Interim Report
State Wildlife Grants
T-1-8
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Endangered, Threatened and Rare Wildlife Conservation Projects

Interim Report for Project Year
January 1, 2019 – December 31, 2019

NJ Department of Environmental Protection

DIVISION OF FISH AND WILDLIFE
ENDANGERED AND NONGAME SPECIES PROGRAM
P.O. BOX 420
TRENTON, NJ 08625

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

Subjob C.2. Snakes

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

Job F. Threat assessment: Emerging Diseases

Project 2. Habitat Management and Planning

A. Strategic Habitat Conservation

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B.1. Forest Habitat Management

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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, 2019

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

Bog Turtle Key Findings:

- During this period we finalized the authoring of the Biological Opinion on the Effects of Road Network Operation, Maintenance, Improvement, and Expansion on the Federally Listed (Threatened) Bog Turtle (Clemmys [Glyptemys] Muhlenbergii) in New Jersey done in part with these federal funds and under the Dept. of Transportation grant ("Memorandum of Agreement to Complete Endangered Species Act Section 7 Formal Programmatic Consultation for the Bog Turtle," Interagency Agreement among the Federal Highway Administration, the New Jersey Department of Transportation (DOT), the New Jersey Department of Environmental Protection's Endangered and Nongame Species Program and Division of Land Use Regulation, and the U.S. Fish and Wildlife Service (USFWS), New Jersey Field Office (NJFO). While the Biological Opinion (BO) portion of the deliverables is now complete, coordination continues with USFWS and DOT on additional trainings and opportunities to implement the BO.
    - Finalizing the completion of the BO included weekly or twice weekly web meetings through the first half of the grant year.
- Staff coordinated monitoring efforts of a site in central NJ where construction of an under-road tunnel system to safely pass turtles and other wildlife between two bisected areas was finalized in early 2019. Monitoring efforts in 2019 included radio-telemetry, road transect surveys, and camera "trapping," i.e., cameras placed inside the tunnels that capture an image of any animal passing through the field of view. Monitoring was paid for using non-federal funds. Under this grant, staff developed monitoring protocols, purchase orders and contracts, and reviewed submitted data. Analysis of monitoring data will be reported here next year.
- Northern staff held group survey opportunities over the course of two days, wherein staff and volunteers conducted standardized visual surveys following regional population monitoring protocols at a total of five core habitats. Southern staff held a group survey at one core habitat in 2019.
- Staff continued a partnership with New Jersey Audubon (NJA) at a site in southern NJ. Phragmites was mowed in March and follow-up herbicide was applied later in the summer. Visual surveys and telemetry continued in the southern section of the property, and 20 consecutive trap nights of monitoring (Phase 3 survey) were carried out in the northern section of the property. One painted turtle was captured and one egg was found floating in the water. No new bog turtles were observed in this section of the wetland.
- Staff met with USFWS staff and Stockton University staff to explore the potential of hydrological restoration at the same southern NJ site. Plans have been submitted for Land Management Review and a Special Use Permit (SUP) for work to find and break up tile drains in the fields, strategically plug ditches coming off the field, and install check dams and weirs to control water flow in the agricultural ditch. USFWS staff will file for NJ Wetlands Act general permit (GP-16) approval.
- Staff coordinated with partners on survey site selection and assessment protocols.

Wood Turtle Key Findings:

- Volunteers conducted stream transect surveys for wood turtles following standardized approaches (survey effort = 1-km/hour) developed under a Regional Conservation Need grant (2014) and further implemented under a Competitive SWG project.

- Sussex County – The primary focus was on a stream transect in an area slated for forestry activity in future years. Volunteers affiliated with Montclair State University began monitoring the transect using visual surveys, and by using radio-telemetry on any captured wood turtles of appropriate size and health.
- Staff continued to participate in regional Competitive SWG monthly conference calls to stay engaged on efforts and to review and provide feedback on state-specific deliverables and the overall Conservation Plan, which was finalized and delivered that that ground in 2019. After completion of the Conservation Plan, sections were adapted for peer-reviewed publication.

Recommendations:

- Continue to apply standardized monitoring approaches for bog and wood turtle beyond the end of regional funding cycles.
- Continue to coordinate with volunteers to monitor priority bog and wood turtle areas.
- Enlist additional, trained volunteers to assist with wood turtle stream transect monitoring.

Subjob C.2. SNAKES

Project Leader: Kris Schantz

Key Findings:

