Interim Report
State Wildlife Grants
T-1-8

F18AF00970-03

Endangered, Threatened and Rare Wildlife Conservation Projects

Final Report for Grant Years
January 1, 2019 – December 31, 2021

NJ Department of Environmental Protection

DIVISION OF FISH AND WILDLIFE
ENDANGERED AND NONGAME SPECIES PROGRAM
P.O. BOX 420
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NEW JERSEY DIVISION OF
Fish and Wildlife

SPORT FISH & WILDLIFE RESTORATION

Project 1. SGCN Conservation and Management

Job A. Birds

Subjob A.1. Raptors (Activated in Grant W-70-R eff. 9/1/15)

Subjob A.2. Landbirds (non-raptors) (Activated in Grant W-70-R eff. 1/1/19)

Subjob A.3. Shore and Marsh Birds (Activated in Grant W-70-R eff. 9/1/15)

Job B. Mammals (Inactive job, presently covered by Grant W-71-R)

Job C. Reptiles and Amphibians

Subjob C.1. Turtles

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Subjob C.3. Amphibians

Job D. Invertebrates

Subjob D.1. Mollusks

Subjob D.2. Macroinvertebrates

Subjob D.3. Effects of Dam Removals

Job E. Marine Wildlife: Identify and Mitigate Threats to Sea Turtles in NJ Waters

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Project 2. Habitat Management and Planning

A. Strategic Habitat Conservation

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Performance Report

Project: **1. SGCN Research, Monitoring and Management**
Federal Aid Project: T-1-8 (State Wildlife Grants)
Segment dates: January 1, 2019 to December 31, 2021

JOB C. REPTILE AND AMPHIBIAN CONSERVATION
Subjob C.1. TURTLES
Project Leader: Brian Zarate

Key Findings:

- During 2021 and throughout the grant period, staff coordinated 1-3 times per year with USFWS New Jersey Field Office Partners for Wildlife (FWS NJFO) staff and other external partners on bog turtle habitat restoration on private lands. These virtual and on-site coordination meetings included identification of bog turtle core habitats in need of restoration and providing guidance on management activities to achieve restoration goals, on a site-by-site basis. Formal development and documentation of site-specific management plans was done by FWS NJFO and restoration activities were performed by FWS NJFO staff and their partners. Completed restoration actions and number of sites managed is maintained by FWS NJFO.
    - ENSP did not develop contracts to implement habitat restoration work in this grant.
- Staff continued a partnership with New Jersey Audubon (NJA) at a site in southern NJ. ENSP provided technical input and field assistance to the project, but habitat restoration activities were funded but a separate source.
    - Phragmites was mowed each winter and follow-up herbicidal application was done each summer. Stockton University installed monitoring wells at six strategic locations throughout the wetlands and uplands to be monitored for hydrology. Over the course of several days in the fall of 2021, seven check dams and three weirs were installed in the modified agricultural ditch bisecting the wetland. A small section of sapling gum trees were removed and used as the material for the weirs, and FWS staff dug a trench to identify and break up any tile drains actively draining the southernmost field on the property; one line was identified and broken. A berm was created with the backfill at the edge of the field, and two large, eroded cuts were also backfilled.
- In 2012, ENSP entered into a Regional Conservation Partnership Program with Conserve Wildlife Foundation (CWF), New Jersey Conservation Foundation (NJCF), US Fish & Wildlife Service (USFWS), and led by NJA for protection and restoration of bog turtle habitat in the Salem River Watershed. Ranking criteria for habitat restoration and easement have been established, and the first round of applications have been received.
- ENSP coordinated bog turtle population monitoring with volunteers at 15 sites in 2021 following regional protocols. Not all data were submitted from volunteers on 2021 survey work as of January 2022. Survey protocols followed Erb (2019) as documented within the regional conservation plan found here: https://www.machac.org/docs/Bog_Turtle_Conservation_Plan_2019.pdf
- ENSP performed field surveys at 5 sites in 2021. At 4 of the sites, the goal was to collect mouth and cloacal swabs for a genetics project being coordinated by FWS Region 5 leads and the active CompSWG bog turtle project coordinator. Sufficient samples were collected at 3 of the 4 sites, which consisted of 1-3 samples per site. Results of submitted samples will help inform future recovery unit updates. At the 5th site, habitat suitability was assessed for bog turtle as the wetland recently was acquired by a state agency, affording it permanent protection. While no bog turtles were observed during the visit, the habitat was highly suitable and future detection of a turtle there in 2022 will result in the addition of a new core habitat.

- No contracts with qualified bog turtle surveyors to implement regional field survey protocols were awarded this reporting period.
- Work was completed in 2019-2020 on the Programmatic Biological Assessment in coordination with NJDOT and FWS and therefore no additional actions were completed during 2021. Final product can be found here: https://ecos.fws.gov/tails/pub/document/14006993
- Staff continued to participate in regional wood turtle monthly conference calls to stay engaged on efforts related to the active Regional Conservation Needs (RCN) grant for wood turtle and to continue working on actions identified in the conservation plan (funded by CSWG) (Jones et. al. 2018). Northeast state biologists received notice of a funding award for a CompSWG II for wood turtle conservation plan implementation.
- Staff and volunteers conducted wood turtle surveys following protocols developed through regional wood turtle projects (e.g., RCN and Comp-SWG) at 6 sites in 2021. A total of 16 wood turtles were found during these surveys. All monitored sites are identified as part of New Jersey's Conservation Area Network (CAN), an output of the first CompSWG for wood turtle. Survey protocols found here: https://www.northeastturtles.org/
- Staff conducted habitat suitability surveys along one wood turtle CAN site that's listed as high priority for the region and New Jersey. Goals of these assessments were to a) determine site-specific suitability for wood turtle of the modeled habitat, b) identify threats to habitat within suitable stretches of stream and associated riparian areas (e.g., erosion, invasive plants), and c) identify critical habitat features (e.g., nesting or overwintering areas) within suitable stretches. In assessed stretches of stream within the CAN, surveys for wood turtles following regional protocols will begin in 2022 along with coordination with landowners.
    - These efforts are the template and first stages for the development of the state status assessment and state recovery plan for wood turtle.
- Additional turtle work this grant period focused on NJ's involvement with RCN/CSWG funded projects for the spotted turtle and box turtle, both species of special concern in NJ:
    - Spotted Turtle: Staff participated in monthly coordination calls and began review of products and deliverables associated with the active CompSWG spotted turtle grant. NJ did not receive funding through the CompSWG.
    - Box Turtle: Staff participated in monthly box turtle RCN committee calls to develop and refine the draft regional survey protocols. Staff coordinated all volunteer survey efforts for New Jersey. In addition, staff conducted plot-based surveys at one site following guidance from the Eastern Box Turtle Population Monitoring Protocol. Survey protocols found here: https://www.northeastturtles.org/

Conclusions and Recommendations:

- Continue to apply standardized monitoring approaches for bog and wood turtle beyond the end of regional funding cycles, in addition to other standardized monitoring for other SGCN turtle species, such as spotted turtle and box turtle.
- Continue to coordinate with skilled volunteers to monitor priority bog, wood, spotted, and box turtle areas. Utilize existing regional conservation plans to guide these surveys.
- Enlist additional, trained volunteers to assist with SGCN turtle monitoring.
- Continue wood turtle CAN site assessments and compile information into state-specific status assessment and recovery plan.
- Continue monitoring and reporting of habitat restoration work on southern New Jersey property in coordination with NJA.

Citations:

- Erb, L. 2019. Bog turtle conservation plan for the Northern population. A report to the Pennsylvania Division of Fisheries & Wildlife and the U.S. Fish and Wildlife Service. 102 pp.

- Jones, M.T., H.P. Roberts, and L.L. Willey. 2018. Conservation Plan for the Wood Turtle in the Northeastern United States. Report to the Massachusetts Division of Fisheries & Wildlife and the U.S. Fish & Wildlife Service. 259 pp

Subjob C.2. SNAKES

Project Leader: Kris Schantz

Key Findings:

- The Venomous Snake Response Team (VSRT):
  - In 2021, due to COVID-19 related restrictions, the Endangered and Nongame Species Program (ENSP) recruited and trained only one new participant for the Venomous Snake Response Team (VSRT) to ensure adequate response coverage for a town inhabited by both timber rattlesnakes and eastern copperheads (*Agkistrodon contortrix*, formerly northern copperhead, *A.c. mokasen*). ENSP continued to work with trained personnel who were able to perform the duties of the VSRT as part of their job's responsibilities (e.g., animal control officers, police officers, etc.) and select volunteers, however some team members were unable to participate due to COVID-19 concerns.
    - Of the 63 active team members in 2021, 35 submitted information regarding their snake responses and time and mileage incurred at the time this report was prepared. Fourteen members had responded to 32 venomous snake calls including 23 timber rattlesnakes and two eastern copperheads. Another responder who failed to submit his paperwork had responded to at least three additional timber rattlesnakes. One of these rattlesnakes was severely injured and treated at Woodlands Wildlife Refuge with the help of Dr. Chadd Tindall, DVM. He remains in captivity for continued medical treatment. The ENSP intends to release the snake after spring emergence, 2022. One male observed (and photographed) by a resident with a female could not be found upon the responder's arrival; the female was relocated. ENSP is working to obtain the official sighting report forms from responders for submission and entry into NJ DEP's Biotics database (Biotics).
    - ENSP recruited a volunteer in southern New Jersey (with law enforcement and military background) who contacted local police and sheriff's departments to recruit people for future venomous snake handling training. Mr. Coleman has contacted ten townships to date. He is awaiting return calls from some of them; others have received a follow-up email with details from the ENSP.
    - ENSP has been unable to develop a strategy to maintain and expand the team while decreasing the ENSP's responsibilities and time required. There are two major hinderances to developing regional team leaders to help manage and dispatch the VSRT members: 1) Trainings are conducted with a borrowed timber rattlesnake; the snake's guardian would not release the snake to strangers. 2) Liability concerns for dispatchers.
  - In 2021, ENSP personnel fielded approximately 77 potential venomous snake complaints from residents via telephone calls coming through our offices, cell phones, and/or the DEP Emergency Hotline. Twenty-seven (35%) of these reports were confirmed as venomous snakes; the remaining were non-venomous, native snakes, five could not be confirmed but were within venomous snake territory, and ten could not be confirmed but were outside of NJ's venomous snake territory. The percentage of complaints confirmed as venomous snakes has increased from approximately 10% to 35%, i.e., fewer callers had misidentified snakes than in previous years.
  - During this grant segment (2019-2021), COVID-19 restrictions and concerns resulted in a reduced ability to recruit and train new team members and a reduction in active team members. ENSP personnel, with assistance from a volunteer, focused on recruitment efforts in preparation for future trainings.
- Data and Partnerships:

- ENSP personnel continued to reduce a backlog of rare snake observation data throughout this grant segment for entry into the Biotics database. This included compiling, formatting, reviewing data obtained by the ENSP personnel, consultants, academics and private researchers, and when necessary, seeking clarification and/or corrections regarding the data from the original observers. A backlog of data remains.
- Due to COVID-19 related concerns, the ENSP's Pinelands Snake Research Team was unable to conduct surveys in the Pine Barrens in 2020 and 2021.
- Partnerships with snake researchers during this grant segment has proven to be invaluable as the ENSP was able to obtain critical information about rare snakes with limited resources (e.g., critical habitat features such as dens, nests or gestation/birthing sites, activity ranges and dispersal distances, habitat use and selection, etc.). In 2021, the ENSP continued to partner with Robert Zappalorti (Herpetological Associates, Inc.), Dr. Howard Reinert (The College of New Jersey), and the Pinelands Commission on a multi-objective Corn Snake (*Pantherophis guttatus*) study involving radio-telemetry, traplines and cover boards, and attempts to recapture cold-started and head-started corn snakes. The ENSP provided the necessary supplies for the study using a combination of funds from this grant and non-federal sources.
  - Forty-four non-hatchling and 113 hatchling corn snakes were pit-tagged in 2021; 74 tagged individuals (tagged 2016-2021) were recaptured at least once during the 2021 field season.
  - The research partners recruited Lauretta Bushar, Acadia University, to assist with DNA analyses of corn snake samples. Analysis began in 2020 with 51 corn snake samples. In 2021, the ENSP contributed DNA sampling materials; 32 corn snake samples were collected for analysis.
  - Noteworthy observations made by the ENSP's research partners include:
    - A radio-tracked snake from a newly discovered communal corn snake den travelled over a mile and spent the active season in an area that was burned by a wildfire in the summer of 2017. This habitat contains few living canopy trees, and consists of an understory dominated by early successional grassland plant communities. The habitat varied greatly from other study areas utilized by corn snakes within the State Forest.
    - Nest area switching: A female corn snake that was found using a nest area during two different years was recaptured at a nest area in 2021 that was almost 1.5mi from her original nest area, and she was again gravid.
    - Hatchling dispersal: Two young corn snake snakes were recaptured in 2021 almost 1.5mi from where they were tagged and released as hatchlings during previous years.
    - New shed tree and nest area: The discovery of a new shed tree with old snake belly scales on the ground at the base of the tree led to the discovery of a new corn snake nest area a few feet away with old, hatched eggshells that were dug up by a mammal. Artificial cover was placed at the tree and two new gravid corn snakes were found using the cover. The two corn snakes were tracked and led to the discovery of a new den.
    - New shed log: A radio-tracked kingsnake used a hollow log in 2020 to shed and old pieces of shed snake skin were present indicating the log was a communal shed log. Artificial cover was placed at the log and four corn snakes were captured in 2021 using the log. The four corn snakes were tracked and led to the discovery of two new dens.
    - Strange bed fellows: A new young kingsnake and an adult corn snake that had been recaptured numerous times during the study were found coiled up next to each other under artificial cover inside an open den corral.

  - ENSP personnel prepared and submitted land management review packages throughout this grant segment to assist our research partners obtain the necessary authorization and special use permits to work on state lands.

- ENSP partnered with Tyler Christensen (Friends of Hopewell Valley Open Space) and Mercer County Park Commission on eastern copperhead research in central New Jersey in 2021 using non-federal funding source.
- ENSP personnel worked to develop plans for future eastern copperhead research through a radio-telemetry study of a northern New Jersey population and research to establish effective survey techniques for this elusive species. This work will be funded by state mitigation funds that will serve as match for the T-1 grant.
- ENSP's Pinelands Snake Research Team proved productive in 2019, observing rare snakes and identifying previously undocumented nesting habitat. However, the team was unable to survey in 2020 and 2021 due to COVID-19 restrictions and concerns.

- Improved trap-line survey techniques:
  - ENSP biologists addressed a concern that northern pine snake surveys conducted in the Pine Barrens pursuant to DEP permits were not being performed in a consistent and sufficient manner by all consultants tasked with this responsibility. After field assessments of existing trap-lines, the ENSP reviewed literature and past surveys to develop standardized protocols for northern pine snake trap-line surveys to ensure uniformity of methods for consultants to trap all age classes of northern pine snakes, and potentially other rare snakes including corn snakes (also referred to as red ratsnakes, *Pantherophis guttatus*), eastern kingsnakes (*Lampropeltis getula*) and northern scarlet snakes (*Cemophora coccinea copei*). Environmental consultants have been implementing these protocols since January 2020.
- Habitat management to benefit rare snakes is reported under Project 2, Job A, *Strategic Habitat Conservation*.
- Law Enforcement: The Division of Fish and Wildlife's (DFW) Bureau of Law Enforcement (BLE) continued to take an active role patrolling and monitoring high-risk areas for illegal collection of rare snakes in this grant segment. While unknown persons (or evidence of their presence) were observed at sites in 2019, no suspicious activity was reported in 2020 or 2021.
- Regional Coordination:
  - The ENSP coordinated efforts by the regional state biologists on the development of draft Regional Conservation Needs (RCN) grants.
  - During these discussions, personnel agreed two tasks were not appropriate for the RCN grant: outreach/education regarding venomous snakes and the impacts of off-road vehicles (including motor bikes) on venomous snakes and their habitats. Therefore, ENSP staff drafted educational materials that would help create a regional outreach approach.
- No progress was made on the Northern Pine Snake Species Status Assessment update or recovery plan or the Timber Rattlesnakes' Species Status Assessment.
- Law enforcement continued to monitor known snake collection hot spots. Although suspicious activity was observed in 2019, none was reported in 2020 and 2021.
- The ENSP created signs regarding venomous snake presence for 17 state parks and forest lands and one property jointly owned by NJ DEP and the NJ Conservation Foundation. Extra signs were made for future installation at Wildlife Management Areas (priority sites to be determined).

<u>Conclusions:</u>

- The Venomous Snake Response Team (VSRT) continues to provide an invaluable service to citizens by moderating the real and perceived threats from New Jersey's rare venomous snakes:
  - The VSRT continues to lack participation in key areas.
  - Obtaining VSRT members' time/mileage and response reports continues to be difficult, often requiring multiple requests for information and even then, not all team members responding. However, the volunteers provide a much-needed service to New Jersey residents and added protection for the snakes; thus, ENSP is hesitant to suspend trained personnel from the team due to a lack of reporting.

    - The percentage of callers accurately identifying venomous snakes has increased from approximately 10% of calls in 2019-2020 to 35% in 2021. This could be an indication of improved outreach and education, and/or local communities with high incident rates simply being more familiar with venomous snake identification.
    - There are two major hinderances to developing regional team leaders who could dispatch the VSRT members: 1) Trainings are conducted with a borrowed timber rattlesnake. The snake's guardian would not release the snake to strangers. 2) Liability concerns for those dispatchers.
- Residents remain confused regarding snake identification and New Jersey's snake species; education regarding snake identification is lacking in New Jersey.
- A rare snake sighting data backlog continues to exist. Although the backlog from previous years has been significantly decreased, each year new information is submitted, adding to the task.
- It is unclear what effect law enforcement's presence at the 2016-identified snake collection hot spots has had on illegal activities at this time. No violations have been recorded or summonses issued, but their attention to the issue may be a deterrent to poaching activities.
- Research partnerships continue to be an effective means of obtaining important data with limited resources.
- Due to COVID-19 restrictions and concerns during 2020 and 2021, ENSP personnel were not able to inspect trap-lines using the standardized methods developed in 2020 to confirm land use applicants and their consultants were implementing the revised protocols.
- Species status assessments and recovery planning:
    - Timber rattlesnake species status assessment must be delayed until the Northern Pine Snake revised assessment and recovery plan are completed as many of the same outside participants will be needed to provide input.
    - Northern Pine Snake's revised species status assessment requires assistance to complete the threat analysis prior to reconvening the participants (i.e., Northern Pine Snake researchers) to review the revised status assessment and continue the development of the recovery plan that began in 2014.

