the U.S. Fish and Wildlife Service (USFWS) and the U.S. Geological Survey (USGS), is advancing the development of a digital aerial imagery and annotation database that will be used to develop and train machine learning algorithms for the automated detection and classification of seabirds and other marine wildlife. The archive of high-resolution digital imagery from several sources includes seasonal survey data collected by BOEM and Normandeau Associates (in collaboration with APEM, Inc.) along the Atlantic Outer Continental Shelf and aerial surveys collected by USFWS across the Great Lakes. Annotation data includes information on species, age, sex, and activity (when resolvable) to support advanced analysis into the future. Machine learning models are being developed to automate the ability of detecting and classifying wildlife in order to improve the efficiency, standardization, and accuracy of airborne population surveys and to improve baseline knowledge of wildlife distribution and abundance to inform environmental assessments and impact analyses for offshore energy developments.

High Resolution Aerial Baseline Surveys of Marine Wildlife in the New York Offshore Planning Area

Contact: Julia Robinson Willmott. Normandeau Associates, Gainesville, FL, jwillmott@normandeau.com.

On behalf of NYSERDA, Normandeau in collaboration with APEM continues a three-year survey effort collecting spatial data using high-resolution digital aerial surveys of wildlife (birds, marine mammals, sea turtles, sharks, rays, large bony fish and fish shoals) in the New York Offshore Planning Area (OPA), from the south shore of Long Island to the continental shelf break. The approximate size of this area is 12,650 square nautical miles and includes state and federal waters. With four seasonal surveys per year, these surveys became the world's largest aerial digital survey effort in the offshore environment. The ultra-high resolution aerial digital surveys are designed to capture seasonal variations in wildlife distributions for three consecutive years. Targets within images are identified to the lowest possible taxonomic group and georeferenced. The objectives are to provide information to support the responsible siting of offshore wind projects, and to act as a baseline for monitoring impacts of stressors on wildlife in the OPA. The survey reporting determines the distribution and relative abundance of wildlife and determines the seasonal and inter-annual variability of the distribution.

The https://remote.normandeau.com (ReMOTe) data management system is used for this project, which allows input from remote collaborators and facilitates data processing, project monitoring, and visualization for the client through a secured password protected log-in. ReMOTe provides efficient workflow, traceable QA/QC, and provides quality data outputs in a timely manner. As resulting data are to support responsible siting of offshore wind projects, the cloud-based interactive GIS visualization tools on ReMOTe provided for client view, and to a lesser extent public view, includes toggle on and off buttons to view distributions by season, species, flight height, and species associations with bathymetry.

High Resolution Aerial Ecological Baseline Studies of the U.S. Outer Continental Shelf, North Carolina and South Carolina

Contact: Julia Robinson Willmott. Normandeau Associates, Gainesville, FL, jwillmott@normandeau.com.

On behalf of Bureau of Ocean Energy Management (BOEM), Normandeau in collaboration with APEM continues to collect information using ultra-high resolution digital imagery along the North Carolina and South Carolina coast line. Survey effort includes more detailed grid surveys of four wind energy areas defined by BOEM. The area covers approximately 11,000 square nautical miles and the surveys record the presence of marine mammals, turtles, birds, cartilaginous fish, large bony fish, boats and other structures, location of sargassum and weed mats, and fish shoals. The ultra-high aerial digital surveys are designed to capture the seasonal variations in wildlife distributions for two consecutive years. Targets in images are identified to the lowest possible taxonomic group and georeferenced. The objectives are to provide information to support the responsible siting of offshore wind projects, and to act as a baseline for monitoring impacts of stressors on wildlife around the North and South Carolina coastline. The survey reporting determines the distribution and relative abundance of wildlife and determines the seasonal and inter-annual variability of the distribution.

The https://remote.normandeau.com (ReMOTe) data management system is used for this project, which allows input from remote collaborators and facilitates data processing, project monitoring, and visualization for the client through a secured password protected log-in. ReMOTe provides efficient workflow, traceable QA/QC, and provides quality data outputs in a timely manner. As resulting data are to support responsible siting of offshore wind projects, the cloud-based interactive GIS visualization tools on ReMOTe provided for client view, and to a lesser extent public view, includes toggle on and off buttons to view distributions by season, species, flight height, and species associations with bathymetry.

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

Contact: Julia Robinson Willmott. Normandeau Associates, Gainesville, FL, jwillmott@normandeau.com.

Two floating LiDAR (light detection and ranging) buoys were deployed in the New York Bight in the summer of 2019 and will be collecting wind resource data for a period of two-years. These buoys are deployed between 35 nautical miles and 50 nautical miles from shore. On behalf of NYSERDA, Normandeau Associates worked with Ocean Tech to add wildlife sensors to the deployed buoys and are analyzing and making wildlife data collected from the buoys available through the https://remote.normandeau.com (ReMOTe) 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 nano-tagged birds and fishes.

Gulf of Mexico Marine Assessment Program for Protected Species

Contacts:
Aerial surveys: Randy Wilson, USFWS Migratory Bird Field Office, randy_wilson@fws.gov
Ship-based surveys: Jeff Gleason, USFWS Gulf Restoration Office, jeffrey_gleason@fws.gov

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

Despite the importance of the Gulf of Mexico for marine species, there is limited information available to quantify species-use in the region. 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, the U.S. Fish and Wildlife Service, the U.S. Geological Survey, and the National Oceanic and Atmospheric Administration. For seabirds, ship-based and aerial surveys are being used. Beginning in April 2017, ~265d (2219hrs) covering ~39,800kms were conducted on 20 pelagic cruises in the northern Gulf of Mexico. Using standard, transect-based methodology ~7,100 observations representing ~36,900 individuals of 67 unique waterbird species (seabirds, shorebirds, wadingbirds, and waterfowl) have been amassed. Preliminary results indicate the Top 5 seabird species were: Black Tern (*Chlidonias niger*), Sooty Tern (*Onychoprion fuscatus*), Laughing Gull (*Leucophaeus atricilla*), Audubon's Shearwater (*Puffinus iherminieri*), Royal Tern (*Thalasseus maximus*), and Herring Gull (*Larus argentatus*). High numbers of non-breeding Black Terns occurred in the Mississippi River delta and Western Gulf habitat; a widespread presence of Brown Booby (*Sula leucogaster*), a tropical species commonly associated with coastal environments, in pelagic waters; an extended presence of European-breeding Band-rumped Storm-petrel (*Oceanodroma castro*) in US waters from March to September; and the regular occurrence of Black-capped Petrel (*Pterodroma hasitata*). The final vessel-based surveys were completed in Aug – Sept of 2019.

Low-level (200'ASL) aerial surveys covering the coastal 50nm were conducted from the USA-Mexico border to Key West, FL including the Dry Tortugas during February 2018 and July 2018. 180 EPA-40km2 hexagons were randomly selected by generalized random tessellation stratified sampling. 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 and three observers collected data along 3 parallel 10nm transects spaced 1nm apart or 30nm of transect were flown per 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. In winter, detections were dominated by gulls (*Larus sp*.) and Northern Gannets (*Morus bassanus*) offshore and waterfowl (e.g., mergansers) and Common Loons (*Gavia immer*) nearshore, whereas in summer several true pelagic species were observed near the outer continental shelf (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. The final aerial survey is scheduled for late Jan – mid Feb 2020.