- Endangered and Nongame Species Program (ENSP) personnel continued to recruit, train and manage the Venomous Snake Response Team (VSRT) in 2019.
  - Seven trainings were held in 2019 including State Parks and Forestry personnel, town-/county-contracted animal control officers, personnel from outdoor education/camping organizations, personnel from the Humane Society at Popcorn Park Zoo, and citizen volunteers.
  - Of the 78 team members, 66 submitted information regarding their snake responses and time and mileage incurred at the time this report was prepared. At least one of the responders that did not submit reports did respond to multiple venomous snake calls not included in the following totals. Thirteen responders had responded to 35 venomous snake calls including 15 Timber Rattlesnakes and 8 Northern Copperheads, with one gravid copperhead requiring four additional visits/capture attempts. Three snake(s) were not present upon the responders' arrivals although homeowners of one snake showed a photograph of the copperhead they saw (not part of these reported calculations); the remainder were confirmed as non-venomous snakes. ENSP is working to obtain the official sighting report forms from responders for submission and entry into NJ DEP's Biotics database (Biotics).
  - ENSP personnel attempted to contact two local police departments (in northern and central New Jersey) that expressed interest in venomous snake response training in 2018. Both departments were unresponsive.
- ENSP personnel fielded more than 100 snake complaints via telephone calls from residents. Approximately two-thirds of the calls were reporting a venomous snake on their property but less than 10 were confirmed as a timber rattlesnake or northern copperhead; the remaining were non-venomous, native snakes. Note these figures exclude texts and emails ENSP biologists received directly from residents reporting potential venomous snake presence on their properties.
- ENSP personnel continued to reduce a backlog of rare snake observation data 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.
- ENSP worked with the ENSP Pinelands Snake Research Team to conduct surveys in the Pine Barrens.
  - In 2019, volunteers were tasked with surveying target areas on State lands in search of:
    - Reptile and amphibian observations.
    - Existing critical habitat features (i.e., winter dens, nesting areas/gestation and birthing areas, shedding stations), and assessed their need for management.

        - Areas where minimal habitat management can create suitable basking, nesting and/or gestation and birthing areas.
        - Questionable shelter arrays (i.e., multiple cover boards, carpet fragments, debris, etc. set within a localized area) indicating potential snake collection sites.
    - Data collected during the 2019 field season included:
        - Thirty (30) snake observations that included two State-endangered species, one State-threatened species, one State-special concern, two species that are candidate for State-special concern, and three stable species.
        - Findings included previously undocumented critical habitat features including seven nest sites (five as part of a large nest complex for two rare species) and one hibernaculum with two snake observations. The remaining observations included seven "on road" observations and 14 observations within general summer habitat.
        - Three volunteer surveyors submitted their data; only two submitted their timesheets prior to this report.
    - In 2019, volunteers were permitted to survey any areas they chose but were provided with targeted areas where the ENSP is lacking data. It appears the team may have spent little time surveying the ENSP-targeted areas.
- In 2018 and 2019, the ENSP partnered with Robert Zappalorti (Herpetological Associates), Dr. Howard Reinert (The College of New Jersey), and the Pinelands Commission on a Corn Snake (*Pantherophis guttatus*) study involving radio-telemetry, traplines and cover boards, and head-starting. The ENSP provided the necessary supplies for the study. To date, the study has resulted in:
    - The discovery of 34 previously undocumented winter hibernacula and five previously undocumented nesting areas, two of which are community egg-laying sites.
    - Preliminary data indicating that hibernacula characteristics are not visibly distinguishable on the surface from other areas within the Pine Barrens.
    - The discovery that both standing live and dead hollow cavity trees are important habitat features as both nest sites and shedding stations.
    - The confirmation that some individual corn snakes come up from their dens to bask on the surface during winter months.
- ENSP partnered with NJ Conservation Foundation conducting radio-telemetry research to identify Pine Barrens' rare snake critical habitat features (hibernacula, nesting areas, gestation/birthing areas). The ENSP provided volunteers to assist in tracking snakes throughout the season.
    - Eight Northern Pine Snakes were tracked including two males and six females. Two of the females were gravid but one female's transmitter failed prior to nesting. Tracking these snakes led to the discovery of three previously undocumented winter hibernacula and one previously unreported nest site. The ENSP is awaiting data submittal.
- No progress was made on the Northern Pine Snake Species Status Assessment update or recovery plan or the Timber Rattlesnakes' Species Status Assessment.
- ENSP personnel conducted a review of literature and past survey efforts in New Jersey on pine snake drift fence/trapline surveys to develop guidance for land use permit-required surveys to ensure future, more uniform effort using the most successful methods to trap all age classes of Northern Pine Snakes and potentially, other rare snakes including but not limited to Corn Snakes (also referred to as Red Ratsnakes, *Pantherophis guttatus*), Eastern Kingsnakes (*Lampropeltis getula*) and Northern Scarlet Snakes (*Cemophora coccinea copei*) to determine their presence in the landscape.
- Law enforcement continued to monitor known snake collection hot spots. Unknown persons (or evidence of their presence) have been observed at sites. The ENSP purchased needed supplies and equipment for continued patrolling and monitoring through this grant.
- Some habitat management efforts have proven successful but may have drawn attention from hobbyists and/or collectors.

- ENSP personnel prepared and submitted land management review packages for five projects to be conducted by research partners on state lands and assisted partners in obtaining the necessary state lands special use permits.

Conclusions:
- Venomous Snake Response Team (VSRT):
  - 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.
- Residents are very unaware of 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.
- Pinelands Snake Research Team requires additional instruction to encourage, if not ensure, they survey ENSP's target areas in 2020.
- 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 are proving to be an effective means of obtaining important data with limited resources.

