

**PAUL S. SARBANES ECOSYSTEM RESTORATION  
PROJECT at POPLAR ISLAND  
ANNUAL UPDATE  
January-December 2022**

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**Poplar Island Researchers -** Please send any updates, findings, or occurrences of note that you have gathered from your monitoring project to Claire Ruark (MES) at [cruark@menv.com](mailto:cruark@menv.com) or call 410-770-6505 so the information can be shared in the update. Also, due to limited boat capacity, when you schedule a site visit, please call ahead of time with the number of people in your party so transport arrangements can be made.

**Operations and Expansion Update**



**Figure 1. Paul S. Sarbanes Ecosystem Restoration Project at Poplar Island 2022 Master Plan Map**

Inflow of maintenance material occurred March 16 through May 30, 2022. The USACE contractor, Cashman Dredging & Marine Contracting Co., LLC (Cashman), placed approximately 1.43 million cubic yards (mcy) of material into Cells 8 and 11 (Table 1). This included approximately 200,000 cubic yards (cy) of dredged material from the emergency Ever Forward recovery, which was placed into Cell 8 from March 20 through April 7.

**Table 1. Inflow Maintenance Dredged Material 2021/2022**

<b>Inflow Point</b>	<b>Location</b>	<b>Project</b>	<b>Total Material Deposited (cy)</b>
1	Cell 8	Baltimore Approach Channels	407,741
2	Cell 11		809,317
1	Cell 8	Ever Forward Recovery	213,486

**Total Material: ~1.43 mcv**

Throughout the year, MES Operations managed the Cells 1D, 4, and 7 sand stockpiles for use in dike raising. The Cell 4C stockpile, near Spillway 9, continued to be utilized as a long-term sand stockpile. MES continued to move the remaining sand from Cell 4AB to the stockpile in Cell 4C. The target elevation for the sand removal is -2' to prepare Cell 4 for future cell development, specifically the expected dredged material inflow into the cell in the 2023/2024 dredging cycle. MES Operations continued hauling the wetter sand from Cell 4ABC to Cell 11 for further drying. In December, after grain size analysis showed that the material met the requirements for dike construction, MES began building a ramp from the current dike (+10 feet) up to the platform of Spillway 21 (+25 feet). Sand was also hauled to Cell 1D for long-term stockpiling. Additionally, MES Operations staff conducted trenching and crust management in Cells 1D, 2A, 2AX, 2B, 2C, 4ABC, and 6. MES Operations continued dike sand slope erosion management along Cells 8, 9, 10, and 11.

The USACE contractor, New Dominion Construction, LLC, was onsite in October 2021 to repair the inlet structure on the east side of Cell 1C. The contract included repairing the perimeter dike and all four interior and exterior inlet wingwalls that were failing in Cell 1C; work concluded in February 2022.

#### **Monitoring Update**

MES continues to implement the Maryland Department of the Environment (MDE) guidance on discharge monitoring procedures. Discharge this reporting period was associated with rainfall accumulation and the 2021/2022 inflow of maintenance dredged material into Cells 8 and 11. There were three noncomplying events in 2022. Two events were related to elevated metals (one likely due to collection error) and one event was related to turbidity (missed readings).

MES Environmental staff continued collecting nutrient load data for Poplar Island throughout the reporting period. Under the existing monitoring plan, nutrient data is collected on a monthly basis from representative spillways and inlets, and daily from spillways located in Phases I (Cells 1, 2, and 3) and II (Cells 4, 5, and 6) during times of discharge. The data will serve as a management tool to assist in development of Best Management Practices (BMPs) when Total Maximum Daily Load (TMDL) allocations are assigned for Poplar Island.