Colony Management and Monitoring

Seabird Banding on the Hampton Roads Bridge-tunnel to Investigate the Effects of Colony Loss

Contact: Ruth Boettcher, ruth.boettcher@dgif.virginia.gov,

Co-PIs and Collaborators:
Daniel Catlin, Sarah Karpanty, Daniel Gibson, Kelsi Hunt, Jim Fraser - VTShorebirds, Fish and Wildlife Conservation, Virginia Tech, https://www.vtshorebirds.org/hrbt

A proposal to expand the capacity of the I-64 Hampton Roads Bridge-Tunnel (HRBT) to ease congestion, including the addition of another bridge and tunnel has been approved at the federal and state levels, and construction is underway. The construction of the original two-lane HRBT in 1957 created artificial islands that serve as the entrance and exit points for the current bridge-tunnels. By the late 1980's, the southern island (South Island) of HRBT was colonized by multiple colonial nesting waterbird species, and following local extirpations of waterbird colonies throughout the Chesapeake Bay and barrier islands of Virginia, the area on the HRBT's South Island became Virginia's largest colony of nesting waterbirds.

The construction of the new tunnel and related activities, however, will preclude almost all nesting on the South Island into the future. To track movements and the potential extirpation of colonial waterbirds related to tunnel construction and the paving of South Island nesting habitat, we uniquely marked a proportion of royal terns, sandwich terns, common terns, gull billed terns, black skimmers, and laughing gulls (adults and chicks) during the 2018 and 2019 breeding seasons. We also attached GPS transmitters to a subset of Common Terns to get information on local movements and foraging locations. These data will be used to inform potential mitigation, assess the success of any mitigation attempts, and monitor the long-term effects of the bridge-tunnel expansion on Virginia's waterbirds.

In 2018, we estimated that at least 15,000 adult seabirds were using the South Island for nesting and loafing. After hatch, there were more than 25,000 birds on the island. We banded 2,350 and 2,687 seabirds (adults and chicks) with plastic field readable bands in 2018 and 2019, respectively. We used these marks to estimate abundance and chick survival on the South Island, where possible, and we continue to collect resightings throughout the Atlantic Flyway. In 2018, between 27–54% of common tern chick mortalities before and after fledge were attributable to vehicles, but few if any vehicle mortalities were reported in 2019. Between the two seasons, nearly half of the nesting locations were paved, particularly those near the highway, in preparation for construction in 2019–2020. Issues negotiating access to the island in 2019 precluded the use of abundance estimator that were employed in 2018, but the colony appeared to decline by at least 20% based on visual inspection. Paving and early season surveying activities shifted the distribution of the seabirds also, and average chick survival rates decreased by 32% after paving part of the island, presumably because the reduced space forced terns and skimmers to nest closer to herring gull nests. Preliminary analyses of royal tern survival following fledging also indicates that HRBT survival was significantly lower than that at two other colonies in Virginia and Georgia. Detailed reports of both season's activities are available by request (vt.plover@gmail.com) and descriptions may be found on our website www.vtshorebirds.org/hrbt.

Habitat, Population Dynamics and Metal Levels in Colonial Waterbirds: a Food Chain Approach

Contact: Joanna Burger, Biological Sciences, Rutgers University, 604 Allison Road, Piscataway, NJ 08854-8082. burger@biology.rutgers.edu

For several years, we (Burger, Michael Gochfeld) have been examining the populations of colonial birds in Barnegat Bay, from 1976 to the present, indicating population levels and success of several species of gulls, terns and herons (particularly Common Tern, Forster's Tern, Laughing Gulls, Herring Gulls). We have also been examining the temporal trends in metal levels in these same species. Data from 1976 to 2015 is provided in our book (see below), but we have continued these studies. We found that nesting islands suitable for nesting in Barnegat Bay is being lost due to sea levels rise. Population levels of most species (except Great Black-backed Gulls) have declined along with the loss of nesting islands.

Metal levels have declined for some metals, but not for others (mercury). It also provides information on contaminant levels in fish and some invertebrates, as well as birds. Metals levels in Horseshoe Crabs eggs is also available for the time period.

The book also provides population estimates and metal levels for some species of colonial nesting birds from the Chesapeake Bay, Delaware Bay, Barnegat, NY-NJ Harbor, Long Island Sound and Boston Harbor. It shows declines in species there as well. The book shows the effect of climate change on nesting birds in the region, with sea level rise a primary cause of island loss (they nest on low salt marsh or sandy islands). Islands were not only lost in Barnegat Bay, but have been lost in the Chesapeake, NY-NJ Harbor, and Long Island Sound, as well as Buzzard's Bay. This work is continuing, and we have data on both population levels and metals levels in these birds every year since the book was published.

Reference:

Burger, J. and M. Gochfeld. 2016. Habitat, Population Dynamics, and Metal Levels in Colonial Waterbirds: A Food Chain Approach. CRC Press, Boca Raton, FL.

An Interdisciplinary Approach to Building Data Literacy in Wildlife Survey Technologies

Contact: Dr. Cynthia Loftin - USGS Maine Cooperative Fish and Wildlife Research Unit, Orono, ME, Cynthia.loftin@maine.edu

Co-PIs and Collaborators:
Dr. Daniel Hayes, Daniel.j.hayes@maine.edu, Dr. Kate Beard-Tisdale, kate.beard@maine.edu.
Dr. Roy Turner, rturner@maine.edu, Anthony Guay, Anthony.p.guay@maine.edu, Dr. Tora Johnson, tora.johnson@maine.edu, Meredith Lewis, Meredith.a.lewis@maine.edu, Logan Kline, logan.kline@maine.edu, Danielle D'Auria, Danielle.dauria@maine.gov, Linda Welch, Linda_Welch@fws.gov

Successful conservation planning is reliant on accurate information about species numbers and distributions and a workforce trained to use the best available science and technologies to gather those data. Our project's overarching goal is to build interdisciplinary data literacy by combining emerging remote sensing and data analysis technologies into user-friendly tools for examining the real-world problem of population assessment of difficult-to-survey coastal species that are facing threats to habitats critical to their persistence. Our project objectives are to 1) build interdisciplinary data literacy through development, application, and evaluation of new technologies for rapid assessment of wildlife populations during time-critical windows, 2) engage students in team science, and 3) transfer this technology to collaborating stakeholders. We are using Gulf of Maine colonial nesting birds as our focal species to develop survey, image collection and processing, and data analysis methods and technologies that are transferrable to other taxa and survey goals. We will be comparing nesting seabird data collected during

plane-, Unmanned Aerial Systems (UAS)- and ground-based surveys to examine effects of platform, sensors (type, spatial, temporal resolution), timing, and deployment approaches on species' detectability, counts, and behaviors. Our analysis will use a variety of data analytical tools, including artificial intelligence and machine learning to develop detection algorithms to process the imagery. Research products will be detection algorithms specific to the sensor types and species, documented comparisons among the survey platforms and sensor types in terms of accuracy, cost, and target population sensitivity, protocols for developing population estimates based on the survey approach, and a user toolkit and interface for facilitating imagery and dataset processing. These products will be shared with the USFWS, MDIFW, and other partners surveying coastal nesting birds.