Recommendations:
- The VSRT will continue in 2020 as ENSP continues to consider possible methods to maintain and expand the team while decreasing the ENSP's responsibilities and time required.
  - ENSP must pursue the two local police departments that expressed interest in training for recruitment as their communities are within venomous snake territories where we lack trained personnel.
  - ENSP needs to recruit and train new personnel statewide to build the VSRT to ensure adequate coverage for NJ residents.
  - ENSP must continue to work with the team members so they understand (and fulfill) what is required of them as official volunteers and as team members not covered under DFW insurance.
- The ENSP will reach out to non-government snake researchers for input on how public snake education could be improved.
- 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.
- The ENSP will determine potential rare snake projects to be contracted with funding assistance from a non-federal source.
- The ENSP will continue to partner with snake researchers on rare snake research to obtain important data and understanding of species' needs.
- The ENSP 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.

Subjob C.3. AMPHIBIANS

Project Leader: William Pitts

Key findings
- Eastern tiger salamander surveys were conducted at known or potential breeding pools throughout the species range. Specific emphasis was placed on surveying potential new breeding pools.

- All survey data up to 2018 was entered into Biotics and will be ready for inclusion in the next version of ENSP's Landscape Project Map.
- ENSP volunteer surveyors have been recording salinity readings at several eastern tiger salamander breeding pools to collect baseline data and monitor for potential impacts from saltwater intrusion.
- No new pools were constructed or old pools modified. However, work began to identify areas to improve connectivity among known breeding pools. New management and/or pool creation will be targeted in areas that are State-owned, currently valued in Landscape Project Map (version 3.3) for eastern tiger salamanders, and adjacent to wetlands or vernal habitat.

Conclusions
- ENSP's survey efforts during the reporting period emphasized monitoring viability of known eastern tiger salamander breeding populations.
- Survey efforts were largely conducted by the ENSP volunteers and Conserve Wildlife Foundation of NJ staff.
- Identification and remediation of threats to eastern tiger salamander populations remains important, especially regarding issues related to disease and habitat destruction due to off-road vehicles.

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

JOB D. INVERTEBRATE CONSERVATION AND MANAGEMENT

Subjob D.1. Mollusks

Project Leader: Jeanette Bowers-Altman

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:
- We contracted Biodrawversity to conduct brook floater surveys in the Lamington River using a modified version of the Brook Floater Working Group's Rapid Assessment Protocol. 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.
- Work in the Lamington River was severely curtailed in 2019 due to high water/low visibility issues caused by a continuous, 200 cfs water release by Round Valley Reservoir, which began in early September and lasted through mid-October. As a result of the release, no sites downstream of the Rockaway River confluence could be effectively surveyed. Biodrawversity biologists instead surveyed the lower Raritan River upstream from the confluence with the Lamington, but only several live eastern elliptio were found. One live brook floater, four live triangle floater, and one live creeper were discovered at the downstream

end of a golf club near River Road West. In addition, biologists surveyed a long section (1,200 meters) of river downstream of Route 523, but only small numbers of eastern elliptio were found.

- Endangered and Nongame Species Program (ENSP) staff conducted qualitative, timed searches at six stream sites throughout the state for listed freshwater mussels during the project period. Searches were supplemented with tactile methods including excavation in areas with softer substrates. Surveys focused primarily on brook floaters and were performed at historic locations, monitoring sites, and/or in previously unsurveyed suitable habitats. We conducted habitat assessments and/or preliminary searches at seven sites to determine if larger surveys were warranted.
- High water and high flow velocities severely limited our ability to complete scheduled surveys throughout much of the project period.
- EPA Habitat Assessment Field Data Sheet scores (high and low gradient combined) ranged from 126 (Stony Brook, lower Kunkel Park, Mercer Co.) to 166 (Stony Brook, near Baldwin Lake, Mercer Co.), out of a possible 200. Previous ENSP studies have shown that mussels occur in a habitat score range of 68-173. All sites surveyed scored within the preferred habitat range.
- Catch per unit effort (CPUE) for all freshwater mussel species combined during timed searches was highest in the Stony Brook at Titus Mill Road, with 0.22 live mussels/minute.
- We recorded six species of freshwater mussels (live and/or shells) during field activities. The eastern elliptio was the most prevalent and widespread mussel species documented. Species richness was highest in the Salem Creek, Salem County, and Stony Brook, Mercer County at Kunkel Park, with four species recorded. Significant findings included, but were not limited to, the discovery of a live creeper (State Special Concern) and fresh creeper shell in the Stony Brook, Mercer Co., a fresh dwarf wedgemussel (Federal/State Endangered) shell in the Pequest River, Warren Co, a triangle floater (State Threatened) shell in Salem Creek, Salem Co. and a tidewater mucket (State Threatened) shell in Rancocas Creek, Burlington Co.
- We conducted searches for the Chinese pond mussel in Wickecheoke Creek, Hunterdon County. In 2010, we documented the first North American occurrence of the highly invasive Chinese pond mussel (*Sinanodonta woodiana*) 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 Chinese pond mussels 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 Chinese pond mussel population.
- 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.
- Endangered and Nongame Species Program and Bureau of Freshwater Fisheries (BFF) biologists conducted a freshwater mussel salvage at Wargo Pond, Mercer County. The pond had been draining for several days due to structural damage at the dam. Approximately 20 eastern floaters were relocated downstream in Honey Brook. In addition, BFF staff relocated numerous individuals that were trapped on exposed substrate into deeper sections of the pond.
- DFW Wildlife Conservation Corp (WCC) volunteers conducted freshwater mussel surveys in Cumberland County.
- 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:

- Brook floater populations appear to be declining in the state. 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, dam construction, 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. Despite survey efforts in the vicinity of known Lamington River populations, Biodrawversity biologists were able to locate only one live individual. Additional surveys in the Stony Brook at historic locations by the ENSP biologists have yielded no new brook floater sightings.
- 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. It is possible that 1) 100% mortality was not achieved during the molluscicide applications in the ponds, 2) there are privately owned ponds in the system that may be harboring additional populations, and 3) 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.
- Freshwater mussel species occurring in lakes and ponds are vulnerable to mortality due to stranding and desiccation from dam failures. It is important to have access to committed volunteers to assist with salvage operations as necessary.

Recommendations:

- Continue surveys for brook floaters in the Lamington 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.
- 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, including Lake Aeroflex, to document occurrences and establish population boundaries.
- Continue monitoring efforts for Chinese pond mussels in Wickecheoke Creek and tributaries.
- 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.
- Publish results of predicative model developed in 2016. Develop protocol that will apply findings to stream restoration techniques to help manage for listed mussels and prepare for extreme weather impacts.
- Continue to identify and survey areas below and adjacent to golf courses and determine whether the development of BMP's 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.
- Continue field truthing 2016 model results to determine efficacy and publish results. Develop protocol that will apply findings to stream restoration techniques to help manage for listed mussels and prepare for extreme weather impacts.

- Continue surveys in previously unsurveyed stream and lake sites within the Mullica River system and other Pinelands areas where pH is suitable (>5.5) for mussels.

Subjob D.2. Macroinvertebrates

Lepidoptera

Project Leader: Robert Somes

Key Findings:

- Staff conducted surveys for Hoary Elfin at two known sites and one potential site. The populations at the known site continue to persist and over 75 individuals were observed at each location. Twenty Hoary Elfins were observed at the new location.
- Extensive Frosted Elfin surveys were conducted by staff at approximately 30 locations in southern and central New Jersey. All known sites for this species were surveyed two to three times during the field season and several new sites were documented: 14 and eight Frosted Elfin were observed at two new locations. Elfins were found at seven known sites, but were absent at the majority of the known sites.
- Northern Metalmark surveys were conducted at three known locations. One of those sites had a count of over 100 individuals and is one the larger remaining populations. The other known sites had fewer than 20 individuals observed. The NJ Division of Fish and Wildlife (DFW) is partnering with the landowner of this site to implement management that will help support the colony. Several areas of invasive vegetation were removed and several patches of nectar source plants were also planted. DFW staff held several meetings to review habitat management activities that could be conducted on several adjacent but historic sites.
- Surveys for Baltimore Checkerspots were conducted at three known locations and one new site and were documented to have occurred at all four sites with numbers ranging from single digits to approximately 20.
- Habitat management for pollinators in general continued with the planting of pollinator seed-mix plots at various locations throughout NJ. Six hundred common milkweed and swamp milkweed plants were distributed for planting throughout the State in 20 state parks and three wildlife management areas. These plants were used to create and expand pollinator gardens.
- Surveys for Leonard's Skipper found 39 at one known colony which is the highest count ever documented for this location.
- 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:

- The partnership with the NJ State Park Service and the State Forest Service to propagate milkweed and to create butterfly gardens and meadows continued to be a success and could be expanded. This year over 20 state parks and wildlife management areas hosted plantings.
- 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 many species; large areas of unsurveyed but suitable habitat exist within NJ for many species.
- Surveys for Frosted Elfin failed to locate many historical populations. Numerous sites appear to be declining due to succession and require proper habitat management.
- Northern Metalmark population numbers appear to be struggling at several historic sites. One historic site, though, had a new high of over 100 individuals, while other sites tend to remain at 10-20 individuals. The eruptive nature of this species makes it challenging to understand their population structure.

Recommendations:

- An extensive survey effort needs to target the butterfly species that were recently added to New Jersey's rare species list. Very limited data exists for many of these species in New Jersey, therefore it is critical that we develop a better understanding of their distribution, life history requirements, and threats.
- The milkweed propagation and butterfly garden/meadow creation project should be expanded within 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.
- 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 expanded to ensure the persistence of our current colonies and allow them to expand into former sites that have become overgrown and unsuitable. Continue working with land managers to maintain existing Northern Metalmark habitats. Work to increase connectivity between sites by maintaining natural corridors and creating suitable habitat by 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.
- Continuing Frosted Elfin surveys should be a high priority in NJ. Frosted Elfin is being petitioned for Federal listing and better baseline data for NJ would be beneficial to the effort. New Jersey is a regional stronghold for the Frosted Elfin, but many sites appear to be declining and a greater management effort needs to be made.
- 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

Project Leader: Robert Somes

Key Findings:

- Staff conducted 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. Nine populations of New England Bluet and 14 populations of Scarlet Bluet and Pine Barrens Bluet were surveyed and documented. Habitat characteristics were also surveyed at these sites to better understand their life history requirements and management needs.
- 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 over 30 sites in this region with the goal of surveying potential sites for NJ's listed species. No listed Odonata species were observed but one SGCN species (Spine-crowned Clubtail) was observed at a new site and several county records for uncommon species were also documented.
- A variety of other SGCN Odonata species were also observed during these surveys and documented. These data will be valuable for species status assessments in the future.