<u>Recommendations</u>:

- The Venomous Snake Response Team (VSRT) will continue in 2022 as ENSP considers ways to maintain and expand the team while decreasing the ENSP's responsibilities and time required.
    - If deemed safe (with regard to COVID-19), the ENSP will hold multiple Venomous Snake Response Team handling trainings to ensure adequate responder coverage in venomous snake territories.
    - The ENSP must continue to work with the team members to help them understand (and fulfill) what is required of them as official volunteers and as team members not covered under NJ Division of Fish and Wildlife (DFW) insurance.
    - Continue to recruit and when able, train and manage participants to ensure annual adequate response coverage.
    - Continue to assess if developing regional team leaders to help manage and dispatch the VSRT members while decreasing the ENSP's role is feasible.
- If time permits, continue revisions on the 2009 Northern Pine Snake Species Status Assessment and share the document with appropriate professionals for their review and input. Upon revisions and finalization, continue work on the Northern Pine Snake's draft recovery plan which had begun in 2014.
- Continue to develop research partnerships and to provide assistance, guidance, and/or input to researchers outside of the ENSP as needed on project and planning efforts that will ultimately benefit snake conservation efforts.
- The ENSP snake biologist will work with other snake researchers to develop potential habitat management strategies that benefit snakes while minimizing the creation of sinks and/or attention from people.

- Continue public outreach and educational efforts to improve residents' abilities to properly identify venomous snakes, understanding of snake behaviors and needs versus myths, and cooperation in seeking assistance to remove venomous snakes from private lands rather than killing them.
- Continue collecting and reviewing rare snake observation data and attempt a more expeditious integration into the ENSP's Biotics database for environmental review processes.
- ENSP personnel shall attempt to inspect trap-lines in 2022 barring COVID-19 concerns.

Subjob C.3. AMPHIBIANS

Project Leader: William Pitts

Key findings

- Eastern tiger salamander surveys were conducted over the reporting period, and despite high variability in precipitation amounts between 2019-2021, egg mass counts were fairly consistent annually. In the winter of 2019-2020 egg masses and adults were observed in the northern complex of pools created on a state land site for the first time.
- No new pools were created or old pools modified by ENSP. Some of the deepest pools at one site that had been targeted for backfilling served as refugia in a particularly dry fall in 2019, and they likely increased the viability of the vernal complex despite not drying out in most years.
- Using the methodology established by Zappalorti (2018), ENSP and Herpetological Associates (HA) identified two pools for egg mass translocation at Peaslee WMA. A total of 40 egg masses were moved in late-January to early-February 2021. Donor sites included those with threats to long term viability, which include development, fragmentation, sea level rise, and saltwater intrusion. This work will be continued into the next grant period.
- Additional pool locations in Cumberland County were identified using a first pass at GIS modeling. So far, the Landscape Map's vernal pool layer, State Open Space, and USGS Streams layers have shown to be the best as targeting potential locations for ground truthing as vernal habitat. Two additional pool complexes have been identified as suitable habitat in Cumberland County.
- A newly formed working group of mid-Atlantic states (VA, MD, DE, NJ, NY) began meeting late in 2021 to discuss efforts undertaken throughout the region. A combination of adult mark/ recapture and egg mass counts are being used to assess population size and health. Participants expressed a desire to standardize survey efforts in the region. A variety of management techniques from pool creation to translocation were discussed, and it was indicated that there is a need for genetic research.

Conclusions

- ENSP's survey efforts during the reporting period continued to focus on monitoring the viability of known eastern tiger salamander populations. Survey efforts were largely conducted by ENSP, Conserve Wildlife Foundation, and US Fish and Wildlife Service.
- Translocation of eggs to suitable vernal pools in Cumberland has the potential to serve as an important stepping-stone of connectivity between known populations in that region.
- Identification and remediation of threats to eastern tiger salamander populations remains important, especially regarding issues related to disease, habitat destruction due to off-road vehicle use, and sea level rise due to climate change.

Recommendations

- Continue working with the NJ Division of Fish and Wildlife's (DFW) Bureau of Lands Management, the NJ Conserve Wildlife Foundation, and other NGOs on vernal pool construction on DFW's and other preserved lands.

- Establish criteria to identify habitats with the highest probability of supporting eastern tiger salamanders. Once suitable habitat is identified for management and/or new pool creation, locations will need to be ground-truthed for viability and accessibility.
- Develop a strategy to protect breeding pools from off-road vehicles, particularly on public lands. Work with DFW's Bureau of Law Enforcement on the use of surveillance equipment to protect known breeding pools from illegal off-road vehicle activity. Work with DFW's Bureau of Land Management to use felled trees to block pools to off-road vehicle use.
- Continue to work with partners and trusted volunteers to monitor pools and encourage amateur herpetologists to submit sightings, with a focus on the identification of new breeding populations.

Zappalorti, R. T. (2018). Experimental Translocation of the Eastern Tiger Salamander in New Jersey: A Conservation Success Story (p. 21) [Report to New Jersey Division of Fish and Wildlife]. Zappalorti Institute for Pinelands Research. https://www.researchgate.net/publication/329104272

JOB D. INVERTEBRATE CONSERVATION AND MANAGEMENT

Subjob D.1. Mollusks

Project Leader: Robert Somes/Jeanette Bowers-Altman (retired as of 9/1/2021)

Objective:

- To document occurrences, monitor populations, and create conservation strategies to aid in the recovery of listed freshwater mussel species throughout New Jersey. Listed species include the Dwarf wedgemussel, Brook floater, Green floater, Yellow lampmussel, Eastern lampmussel, Eastern pondmussel, Tidewater mucket and Triangle floater.

Key Findings:

- Endangered and Nongame Species Program (ENSP) staff were unable to conduct freshwater mussel surveys during the 2020 field season due to concerns relating to Covid-19 exposure, restrictions placed on field work by the State of NJ in response to the pandemic, and a 10-day State imposed furlough during optimum survey times. Surveys during 2021 were severely limited due to Covid-19 impacts.
- We contracted Biodrawversity to conduct surveys in the NB Raritan River, from the Lamington River confluence to the confluence of the SB Raritan using a modified version of the Brook Floater Working Group's (BFWG) Rapid Assessment Protocol to determine presence of Brook floater (*Alasmidonta varicosa*) and other species and assess habitat in the river and select tributaries (Somerset County). New Jersey is now a supporting member of the working group. We are using the rapid assessment protocol wherever feasible to maintain consistency with regional surveys. Surveys were also conducted in a small portion of Rockaway Creek.
- North Branch Raritan River (July 24-25). Nineteen survey sites found 3 live brook floater and no shells. Brook floater were documented at three separate sites and single creeper was also documented.
- Rockaway Creek (July 25): Looked for access and documented habitat at four sites but gained access at only one site on Lamington Road. Found 2 live creeper, one triangle floater shell, and moderate density of eastern elliptio. Habitat was very good. Volunteers from Amy Greene Environmental Associates conducted qualitative, timed searches at one historic brook floater site in the Stony Brook, Mercer County. Searches were supplemented with tactile methods including excavation in areas with softer substrates.
- Searches for the Chinese pond mussel (*Sinanodonta woodiana* (CPM) in Wickecheoke Creek, Hunterdon County were temporarily suspended in 2021 due to Covid-19. In 2010, we documented the first North American occurrence of this highly invasive mussel from ponds owned by NJ Conservation Foundation (NJCF). The ponds had formerly been used as part of a fish farm operation for holding bighead carp and other fish species. Monitoring by the ENSP staff at six locations downstream of the source ponds to the Delaware River confluence continued during the project period. No live CPM or shells were found. In 2019, the NJCF, USFWS and other partners (including other bureaus from within the NJ Division of Fish and Wildlife; DFW) applied a series of molluscicide treatments to the ponds to eradicate the remaining CPM population. Since that time, Rutgers genetics lab staff have been tracking eDNA hits for CPMs in one section of the Raritan River and in one NJCF-owned pond. Follow-up eDNA surveys during the fall of 2021 failed to have repeat hits in the Raritan River but continued to get positive results for two of the original impoundments.
- In 2019, we provided Urbani Fisheries LLC. with a detailed description of brook floater habitat requirements and preferred stream characteristics to be applied to sections of a stream enhancement project in the Lamington River, Somerset Co. Urbani was contracted by a private organization that partnered with numerous local groups to create/enhance fish habitat along a 10,000 linear foot stretch of the river via instream enhancements, bank stabilizations and riparian plantings. The stream segment was devoid of freshwater mussels and approximately one mile upstream of brook floater occurrences. Biologists at Urbani agreed to create brook floater and other mussel habitat in several key sections of

the project area. We inspected the site on three separate occasions and are encouraged that the newly created habitat appears suitable for brook floaters and other rare species that occur downstream. Plans to inspect the newly created habitat were temporarily suspended in 2021 due to Covid-19 concerns and inability to access the project site.

- Following Tropical Storm Ida flooding, staff conducted shell surveys in known brook floater habitat in the Stony Brook, Raritan River, Lamington River, and the Whippany River. No brook floaters were observed at any location and one relict creeper shell was observed in Stony Brook. Habitat surveys were also conducted at these locations to plan for upcoming survey efforts.
- We participated in NJ FWM working group meetings led by the Musconetcong Watershed Association. The ENSP helped select initial members and provided information to the group on SWAP mussel threats and actions.
- We participated in meetings with Rutgers, FWS, NJCF and other organizations regarding the potential occurrence of CPMs in the Raritan River and assisted with selecting eDNA testing sites in northern NJ. The project is ongoing.
- Listed and Special Concern freshwater mussels recorded during surveys covered in this report and others (e.g., private consultants, USGS, nonprofit organizations, etc.) have been/are in the process of being incorporated into the Biotics database. These locations will be included in the next Species Occurrence Area (SOA) file, which is used by DEP's Land Use Regulation and other entities for environmental review purposes, as well as being incorporated into the next version of the Landscape Project Map to identify critical areas for listed mussel populations.