Laying the Groundwork for Science-based Management of Colonial Waterbirds

Contact: Dr. Cynthia S. Loftin, cynthia.loftin@maine.edu, Loftin - USGS Maine Cooperative Fish and Wildlife Research Unit, Orono, ME

Co-PIs and Collaborators:
Dr. Zachary G. Loman, zachary.loman@maine.edu, Dr. Mark Wimer, mwimer@usgs.gov, Dr. Mike Runge, mrunge@usgs.gov, Dr. Jim Lyons, jelyons@usgs.gov, Shannon Beliew, sbeliew@usgs.gov, Caleb S. Spiegel, caleb_spiegel@fws.gov, Ruth Boettcher, ruth.boettcher@dgif.virginia.gov, Walker Golder, wgolder@audubon.org

The project "Laying the groundwork for science-based management of colonial waterbirds" began in July 2018. Our first objective was to evaluate contents of the USGS-managed Colonial Waterbird Database (CWBD) and update it with data collected within the eastern US since the database became inactive in 2013. We received the CWBD from Patuxent, and thoroughly reviewed the contents of the database including state (or province), yearly, species, and data source summaries. We began the process of soliciting data from the various state agencies on the east coast. We have since added considerable data to the database including from previous Atlantic flyway waterbird survey efforts during 1976-1996. We've tracked down data from more current waterbird surveys from the Northeast region with a focus on outstanding MANEM (mid-Atlantic New England and Maritime regional step down plan surveys) data. We've also incorporated data from other databases including the North Carolina PAWS database, Maine Seabird Registry, and Southeastern Seabird Registry. This process is ongoing.

The CWBD had no functioning access to data, no updated contact information and no way to view, visualize, contribute to, summarize, download or analyze its contents. We created and deployed the beta version of a web-based tool using Shiny Apps in R to address these needs (https://visualizebirds.shinyapps.io/shinyApp/). We have worked with state and federal partners to solicit feedback on the web tool to revise and update it to best address stakeholder needs. The web tool provides a geospatial interface for displaying data, and interactive data tables and plots that stakeholders can use to understand, visualize or explore the contents of the CWBD and its data sources. Trend analyses for focal species will begin upon receipt of outstanding state species data from 2018 waterbird surveys from state partners, and will be incorporated into the web app. We worked with USFWS, Massachusetts Division of Fisheries and Wildlife, and Virginia Department of Game and Inland Fisheries to develop and distribute a standardized data recording format with instructions for state agencies along the Atlantic coast that we disseminated with detailed instructions for submitting 2018 and future waterbird data for use in the CWBD. We also have made available standardized survey best- and secondary methods developed by Biodiversity Research Institute (BRI) specifically for waterbird surveys that were created following 2013 MANEM surveys. This information and other relevant information are available through a newly created colonial waterbird website hosted through USGS (https://www.pwrc.usgs.gov/cwb/index.html) that we created to provide updated information about the CWBD.

Seabird Monitoring at Machias Seal Island, New Brunswick

Contacts: Heather Major, hmajor@unb.ca & Tony Diamond, diamond@unb.ca
University of New Brunswick

At Machias Seal Island (MSI), 2019 marked the 25th consecutive year of research and monitoring of the seabird community. Graduate students, Mark Dodds and Mark Baran, helped train our new crew on MSI and continued to analyze and write their theses. New PhD student Sarah Durham led the crew and will be working on assessing population dynamics of puffins and razorbills at MSI. Breeding success of puffins in 2019 was up from 2018 and at our long-term average. This was mostly a function of high nestling survival, supported by a diet of mostly hake. Razorbill breeding success remained similar to previous years, with ~40% of the diet as herring. Arctic terns had an unsuccessful season after most of their chicks died of exposure shortly after hatch, when we had a number of very wet, rainy days; diet was mostly hake. However, the terns did manage to fledge a few chicks for the sixth consecutive year since the 2014 restoration following colony collapse in 2006. We completed our third year of monitoring Leach's storm-petrels and monitored 23 burrows for productivity and 23 for survival. We depart MSI before the petrels fledge, thus only have adequate data to calculate hatching success, which was 65% in 2019 down from 71% in 2018. Lauren Scopel continues to work on completing her PhD thesis and Mark Baran should defend his MSc shortly.

Tern Colony Management at Monomoy NWR

Contacts: Eileen McGourty, Eileen_McGourty@fws.gov & Stephanie Koch, Stephanie_Koch@fws.gov,
USFWS Refuges Program

Monomoy NWR staff have been actively managing and monitoring a large tern colony on South Monomoy Island since 1996. In 2019, this colony supported more than 14,000 pairs of common terns, which is likely the largest common tern colony in the world! Numbers of nesting pairs have been steadily increasing for the last 7 years, and the colony has numbered more than 10,000 pairs for the last 4 years. In addition to common terns, the site supports nesting roseate terns. Unfortunately, the number of nesting pairs of roseate terns has remained small and variable through the years, with a high count of only 36 pairs since 2000, and with only 12 pairs confirmed in 2019. Monomoy NWR staff maintains a field camp on the edge of the colony from May through July to facilitate data collection including nesting distribution using a 60x60m grid, productivity of sample nests from egg laying to fledging, diet studies, and predator impacts. Predator control is an integral component of our management program, with an emphasis on minimizing direct impacts from coyotes, large gulls, and, black-crowned night-herons, as well as reducing the number of competing nesting laughing gulls. We also manage habitat to improve suitability for terns, and discourage competitor and predator species, using herbicide and prescribed burning.

Seabird Colony Management in Buzzards Bay, Massachusetts

Contact: Carolyn Mostello, Massachusetts Division of Fisheries & Wildlife, carolyn.mostello@mass.gov

For the past 20 years, MassWildlife has managed, monitored, and restored colonial nesting seabirds and their habitats on Bird, Ram, and Penikese Islands in Buzzards Bay (southeast Massachusetts). These sites support 50% of the endangered Roseate Tern population. Other species include Common Tern, Arctic Tern, Leach's Storm-Petrel, Herring Gull, Great Black-backed Gull, Double-crested Cormorant, and Common Eider. On an annual basis, we manage predators and vegetation, conduct censuses of seabirds, monitor productivity of terns, and conduct or support various research studies, including investigations of tern diets and effects of banding. Periodically, we undertake major habitat restorations to benefit seabirds, particularly terns. These efforts have involved island nourishments and stabilizations, and the use of prescribed fire and herbicide.