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 2020. Follow-up surveys should be conducted at historic locations where listed species were absent during 2019 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 2020 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 conducted for Harpoon Clubtail along the Delaware River to determine the distribution in the watershed.

Hymenoptera (Pollinating Bees)
Project Leader: Robert Somes

Key Findings:
- The NJ Division of Fish and Wildlife and Rutgers University recently completed a joint research project (under NJ AFA-15AP00727) to create a native bee list for the State of NJ, assess their rarity and distribution, and compile their life history data. These data are complete and will be available for conservation and management planning.
- New Jersey is a partner in a regional project assessing the impacts of management activities on Xeric Pollinating Bee populations. Surveys were conducted 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 will then be part of a prescribed forest fire management burn 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 of NJ and 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. A second bee survey site should be added at a site where forest management activity is occurring in the Stafford Forge Wildlife Management Area.
- 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.

Cicindelidae (Tiger Beetles- Ellipsoptera)
Project Leader: Robert Somes

Key Findings:
- Limited survey efforts were conducted related to tiger beetles this season.
- A research project by a partner (Conserve Wildlife Foundation of NJ) assessed the *Ellipsoptera lepida* population in Wildwood, one of five known occurrences in 2011. The study compiled data on population size and distribution. This population colonized a passive beach dune restoration site that resulted from dune fence installation, habitat that is different from engineered dune systems built to be more stable. Sand grain size also appears to be a determining factor in occurrence of this species.

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.

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 focused 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 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.
- 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 (presence/absence) 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.
    - Freshwater mussels were present at six out of the seven segments surveyed, with only three species represented. Eastern elliptio and alewife floater (both common) were the most abundant species found. One live eastern lampmussel (State threatened) was located in a side channel below the former dam location. Biodrawversity biologists rescued numerous mussels in this section that were stranded in very shallow water, moving them back to the main channel.
- 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. The small islands that existed prior to dam removal were entirely gone. The right side of the river is now a large elevated gravel bar. River left is now exposed gravel and cobble, with some placed boulders; the area is only submerged at higher flows. The main channel is about half its former width and is now a shallow riffle/run with strong flows, coarse substrates, some large placed boulders and depths <2 feet. There is a large area of unstable, accumulated silt just downstream. There are side channels and isolated pools associated with the depositional areas,

where Biodrawversity biologists found mussels trying to actively escape. Biologists relocated as many mussels as possible into the main channel.

- 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. Flows are generally moderate to strong here. 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 and two alewife floater.
- In addition to assessing habitat changes relative to freshwater mussels, we evaluated Odonata fauna during the Spring/Summer of the project period. Survey results were compared to pre-removal Odonata lists compiled by the ENSP and others.
- At least 27 Odonata species were reported to occur between the Columbia dam upstream to Brugler Road. Post-removal surveys indicated that of the 27 species recorded during earlier surveys, only 12 were present. One species (Arrow Clubtail) was found in 2019 which hadn't been included in earlier species' lists (Table 1).
- Prior to the dam removal, the Paulins Kill was mostly stagnant for approximately 1.5 miles upstream of the impoundment. Odonata species present within this zone were those typically found in ponds and lakes. These species tend to be highly elastic and common.

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. It is unlikely that the stretch will ever harbor six mussel species again. 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, which is prevalent in the Delaware River, and eastern lampmussel, 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. 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.

Table 1. Preliminary analysis of Odonata fauna found at Columbia WMA, pre and post dam removal.

		Pre removal		Post-removal
Ebony Jewelwing (Calopteryx maculata)		X		X
Swamp Spreadwing (Lestes vigilax)		X		
Slender Spreadwing (Lestes rectangularis)		X		
Violet Dancer (Argia fumipennis vioacea)		X		X
Familiar Bluet (Enallagma civile)		X		
Stream Bluet (Enallagma exsulans)		X		X
Skimming Bluet (Enallagma geminatum)		X		X
Orange Bluet (Enallagma signatum)		X		
Fragile Forktail (Ischnura posita)		X		
Eastern Forktail (Ischnura verticalis)		X		X
Common Green Darner (Anax junius)		X		
Cyrano Darner (Nasiaeschna pentacantha)		X		
Springtime Darner (Basiaeschna janata)		X		X
Lancet Clubtail (Phanogomphus exilis)		X		X
Ashy Clubtail (Phanogomphus lividus)		X		X
Arrow Clubtail (*Stylurus spiniceps*)				X
Unicorn Clubtail (Arigomphus villosipes)		X		
Common Baskettail (Epitheca cynosura)		X		
Prince Baskettail (Epitheca princeps)		X		X
Common Whitetail (Plathmis lydia)		X		X
Widow Skimmer (Libellula luctuosa)		X		X
Twelve-spotted Skimmer (Libellula pulchella)		X		
Slaty Skimmer (Libellula incesta)		X		
Autumn Meadowhawk (Sympetrum vicinum)		X		X
Eastern Amberwing (Perithemis tenera)		X		
Blue Dasher (Pachydiplax longipennis)		X		
Eastern Pondhawk (Erythemis simplicicollis)		X		
Calico Pennant (Celithemis elisa)		X		