Conclusions:

- The prevalence of Covid-19 in NJ severely curtailed freshwater mussel survey efforts in 2021.
- Brook floater populations appear to be declining in the state. Despite efforts by Biodrawversity and volunteers from Amy Greene Environmental Associates, only 3 live brook floaters were found in six miles of the NB Raritan River. Habitat conditions at several historic brook floater sites may warrant the use of stream/riparian restoration due to projected increases in flooding and extreme weather events. Brook floater declines in NJ may be attributed, in part, to the loss of stable habitat via transport downstream due to flooding and extreme events such as tropical storms Lee and Irene in 2011. Other threats include water quality degradation, habitat loss, dams, and dam removal, warming water temperatures, and the prevalence of invasive species. The apparent lack of juvenile mussels at most occupied sites indicates that little reproduction is occurring within populations.
- Although eradication efforts at the NJCF ponds resulted in the mortality of numerous Chinese pond mussels, it is critical that monitoring of downstream and nearby sites continues. First, 100% mortality was not achieved during the molluscicide applications in the ponds. In addition, it is possible that there are privately owned ponds in the system that may be harboring additional populations, and there may have been individuals that were undetected during previous monitoring efforts. The impacts of a Chinese pond mussel invasion in the Delaware River to native freshwater mussel populations in NJ and PA could be catastrophic.

Recommendations:

- Continue surveys for brook floaters in the Stony Brook, Lamington River, Raritan River, and other areas in the northern half of the state. Draft the brook floater species assessment and state recovery plan, and coordinate with BFWG to fill in data gaps and develop protective measures for critical areas. Determine suitable areas where brook floaters may be re-established using hatchery-raised mussels.
- Continue surveys for listed species in previously unsurveyed suitable habitats to document distribution; monitor populations in known locations to determine trends.
- Continue surveys for dwarf wedgemussels in the Pequest River watershed, especially the northern-most areas, to document occurrences and establish population boundaries.

- Continue monitoring efforts for Chinese pond mussels in Wickecheoke Creek and tributaries and assist with ongoing eDNA efforts to locate possible populations in the Raritan River and elsewhere.
- If the ENSP is able to obtain access, conduct freshwater mussel surveys in the Lamington River to determine whether mussels have colonized habitat created by Urbani Fisheries. If no mussels are present, assess water quality parameters and determine whether a pilot study using caged common species to determine suitability for potential seeding is warranted.
- Continue participating in the NJ Freshwater Mussel Working Group (FWM) and coordinate efforts to target habitat restoration and survey efforts in new areas.
- Continue to identify and survey areas below and adjacent to golf courses and determine whether the development of BMPs specific to freshwater mussel protection is warranted.
- Investigate potential opportunities for habitat/mussel restoration within applicable areas.
- Solicit assistance from additional WCC volunteers; train volunteers to identify and survey for mussels; assign specific areas for survey work where data are lacking.

Subjob D.2. Macroinvertebrates

Project Leader: Robert Somes

Objectives:

To document occurrences, monitor populations, and create conservation strategies to aid in the recovery of listed Lepidoptera species throughout New Jersey. To conduct beneficial habitat management activities for the conservation of these species.

Lepidoptera

Key Findings:

- Due to the continued negative impacts of the Covid 19 pandemic on staffing and resources many projects have been negatively impacted.
- During 2021, Northern Metalmark surveys were conducted at five known populations of Northern Metalmarks in northern NJ over the course of eight different days/survey efforts. A range of 1-10 individuals were observed at the various sites and locations.
- During 2021 an extensive effort was made to remove and control the invasive woody shrubs (primarily Autumn Olive, Japanese Honeysuckle, Japanese Barberry, Multiflora Rose, Oriental Bittersweet) threatening Northern Metalmark sites. Invasive shrubs were manually removed at four sites over a total area of approximately five acres. An effort was made to improve connectivity of the foodplant patches by targeting invasive plant removal at connecting corridors between sites as well.
- Leonard's Skipper surveys were conducted at six known sites with 2-5 individuals observed during four different survey efforts. There were no reports of Leonard's Skipper observed in southern New Jersey through local volunteer groups and all observations were restricted to northern New Jersey.
- Surveys for Bronze Copper were conducted during seven different survey efforts at four known locations where a single individual and a maximum of seven individuals were observed. One site has decreased in numbers substantially due to land-use changes at the site.
- Extensive survey efforts were conducted for Arogos Skipper in NJ. Numerous historic sites as well as potential sites were surveyed for this species at over 20 locations with a total of five Arogos Skippers observed in one southern NJ population and one and two individuals observed in two locations in the Northern NJ population.
- Frosted Elfin surveys conducted over four days at three different known sites documented only single individuals. A new Frosted Elfin occurrence was documented in Ocean County for the first time and follow up surveying in the area documented the host plant on adjacent Department of Defense property.

- Habitat management for pollinators in general continued with the planting of pollinator seed-mix plots at various locations throughout NJ and through the planting of native plant seedlings. Approximately 3,200 plants of 20 different nectar source and butterfly foodplant species were propagated and planted at over 20 pollinator gardens and restoration sites throughout NJ.
- Partnering with the North American Butterfly Association-North Jersey Chapter and the South Jersey Butterfly Club has led to an increase in data collection for rare butterflies in NJ and particularly has helped us to better document recently listed species.

Conclusions:

- Over the course of several years survey effort, the populations of many Northern Metalmark colonies have been observed to be highly variable with some year's numbers ranging from 25-50 observed followed by years where numbers are depressed to less than ten. NJ's Northern Metalmark populations are reduced to 3 metapopulations. Two of these populations are stronger and often have 10-50 individuals observed. The third site is smaller, never numbering more than 20 individuals. The population of Northern Metalmark is struggling and faces many conservation challenges. The single biggest threat to Northern Metalmark is invasive plant species takeover of their habitats and habitat succession. The species naturally occurs in cedar glades that are mid-successional and transitional habitat that without disturbance and invasive plant control, quickly becomes overgrown and shaded out.
- During the last three years of Leonard's Skipper surveys, it has been found that most of the northern NJ populations continue to persist in known locations and new colonies are able to be identified when suitable habitat is surveyed. However, this species has not been observed in southern NJ during any of the last few years.
- Bronze Copper surveys continue to monitor known populations and new colonies continue to be discovered. This species faces challenges in southern NJ with land use and management changes and the species is restricted to several populations compared to its former range.
- Surveys for Arogos Skipper were highly successful this year but the populations that remain are very restricted. Areas of potential habitat exist in northern NJ that are yet unsurveyed. The species is often found in low density with highly dispersed individuals, making detection challenging. The largest remaining area of occupied habitat is on Joint Base-Fort Dix-McGuire-Lakehurst. The northern NJ colonies remain on isolated patches of habitat on utility rights of way.
- Frosted Elfin surveys conducted in 2021 observed small numbers of individuals; the last several years of survey effort found the species in low numbers at only four core populations. Many historic sites appear to be extirpated, particularly in the western populations in southern NJ. The new Ocean County occurrence illustrated the continued need for surveys in new locations with potential habitat.
- The partnership with the NJ State Park Service and the State Forest Service to propagate wildflowers and butterfly foodplant species and to create butterfly gardens and meadows continued to be a success and was expanded this year to include a greater variety of nectar plants and butterfly host plants. This year over 20 state parks, wildlife management areas and county parks hosted plantings and over the last three years over 50 sites have been planted. These plantings include a variety of milkweed species for the Monarch Butterfly and nectar with a variety of flowering times to support the migration needs of this species.
- The DFW Bureau of Land Management actively manages hundreds of acres of land each year including extensive mowing and seeding. By working together, we are improving large sections of Wildlife Management Areas for the benefit of rare butterflies and pollinators by delaying mowing until after September 30, and by changing the seed mixes used for planting to include more plants suitable as foodplants and as nectar sources for native butterflies and pollinators.
- Surveys of potential rare butterfly species habitat continued to yield discoveries of new colonies for several species; large areas of unsurveyed but suitable habitat exist within NJ for many species.

Recommendations:

- An extensive survey effort needs to target the butterfly species that were recently added to New Jersey's rare species and SGCN lists. Very limited data exist for many of these species in NJ, therefore it is critical that we develop a better understanding of their distribution, life history requirements, and threats.
- The wildflower and butterfly foodplant propagation and butterfly garden/meadow creation project should continue with the NJ State Park and Forest Service, and we should strive to expand the number of seedlings that we distribute throughout the State. This program should also be expanded to include a variety of nectar source plant species as well as butterfly foodplant species to support restoration projects. This program could also be expanded to include pollinator habitat plantings in more non-traditional locations for the benefit of the Monarch Butterfly and to expand awareness about pollinator conservation.
- The partnership with the Bureau of Lands Management should be expanded to create larger areas of habitat suitable to our rare butterflies and native pollinators.
- Habitat management for Northern Metalmark should be continued and expanded to ensure the persistence of our current colonies and expanding them into former sites that have become overgrown and unsuitable. Continue working with land managers to promote proper management, and to increase connectivity between sites by maintaining natural corridors and thinning invasive shrubs and trees. Work together with the NJ Park Service to develop a maintenance plan for Northern Metalmark sites found on Kittatinny Valley State Park. Work together with the Division of Fish and Wildlife Bureau of Land Management to continue and expanded management of the species of Division of Fish and Wildlife maintained lands.
- Surveys for Frosted Elfin should be a high priority due to the diminished numbers observed during the 2021 flight season. Frosted Elfin is being petitioned for Federal listing and better baseline data for NJ would be contribute to the status assessment. New Jersey is a regional stronghold for the Frosted Elfin, but many sites appear to be declining, calling for improved land management.
- Surveys for Arogos Skipper should be a high priority in NJ. Arogos Skipper is being petitioned for Federal listing; therefore, NJ data would serve the state and regional understanding. This species has regional strongholds in NJ and is probably one of our most imperiled species.