Additionally, mass balance nutrient monitoring was introduced during the 2014/2015 inflow season and has occurred during subsequent inflow seasons until the 2019/2020 inflow season. This monitoring did not occur during the 2020/2021 or 2021/2022 inflow seasons due to the location of the inflow points in the Poplar Island Expansion (PIE). TMDL and mass balance sampling is currently conducted in cells with historical discharge data in order to better recognize trends. PIE spillways may be added to the monitoring plan in the future. This monitoring will help determine whether development of the Poplar Island project sequesters nutrients from the dredged material.

**Table 2. Vegetated Wetland Cells Development Timeline**

Wetland Cell	Cell 4D	Cell 3D	Cell 1A	Cell 1C	Cell 1B	Cell 3A	Cell 3C	Cell 5AB	Total Acres of Wetland
Last Dredged Mat. Inflow (month, year)	NA	Jan. 2003	Mar. 2006	Mar. 2006	Mar. 2006	Apr. 2007	May 2010*	Jan. 2012	
Opened to Tidal Flow (month, year)	Apr. 2003	Mar. 2005	Mar. 2009	Jan. 2011	Feb. 2012	Oct. 2014	Sep. 2015	Nov. 2017	
Completed Planting (month, year)	Aug. 2003	Jun. 2006	Sep. 2009	Jun. 2011	May 2012	Jun. 2015	Jul. 2016**	Jun. 2018	
Date Last Monitored (month, year)	NA	April 2016	April 2016	April 2016	April 2016	April 2018	May 2019	May 2021	
Acreage	24	32	45	40	36	55	57	83	372

\*2010 inflow of sand from Poplar Harbor channel dredging.

\*\*12 acres damaged by bird predation replanted in 2018

### Framework Monitoring Update

Beginning in June 2021, routine community algae analysis was replaced with Harmful Algal Bloom (HAB) specific monitoring. Algae samples were collected at all spillways with ponded water and were analyzed for the presence of potentially toxigenic (PTOX) cyanobacteria and analyzed for toxin, if necessary, by GreenWater Laboratories. As per the monitoring plan, monitoring for signs of the establishment of a HAB was conducted in Cell 6. MES conducted weekly monitoring at Spillway 16, including the use of a handheld fluorometer to measure the concentration of phycocyanin, a unique pigment found in blue-green algae.

During the reporting period, algae samples contained concentrations of *Limnospira* sp., *Anabaenopsis* sp., *Pseudanabaena* sp., *Oscillatoria/Phormidium* sp., *Phormidium* sp., *Microcystis aeruginosa*, and *Microcystis* sp., all potentially harmful algal species. Toxin analyses showed results were nondetect, with the exception of samples that contained *Microcystis aeruginosa* or *Microcystis* sp. Samples collected on September 12 in Cells 8 and 9 had microcystin concentrations of 58,300 and 12,500 ppb, respectively, which were the highest concentrations observed during the HAB event. This is above the Environmental Protection Agency (EPA) recommended threshold for recreation (8 ppb). At the time, Spillway 19 discharge was on hold due to an ongoing avian mortality event. Out of precaution due to the toxin results, discharge remained on hold. Once samples showed that toxin levels were below the EPA threshold, Spillway 19 was opened for discharge on November 7. Algal monitoring of the discharging water continues every two weeks as per the HAB monitoring plan, while cyanobacteria is still present. *Microcystis* sp. continues to be detected in follow up samples although toxin levels remain nondetect or well below the threshold.

From June 30 to November 1, MES and the United States Fish and Wildlife Service (USFWS) responded to an avian mortality event that primarily affected Cells 8, 9, and 10 in the PIE. Several birds were sent to

the National Wildlife Health Center for analyses. Botulism was confirmed and is suspected to have affected the majority of the individuals collected. Botulism is caused by a naturally occurring bacteria found in the sediments. The event affected 1,627 individuals across 31 species. The most affected guilds were waterfowl and shorebirds. In an effort to reduce mortality by limiting shoreline foraging habitat, the water level in Cells 8, 9, and 10 was raised by pumping water from Cell 11 into Cell 10 from August 3 to August 24. Pumping was discontinued when water levels in all affected cells reached the target elevation.