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. Observations were made in the fall 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. Results of many of these tests are pending. DFW staff plan to present information on these lesions at the 2020 Northeast Association for Fish and Wildlife Agencies meeting that New Jersey is hosting in April. A monitoring plan to identify the distribution of afflicted turtles and potential impact on the populations will be developed ahead of turtle emergence in 2020.
- ENSP required permit holders and volunteers conducting snake research to report snakes exhibiting symptoms of snake fungal disease (SFD) to populate a database of such observations. None provided such information to the ENSP, however one group of researchers in the Pine Barrens has been working with the USGS National Wildlife Health Center on wintering snakes.

Conclusions:

- Volunteers did not observe SFD-symptomatic snakes during their surveys. It is unclear if permit holders did not observe SFD-symptomatic snakes or simply failed to report them.

Recommendations:

- ENSP will develop a red-bellied cooter monitoring plan for 2020 and solicit the assistance of volunteers and experts for field surveys.
- ENSP will continue to request and encourage permit holders and volunteers to report SFD-symptomatic snakes for future reference should New Jersey snake populations demonstrate severe declines.

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, 2019

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:

- ENSP continued to work with the NJ Division of Parks & Forestry and DFW's Bureau of Land Management to conduct rare snake-specific habitat management within State lands. This grant contributed to efforts on state parks and forest lands and ENSP personnel time, and management done by the Bureau of Land Management used non-federal funds (CBT state funds). Monitoring snake use of these areas was conducted by an experienced volunteer who confirmed continued rattlesnake use of previously managed areas for gestation and birthing, and researchers found other previously managed sites continued to be used by four rare snake species (Timber Rattlesnake, Northern Pine Snake, Corn Snake and Eastern King Snake) for basking, shedding and for one species, nesting.
- ENSP staff continued overseeing forestry activities and habitat planning on Sparta Mountain and Weldon Brook Wildlife Management Areas (WMAs) after the retirement of the NJ Division of Fish and Wildlife's (DFW) northern region habitat planner.
    - The practice plan for Year 1 forestry activities at Sparta Mountain WMA was revised in January 2019 as a compromise with groups opposed to forest management. This revised practice plan was implemented in February and March 2019, resulting in 17 acres of single tree and group selection treatment and 9.4 acres of modified seed tree treatment. The purpose of treating the 17 acres was to mimic the natural regeneration processes of an old-growth forest through a concept known as "gap-phase replacement." The purpose of treating the 9.4 acres was to create young forest habitat for golden-winged warblers and other species dependent upon young forest habitat. The forester and contractors were paid for this work in 2019 with non-federal funds.
    - Staff worked with groups opposed to forest management as well as State Forest Service to determine Year 2 forestry activities at Sparta Mountain WMA. Based on those meetings, a site was selected to conduct 10 acres of modified seed tree treatment and a forester was hired to mark the trees and create the practice plan. The purpose of treating the 10 acres is to create young forest habitat for golden-winged warblers and other species dependent upon young forest habitat. The plan is to be completed January 2020 and implementation will likely occur in February and March 2020. The forester and contractors will be paid for this work with non-federal funds.
    - Staff worked with technical stakeholders to select sites for forestry activities on Weldon Brook WMA in 2019. A forester was hired who marked the trees and created the practice plan to manage 27 acres with a modified seed tree treatment, which will likely be implemented in February and March 2020. The purpose of treating the 27 acres is to create young forest habitat for golden-winged warblers and other species dependent upon young forest habitat. The forester was paid for this work in 2019 with non-federal funds, and implementation in 2020 will be funded by non-federal funds.
- ENSP staff continued to monitor the bird response to forest management on Sparta Mountain (Figure 2A-1) and Weldon Brook WMAs.
    - Overall species richness was lower this year on all sites in Sparta Mountain and Weldon Brook WMAs. This aligns with a decrease in species richness in 87% (39/45) of other sites, both managed and unmanaged (control), surveyed in 2018**.**

- During the 2019 surveys, 43 species (17 of which are Species of Greatest Conservation Need, SGCN, per NJ's State Wildlife Action Plan) were observed in at least one of the seven managed sites on Sparta Mountain WMA. A total 14 species (8 of which are SGCN) were observed in the one managed site on Weldon Brook WMA.
- Based on observations from 2014 through 2019, 80 different bird species, 29 of which are SGCN, have been observed using managed sites on Sparta Mountain WMA.
- Although not detected during the 2019 survey, two red-shouldered hawks were observed soaring above the site that was most recently managed.

