Federal Aid in Wildlife Restoration

W-71-R-2

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Species of Greatest Conservation Need Mammal Research and Management

Interim Report

for

September 1, 2016–September 30, 2017

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

DEPARTMENT OF ENVIRONMENTAL PROTECTION NEW JERSEY

SPORT FISH & WILDLIFE RESTORATION

PERFORMANCE REPORT

STATE: New Jersey **PROJECT NUMBER:** W-71-R-2

PROJECT TYPE: Research and/or Management

PROJECT TITLE: SGCN Mammal Research and Management

STUDY NUMBER AND TITLE: 1. Mammals

PERIOD COVERED: September 1, 2016 to September 30, 2017

JOB NUMBER AND TITLE: 1A. Bobcat Conservation
Prepared by: Gretchen Fowles

OBJECTIVE: Determine the distribution, minimum size, population and genetic structure, and habitat needs of New Jersey's bobcat population and use the information to preserve the habitat necessary to maintain a viable population.

Key Findings:

- The statewide Connecting Habitat Across New Jersey (CHANJ) working group (NJ T-11-T-1, Job 3, Habitat Connectivity Project) is developing a mapping approach that will likely serve the needs for a landscape level bobcat habitat map and corridor model. Bobcat location data is being used to validate the CHANJ core and corridor mapping being developed statewide. Therefore, we have not yet created an updated landscape predictive habitat model for bobcat as initially proposed in this project.
- ENSP plans to conduct a GIS analysis of the bobcat collar data to date. Two scales of habitat analysis are planned.
- An analysis of habitat change over time has not been completed and is pending the predictive model development. ENSP's Habitat Change Analysis Project data for bobcat may be adequate for the purpose of quantifying habitat loss over time.
- The dog-handler team conducted bobcat scat surveys in north central New Jersey where ENSP had not received bobcat observations since the mid-1990s.
    - The dog-handler team ran 8 transects that were, 1-4km in length between January and March 2017. No bobcat scats were collected.
- A trail camera photo of a bobcat was submitted to ENSP from the public in late March in the area of the Sourlands Mountains in north central New Jersey, making it the first documented bobcat occurrence in that area for over at least 20 years.
- Thirty one tissue samples were collected from animals hit by cars (N = 14), accidentally trapped (N = 17), during the reporting period for a total of 160 tissue samples to date. All samples were submitted to the National Genomics Center for Wildlife and Fish Conservation (formerly Rocky Mountain Research Lab) for DNA analysis.
- ENSP compiled all of the scat survey data through 2016 (2004–2016) along with the tissue, and collar data through 2016 (2002–2016) and are now working with a statistician in the DEP's Division of Science, Research, and Environmental Health to conduct a spatially explicit mark-recapture analysis using all bobcat individual data (from tissues

and scats) collected to date (2002 – 2016) to estimate population size and density, as well as survival over time in northern New Jersey. Various iterations of the analyses were run using a SECR approach and then Bayesian approach, using different grid cell sizes (1 km^2, 6.25 km^2, and 25 km^2), scat only vs. scat and tissue data, to evaluate which had the best fit. The analyses are complete and the final report is being prepared for review and approval by the Division of Science, Research, and Environmental Health. For the past several years, biologists were working with a statistician from Rutgers University to conduct the analyses, but results were needed and the statistician had family issues to attend to, so the datasets were transferred to the statistician at DEP, who was recently hired.

- A pilot Bayesian analysis that was the best fit, but incorporating landscape resistance values rather than straight line distance is planned using one year's worth of data to understand how to build the models and whether it is worth using the resistance parameter going forward in the analyses for better estimates as suggested by recent studies (Royle et al. 2013).
    - As of 2016, 531 bobcat scats have been collected by the dog-handler team and have resulted in the identification of 174 unique individuals (90 females, 84 males).
    - The compiled bobcat dataset, representing both scat and tissue samples collected 2002-2016, includes 292 unique individuals (147 females, 145 males).
    - The dataset includes close to 60 individuals with recaptures over time, including spanning across multiple years. Analyses are planned to evaluate age, site fidelity, movement distances and patterns.
    - All locations and associated data have been compiled and entered into the Biotics database.
- ENSP is working with the National Genomics Center for Wildlife and Fish Conservation to evaluate the substructure and gene flow of the NJ bobcat population to determine if there are impediments to movement that are resulting in genetic substructuring.
    - The lab plotted principal coordinates and evaluated F_{ST} values (a common measure of gene flow) between different pairwise groupings of genetic samples provided by ENSP that were based on various combinations of different ecoregions and ecological subsections as well as high volume roadways. The lab is currently calculating the significance values of the F_{ST} values.
    - The lab ran a mantel test for isolation by distance, which compares genetic and geographic distance and it showed little relationship between the two indicating that the structure of the data is not explained by geographic distance alone, but there are possibly features in the landscape that are causing genetic differences in the population.
    - The lab is currently working on a Geneland analysis that evaluates the genetic structure of a population by taking into account both genotypes and location information.
- Six reproductive tracts (for a total of 10 to date that were evaluated fresh) and teeth from 20 animals (for a total of 86), were collected opportunistically from bobcat carcasses during the sampling period. The reproductive tracts was analyzed by a veterinarian and only one was found to have placental scars indicating that the female had successfully bred within the last year. The teeth samples have been prepared for submittal for the