This season, the United States Geological Survey (USGS), with USFWS assistance, continued conducting surveys of Poplar Island's target nesting bird populations (Figure 2). Tern pair counts were slightly less for Common Tern (408) and slightly higher for Least Tern (378) this year compared to last year (445 and 363 in 2021, respectively). The Common Tern colony did not occupy the historic location in the northwest corner of Cell 2C; instead, most nests were dispersed along the northwest corner of Cell 7, north side of Cell 11, and on the habitat islands in Cells 1B and 3C, with an additional colony on the east side of Cell 11. Most of the Least Tern nests were located on the north side of Cell 11, with additional colonies in the northwest corner of Cell 7, the east side of Cell 11, and the west side of Cell 1D. For the tenth year, the USGS conducted a banding and resighting program in order to better document tern fledging success. In 2022, 600 Common Tern chicks and 241 Least Tern chicks were banded as of June 28, 2022. After potential neurological and avian botulism symptoms were detected, chick handling and banding was halted for the season.

In order to continue accessing PIE construction sand, tern and bank swallow nesting activity was carefully managed. USFWS advised MES when managing the sand stockpiles to leave slopes instead of sheer cliffs (in which bank swallows will nest), and to continue activity in certain areas to deter tern nesting. This season, a few areas within the Cells 1D, 4ABC, and 7 stockpiles were set aside as tern and bank swallow nesting areas, while the rest of the stockpiles were actively managed without nesting issues.

The USGS and the USFWS also surveyed nesting populations of Osprey, Snowy and Cattle Egrets, and Double-Crested Cormorants (DCCO) on and just offsite. The site's colonial nesting waterbirds and target nesting birds continue to nest successfully on Poplar Island. Osprey pairs decreased to 21 active pairs on Poplar Island and Poplar Harbor in 2022 (compared to 24 in 2021).



**Figure 2. 2022 Poplar Island Bird Nesting Map**

MES continues bimonthly bird surveys for the entire site and confirmed 33 nesting species onsite for the 2022 season with six more suspected. Onsite nesting species include Canada Goose, Northern Shoveler, Gadwall, Mallard, American Black Duck, Blue-winged Teal, Virginia Rail, Common Gallinule, Black-necked Stilt, Killdeer, Willet, Herring Gull, Great Black-backed Gull, Least Tern, Common Tern, DCCO, Snowy Egret, Little Blue Heron, Cattle Egret, Black-crowned Night-Heron, Glossy Ibis, Osprey, Fish Crow, Tree Swallow, Bank Swallow, Barn Swallow, Northern Rough-winged Swallow, Carolina Wren, Marsh Wren, Brown Thrasher, European Starling, Seaside Sparrow, Common Grackle, Barn Owl, and Red-winged Blackbird. Outstanding bird occurrences throughout the reporting period included first site records of White Ibis, Nashville Warbler, and Canada Warbler, and rarities: Ipswich Sparrows in January, February, and March, Least Flycatcher and Solitary Sandpipers in May, Black Skimmer in June, Clapper Rail in July and August, Blue-winged Warbler, Alder Flycatcher, and Northern Waterthrush in August, Blackburnian Warbler in September, Lapland Longspur and Sedge Wren in November, and Orange-crowned Warbler in December. Bird censuses performed at Poplar Island during the reporting period had daily bird counts that ranged from 1,228 birds utilizing the site during a February survey to 6,280 birds onsite during a July survey.

On March 3, 2021, Maryland Department of Transportation Maryland Port Administration (MDOT MPA) received an incidental take (disturbance) permit from USFWS regarding a pair of eagles that had been attempting to nest in the PIE. This permit includes restrictions such as avoiding pedestrian traffic within 330 feet of the nest and avoiding pausing when traveling within 660 feet of the nest during breeding season. When the nest was abandoned by the eagles with no eggs laid, an amended permit was applied for and was received on November 23, 2021 that allowed for the structure and remaining nesting material to be removed completely. The amended permit also allows for USFWS and MES field crew to remove sticks from all onsite man-made structures where nests have been unsuccessful. The permit will be in effect for four nesting



seasons. Monthly eagle monitoring throughout the nesting season (December 15–June 30) will be conducted by USFWS field crew or MES Environmental staff.