Aerial Counts of Seabird Colonies in South Carolina

Contacts: Felicia Sanders, SandersF@dnr.sc.gov, Mary-Catherine Martin, MartinMC@dnr.sc.gov, Janet Thibault, ThibaultJ@dnr.sc.gov, South Carolina Dept. of Natural Resources

The South Carolina Department of Natural Resources has been censusing nesting seabirds annually since the 1970's. Nine species of seabirds, including Brown Pelicans, Royal Terns, Sandwich Terns, and Black Skimmers, regularly nest in South Carolina in large colonies of hundreds to thousands of pairs. Each spring and summer, staff biologists survey islands to determine abundance and distribution of nesting birds of each species. Biologists fly over DNR Seabird Sanctuaries to photograph nesting areas and count seabird nests from compiled photos. This season, DNR also obtained aerial images from Unmanned Aerial Vehicle (UAV, drone) at several properties. Biologists counted 6,109 Brown Pelican,12,983 Royal Tern, 3,562 Sandwich Tern, and 1,049 Black Skimmer nests in South Carolina. All of these colonial seabirds are listed as Highest Priority Conservation Status under the South Carolina Comprehensive Wildlife Conservation Strategy. For more information on these coastal birds and the work DNR does for these species, check the DNR Coastal Bird webpage:
http://www.dnr.sc.gov/wildlife/species/coastalbirds/index.html

Colonial Waterbird Management and Monitoring in North Carolina

Contacts: Sara Schweitzer, sara.schweitzer@ncwildlife.org, & Carmen Johnson, carmen.johnson@ncwildlife.org, NC Wildlife Resources Commission
Lindsay Addison, laddison@audubon.org, Audubon, NC,
Ray Danner, dannerr@uncw.edu, University of NC Wilmington
Tracy Ziegler, tracy_ziegler@nps.gov, National Park Service

In North Carolina, the NC Wildlife Resources Commission (NCWRC) leads a multi-partner effort to manage and monitor colonial waterbirds (as well as nesting shorebirds) in the state. Approximately 84-94 sites are posted annually against trespass by 13-15 partner agencies and organizations.

At most sites, little or no productivity monitoring is conducted, with exceptions being at the south end of Wrightsville Beach and Lea-Hutaff Island where Audubon North Carolina tracks productivity for Common Terns, Least Terns, and Black Skimmers (as well as plovers and oystercatchers). Audubon North Carolina also bands Black Skimmer chicks, which thus far have been resighted in North Carolina (off-colony), South Carolina, Georgia, and Florida. Vegetation management to benefit Royal and Sandwich Terns, among others, takes place at two dredge islands on the Cape Fear River with a combination of fire and herbicide treatments as needed. NCWRC works with the US Army Corps of Engineers (USACE) to insure that dredge material placed on spoil islands takes the needs of nesting seabirds (primarily terns and Black Skimmers) into consideration during dredging projects. NCWRC also works with the USACE on beach nourishment projects to minimize disturbance to sea- and other waterbird species.

Audubon North Carolina, NCWRC, NC Coastal Reserve volunteers, and private individuals conduct International Shorebird Surveys conduct ISS-type surveys at 12 sites in North Carolina and include in these surveys counts of all bird species, including AMBC focal species.

Two student research projects from the Ray Danner Lab in UNC-Wilmington's Department of Biology and Marine Biology concluded with their successful graduations. Laura Schaale used a drone to map the thermal landscape of a beach colony site and investigated how temperature affects Least Tern nest site selection and success. Rebekkah Leigh LaBlue investigated how differential egg patterning in Least Terns contributes to individual heat gain and hatching success and the color-mediated tradeoff between heat

gain and camouflage. In 2020, the Danner Lab will initiate a new project examining Least Tern productivity on Cape Hatteras National Seashore with incoming student Erin Gallagher.

Through the partnership of site managers, independent researcher John Weske bands most Royal Tern and Sandwich Tern chicks fledged in the state, as well as a smaller proportion of Brown Pelicans. His banding work in North Carolina has been ongoing since the 1970s.

Seabird Colony Management at Maine Coastal Islands NWR

Contact: Linda Welch, USFWS, Linda_Welch@fws.gov

Maine Coastal Islands NWR has been working for the past 35 years to restore, manage, and monitor colonial nesting seabirds along the coast of Maine. The Refuge owns over 70 seabird nesting islands, and actively manages six islands for nesting common, Arctic, and roseate terns, Atlantic puffins, razorbills, common murres, black guillemots, Leach's storm-petrels, common eider, and laughing gulls. We have a long history of cooperatively managing several of the islands with National Audubon Society. We monitor productivity and chick growth rates, diet composition and feeding rates, conduct metapopulation research on puffins and Arctic terns. Management efforts focus on predator control and habitat enhancement. Recently our research efforts have focused on trying and understand how the climate driven changes in the Gulf of Maine are influencing seabird fitness and productivity.

Seabird Tracking Studies

Using GPS Loggers to Track Arctic and Common Terns

Contacts: Liz Craig, Shoals Marine Lab ecc79@cornell.edu,
Pam Loring, USFWS Migratory Bird Program, Pamela_Loring@fws.gov,
Linda Welch, Maine Coastal Islands National Wildlife Refuge, Linda_Welch@fws.gov

The USFWS (Maine Coastal Islands NWR and the North Atlantic-Appalachian Region Migratory Bird Program) worked with Shoals Marine Lab and National Audubon Society to deploy 30 GPS loggers on common and Arctic terns nesting on three islands in the Gulf of Maine. GPS tags were attached to incubating terns using leg-loop harnesses, and data were remotely downloaded to receiving stations placed in the breeding colonies and on Cape Cod. We documented daily and seasonal foraging patterns, identified important foraging habitat, and demonstrated that terns are flying more than 50 km on their forging trips. MCINWR also initiated a pilot project to track Leach's storm-petrels with GPS loggers. Petrels flew more than 300 km (one-way) to feed on Georges Bank during their 3-5 day foraging trips. Both projects are anticipated to continue in 2020.

Defining Bermuda Petrel Marine Habitat Use

Contact: Carina Gjerdrum, Canadian Wildlife Service, Environment and Climate Change Canada, carina.gjerdrum@canada.ca

The Bermuda Petrel is one of the rarest seabird species on the planet, although the population is slowly increasing as a result of intensive conservation efforts by the Government of Bermuda. In 2010, it was revealed for the first time using geolocator (GLS) technology that adult birds travel thousands of kilometres into Canadian waters to find food for their chicks. In an effort to build upon this initial work, in collaboration with Jeremy Madeiros, Senior Conservation Officer, Dept. of Environment and Natural Resources, Bermuda and Dr. André Raine, University of Hawaii, in April 2019 we deployed GPS tags on

six breeding adults. The data confirm the Bermuda Petrels' regular occurrence in Canadian waters. Ongoing analyses will help define marine habitat use and identify threats associated with their at-sea distribution, especially those posed by offshore oil and gas activities in Canadian waters.

Tracking and Movement Patterns of Black-capped Petrels Captured At-sea

Contacts: Patrick Jodice, pjodice@usgs.gov & Yvan Satgé, ysatge@clemson.edu, U.S. Geological Survey South Carolina Cooperative Fish and Wildlife Research Unit, Clemson University

The Black-capped Petrel (*Pterodroma hasitata*) is a highly endangered seabird in the North Atlantic, is listed as globally Endangered by the International Union for the Conservation of Nature, and is currently being reviewed for listing under the U.S. Endangered Species Act. Unlike the two previous efforts to individually track petrels (2014 and 2018) which deployed tags at nest sites, this effort sought to capture birds at sea and subsequently track their movements. In May 2019, we captured 10 petrels along the western edge of the Gulf Stream east of Cape Hatteras, North Carolina. We used a hand-held net launcher powered by compressed air to capture birds in flight over chum. Our capture rate was ~ 50% of attempts made. Three birds were female and 7 birds were males. Six birds were classified as dark-morphs, and four birds were classified as white-morphs. Birds were equipped with 8 g solar-powered satellite tags set on a 6 hour on/28 hour off duty cycle. Subsequent tracks (May – November) showed that most locations ranged from 28.4 – 41.2 degrees latitude. Two petrels travelled to Hispaniola in late September (light-morph individual) and early November (dark-morph individual). While birds did use areas west of the Gulf Stream and over the shelf, we also recorded substantial levels of activity east of the Gulf Stream, and ingress into the Canadian EEZ. Compared to birds tracked from breeding sites in 2014 and 2018, the current use areas appear similar to use areas during post-breeding periods, but dissimilar to use areas from 15 trips recorded during known breeding periods.