Odonata

Key Findings:

- Due to the continued negative impacts of the Covid 19 pandemic on staffing and resources many projects have been negatively impacted.
- Staff continued limited surveys for Scarlet Bluet, Pine Barrens Bluet, and New England Bluet as part of a regional effort to address the conservation of these species because they are endemic to the Northeastern United States. Surveys were conducted at three historic locations on 4 different dates documenting Scarlet and Pine Barrens Bluet at two historic locations
- Surveys for Grey Petaltail yielded a new population. Surveys over the course of eight days documented a large metapopulation occupying a number of locations in one area.
- Surveys for other listed Odonata species was limited this season. However, a regional surveying effort was made in Mercer and Monmouth counties in central NJ. Odonata surveying efforts have historically been lacking in this region and data are sparse. Staff conducted baseline Odonata surveys at approximately 10 sites in the region but failed to document any listed species.

Conclusions/recommendations:

- Surveys of historic sites and potential new sites were successful for Odonata even if they failed to document any listed species. Several areas of potential habitat for listed Odonata species were documented and should be targeted for survey efforts during 2022. Follow-up surveys should be conducted at historic locations where listed species were absent during 2021 to determine if the species were just missed during the surveys.

- Survey potential Tiger Spiketail habitat in central and southern New Jersey to locate new colonies and fill in the range gap between Hunterdon and Camden counties.
- Surveys for Pine Barrens Bluet, Scarlet Bluet, and New England Bluet should be a high priority because these species are a high regional priority, with New Jersey considered a stronghold.
- Surveys for other listed Odonata species should continue and be expanded during 2022 to fill in knowledge gaps and gain a better understanding of their distribution in New Jersey. Efforts should be made to revisit known sites that have not been recently surveyed to determine if previously documented species are extant.
- Surveys should be continued and expanded for Gray Petaltail. The discovery of a new colony illustrates that there are still populations of this species to be found and documented.

Cicindelidae (Tiger Beetles- Ellipsoptera)

Key Findings:

- Surveys were conducted for the NJ Pinebarrens Tiger Beetle in eight different locations during four survey days and a new population was documented.

Conclusions/recommendations:

- Surveys should be targeted at tiger beetle species identified as Species of Greatest Conservation Need in NJ's State Wildlife Action Plan to better understand their distribution and habitat requirements in New Jersey.
- Preliminary research and data collection should be completed to conduct a status assessment of tiger beetles found in New Jersey.
- Surveys for NJ Pinebarrens Tiger Beetle should be expanded because this species is highly dependent on wildfire for the maintenance of its habitat and better documentation of its distribution could help to better focus management efforts.

Hymenoptera (Pollinating Bees)

Key Findings:

- ENSP worked together with Rutgers University to recommend survey locations and facilitate access to public lands to continue targeted bee surveys to help better document and understand the State's pollinating bee species.
- New Jersey is a partner in a regional project assessing the impacts of management activities on Xeric pollinating bee populations. Surveys were conducted along several transects to monitor bee populations and species composition at a research site in the NJ Pinelands to collect baseline data over the course of spring, summer, and early fall. This site is part of several management activities including thinning and prescribed forest fire management and the impacts of this activity on bee populations will be assessed.

Conclusions/Recommendations:

- Rutgers University is conducting extensive native bee research in the state. We should continue to partner with them to share data and develop joint research projects.
- Bee research projects should continue and be expanded to assess the impacts of different management activities on bee and other insect species populations.
- New Jersey should expand efforts to plant and maintain a variety of habitats beneficial to native pollinators and the variety of other species that depend on those habitats.

Subjob D.3. Impact of Dam Removals on Macroinvertebrates

Project Leader: Jeanette Bowers-Altman

Objective:

Identify and monitor rare freshwater mussels and Odonata that occur up and downstream of dams in the Musconetcong and Raritan rivers, and potentially other watersheds throughout New Jersey to 1) document short and long-term impacts of dam removal to populations 2) determine whether there are safe alternatives to current dam removal methods and 3) develop strategies to mitigate short-term impacts of dam removal to minimize injury and/or mortality to individuals. Stream segments adjacent to dams planned for removal within the next two years will be emphasized.

Key Findings:

- This project focuses solely on impacts of the Columbia Dam Removal Project, Warren County.
- The Columbia Dam was the lowermost dam on the Paulins Kill, located 475 meters from the Delaware River. The dam was 5.5 m high, 100 m long and created a 1.5-mile-long, 32-acre impoundment. In addition to the dam, there was an associated remnant structure located 300 m downstream of the dam. Both structures were located within the Columbia Wildlife Management Area, which is owned and managed by the NJDFW.
- Both the Columbia Lake dam and its associated remnant structure were removed in 2018 as part of a conservation effort to restore aquatic habitat, ecosystem processes and the thermal regime of the lower part of the river, along with reestablishing connectivity and historic habitat for migratory fish and other aquatic species. Partners including The Nature Conservancy (TNC), American Rivers, DFW, FWS, and others had been planning the removal since 2013.
- To minimize impacts of the dam removal to freshwater mussels (including three state threatened species and one special concern) living below the dam, along with more common species above the dam, TNC contracted Biodrawversity to perform a mussel relocation. Listed mussels were tagged and moved to one of several relocation areas; common species were also moved, but not tagged. Biodrawversity is monitoring all tagged individuals.
- We contracted Biodrawversity in 2019 and 2020 to assess habitat changes above and below the former Columbia Dam as part of a long-term monitoring effort to determine impacts of dam removals on freshwater mussels. The research will ultimately help inform decisions regarding future dam removal projects in the state. Habitat changes were documented using photographic/visual observations pre- and post-removal, presence/absence of freshwater mussels, comparison to habitats of relocated individuals, and other metrics.
- In 2019, freshwater mussel habitat was evaluated post-removal at 10 segments between the Delaware River near the Paulins Kill confluence and upstream to near Brugler Road and compared to pre-removal conditions. Mussel surveys were performed at seven out of 10 segments. Three segments were excluded from survey efforts due to pre-removal low densities or difficulty in accessing the channel because of unstable substrate. In general, mussel habitats within close proximity of the dam fared poorly after the removal: no live mussels were found near the footprint of the former dam. Similarly, the former lower impoundment underwent major habitat changes. The area is now a relatively straight channel with long shallow runs, riffles, and rapids. Substrate includes areas of firm gravel and cobble, but also contains large sections of clayey muck in which it is difficult to walk. The habitat is somewhat homogenous, with moderate to strong flows. No mussels or shells were found. Other habitats showed fewer impacts due to the dam removal. Habitat was found to be mostly unchanged in the Delaware River near the Paulins Kill confluence and in lower Paulins Kill to the Rt. 46 overpass. This area is a sediment transport reach, with flows generally too strong to allow fine sediments to accumulate. There may have been some sediment accumulation near the confluence, river left on the inside bend. Otherwise, flow, substrate and depth were comparable to pre-removal conditions. A 40-minute mussel survey yielded approximately 50 live Eastern elliptio (*E. complanata*) and Two alewife floater (*P. cataracta*).
- In 2020, Biodrawversity conducted qualitative surveys for juvenile and adult mussels in the former Columbia Lake to determine post-dam removal mussel densities, assessed mussel habitat suitability and selected potential sites for long-term monitoring. In addition, Biodrawversity is assisting the

ENSP with developing a long-term study plan that will document potential mussel colonization and recovery in the areas of the Paulins Kill

- Biodrawversity surveyed nearly the entire length of the former impoundment, from near the footprint of the former dam to 175 meters upstream from Warrington Road. The entire reach from I-80 to the upper end was kayaked; both photos and video were recorded to help document habitat through this reach. The reach from the former dam to I-80 were accessed on foot. Biologists identified, surveyed, and assessed several areas with suitable mussel habitat, which could be used for long-term monitoring. However, mussel densities remain extremely low in the impoundment. Biologists found a small number of relic shells of Eastern elliptio (*E. complanata*), Eastern floater (*P. cataracta*), and Triangle floater (*A. undulata* - T*)*, but found live mussels (Eastern elliptio, *E. complanata*) only at the uppermost site upstream from Warrington Road. There is no evidence of recruitment in the former impoundment.
- Paulins Kill at the former Columbia Lake monitoring 2021 occurred from July 22-23 and included repeated monitoring above and below the former Columbia Dam. 4 monitoring sites were surveyed in the former impoundment and re-checked mussel populations farther downstream. Still no evidence of recruitment in the former impoundment but habitat appears to be stabilizing and seems quite good for mussels
- Endangered and Nongame Species Program (ENSP) staff were unable to conduct Odonata surveys at the former dam site during the 2020 or 2021 field seasons due to concerns relating to Covid-19 exposure, restrictions placed on field work by the State of NJ in response to the pandemic, and due to staffing shortages.

Conclusions:

- It is undetermined whether freshwater mussel habitat will return to or surpass previous pre-dam removal levels in the Paulins Kill within Columbia WMA. Despite disrupting aquatic connectivity, the dam was instrumental in creating stable, well-oxygenated habitat for a variety of species (n=6) such as Yellow lampmussel (*Lampsilis cariosa*), which is prevalent in the Delaware River, and Eastern lampmussel (*Lampsilis radiata*), which occurs in the Paulins Kill. It was the only site in the state where these two species were known to co-occur. Although restored aquatic connectivity will allow the passage of some host fishes to travel up the Paulins Kill and increase mussel distribution via glochidial transport, migratory fish such as American eel and *Alosa sp*. serve as hosts to common Eastern elliptio and Alewife floater, respectively. It is too early to determine what the impacts of dam removal will be on listed freshwater mussels in the long-term.
- Some areas in the impacted stretch may in time provide suitable habitat for mussels. For example, although it was impossible to access the main channel between I-80 and Warrington Road (former lake bed) due to instability, Biodrawversity biologists reported that this location shows promise. With the extensive riparian plantings being done in this area, and the low gradient stream channel that should retain coarse woody material and sediment and thereby promote habitat complexity, the former lakebed could become good mussel habitat in the future. However, there is no evidence to date of mussel recruitment in this area. Similarly, the area of the former lower impoundment, with the addition of large trees to create habitat complexity, may in time support mussels.
- Close inspection of the post-removal conditions suggests that several river specialist Odonata species will potentially colonize newly freed waters in the next 5-10 years. Species that may move into these habitats include River Jewelwing, American Rubyspot, Fawn Dawner, Dragonhunter, Black-shouldered Spinyleg, Spine-Crowned Clubtail, Rabids Clubtail (State special concern), Brook Snaketail (State threatened), Eastern Clubtail, Illinois River Cruiser, Uhler's Sundragon and Umber Shadowdragon.