In late February 2022, a pair of Bald Eagles was observed loafing and bringing nesting material to a tree with an abandoned crow nest on the Cell 1C habitat island. Due to the late timing in the nesting season, there was no egg laid. In October 2022, MES received a Service determination through correspondence with the USFWS permitting office that states there are no immediate concerns about project activity near the Cell 1C nest since the location was selected by the eagles while construction was ongoing. The location will continue to be observed for future activity during monthly eagle monitoring according to the protocol detailed in the permit above.

Poplar Island was registered as a Monarch Waystation in 2016. Since then, USFWS has monitored both butterfly and milkweed presence in each developed wetland cell in the summer and early fall. In 2022, a continued monarch tagging effort was conducted to provide data on sex ratios, migration patterns, weather influence, and mortality rates. During the 2022 season, 150 monarchs were tagged onsite. The 2020 Endangered Species Act listing status was reviewed and determined the monarch is a candidate species and therefore warranted to be listed but precluded by high priority listings. Annual review of this status will be conducted. USFWS recommended that mosquito control aerial sprays should be restricted during monarch migration. In 2022, aerial sprays were restricted between September 14 through October 15; however, the restricted dates may be adjusted annually depending on migration activity and USFWS field crew onsite monarch survey data. This year, roads were watered periodically depending on site dust conditions due to concerns about coating important monarch habitat in dust along roadways.

During May, July, and September, the USFWS conducted seasonal monitoring of submerged aquatic vegetation (SAV) in Poplar Harbor, Cell 5AB pond, and reference areas. USFWS reported 49% cover in Poplar Harbor in May 2022, as compared to 32% in May 2021. In July and September, SAV was detected only in the reference areas.

The Maryland Geological Survey (MGS) conducted the Phase III Expansion post-construction side-scan survey in April, in order to document changes in the sediment environment due to construction. Surveys included side-scan sonar, acoustic sub-bottom profile, and seabed classification (with sediment sampling to ground-truth). The images are in the process of being reconciled, fine-tuned, and classified; at which point they can be paired with the grab samples to determine the type of sediment at the bay bottom.

The University of Maryland Center for Environmental Science (UMCES) continued collecting rod-Surface Elevation Table (SET) data in order to track accretion rates within the marshes. The accretion rates vary between wetland cells and within cells; generally, areas closer to the inlets are keeping pace with sea level rise (SLR) better than areas further from the inlets. Most accretion rates at Poplar Island are above the current rate of SLR reported for Annapolis (4.04 millimeters per year). The accretion rates in younger wetland cells are generally higher when compared to older wetland cells, which could be due to higher initial elevations and/or soil processes reaching equilibrium in older cells. UMCES plans to analyze data further to examine drivers of variability, including but not limited to, biomass production, starting elevation, and distance of the SET from the inlet. Data collected and analyzed from sediment, porewater, and vegetation samples continues to be used by UMCES to assist in determining the cause of periodic vegetation die-back within the developed wetland cells, as well as monitoring the overall health of the site's restored marshes.

UMCES continued to evaluate the pond in Cell 5AB. The purpose of the study is to evaluate the pond's stability, role in sediment transport, and habitat suitability (specifically in terms of dissolved oxygen content). In October, a series of instruments were deployed including an Acoustic Doppler Current Profiler (ADCP) to analyze water and sediment transport, a wave gauge to collect wave energy data, and a Hydrolab to collect water quality data. Sediment flux cores were also collected to analyze oxygen and nutrient fluxes. Another deployment is anticipated in winter 2022/2023. UMCES also deployed a new tide gauge in the

same location as the previous gauge at the personnel pier. The gauge was leveled by MES Survey crew and began collecting data in September. Data will be collected for a full year before new tidal datums can be calculated.