Cooperative Roseate Tern Metapopulation Project

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

For the past 30+ years I've been coordinating a broad research program – the Cooperative Roseate Tern Metapopulation Project (CRTMP) - on the metapopulation dynamics and ecology of the endangered NW Atlantic breeding population of Roseate Terns (ROSTs, *Sterna dougallii*). The overarching goal of the CRTMP is to determine the major factors that are limiting the recovery and growth of this population. Many cooperators continue to work at breeding colony sites, but since 2011 have focused my fieldwork on Staging Site Studies (SSS), mainly in the "Greater Cape Cod & Islands" area of southeastern Massachusetts (CCMA). This work involves sighting colorbanded individuals with 3-character plastic field-readable (PFR) bands to examine temporal and geographic variation in the use of staging sites by ROSTs of different age and breeding status (e.g., Hatch Year [HY] birds; nonbreeding 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.

The 2017 SSS results differed considerably in several ways from those from 2011-2016 because there was a major decline in the use of CCMA staging sites in late August 2017 and many terns moved westwards. We were able to document that even ROSTs originally banded as chicks in Maine and Nova Scotia were passing through Nantucket Sound (MA) and Block Island Sound (RI) to reach staging areas around Great Gull Island (GGNY) that year, and we have been seeing some secondary consequences in 2018 and 2019 from those atypical movements in 2017. However, I am still waiting for 2019 (and even some 2018) data from some sites and so will provide only preliminary comparative results based on my own fieldwork here. Compared to 2017 (when sandlance abundance around northern CCMA apparently

was unusually low) and 2018 (when I wasn't able to start fieldwork until 7-25, but ROSTs seemed to go back to more typical use of the CCMA staging sites in Aug. & Sep. compared to what they did in 2017), in 2019 SSS fieldwork began in early July but for the first four weeks fewer individuals were identified on a daily basis than during the same periods in 2017 & 2018. However, observations picked up considerably in 2019 in the last few days of July and early Aug., and another surge in PFRs identified occurred in late Aug. and the first half of Sep. resulting in a 2-week period when, on average, more than 125 PFRs were identified on a daily basis (see attached table). The single highest daily count for 2017 of 82 PFRs read occurred (relatively early) on 7-27. In 2018 I had 4 daily counts of at least 120 PFRs read from 8-29 to 9-09, and in 2019 I had 11 daily counts of at least 120 PFRs read from 8-26 to 9-11. The overall increase in the number of PFRs read on a daily basis in 2019 compared to 2017 & 2018 likely is a result of the large number of ROST chicks banded in 2016 & 2017 at GGNY that returned north as nonbreeding 2- and 3-yr-old adults this year. Although I retired at the end of 2018, I plan to continue to collect and analyze data on staging terns for several more years as an "Emeritus".

Tracking Great Shearwater in the Gulf of Maine

Contacts: Dave Wiley, David.Wiley@noaa.gov & Kevin Powers, kdpowers24@gmail.com, Stellwagen Bank National Marine Sanctuary

Great Shearwaters are one of the most abundant, highly mobile, top predators in the Gulf of Maine and are subject to high levels of bycatch in commercial fisheries. Stellwagen Bank National Marine Sanctuary (SBNMS) continued its ongoing (2013 – present) program investigating the movements, habitat use and food habits of Great Shearwaters through the use of PTTs (10 per year), stable isotope analysis of exhaled gas, blood and feather samples, and fecal DNA. Annual variation in spatial use of the Gulf of Maine from 2013-2017 is being submitted for publication this winter. Spatial overlap results from PTTs and information derived from fecal DNA indicate that sand areas and sand lance forage fishes (*Ammodytes* spp.) are major drivers of Great Shearwater habitat use. Necropsy results from commercial fisheries bycatch of great shearwaters shows that nearly 90% of bycatch are young (0-1 yr). The length and scope of the project, in combination with the high mobility of Great Shearwaters, could help identify potential climate induced changes in the Gulf of Maine. Two years of stable isotope analyses were published in 2019: Peter Hong, David N. Wiley, Kevin D. Powers, Robert H. Michener, Les Kaufman and Kent A. Hatch (2019) Stable Isotope Analyses of Multiple Tissues of Great Shearwaters (Ardenna Gravis) Reveals Long-Term Dietary Stability, Short-Term Changes in Diet, and Can be Used as a Tool to Monitor Food Web, Diversity 2019, 11, 163; doi:10.3390/d11090163. The project was funded by the US Department of the Interior, Bureau of Ocean Energy Management (BOEM) through Inter-Agency Agreement Number M17PG0019 with the US Department of Commerce, NOAA, National Ocean Service, SBNMS, the Volgenau Foundation and SBNMS. The project is a collaboration among SBNMS, USFWS and Boston University.

Forage Ecology, Diet, and Prey

Multi-scale Relationships Between Marine Predators and the Distribution of Forage Fish

Contact: Evan Adams, Biodiversity Research Institute, evan.adams@briloon,

Co-PIs and Collaborators:
Kevin Friedland, Andrew Gilbert, Holly Goyert, Julia Gulka, Iain Stenhouse, Kate Williams, and Arliss Winship

An increased interest in offshore wind energy development has led to multiple efforts to accrue baseline information on the abundance and distribution of marine species in the northwestern Atlantic Ocean. Recently, the New York State Energy Research and Development Authority (NYSERDA) funded a series of projects that are designed to use these data sets to answer questions about the effects offshore wind development may have on marine species in this region. A collaboration between Biodiversity Research Institute (BRI) and the National Oceanic and Atmospheric Administration (NOAA) resulted in a successful proposal that focused on understanding relationships between marine prey and predators at multiple temporal and spatial scales.

Data from the Northeast Atlantic will be used to quantify how forage fish populations affect key seabird predators like Northern Gannets and Red-throated Loons at three scales: individual movements and habitat use, seasonal changes in species distribution and abundance, and annual population trends. Forage fish distributions will be quantified by combining models based on NOAA bottom trawl surveys with digital aerial survey data that describe forage fish availability at the ocean surface. Forage fish surface availability will be connected to: predator movements using behavioral models derived from satellite telemetry data, changes in seasonal predator distributions using integrated modeling techniques for combining data from multiple types of surveys, and long-term predator population trends by combining archival survey data for predator and prey species in locations of high survey density and longevity. This research will be used to understand the potential for offshore wind development to shape marine communities through trophic interactions in the northwestern Atlantic Ocean. Work on the project is set to begin in fall 2019 with anticipated project completion in fall 2022.