- ENSP staff attended a seminar focused on the uses of drones for conservation. Due to the noise of the motors, using drones to record bird species was deemed not feasible at this time.

Conclusions and Recommendations:

- Continue identifying, assessing, managing and monitoring habitats to benefit snake conservation within the Pinelands, Highlands and Ridge and Valley Regions. Work with other snake researchers to determine best management strategies to benefit the snakes while avoiding the creation of sinks. When possible, use alternate, non-federal funding sources to accomplish this work.
- There was a demonstrable decline in bird species richness detected on all sites surveyed, including unmanaged controls, in 2019.
- 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 State endangered red-shouldered hawk.
- 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 management on Sparta Mountain and Weldon Brook WMAs during the winter of 2019/20 as outlined in the approved forest stewardship plans.
  - Continue to meet with technical stakeholders to discuss areas to be managed in subsequent years on Sparta Mountain WMA.

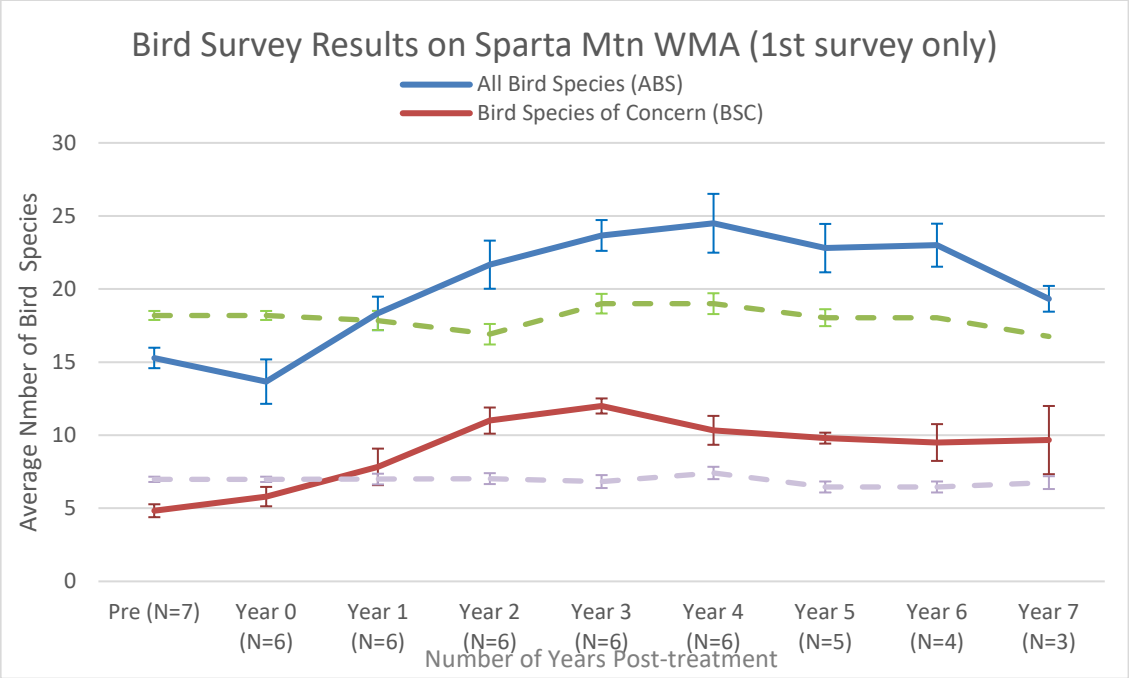

Figure 2A-1. Average (± SE) number of bird species (blue, green) and bird species of concern (red, violet) observed during breeding bird surveys on Sparta Mountain WMA. Pre-treatment surveys were conducted in 2004 and/or 2008 and selected based on proximity to treatment sites (conducted 2012-2019) within the same forest stand.

JOB B.1. Forest Habitat Management

Key Findings:

- ENSP, NRCS, Conserve Wildlife Foundation, and NJ Audubon jointly conducted one outreach seminar in March 2019 and a field tour in May 2019 for private forest landowners and consultant foresters in northern NJ to provide information about the need for forest management and available incentive programs.
- ENSP, NRCS, Conserve Wildlife Foundation, and NJ Audubon jointly conducted visits to seven private landowners interested in Working Lands for Wildlife (WLFW).
- In 2019, surveys for all bird species, including golden-winged warblers (GWWA), were conducted to evaluate the success of Working Lands for Wildlife in terms of the number of bird species and presence of *Vermivora* species.
    - A total 100 sites were surveyed for all bird species in 2019: 26 WLFW, 18 Management (MGMT), 41 Natural (NAT), and 11 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 to promote young forest habitat that were not enrolled in WLFW. WLFW sites were only considered if they were enrolled in the WLFW program.
    - From 2014 – 2019, species richness (SPP) in NAT sites had a trend of -0.06 per year while bird species of concern (BSC) had a trend of -0.04 per year. Species richness in MGMT+WLFW sites had a trend of 0.96 per year while BSC had a trend of 0.51 per year (Fig. 2B1-1).
        - Overall species richness was lower this year in 76% (19/25) of WLFW sites, 70% (9/13) of MGMT sites, and all 20 NAT sites surveyed in 2018. Five of the 10 sites that did not have a decrease in species richness were sites in Year 0 or Year 1 post-treatment, which is when the greatest increase in species richness is expected to occur in response to management.
    - A paired T-test was used to analyze differences of SPP and BSC between NAT sites and WLFW+MGMT sites from 2014 - 2019. As expected with an increasing trend, WLFW+MGMT sites had significantly greater SPP and BSC compared to the NAT sites (P=0.002; P=0.004)