The National Oceanic and Atmospheric Administration (NOAA) conducted spring and fall nekton monitoring in April/May and October. NOAA reported that results from 2022 monitoring show that total number of fish species within restored wetland cells is lower than reference marsh creeks regardless of gear type. NOAA observed juvenile Spot in the Poplar Island marshes, primarily in Cell 5AB, suggesting that the restored marshes are being used as a nursery ground by this important commercial and recreational fish species.

In August, NOAA deployed approximately four million oyster larvae on one of the embayment rock reefs as part of a new study. The location will be monitored throughout 2023, then annually, if larvae become attached. As part of the deployment, an ADCP and oyster shell bags were placed, then retrieved the next month, to evaluate water conditions near the rock reef and to assess for early signs of larval attachment.

In early spring of 2022, Ohio University (OU) collected and processed 90 overwintering terrapin hatchlings. Along with the 738 hatchlings that were processed in fall 2021, a total of 828 hatchlings were tagged, measured, and marked for the 2021 nesting season. Between April and June 2022, there were 125 terrapin yearlings released on Poplar Island as part of the Terrapin Education Research Partnership (TERP) Headstart program, where Maryland school children raise the hatchlings collected on Poplar Island in the fall and then release them onsite the following spring. OU reported a total of 303 nests for the 2022 diamondback terrapin nesting season; 31 nests were left to overwinter until spring 2023. OU collected and processed 819 hatchlings in fall 2022 with 151 hatchlings included in the Headstart program.

### **Wildlife and Invasive Vegetation Management**

Under a Federal Fish and Wildlife Depredation Permit, certain species continue to be managed on Poplar Island. Management of wildlife is conducted to ensure target species and their habitats are protected. In an effort to protect the site's vital waterbird nesting area, during the 2022 season, gull control occurred, with the removal of 98 individuals and the oiling of eggs in 240 nests. Six adult Fish Crows, 18 Canada Goose individuals, and eggs from five goose nests were removed throughout the site. Additionally, three Great Horned Owls were removed from Coaches Island, with no evidence of nesting. Due to the large muskrat population recorded in winter of 2021, USFWS removed 128 muskrats from across the site.

The USFWS did not perform any control on DCCO during the reporting period. Approximately 300 DCCO nested on the Cell 1A habitat island. Monitoring of the vegetation and soil pH recovery on the Cell 3D habitat island after DCCO damage in 2020 will continue.

During 2022, MES Environmental staff continued annual noxious and invasive control of bull thistle, Canada thistle, tree-of-heaven, mile-a-minute vine, and *Phragmites australis* throughout the site. Environmental staff also conducted maintenance vegetation removal of the sparsely vegetated habitat islands in Cells 1B and 3C, which included mechanical and chemical control. This is done in order to promote colonial waterbird nesting. Environmental staff continued to monitor mosquitoes on an as needed basis during the 2022 season. When conditions are deemed uncomfortable for onsite staff, Environmental staff will conduct monitoring including trap counts to ensure that the Maryland Department of Agriculture (MDA) minimum action thresholds are met before requesting aerial mosquito control be conducted. No mosquito aerial sprays were conducted in 2022.

### **Safety**

As discussed at the Poplar Island Working Group meetings, to ensure that all activities occurring on the project site are coordinated and everyone is following the appropriate safety procedures, it is required that all guests contact the site to inform staff of a visit at least one day in advance. This would also be the appropriate time to set up any transportation that is needed. Advanced coordination should also be made

for those with their own boat transportation. Safety procedures include the wearing of high visibility vests at all times while not in a vehicle as well as closed-toed shoes with appropriate soles. Everyone must sign in when they arrive onsite.