Recommendations:

- Work with the NJ DEP's Bureau of Dam Safety to determine schedule of dam removals.

- Continue monitoring dam removal sites over time to document changes in species diversity and abundance. Monitoring will continue for at least five years. Monitoring of the Paulins Kill above and below the former Columbia Lake dam should be a priority. This area provides a unique opportunity to study short- and long-term impacts of large dam removal projects on freshwater mussels, Odonata, and their habitats.
- Investigate methods to mitigate dam removal impacts on freshwater mussels, Odonata, and other macroinvertebrates. Mitigation methods may include, for example, relocating rare mussels to suitable areas outside the direct zone of impact where individuals may be smothered or exposed to excessive sedimentation.
- Well targeted habitat restoration may prove to be a valuable tool for mitigating impacts of dam removals. Creation of instream mussel habitat in select areas may be helpful in jumpstarting post-removal colonization.

JOB F. THREAT ASSESSMENT: Emerging Diseases

Subjob F.1. Emerging Diseases

Project Leader: Kris Schantz and Brian Zarate

Key Findings:

- Staff biologists learned of northern red-bellied cooters (*Pseudemys rubriventris*) showing significant lesions on the plastrons from several ponds primarily in the Salem River watershed in 2019. Observations were made in the fall 2019 season when a volunteer happened to be working in the area. In coordination with volunteers, wildlife disease specialists, and the NJ Division of Fish and Wildlife's (DFW) pathologist, biopsies and other samples were taken from affected individuals and submitted for testing in 2020 and in 2021.
    - Staff, volunteers, and faculty from Montclair State University and Stockton University assisted DFW with sampling of cooters from two study ponds in March 2021, resulting in the collection of 18 samples from the two sites. Samples are being held until funding becomes available to process them.

Conclusions and Recommendations:

- ENSP will seek to fund the lab work to process the 2021 red-bellied cooter samples and produce a final report after lab results become available, including identifying need for any additional field work.

Performance Report

Project: **2. Habitat Management and Planning**
Federal Aid Project: T-1-8 (State Wildlife Grants)
Segment dates: January 1, 2019 to December 31, 2021

JOB A. Strategic Habitat Conservation

Project leader: Sharon Petzinger, Brian Zarate and John Heilferty

Objectives: Enhance, create or restore habitat to support species of greatest conservation need.

Key Findings:

- Habitat management for rare snakes:
  - Pine Barrens: ENSP did not conduct habitat management to benefit rare snakes, but did continue to investigate potential sites for management through an examination of species occurrence data, venomous snake response team incidents, potential rare plant presence (requiring 12-months of surveys before management can be performed), aerial imagery, and elevation contours. However, during this grant segment, habitat management was conducted within the Pine Barrens through an alternate funding source and proved successful as timber rattlesnakes were documented gestating and birthing within managed areas. However, the newly opened canopy parcels were easily located on aerial imagery and became attractants to reptile-enthusiasts. ENSP required management to cease and met with pinelands snake researchers to discuss habitat management options.
    - ENSP met with Pinelands snake researchers to discuss potential habitat management strategies. Most agreed that if habitat management occurs, it should be limited to creating small, dispersed openings that mimic natural "blow downs" (e.g., felling 1-3 trees) and to provide habitat likely to become suitable for shedding, basking, or denning over time (e.g., creating living snags, leaving 3-4-ft trunks, some tree trunks still partially connected to the stumps, felled logs, etc.). One researcher remained hesitant given the potential to damage or destroy habitats and features already used by the snakes but unknown to us. ENSP continues to communicate with these researchers to determine an appropriate path forward given the opposing views.
  - Central New Jersey: Habitat management was conducted by a conservation partner through an alternate ENSP funding source and demonstrated success for eastern copperheads (*Agkistrodon contortrix*, formerly northern copperhead, *A. c. mokasen*) as telemetered snakes were found basking within some of the managed areas post-management.
  - Northern New Jersey's montane habitat: No habitat management for rare snakes was pursued in northern NJ as all sites targeted by the ENSP were valued for rare plants by DEP botantists. Pursuing habitat management in rare plant sites would require the ENSP to contract 12-months of plant surveys for each site, increasing cost and timelines.
- Worked with land managers and landowners to incorporate SGCN management into forest management plans. Engaged with land management agencies to ensure SGCN are included in the management planning on the landscape.
  - ENSP staff continued overseeing forestry activities and habitat planning for SGCN on Sparta Mountain and Weldon Brook WMAs after the retirement of the Division's northern region habitat planner. From January 2019 through December 2021, ENSP staff planned for the creation of 28.4 acres of young forest on Sparta Mountain WMA, along with plans to conduct an additional 10 acres of open-canopy forest in early 2022 for SGCN habitat. Implementation of forest management was funded with non-federal monies and used as match for this grant.
  - Year 3 forestry activities in Stand 12 at Sparta Mountain WMA, a 9.2-acre modified seed tree treatment, began in February 2021, and completed in March 2021. The purpose of treating the 9.2

acres was to create habitat for SGCN, specifically golden-winged warblers and other species dependent upon young forest habitat. Cavity trees and trees with sloughing bark were also targeted for retention for Indiana bat roosts. This implementation was funded with non-federal monies and used as match for this grant.

- To streamline the public review process, staff finalized criteria for selecting future forestry activities at Sparta Mountain WMA in the form of an Addendum to the current Forest Stewardship Plan for Sparta Mountain WMA. This responded to concerns and stipulations expressed by stakeholder groups opposed to forest management,
  - The Addendum went out for a 30-day public comment period in April 2021 to stakeholder groups and >25,000 individuals. A total 45 comments were received from 42 different individuals/groups, half of which were form letters objecting to logging on state lands. Many of the submitted comments contained false statements without substantive suggestions, the most egregious of which were submitted by the NJ Sierra Club, claiming the logging at Sparta Mountain WMA will impact endangered "deep forest birds like the northern harrier, pied-billed grebe, black rail, and upland sandpiper." Only nine comments had substantive suggestions and were considered in the changes made to the Addendum.
  - Comments were incorporated and the Addendum was finalized in July 2021. The Addendum contained the site-selection criteria in addition to location maps and timelines of where and when activities will occur, and can be viewed and downloaded from the following website: https://www.nj.gov/dep/fgw/sparta/sparta-fsp-addendum-final-7-9-21.pdf
- The site for Year 4 forestry activities in Stand 9 at Sparta Mountain WMA was selected based on the criteria in the Addendum and in accordance with the approved Forest Stewardship Plan for Sparta Mountain WMA.
  - The draft location map and prescription for Stand 9 2021/2022 activities went out for a 30-day public comment period in July 2021. A total 6 comments were received. Many of the comments submitted were already addressed in the selection criteria outlined in the Addendum. The remainder of the comments were considered in the final site selection.
  - The 10-acre boundary and retention trees were marked, and a practice plan was submitted in October 2021 for a shelterwood prescription. The purpose of treating the 10 acres is to open the forest canopy for golden-winged warbler post-fledging habitat and other species dependent upon open-canopy forest habitat. Cavity trees and trees with sloughing bark were also targeted for retention for Indiana bat roosts. Implementation will likely occur January through March 2022. The implementation work done in 2021 was funded with non-federal funds and used as match for this grant.
  - Despite the public comment periods and the release of the Addendum outlining specific site selection criteria, a few stakeholder groups who were involved in the creation of the site-selection criteria continued to ask for meetings and oppose the planned Year 4 forestry activities.
- Forestry activities were not implemented on Weldon Brook WMA in 2021 because of concerns about the long skid and the need to obtain stakeholder feedback prior to relocating the project.

- Worked with all partners to include strategic habitat conservation elements in all management plans and evaluate the effectiveness of those management activities in improving SGCN populations. The results of those evaluations can be used to inform land managers to implement adaptive management strategies to continue to improve our management efforts.
  - ENSP staff continued to evaluate the effectiveness of SGCN habitat management by monitoring the bird response to forest management on Sparta Mountain (Figure 2A-1) and Weldon Brook WMAs. From January 2019 through December 2021, ENSP staff conducted 32 bird surveys on 13 different management sites: 5 surveys were pre-management and 27 surveys post-management.
    - Eleven management sites were surveyed for birds on Sparta Mountain and Weldon Brook WMAs in 2021: one pre-management and ten post-management (Table 2A-1)
    - During the 2021 surveys, 44 species (17 of which are SGCN) were observed in at least one of the nine managed sites on Sparta Mountain WMA.

    - Based on observations from 2012 through 2021, 82 different bird species, 30 of which are SGCN, have been observed using managed sites on Sparta Mountain WMA.
- Used GIS and other analysis tools to identify and prioritize parcels for management activities for targeted SGCN. Engaged with land managers to incorporate and implement habitat management activities to benefit those species; include monitoring efforts to evaluate effectiveness of activities.
    - Individual locations of potential SGCN habitat management projects on Sparta Mountain and Weldon Brook WMAS were analyzed using GIS software to assess the amount of forest cover as well as development and agriculture within a 1.5-mile radius. This information was combined with the distance of potential sites to vernal pools, streams, wetlands, rare plants, and existing access roads to locate future SGCN habitat management projects while minimizing impacts to other resources.