laboratory to estimate age of each animal from which teeth were extracted, but are waiting for a couple of more samples to have enough for a reduced cost.

- Opportunistically collected bobcat carcasses were also tested for rodenticide exposure (Fish and Wildlife Health Project, FW69-R-19). Sixteen carcasses collected between 8/17/16 and 2/23/2017 were been tested and 5 (31%) were found to have exposure to rodenticides. To date, 12/37 (32.4%) bobcat carcasses tested have been found to have exposure to rodenticides.
- An ad was again published in the Division of Fish and Wildlife's Hunting Digest that requested information on bobcat sightings, vehicle mortality and accidental trapping and described the reporting mechanisms.
- The bobcat biologist within the Endangered & Nongame Species Program (ENSP) again collaborated with Bureau of Wildlife Management (BWM) biologists to respond to bobcats accidentally captured in cable restraints. ENSP continues to work on developing mechanisms to better understand and minimize injury and mortality resulting from accidental capture.
    - A similar protocol was followed by the ENSP and BWM biologists responding to bobcat calls as last trapping season. The protocol follows the latest recommendations from Safe-Capture International, Inc. training, and helps insure that standardized data are collected and samples and recorded information get to the appropriate ENSP biologist.
    - A total of 19 trapped bobcats (Fig. 1) were reported by trappers during the reporting period; 1 in a cage trap, 18 in cable restraints. The bobcat in the cage trap was released without immobilization and a scat was collected for DNA analysis. Of the 18 bobcats in cable restraints, 8 (44%) died and 10 (56%) were successfully released. One of the 19 was released by trapper before calling DFW. Ear tags were put in all of the bobcats handled and released successfully by ENSP/BWM and DNA samples were taken from all bobcats and carcasses handled by ENSP/BWM. 14/19 (74%) of the bobcats reported trapped were in Warren County. That follows a trend of a disproportionate number of trapped bobcats being reported in that one county over the past several years.
- There were 12 road-killed bobcat carcasses recovered by ENSP during the reporting period (Fig. 2), from which tissue samples, teeth, reproductive tracts (females) were taken and rodenticide testing was performed. Another bobcat was found hit by a car, its leg was surgically repaired, and was eventually released approximately 4 months later. Four other road-killed bobcats were reported to ENSP from credible sources, but were unable to be located. ENSP has spoken with supervisors at the DOT maintenance yards along the western half of Rte. 80 to try to get help of the DOT maintenance crews in alerting DFW when they observe a road-killed bobcat during the course of their work.
- A bobcat tested positive for rabies during the reporting period for the first time since at least 1932 when rabies documentation began.
- During this reporting period, a bobcat that was originally tagged by the Division in 2014 as a juvenile, was legally harvested near Harrisburg Pennsylvania, a linear distance of 108 miles. What makes the finding even more interesting is that the individual was a female. Juvenile males generally disperse farther than females and 108 miles is an extremely long distance even for a male. ENSP collaborated with biologists from the PA

Game Commission to write and submit a Note about the finding to the Northeastern Naturalist publication.

- ENSP was invited to record a DEP Podcast about bobcats in New Jersey, which was recorded in March 2017 (http://www.nj.gov/dep/podcast/).
- ENSP is filming an episode of the Creature Show about bobcats in New Jersey, particularly the use of a detection dog to better understand the status of the population. The episode is due to be released in early 2018.
- No bobcats were collared during the reporting period.
- The University of Delaware has reached out to ENSP about and is interested in assisting with bobcat research in New Jersey and is willing to provide student volunteers, support a master's degree student, and contribute equipment and other resources.
- Several ENSP biologists have begun recovery planning for a select set of species, including bobcats, using the new framework that the USFWS is using. The ENSP bobcat biologist has begun outlining information to inform the plan for bobcats, has met with a statistician from the DEP's Division of Science, Research, and Environmental Health and biologist from Bureau of Wildlife Management for input, and started investigating population viability analysis software.