For those researchers who are at the site during off-peak times, please contact the site to let them know when you will be onsite; a sign in sheet and safety vests will be provided for your use during those times. For safety reasons, if you are by yourself, you will need to be accompanied by an MES employee for the time you are on the island. While visitors are welcome, normal operations duties may make it necessary to postpone certain visits if enough notice is not provided.

### **Tours**

During the 2022 tour season, Poplar Island was visited by 1,049 members of the general public, 179 special interest participants, 626 students, and 165 birders, for a total of 2,019 visitors. To schedule a tour please send an email to [poplartours@menv.com](mailto:poplartours@menv.com) or call 410-770-6503.

### **Meetings, Media, and Noteworthy**

Site Operations meetings were held approximately every three weeks throughout the period including the USACE, MDOT MPA, MES, Moffat & Nichol (M&N), and Gahagan & Bryant Associates, Inc. (GBA).

The Poplar Island public website's URL is [www.poplarislandrestoration.com](http://www.poplarislandrestoration.com). Features of the website include project goals, media highlights, photos and maps, current newsletter, link to the onsite weather station, wildlife link to Ebird.org, social media links for USACE, MDOT MPA, and MES, all documents, work cited for any articles, papers, or conferences related to Poplar Island, and a contact page that links directly to MES tour staff to schedule a tour.

The annual Habitat Subgroup meeting was held in a hybrid format (in person and virtually) on March 9, 2022. The Poplar Island semiannual Working Group meetings were held in a hybrid format on July 7, 2022 and November 17, 2022. Please check the project website [www.poplarislandrestoration.com](http://www.poplarislandrestoration.com) documents list or contact Bronwyn Bare with MES at [bbare@menv.com](mailto:bbare@menv.com) if you would like a copy of the meeting summaries. The next Working Group meeting will be held in the fall of 2023.

The following articles and presentations relating to Poplar Island were published and conducted throughout the reporting period:

- Throughout the year, Kristina Motley (MES) presented “Poplar Island an international model of innovative reuse” to multiple groups including the Tilghman Waterman’s Museum, Tilghman Country Store, and the Talbot Historical Society.
- In January, *Chesapeake Bay Magazine* published an article titled “How your Christmas tree can save the bay” about Christmas trees and their benefits in creating habitat for wildlife.
- In March, media referencing Poplar Island included the following:
  - *Dredging Today* published an article titled “The Ever Forward dredge ops in full swing” discussing the dredging effort to free the ship the Ever Forward and how the dredged material went to Poplar Island.
  - *Dredging Today* released an article “Army Corps receives more than \$97 million for essential water resources projects in Chesapeake Bay region” stating how funding will be used to continue the placement of material dredged from the approach channels to the Port of Baltimore to restore Poplar Island.
- In April, *Bay Weekly* published an article titled “Back from the brink” covering the dredging effort to free the ship the Ever Forward and how Poplar Island will benefit from receiving the dredged material.