Selected East Coast Osprey Colonies as Quantitative Biomonitors of Regional Menhaden Abundance: Proposed to the Atlantic States Marine Fisheries Commission as "Ecological Reference Points" for Long-term Menhaden Management

Contact: Paul R. Spitzer, PhD, 31672 Old Orchard Rd., Trappe, MD 21673, spitzer_paul@hotmail.com

Spitzer and colleagues have carried out 50 years of osprey field research since 1968. For the first decade, this was assessment of the profound destructive impact of DDT and dieldrin residues on reproduction and population dynamics (Spitzer *et al.* 1978, Spitzer 1980). Recovery followed, to a current state of abundance that enables precise study of food limitation, with no known contaminant effects. We have developed an array of simple, easy study techniques; plus intimate familiarity with the ecology of selected colonies where Atlantic Menhaden are the prime food fish during the eight-week nestling period and subsequent fledgling period. With adequate context, this enables annual quantitative assessment of regional menhaden abundance, using the osprey reproductive parameters "young fledged/active nest" (Y/AN) and "young fledged/successful nest" (Y/SN), or "mean brood size".

Three East Coast osprey colonies are proposed to serve this scientific function:

1) High Menhaden Abundance: The Connecticut River Estuary, CT, colony has been studied since the 1930's, and was reduced to one active nest at the end of the DDT/dieldrin era (Spitzer 1980). The current active nest count is about 120, which continues to rise when appropriate nest sites are available. A pre-fledging Y/SN check of the predator-proof nest platforms at the Roger Tory Peterson Wildlife Area, Great Island, Old Lyme, CT, yields consistently large broods of young, with many three-young broods. This estuary and adjacent Long Island Sound are a consistent menhaden "hotspot" and sanctuary, with ecological parameters that enable the fishes' active habitat selection, and no local harvest pressure.

2) Variable Menhaden Abundance: The Gardiners Island, NY, colony has supported 200-300 active nests since the historic visit of Alexander Wilson in 1803 (Wilson 1812). Spitzer first visited this colony in 1969, finding 38 nests near the end of the DDT era (Spitzer 1980). This isolated, predator-free island is

surrounded by the open, tidal waters of Gardiners Bay and Block Island Sound (Atlantic Ocean). This is prime menhaden habitat--but the colony is apparently highly sensitive to variable regional abundance of these migratory fish. For much of our 50-year time-series (maintained by Michael Scheibel of TNC and NYSDEC), Y/AN and Y/SN appear to track menhaden abundance (the working hypothesis, supported by ample annual observations). Since the ASMFC limitation of harvest quotas in 2013, both Y/AN and Y/SN have been high, and this food-limited population has recovered from 20 nests to 55 nests. If current trends are maintained, we hope for increase toward historic levels. Thus Gardiners is a bellwether of menhaden management for ecosystem benefits. The owners of this private island are highly supportive of this objective.

3) Mediocre Menhaden Abundance: The Broad Creek colony, off the Choptank River, near St. Michaels, MD, on the eastern shore of Chesapeake Bay. Spitzer (unpublished) studied this breeding cluster in 1983-87 and 2018, finding consistent Y/AN slightly above replacement rate of ~0.8 Y/AN (Spitzer 1980): the 6-year mean is 0.95, and the range 0.72-1.17. Y/SN mean is 1.56, range 1.36-1.80, with dramatic losses due to nestling starvation and resulting brood size reduction. In three years of intense study, 1984-86, this nestling loss was 41%, 57%, and 43% . The 2018 active nest count was 39, compared to 1983-87 mean of 48 (range 46-53). (This is due to reduction of manmade predator-proof offshore nest sites—but the breeding population is considered to be stable. In the five years 1970-74, with less nest site management, Jan Reese found a mean of 36 active nests in Broad Creek.) The almost exclusive prey at Broad Creek are menhaden, mostly smaller 2-year-old fish. High local plankton density and green turbidity (Secchi ~1 m) has shaped this diet in the past, and for the foreseeable future. Menhaden rich in lipid are thought to supply "metabolic water" to nestlings facing heat stress—which can be extreme at this southern site. The between-colony comparison is very important to note: The Gardiners Island, NY, colony held on at a reduced level of active nests through many years of menhaden limitation, large-scale nestling starvation, and reproduction which averaged near the estimated replacement rate of 0.8 Y/AN.

Research for Possible Regional Extension of This Biomonitor Approach: New York Bight waters are known to be rich in seasonal, migratory menhaden, and currently attract Humpback Whale watchers from the adjacent NYC urban region. Osprey colonies are situated at the "Gateway" public shore preserves on each side of the Bight: Sandy Hook, NJ, and Jamaica Bay, NY. These need study and quantitative assessment as possible "menhaden colonies".

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Assessing the Pre-breeding Foraging Ecology of Seabirds Along the Northeast U.S. Coast Using Stable Isotope Analysis

Contact: Michelle D. Staudinger, DOI Northeast Climate Science Center, mstaudinger@usgs.gov

As part of the Five College Coastal and Marine Sciences summer internship program (https://www.fivecolleges.edu/marine), students at the University of Massachusetts Amherst, in collaboration with the DOI Northeast Climate Adaptation Science Center, USFWS, Project Puffin, and regional state agencies are evaluating the pre-breeding foraging ecology of seabirds nesting along the Northeast U.S. coast. Stable carbon and nitrogen isotopes, which serve as ecological tracers of diet, measured in hatched eggshell tissues were collected during the 2016, 2017, 2018, 2019 nesting seasons.

Evaluations are testing: 1) inter-specific differences among species nesting on shared islands, primarily terns (Arctic, Common, and Roseate terns) and alcids (Atlantic puffin, razorbills, and black guillemots) but seabird community analyses include a variety of other species of interest including spotted sandpiper, common eiders, and gulls; 2) intra-specific differences of populations nesting across different colonies; and 3) inter-annual differences among species nesting on shared islands. In 2016 and 2017, sampling was limited to the Gulf of Maine; in 2018 and 2019 collections were expanded to include southern colonies in NH, MA, CT and NY. Approximately 1,850 samples have been collected of which ~785 have been analyzed to date.

This year, Rachel Bratton, an undergraduate student at the University of Massachusetts Amherst completed her honors thesis, which evaluated the pre-breeding foraging ecology of Arctic, Common and Roseate terns on seven nesting islands (Matinicus Rock, Eastern Egg Rock, Jenny Island, Outer Green Island, Stratton Island, Seal Island NWR, Pond Island NWR) in the Gulf of Maine from 2016-2018. Results indicated interspecific variation in foraging consistent with long-term chick provisioning data; intraspecific variation in foraging between geographically distinct nesting populations; and interannual shifts in isotope values, with $\delta^{13}C$ levels becoming significantly depleted in more recent years. In some cases, Roseate tern tissues showed more depleted habitats indicating offshore foraging, which was contrary to previous observations of provisioning studies where they typically forage in shallow inshore areas. This analysis has revealed new information about the pre-breeding foraging habits of migratory terns in the Gulf of Maine and provides insights into their behaviors and trophic ecology under changing conditions.

In addition, Henry Legett an NSF INTERN student from Purdue University expanded analyses to evaluate trophic niche metrics using SIBER (Bayesian) ellipses including measures of isotopic niche breadth, diversity and overlap. These techniques were applied to Gulf of Maine island comparisons and to additional southern colonies along the coast to answer the questions: 1) How do the trophic niches of Common and Arctic terns vary across Northeast regional colonies?, and 2) How does niche overlap (competition) vary with latitude? This work is ongoing and expected to be completed in 2020.