- Identified forestry management opportunities that are currently ongoing but without SGCN consideration within all forests in NJ, including government, NGO, and private lands.
    - From January 2019 through December 2021, ENSP staff identified two forest management plans on public lands lacked feedback from ENSP staff on SGCN.
        - ENSP submitted comments on one plan during the public comment period.
        - The other plan was being implemented when ENSP became aware of it. ENSP staff reached out to the land managers to discuss how to incorporate SGCN when implementing the plan in the future.

Conclusions

- Forest management conducted on state lands to allow the regeneration of oak/hickory forests (i.e., Modified Seed Tree with Wildlife Reserves) within a mature forested landscape creates breeding habitat for many bird species of conservation need, and is also used by mature forest bird species, including the endangered red-shouldered hawk.
- Some stakeholder groups who oppose forest management will continue to actively oppose forest management even after many of their concerns have been addressed during the planning process and stipulations codified in an addendum.

Recommendations

- Continue to manage forests on state lands to allow the regeneration of oak/hickory forests (i.e., Modified Seed Tree with Wildlife Reserves) within a mature forested landscape, provided the amount of forest in the young forest stage (<20 years post-harvest) does not exceed 20% of the forested landscape at a given time.
- Conduct Year 4 forestry activities on Sparta Mountain WMA during the winter of 2021 as outlined in the approved forest stewardship plans.
- Continue to assess the benefit of spending time and money continuously meeting with stakeholder groups who are opposed to forest management and unwilling to compromise.

Table 2A-1. Number of bird species and bird species of concern observed during the 2021 breeding bird surveys in management sites on Sparta Mountain and Weldon Brook WMAs.

Site	# Years Post-management	# Bird Species	# Bird Species of Concern
Sparta Stand 12 MST 2021	0	13	8
Sparta Stand 8 MST 2020	1	14	7
Sparta Stand 18 MST 2019	2	25	12
Sparta Stand 18 SHWD 2015 (RHWO)	6	17	10
Sparta Stand 2 MST 2014 (Collins Pond)	7	16	8

Weldon MST 2014	7	18	11
Sparta Stand 18 MST 2013	8	17	6
Sparta Stand 1/2 MST 2011-1	9	22	11
Sparta Stand 1/2 MST 2011-2	9	14	7
Sparta Stand 1/2 MST 2011-3	9	18	6
Sparta Stand 9a SHWD 2022	pre	7	3

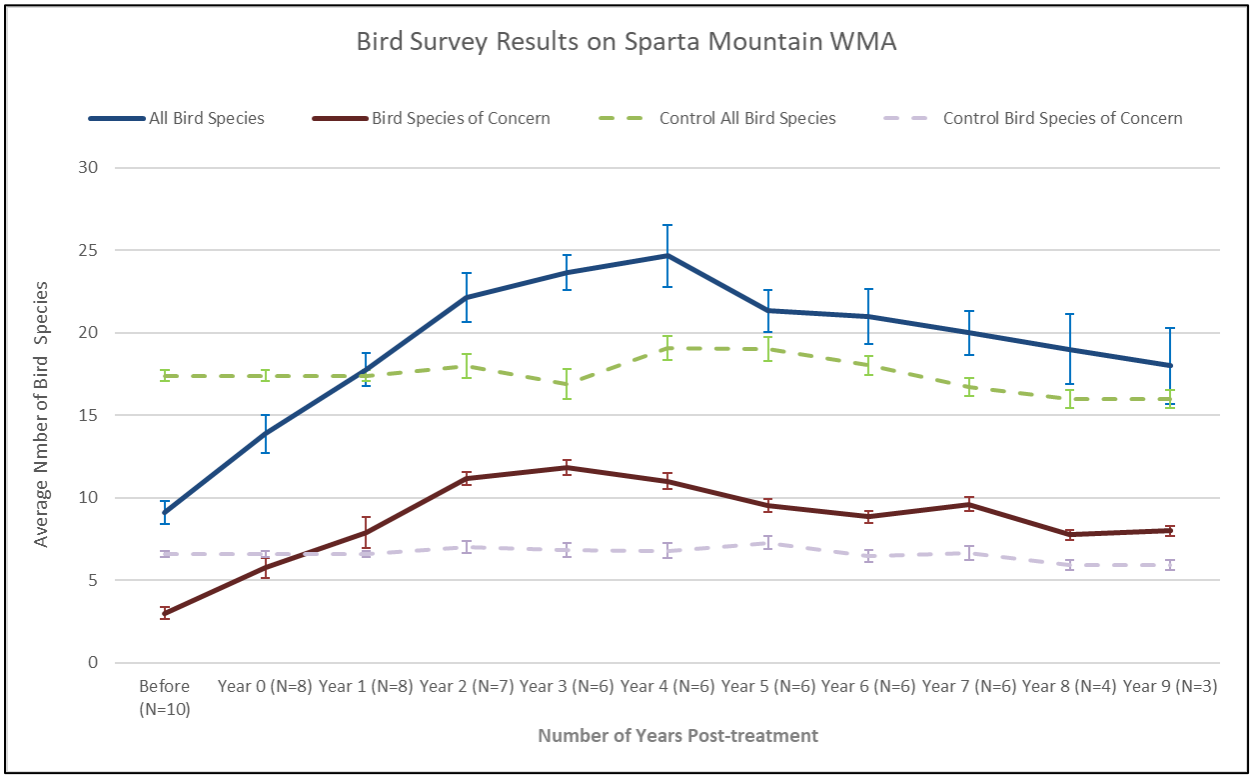


Figure 2A-1. Average (± SE) number of bird species (blue, green) and bird species of concern (red, violet) observed during breeding bird surveys on Sparta Mountain WMA. Pre-treatment surveys were conducted in 2008 and selected based on proximity to treatment sites (conducted 2012-2021) within the same forest stand, or conducted on site prior to treatment.

JOB B.1. Forest Habitat Management

Key Findings:

- ENSP conducted no further work on draft guidance documents for forestry and forest fire practices to minimize the risk of harm to rare snakes and/or their critical habitat features (i.e., winter dens and nesting/gestation and birthing areas). Instead, guidance was provided on a project-by-project basis in an effort to minimize conflicts between agency programs with varying objectives.
- Assess parcels throughout the state to determine which ones will have the greatest benefit from forest management on SGCN. Conduct research as necessary to determine impacts of forest management types on SGCN.
    1) Continue to work with public and private landowners to develop management plans (through Working Lands for Wildlife and other initiatives) for the forests in New Jersey for focal bird species dependent upon young forest within a larger matrix of mature forest in order to stabilize and reverse declines.

a) Staff from ENSP, NRCS, Conserve Wildlife Foundation, and NJ Audubon continued to work together to promote the Working Lands for Wildlife (WLFW) program for golden-winged warblers in New Jersey. From January 2019 – December 2021, a total of 2 outreach seminars and 15 site visits were conducted for private landowners in northwestern New Jersey. Almost all of the private landowners where site visits were conducted incorporated GWWAS and other SGCN habitat needs into their forest management plans.
    1. In 2021, staff from ENSP, NRCS, Conserve Wildlife Foundation, and NJ Audubon presented at one WLFW virtual outreach seminar, which was held on April 5, 2021. Fourteen private landowners were in attendance.
    2. In 2021, staff from ENSP, NRCS, Conserve Wildlife Foundation, and NJ Audubon jointly visited six private landowners interested in Working Lands for Wildlife (WLFW).

2) Using GIS and bird survey data, continue to identify areas within large patches of contiguous forest where young forest and native understory vegetation are lacking and in need of management and/or post-disturbance monitoring in GWWA range and in the Piedmont region.
    a) Individual locations of potential forest management projects in the GWWA range of northwestern NJ were analyzed using GIS software to assess the amount of forest cover as well as development and agriculture within a 1.5-mile radius. This information was used to rank private landowners interested in creating habitat for golden-winged warblers as well as locate future forest management projects on state lands.
    b) The Sourland Mountains and Baldpate Mountain were identified in the Piedmont region as containing a large amount contiguous forest in the Piedmont region. ENSP staff provided recommendations to enhance these areas for hooded and Kentucky warblers documented breeding there.
3) For each region in NJ, continue to identify and assess threats that may reduce the suitability of large patches of forest for SGCN.
    a) Based on rapid vegetation assessments at 31 sites, invasive plant species are more problematic, reaching 10% vegetation cover, in 29% of the sites. Just less than half of areas that had a potential history of agricultural land use contained problematic invasives, and 20% of areas with no history of agricultural land use contained problematic invasives. Eight of the nine sites with problematic invasives also showed signs of excessive deer browse, and the one site without a history of past agricultural land use and little to no deer browse had a road bisect the site.
    b) The presence of invasive plants, up to 30% of the total vegetation cover, did not impact bird species richness. Instead, opening the forest canopy increased bird species richness (9 out of 9 sites) more than controlling invasives within an already open forest canopy (1 out of 3 sites).
    c) An increase in black birch saplings as a dominant understory species may be correlated with a decline in bird species richness.
    d) There were 21 instances of bird species richness declines in 17 sites over 5 years post-management. Eight (38%) of those instances correlated with an increase in black birch saplings, and four (19%) correlated with an increase in rubus. Increases in blueberry, mugwort, hay-scented fern, hickory, aspen, and sassasfras each occurred in a single instance, and two instances had no apparent correlation with changes in vegetation.
4) Continue to work with partners to plan and implement forest management within identified areas for SGCN.

a) During the winter of 2020/21, fourteen private landowners implemented forest management for GWWA habitat through the WLFW program and with NRCS funding sources.