- In May, *WBAL-11 TV* reported “Dredging to save Poplar Island restores wildlife habitat from effects of climate change” that highlighted the project and the many benefits of using dredged material to restore an ecosystem.
- Dr. Lorie Staver and Dr. Jeff Cornwell (UMCES) gave a presentation; “Soil effects on success of vegetation establishment for tidal marsh restoration,” which discusses their work done on Poplar Island with marsh restoration, at the Joint Aquatic Sciences Meeting on May 17.
- On June 28, USGS gave a presentation titled, “Quantifying the Forage Base and Critical Forage Taxa for Chesapeake Waterbirds” at the annual meeting of the American Ornithological Society discussing their work done on Poplar Island monitoring the abundance and status of key forage taxa from waterbird species as a proxy for ecosystem health.
- On June 29, UMCES presented a talk “Tidal marsh restoration at Poplar Island: maximizing resiliency” at the Queen Anne’s County Free Library.
- In August, *NBC4 Washington* aired a video called “Rebuilding islands in the Chesapeake Bay” that highlights the work being done on Poplar Island and the benefits it provides. Reporters visited the island to collect footage for the piece.
- On October 30, Willem Roosenburg (OU) presented “Demographic comparison of Head-start vs. natural release terrapin hatchlings” at the 9<sup>th</sup> Workshop on the Ecology, Status, and Conservation of the Diamondback Terrapin in Athens, GA.
- In December, media referencing Poplar Island included the following:
  - *The National Aquarium* released an article “Connecting dots: The science of tracking wildlife” discussing the Poplar Island TERP and it’s ongoing research component conducted by Willem Roosenburg on diamondback terrapins.
  - NOAA Fisheries wrote an article called “Does rebuilding an island rebuild fish habitat?” that describes the nekton monitoring at Poplar Island.
- Lorie Staver, Alexa Poynter, and Ryland Taylor (MES) presented “*Twenty years of marsh restoration at Poplar Island: successes, challenges and focus for the future of a large-scale beneficial use project*” at the Restore America’s Estuaries Summit in New Orleans, LA on December 7. Lorie also presented a poster titled “*Poplar Island and Sabine National Wildlife Refuge as case studies for marsh restoration trajectories*” at the Summit.
- Barnett Rattner (USGS) presented a talk called “*Do Harmful Algal Blooms Adversely Affect Wildlife in the Chesapeake Bay?*” at the Maryland Water Monitoring Council Conference on December 15 which discussed algal blooms and possible relationships with wildlife on Poplar Island.

Publications referencing Poplar Island included the following:

## USGS

- John B. Taylor, Jeffery D. Sullivan, Claire S. Teitelbaum, Jan G. Reese, Diann J. Prosser. 2022. *Comparing Landsat Dynamic Surface Water Extent to alternative methods of measuring inundation in multiple landcover types*. Remote Sensing Applications: Society and Environment: 100845.
- Evan J. Buck, Jeffery D. Sullivan, Claire S. Teitelbaum, David F. Brinker, Peter C. McGowan, and Diann J. Prosser. 2022. *An evaluation of transmitter effects on adult and juvenile Common Terns using leg-loop harness attachments*. Journal of Field Ornithology 93: [online].
- Prosser, Diann J., J.D. Sullivan, Christopher J. Gilbert, Peter C. McGowan, Carl R. Callahan, Ben Hutzell, Laurence E. Smith, David F. Brinker. 2022. *A Comparison of Direct and Indirect Survey Methods for Estimating Colonially Nesting Waterbird Populations*. Waterbirds 45:189-198.
- Jeffery D. Sullivan, Amy W. O’Donnell, Lauren L. Lescure, Andrew J. Rapp, Carl R. Callahan, Peter C. McGowan, Tim Carney, and Diann J. Prosser. 2022. *Managing conflict between nesting common terns and herring gulls*. Journal of Fish and Wildlife Management. Under Review.

## OU

- Bryan S Vorbach, B.S. L.A. Clayton, W.M. Roosenburg, T.M. Norton, L. Adamovicz, C.A. Hadfield, M.C. Allender. 2022. *Prevalence of multiple reptilian pathogens in the oropharyngeal mucosa, cloacal mucosa, and blood of Diamond-backed Terrapin (Malaclemys terrapin) populations from Maryland and Georgia, USA* Journal of Wildlife Diseases 58:782–790.

## USFWS

- Rattner, B.A., C.E. Wazniak, J.S. Lankton, P.C. McGowan, S.V. Drovetski, and T.A. Egerton. 2022. *Review of Harmful Algal Blooms and Implications for Avian Wildlife in The Chesapeake Bay Region*. J. Harmful Algae. 120.
- Scarpulla, E.J., P.C. McGowan, and R.C. Callahan. 2022. *A Yearlong Survey of the Bees (Hymenoptera: Apoidea) at a Large-scale Island Restoration Project Created from Dredged Material: Poplar Island, Chesapeake Bay, Maryland, USA*. The Maryland Entomologist 8(2):28–57.