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The Ecological Role of Sand Lance in the Northwest Atlantic

Contacts: Michelle D. Staudinger, DOI Northeast Climate Science Center, mstaudinger@usgs.gov
Linda Welch, Maine Coastal Islands NWR, Linda_Welch@fws.gov;
Dave Wiley, Stellwagen Bank National Marine Sanctuary, David.Wiley@noaa.gov

The American sand lance (*Ammodytes americanus*) and the Northern sand lance (*A. dubius*) are small forage fishes that play an important functional role in the Northwest Atlantic Ocean (NWA). However, specific aspects of their regional ecology, population dynamics, and vulnerability to current and future stressors are poorly understood. The NWA is a highly dynamic ecosystem currently facing increased risks from climate change, fishing, and energy development. Consequently, a better understanding of the biology, population dynamics, and ecosystem role of *Ammodytes* is needed to inform relevant management, climate adaptation, and conservation efforts. To meet this need, in May 2017, a multidisciplinary and international workshop convened 55 scientists, natural resource managers, and

conservation practitioners from 15 state, federal, academic, and non-governmental organizations with interests in sand lance and concerns for the future in the NWA. Meeting outcomes were combined with a comprehensive literature review, insights from ongoing field and laboratory work, as well as new analyses of long-term datasets collected over multiple decades to summarize the current state of knowledge in a comprehensive review. Data was summarized on the 1) life history, behavior, and distribution, 2) trophic ecology, 3) threats and vulnerabilities, and 4) ecosystem services role related to *Ammodytes* in the NWA. Overall, 72 regional predators including 45 species of fishes, 2 squids, 16 seabirds, and 9 marine mammals were found to consume *Ammodytes*, highlighting the key role they play as forage. Priority research needs identified during this effort include: basic information on the patterns and drivers in abundance and distribution of *Ammodytes*, improved assessments of reproductive biology schedules, and investigations of regional sensitivity and resilience to climate change, fishing, and habitat disturbance. Holistic studies are also needed to evaluate trophic linkages, such as the consequences of inconsistent zooplankton prey and predator fields on energy transmission processes within the NWA ecosystem. Results represent the first comprehensive assessment of *Ammodytes* in the NWA and are intended to inform new research and support regional ecosystem-based management approaches.

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An Examination of Common, Arctic, Roseate, and Least Terns Diets in a Changing Climate in the Gulf of Maine

Contact: Michelle D. Staudinger, DOI Northeast Climate Science Center, mstaudinger@usgs.gov

Keenan Yakola, a Masters student at the University of Massachusetts Amherst and a fellow with the DOI Northeast Climate Adaptation Science Center, completed his thesis evaluating chick diets of Common, Arctic, Least and Roseate Terns on seven seabird colonies (Matinicus Rock, Eastern Egg Rock, Jenny Island, Outer Green Island, Stratton Island, Seal Island NWR, Pond Island NWR) in the Gulf of Maine, USA. Provisioning data was collected over a 32 period (1986 and 2017) and evaluated to: 1) quantify and compare dietary differences among tern species; 2) discern spatial and temporal differences in foraging ecology across the region, 3) characterize long-term dietary trends across nesting islands, 4) describe within-season dietary phenology, and 5) quantify how climate change influences dietary patterns. Findings suggest there are significant differences in diets among tern species and islands; however, three prey groups (hake, sand lance and herring) comprise the majority of chick diet for all terns and islands. The reliance on a few prey items led to narrow foraging niches, potentially increasing their vulnerability to climate change, fisheries practices, or other localized disturbances. Over time there was a declining trend in the occurrence of hake and increasing amounts of sand lance in Common tern diets. In addition, hake and sand lance occur with higher frequency earlier in the season, while butterfish and a variety of other fish (historically of lower importance) showed the opposite trend. Furthermore, results indicated that the within-season decline of hake occurs more rapidly in years with earlier spring onset, potentially indicating a phenological shift. Finally, warming sea surface temperatures were found to be negatively correlated with hake and positively correlated with the "other fish" prey group. Results from this project identify forage fish species that support the long-term sustainability of regional tern populations and provide insights on how climate change is altering the availability of forage resources to seabirds nesting in the Gulf of Maine. The islands included in this study are managed and data collection is managed by

the National Audubon Seabird Restoration Program and the Maine Coastal Islands NWR who are collaborators on this project.

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Bycatch

Reducing Gillnet Bycatch: Seaduck Underwater Hearing Thresholds and Auditory Deterrent Devices

Contacts: Kathleen McGrew, USGS Patuxent Wildlife Research Center & University of Delaware
Alicia M. Berlin, USGS Patuxent Wildlife Research Center, aberlin@usgs.gov
Chris Williams, University of Delaware, ckwillia@udel.edu

As diving foragers, sea ducks are vulnerable to underwater anthropogenic activities, including naval sonar activity and gillnet fisheries. Bycatch in gillnets is a principle driver of mortality for sea ducks, killing hundreds of thousands of seabirds annually. To reduce gillnet bycatch, we researched the underwater hearing in affected sea duck species to assist with possible development of mitigation strategies via auditory deterrent devices. Additionally, knowledge of underwater acoustic sensitivity is important to current regulatory and management priorities in order to evaluate the impact of noise pollution. To determine underwater hearing sensitivities for diving ducks vulnerable to bycatch, we used psychoacoustic techniques to train captive ducks to respond to sound stimuli. From 2016–2018, we raised and trained Long-tailed Duck (*Clangula hyemalis*), Surf Scoter (*Melanitta perspicillata*), and Common Eider (*Somateria mollissima*) ducklings at Patuxent Wildlife Research Center's breeding facility to participate in underwater hearing tests in the center's dive tanks. We trained ducks using operant conditioning to perform a Go/No-go task, where they reported whether they heard tones of varying frequency and sound pressure level. We performed a logistic regression ($P < 0.05$) on the trials of Go/No-go data across the different sound pressure levels to ascertain the likelihood that each individual heard a specific frequency. The predicted 50% threshold for each individual at each frequency was determined from the derived logistic model. Greatest hearing sensitivity was observed at 2.96 kHz for the long-tailed ducks (average predicted threshold of 101.6 $\pm$ 0.6 dB) and common eider (predicted threshold of 105.9 dB), while the surf scoters exhibited greatest sensitivity at 1.0 kHz, with an average predicted threshold of 104.8 $\pm$ 0.8 dB. Underwater hearing threshold data suggest that these species share a common range of auditory sensitivity, from 1.0–3.0 kHz. Based on the results of this study, sea duck underwater hearing sensitivities are within range of high intensity noise pollution generated from mid-frequency sonar, small vessel activity, and offshore drilling. The consequences of the overlap between sea duck sensitivity and multiple sources of underwater noise pollution are unknown, but could include disruption of normal biological behavior, masking, and physiological stress. Most commercially available acoustic deterrent devices emit high frequency tones which would not be detected by the species tested in this study; however, a lower frequency pinger in the 2–3 kHz range would fall within sea duck sensitivity and may be a viable option for field testing. While a pinger that emits tones under 3 kHz would be ideal for species with lower frequency sensitivity like surf scoters, tones at this frequency may also fall within sensitives of target fish species, warranting the need for extensive field testing.