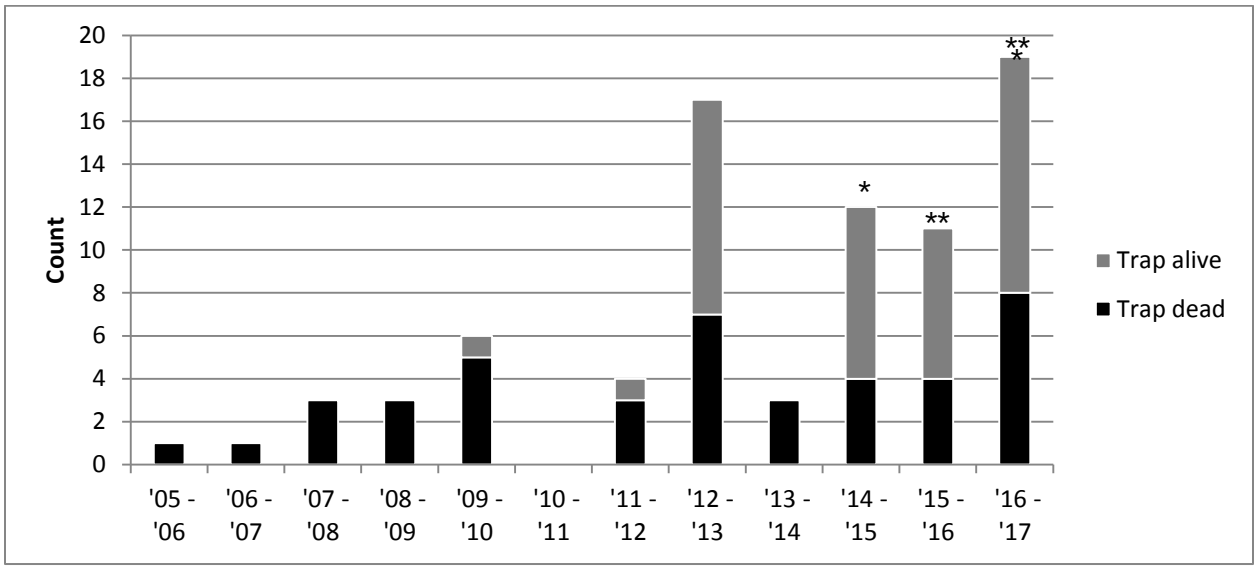

Figure 1. Number of bobcats trapped accidentally in New Jersey over the past 12 reporting periods from September 1 to August 31 each year. The '09 – '10 year was the first year of a trapper response team available to help release bobcats. The '15 – 16 year was the first year of mandatory reporting of bobcats.

* - 1 alive released by trapper, not sure of condition
** - 1 alive caught in cage trap