5) Continue to evaluate success of habitat restoration, mitigation, and management projects on SGCN through appropriate surveys and/or other standard monitoring methodologies. Survey for target SGCN species where management for young forest has been implemented, on both public and private lands.
    a) ENSP staff continued to monitor for presence of all bird species, including golden-winged warblers (GWWAs), to evaluate the success of WLFW. Many of the WLFW surveys were conducted by NJ Audubon using non-federal monies. From January 2019 – December 2021, a total of 359 bird surveys were conducted.

1. In 2021, the start date of surveys was delayed by 5 days because of the late migration. A total of 126 locations relating to WLFW were surveyed for all bird species in NJ in 2021: 40 WLFW, 25 Management (MGMT), 61 Natural (NAT), and 1 pre-management (PRE). NAT sites represented naturally-occurring "young forest" habitat within wetlands and were considered the control sites. MGMT sites represented other forest management prescriptions on private and public lands to promote young forest habitat that were not enrolled in WLFW. WLFW sites were only considered if they were enrolled in the WLFW-GWWA program. PRE sites are intended to be managed to create young forest habitat, regardless of ownership or enrollment in WLFW. Most PRE sites are closed-canopy deciduous forest stands with an average age between 70 and 100 years.

b) From 2014 – 2021, the average species richness (SPP) in NAT sites had a trend of -0.27 per year while the average bird species of concern (BSC) had a trend of -0.13 per year, though the average number of bird species for both increased slightly in 2021. Species richness in MGMT+WLFW sites from pre-management to year 8 post-management had a trend of 0.20 per year while BSC had a trend of 0.18 per year (Fig. 2B1-1).
   1. Overall species richness in 2021 was slightly greater than last year; only 34% of NAT sites (21/61) had lower species richness in 2021 compared with 2020. Species richness averaged 16.55 species in 2021 compared to 15.93 in 2020 but was still below the average 16.7 species in 2019. Only 41% (25/61) NAT sites had lower species richness that the average in 2020 and 51% (31/61) NAT sites had lower species richness than the average in 2019. Greater species richness was also observed in managed sites 2021 with only 40% (22/55) of managed sites showing lower species richness in 2021 compared with 2020.
   2. A paired T-test was used to analyze differences of SPP and BSC between NAT sites and WLFW+MGMT sites from 2014 - 2021. As expected with an increasing trend, WLFW+MGMT sites continued to have significantly greater SPP and BSC compared to the NAT sites (two-tailed; $P=0.022$ for SPP; $P<0.001$ for BSC).

c) Based on a combination of years since treatment and regeneration rates, only 24 managed sites (9 WLFW sites, 15 MGMT) surveyed in 2021 were considered suitable breeding habitat for GWWAs. Of those, 12 sites (6 WLFW, 6 MGMT) contained >75% forest cover. The threshold for forest cover was increased from 70% to 75% based on information provided via personal communication with Dr. J. Larkin.
   1. Two GWWAs were detected on two MGMT sites with suitable habitat in 2021, which equates to 8.3% naïve occupancy on all suitable sites and 17% naïve occupancy on suitable sites with >75% forest cover. The occupancy estimated for suitable sites is lower than in 2020 and sites with >75% forest cover is now below the 20% naïve occupancy found in the eastern study region (McNeil et al. 2020).
   2. Four GWWAs were detected on four NAT sites. All NAT sites were considered suitable habitat for GWWAs, which equates to 6.6% naïve occupancy of GWWAs in suitable NAT sites. Forty-one (67%) of the 61 NAT sites contained >75% forest cover. All four GWWAs were detected at NAT sites containing >75% forest cover, which equates to a naïve occupancy of 9.8%.

6) Continue to participate in and collaborate with the national and regional working groups to assist in designing monitoring protocols and management guidelines for golden-winged warblers and other SGCN songbirds.

a) From January 2019 through December 2021, ENSP staff collaborated with the Appalachian Mountains Joint Venture to address how forest management for SGCN can be better implemented in New Jersey, as well as NJ Audubon and Indiana University of Pennsylvania to ensure monitoring protocols were compatible across NJ and the region.
   1. In 2021 ENSP staff participated in ten meetings with the Appalachian Mountain Joint Venture to discuss unified messaging to promote and implement habitat management for golden-winged warblers and other species, as well as better understand full annual life cycles and monitoring of priority bird species within the AMJV.

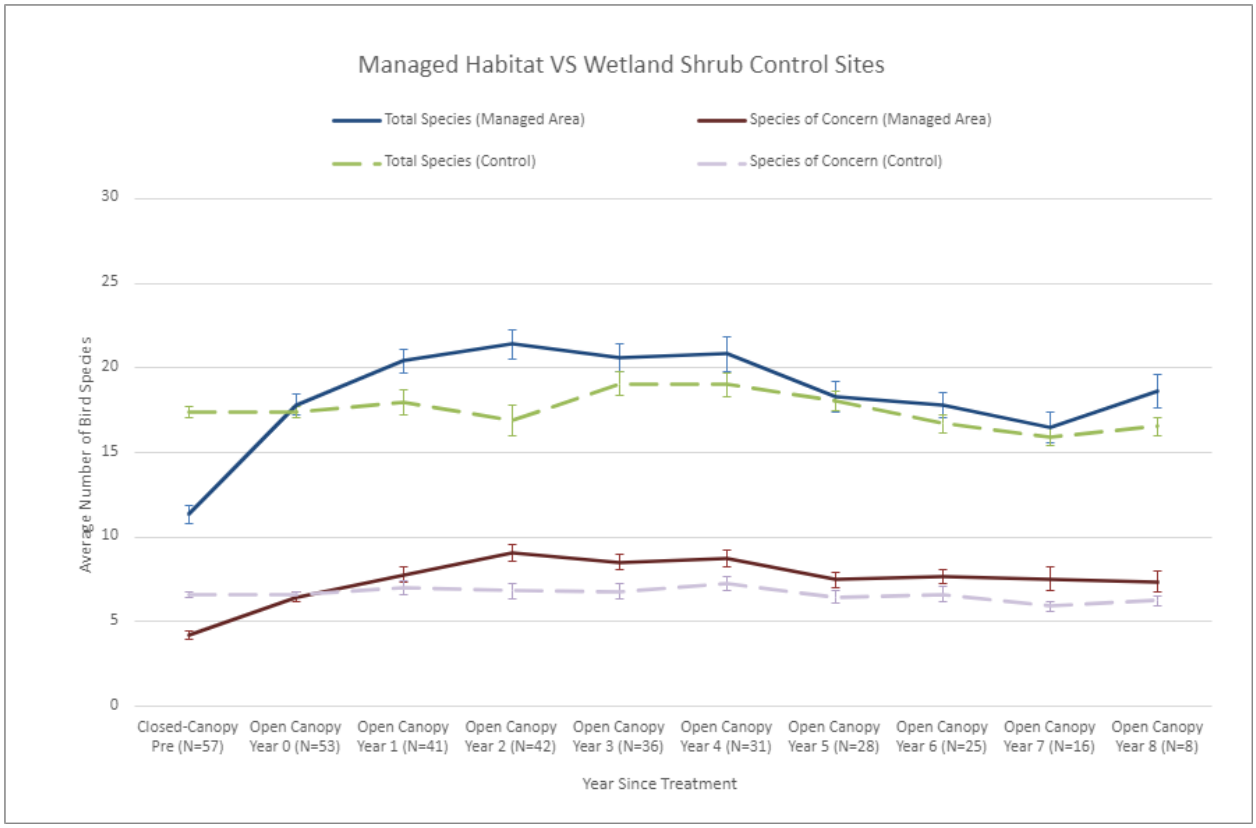
2. Staff virtually attended the regional Appalachian Mountain Joint Venture Technical Meeting August 17-18, 2021.

b) An analysis was conducted to determine if there was a difference in the number of bird species detected in ten survey points between two survey dates with the NJ Audubon (NJA) bird monitoring protocol (10 minutes passive followed by GOWAP call-playback) and one survey date using the GOWAP protocol (3 minutes passive followed by GOWAP call-playback). A Chi-squared test showed no significant difference (P >0.05) between the GOWAP surveys and NJA surveys, though there was a difference between the two NJA surveys. A 2-tailed paired T-Test indicated a difference between the GOWAP and the 2nd NJA survey (P=0.02), but most of the GOWAP surveys had greater number of species detected than the 2nd NJA survey, which indicated time of year of surveys influences number of species detected more than the extra 7 minutes of passive listening.

7) Continue to educate stakeholders, private landowners, and the general public on the benefits and techniques of maintaining/managing mature forests and creating young forest habitat.

a) From January 2019 through December 2021 ENSP staff gave presentations to two Woodland Stewards cohorts and three college classes as well as three field tours with stakeholders and members of the public.

b) In 2021 alone, ENSP staff attended more than 20 webinars to learn updated information about SGCN habitat needs, which was then summarized and disseminated to partners involved in forest management in New Jersey.



Conclusions

- Even in its early stages, young forest management on private properties has benefited a number of early-successional songbird species and attracted a greater diversity of bird species than other managed and natural sites. Overall, opening the forest canopy to create GWWA breeding habitat results in a 50% increase in the number of bird species using the site during the breeding season. However, most of the managed forest sites are still too young to attract golden-winged warblers.
- Without the maintenance of existing and/or creation of new breeding habitat in NJ specifically for golden-winged warblers, the population will continue to decrease as NJ runs out of new potential breeding sites to survey, and occupancy or recolonization of previously-occupied sites continues to decline.

Recommendations

- Continue to monitor the songbird species richness and *Vermivora* presence in forested lands managed for golden-winged warblers and other wildlife on private and public lands, including WLFW.
- Continue to provide technical assistance pertaining to forest management for golden-winged warblers and other wildlife habitat needs on private and public lands, including WLFW.

JOB B.2. Habitat Connectivity and Management

This was inactive here, but is covered in NJ W-78-R.