Marine Debris and Pollution

Heavy Metals in Food Chains (including invertebrates, fish, and birds)

Contact: Joanna Burger, Biological Sciences, Rutgers University, 604 Allison Road, Piscataway, NJ 08854-8082. burger@biology.rutgers.edu

We have been investigating the levels of several heavy metals (mercury, cadmium, lead, selenium, cadmium, chromium) in: 1) invertebrates (such as Horseshoe Crab tissues and eggs), 2) fish (prey fish for birds as well as fish eaten by people), 3) feathers and eggs of birds, and 4) in internal tissues of birds. Some of these data have been published in Burger and Gochfeld (2016), and in several other papers. We have also specialized on examining levels in shorebirds, and elsewhere (e.g. Brazil, Suriname). We have found that some metals have clearly declined (lead, cadmium), while mercury has not.

One of our objectives is to examine whether metal levels are sufficient high to suggest that they may contribute to adverse effects. The potential effects vary by species, and time, as well as by the location of collection. Long-term data sets are essential to begin to understand both patterns of exposure, and possible adverse effects. Levels of heavy metals in eggs of Common Terns, for example, have been examined every year since the early 1970s, one of the longest such data sets.

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Plastic Ingestion and Bycatch Demographics of Great Shearwaters from the Gulf of Maine

Contacts: David Wiley, Stellwagen Bank National Marine Sanctuary, david.wiley@noaa.gov
Anna Ruth Robuck, University of Rhode Island, anna_robuck@uri.edu
Gwenyth Emery, University of Rhode Island, gwenyth.emery@gmail.com
Christy Hudak, Center for Coastal Studies, chudak@coastalstudies.org
Johanna Pederson, Integrated Statistics, Inc., johanna.pedersen@noaa.gov
Joshua Hatch, Northeast Fisheries Science Center (NEFSC), joshua.hatch@noaa.gov

Since 1950 globally monitored seabird populations have declined significantly, with possible causal factors including plastic pollution, fisheries bycatch, and climate change. Seabirds are particularly prone to plastic ingestion and are excellent indicators of plastic pollution. Procellariiformes, like Great Shearwaters (GRSH; *Ardenna gravis*), are particularly prone to plastic ingestion with 71% of sampled GRSH from 2005 – 2008 along the U.S. East Coast containing at least one piece of plastic (n = 17). Surface water plastic abundance is correlated with plastic production, which is slated to quadruple by 2050. Therefore, seabird plastic ingestion will likely increase with unknown consequences for seabird population resilience. Anecdotally, this hypothesis has been supported with 94% of juvenile GRSH examined in 2017 containing at least one piece of plastic (n = 19; Anna Robuck *pers. comm.*). This project will make use of an existing dataset of necropsied GRSH collected by fisheries observers from the Gulf of Maine during 2007 – 2018. An additional 30 GRSH collected in 2019 will be necropsied to supplement the existing dataset. Ingested plastic debris from 6 – 12 necropsied GRSH per year will be analyzed to identify polymer type (n ≈ 1000 plastic pieces from ~100 GRSH). Modeling techniques will then be used to assess relationships between plastic metrics and polymer identity with the GRSH necropsy data, which also includes demographic information (e.g., sex, age, and overall basic health). This project will be one of the first to comprehensively measure plastic ingestion by GRSH and to assess plastic polymer identity relevant to a regional species.

Multi-Topic and Miscellaneous Updates

Monitoring, Tracking, and Other Research on Great Black-Backed and Herring Gulls on Appledore Island

Contact: Sarah Courchesne, Northern Essex Community College, necc.mass.edu

This year, we saw a marked increase in the number of breeding adult gulls found dead or dying on Appledore Island in the southern Gulf of Maine. Necropsy of several birds was inconclusive, but the working diagnosis is paralytic illness due to a harmful algal bloom (HAB). There was a severe HAB along the ME, NH, and MA coasts this spring, and we presume the birds were fatally affected by it.

Last year, we placed GPS data loggers on five Great Black-backed Gulls. The birds chosen already had bands, but had not been sighted anywhere but at the breeding colony, so we had no data on their travels beyond Appledore. Preliminary data collected from the loggers indicate that some of these rarely seen birds are foraging primarily at sea, but others are visiting terrestrial sites like landfills or mudflats. Unfortunately only one bird returned to Appledore with an intact, functioning logger. We hope to try again next year with some replacement units.

We had two summer interns monitoring our gulls this summer, and one of our interns also conducted an independent project on individual variation in defensive behavior, and whether mates tend to show similar or different levels of aggression. That intern, Brielle Michener, will present her research at the Gulf of Maine 2050 Symposium later this year.

Finally, gull blood smears collected between 2017-2019 are currently being analyzed and used as fodder for a Course-based Undergraduate Research Experience (CURE) at Northern Essex Community College. Visit our blog (http://gullsofappledore.wordpress.com) to read more.

Seabird Ecological Assessment Network: Building Collaboration, Community and Credibility through Citizen Scientists

Contact: John Stanton, U.S. Fish and Wildlife Service, john_stanton@fws.gov

The Seabird Ecological Assessment Network (SEANET) is a citizen science program that brings together researchers and members of the public in a long-term, collaborative effort to collect data on seabird mortality along beaches up and down the eastern seaboard. SEANET was started by researchers at Tufts Center for Conservation Medicine in 2002. Since that time, SEANET expanded to beaches from Maine to Florida. Dependent largely on volunteers, the participation in SEANET has waxed and waned. However, through hosting of regional SENAET workshops to promote collaboration and a sense of community, potential volunteers (i.e. citizen scientists) are introduced SEANET survey protocols. These regional workshop are crucial to establishing new SEANET survey routes and expanding the overall participation in SEANET. In addition, the need to store and manage SEANET data (ca 15,000 survey records) is a constant requirement to the success of the SEANET. Originally, SEANET data was hosted online via a university server, but was closed down in 2017 because of internal university IT security concerns. Currently, SEANET survey data are stored and managed on Anecdata.org, a free citizen science platform anyone can use to collect observations of our changing world, to further the collaboration, community and credibility of a largely citizen scientist-based seabird monitoring program. In addition, SEANET has been leveraged for science education, social engagement around science and the subject of, and raising awareness about seabirds in the ocean environment.

Regional Collaboration to Understand and Minimize Waterbird Impacts from Offshore Wind Energy Development

Contact: Kate Williams, Biodiversity Research Institute, kate.williams@briloon.org

The New York State Energy Research and Development Authority is leading a range of regional, science-based stakeholder engagement efforts under the umbrella of the Environmental Technical Working Group for Offshore Wind (E-TWG). The E-TWG, which was formed in 2018, is working to develop conservation guidance and fill data gaps around the potential risks and impacts of offshore wind energy development to wildlife. We are soliciting AMBC members' expertise and engagement on several ongoing efforts to address impacts to waterbirds, including: (1) development of a scientific research framework to understand the long-term impacts of offshore wind development on birds and bats and identify priorities for funding and future research, (2) the May 2020 "State of the Science" workshop on cumulative impacts, which will bring together scientific experts in the field to assess the state of knowledge about offshore wind and wildlife science and develop a research agenda for understanding cumulative impacts to wildlife as the offshore wind industry progresses in the United States, and (3) the collaborative development of best management practices to reduce impacts to birds and bats from offshore wind projects. For more information and to sign up for e-mail list serv, visit www.nyetwg.com.