- Based on a combination of years since treatment and regeneration rates, only nine WLFW sites and 12 MGMT sites surveyed in 2019 were considered suitable breeding habitat for GWWAs. GWWAs were detected on three of the 12 suitable MGMT sites but not on any of the nine suitable WLFW sites.
  - Seventeen WLFW sites and 12 MGMT sites surveyed in 2019 were considered suitable breeding habitat for Blue-winged warblers (*Vermivora cyanoptera*; BWWAs). BWWAs were detected on ten of the 12 suitable MGMT sites 12 of the 17 suitable WLFW sites.

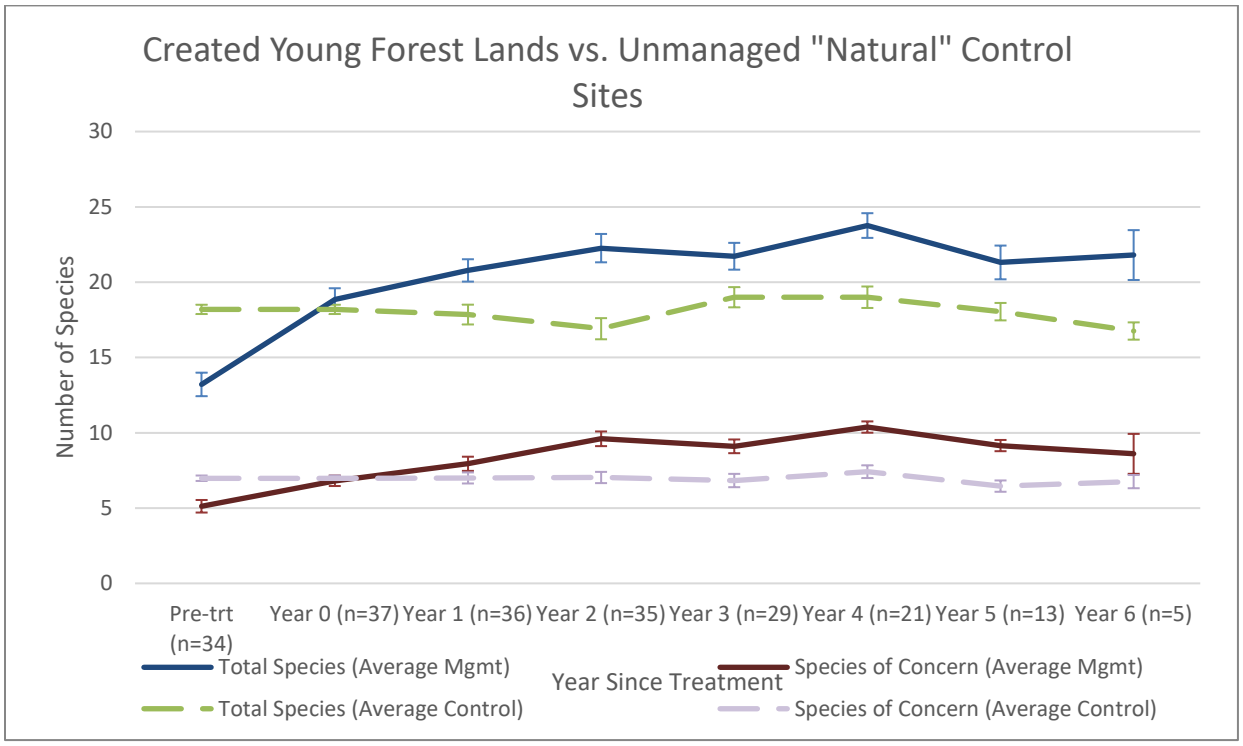

Figure 2B1-1. Average (± SE) number of bird species (blue, green) and bird species of concern (red, violet) observed during breeding bird surveys on Managed (WLFW & public lands treated to create or enhance habitat for GWWAs) and Unmanaged (Natural Control) sites.

Conclusions

- There was a demonstrable decline in bird species richness detected on all sites surveyed, including unmanaged controls, in 2019.
- 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 40% increase in the number of bird species using the site during the breeding season. However, most of the forest stands 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 provide technical assistance pertaining to forest management for golden-winged warblers and other wildlife habitat needs on private and public lands, including WLFW.

- Continue to provide technical assistance pertaining to forest management for golden-winged warblers on private and public lands, including Working Lands For Wildlife.
- Continue to work with utility companies, NJ Division of Parks and Forestry, NJ Division of Fish and Wildlife's Bureau of Land Management, Morris County Park Commission, and The Nature Conservancy-New Jersey Chapter to manage the last remaining active golden-winged warbler breeding areas.

JOB B.2. Habitat Connectivity and Management

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