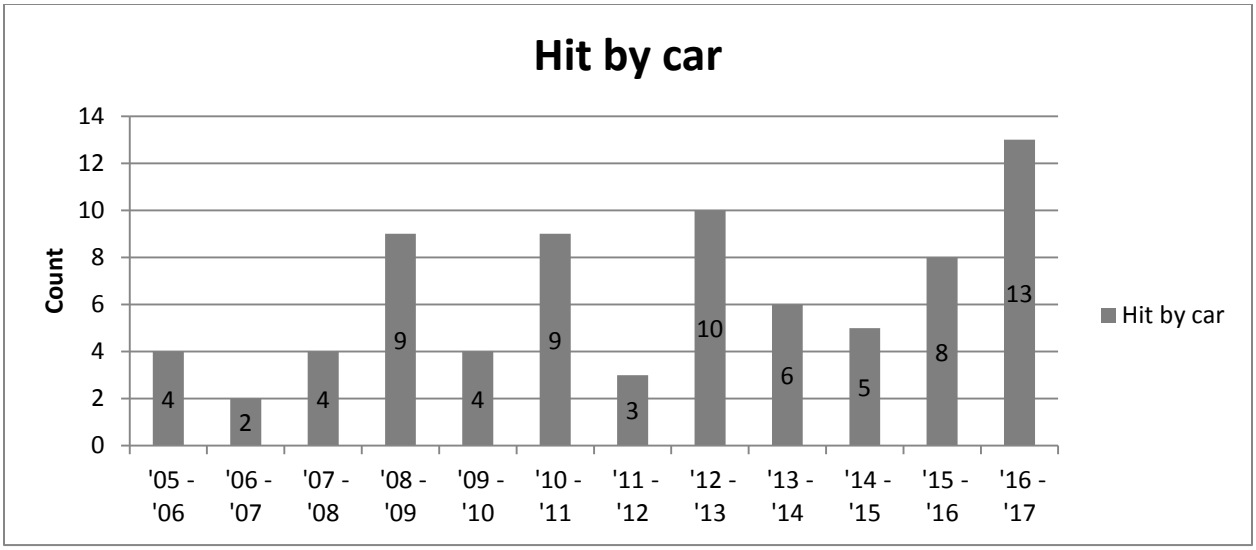

Figure 2. Number of confirmed bobcats struck by vehicles in NJ over the past 12 years, through 8/31/17.

Conclusions:

- The survey effort in 2017 by the dog-handler team was conducted in north central New Jersey for the first time, in an area where there had not been a confirmed bobcat sighting in over 20 years. No bobcat scats were found. It is likely that this was the last survey effort that the working dog will be able to do due to the arthritis in his hind legs and general aging. He is 14-15 years old. His desire for the work has not waned!
- A trail camera photo was submitted to ENSP from the area of north central New Jersey at the end of March, which is the first confirmed bobcat observation in the area south of Rte. 78 in many years. The reporter spent several months attempting to get the photos so between that effort and the lack of bobcat scats picked up by the dog-handler team, the density of bobcats in the area is likely quite low.
- The opportunistic collection of DNA samples from live bobcats as well as teeth, reproductive tracts, DNA samples, and rodenticide testing, including the spatial locations of those samples, are all contributing valuable information to increase our understanding of the status and health of the state's bobcat population, as well as level of various threats.
- An extensive compiled dataset of individual IDs, sex, and spatial locations of bobcats collected between 2002 and 2016 now exists and was analyzed by a statistician at DEP's Division of Science, Research, and Environmental Health to evaluate population size, density, and survival rate of the bobcat population in Northern New Jersey over time. A final report is being prepared detailing the analyses and results. A pilot project of future analyses incorporating landscape resistance in the spatially explicit capture-recapture models to estimate population size and density is being planned. Additional analyses using the recapture data over time are being planned as well.
- Several analyses are being run in collaboration with the National Genomics Center for Wildlife and Fish Conservation to evaluate the substructure and gene flow of the NJ bobcat population to determine if there are impediments to movement that are resulting in genetic substructuring.

- It is concerning that about 1/3 of the bobcat carcasses tested (12/37) show rodenticide exposure.
- The number of bobcats struck by vehicles increased slightly during this reporting period from previous years.
- The number of non-target bobcats reported in traps has fluctuated over time, though the number reported during this reporting period was the most on record. It is unclear if the disproportionate number of bobcats reported in traps in Warren County is due to differing trap effort in that county or some other explanation such as non-reporting.
- The rate of successfully releasing bobcats caught in cable restraint traps was 56% (10/18) which was lower than the past two years (67% and 60%, respectively). Over the past 6 years, the rate of successful release has consistently fallen below 70% (25%, 0%, 59%, 67%, 60%, and 56%).
- There is an interest in nearby academic institutions to participate in bobcat research, which ENSP is exploring.
- Work on outlining a recovery plan for bobcats has begun.

Recommendations:

- Determine whether the mapping approach chosen by the statewide connectivity map working group will serve the needs for a landscape level bobcat habitat map and corridor model. If not, develop an updated landscape level habitat predictive map to feed into bobcat specific corridor modeling effort. Develop a within home range predictive model now that all of the collar data is available. Identify and prioritize movement corridors among core bobcat habitat areas to focus on for working to protect land and increase safe passageways through roadways in those areas.
- Continue to collaborate with the National Genomics Center for Wildlife and Fish Conservation to evaluate the substructure and gene flow of the NJ bobcat population to determine if there are impediments to movement that are resulting in genetic substructuring. The results should help prioritize movement corridors to focus on for evaluating safe passageway options for bobcats.
- Continue to use scat, tissue, remotely triggered camera, and GPS collar data to help validate CHANJ core and corridor modeling and to inform guidance on increasing the permeability of the landscape for bobcats.
- Evaluate the ENSP's Habitat Change Analysis Project bobcat layers to determine if the mapping will be adequate for quantifying bobcat habitat change over time.
- Explore acquiring a new wildlife detection dog now that the existing dog, originally acquired in 2005 at age 2½ to 3, is reaching the end of his ability to do the work due to his age. The effectiveness of using a dog for the work of detecting bobcat scat from which good quality DNA can be extracted has been proven over the past 12 years. An extensive database of over 530 bobcat scats was built using the current detection dog, and is being used to evaluate population size and density over time, sex ratio, movement patterns and age based on recapture data, to evaluate the genetic health of the population and evaluate gene flow, etc. all for the first time. The benefits of a dog as a sampling tool, particularly for a wide-ranging elusive species like the bobcat are many, including the amount of ground that they can cover, and it is a noninvasive approach that does not require baiting, which can bias sampling effort. In addition, just one visit to a location is required rather than repeated visits. The use of a detection dog is particularly useful in

areas where a species occurs at low densities, such as central and southern NJ, where we have done limited surveys. A dog can also be very useful in finding scats along possible movement corridors to evaluate functional connectivity, which is extremely beneficial for validating and prioritizing the CHANJ modeling, and informing the accompanying guidance.

- Continue to opportunistically collect tissue samples from live and dead bobcats to add to the capture-recapture database.
- Continue to work with the statistician at DEP's Division of Science, Research, and Environmental Health to finalize the report detailing the results from the spatially explicit capture-recapture model using the compiled bobcat dataset (2002-2016), that estimates sex ratio, population size, density, and survival rate of the bobcat population in northern New Jersey over time. Use the resultant analyses to inform the recovery plan. Continue to work with the statistician to refine the estimates by incorporating landscape resistance into the models, and use newly acquired data to add updated yearly estimates to continue the trend data.
- Continue to collaborate with the Bureau of Wildlife Management to respond to bobcats accidentally captured in traps and work to collect data, tag, and safely release the animals.
- Continue to try to work with the Bureau of Wildlife Management and trappers, ideally in collaboration with the authors of AFWA's Best Management Practices for Trapping in the United States (http://jjcdev.com/~fishwild/?section=best_management_practices) to figure out ways to decrease the rate of injury and mortality to bobcats accidentally trapped in New Jersey.
- Continue collecting and analyzing reproductive tracts and teeth to gain a better understanding of the age structure, fecundity, and pregnancy rates of the population, and continue to test bobcat carcasses for rodenticide exposure to assess the extent of the risk factor.
- Continue to collect bobcat roadkill data to assess the extent of the risk factor, to validate the CHANJ core and core modeling, and to help prioritize mortality hot spot areas to focus road mitigation efforts for bobcats to help increase the permeability of the landscape. Continue to each out to agencies and the public who may not be aware that we are interested in the collection of the data and carcasses to increase the recovery rate of bobcat roadkill data and carcasses.
- Pursue a collaboration with the University of Delaware on bobcat research that will inform a recovery plan.
- Continue to compile the results of the varied analyses in a bobcat status assessment/recovery plan and develop outreach information based on the analyses and assessment to distribute to trappers, state and municipal police, and animal control officers to inform them about the health and status of the New Jersey bobcat population and the important contribution samples from both road-killed and trapped bobcats have been making to our understanding of the population to encourage increased reporting.

Literature Cited:

Royle, J.A., R.B. Chandler, K.D. Gazenski, and T.A. Graves. 2013. Spatial capture-recapture models for jointly estimating population density and landscape connectivity. Ecology 94: 287-294.

STATE: New Jersey **PROJECT NUMBER:** W-71-R-2

PROJECT TYPE: Research and/or Management

PROJECT TITLE: SGCN Mammal Research and Management

STUDY NUMBER AND TITLE: 1. Mammals

PERIOD COVERED: September 1, 2016 to September 30, 2017

JOB NUMBER AND TITLE: 1B. Allegheny Woodrat Conservation
Prepared by: Gretchen Fowles

OBJECTIVE: Annually monitor NJ's Allegheny woodrat (*Neotoma magister*) population and assess the potential exposure risk to raccoon roundworm (*Baylisascaris procyonis*). Actively manage raccoon roundworm levels in the raccoon population at New Jersey's last remaining Allegheny woodrat population through the use of medicated raccoon baits.

Key Findings:

- ENSP continued to partner with a Montclair State University (MSU) professor and AmeriCorps members working with that same professor to conduct research on woodrats in New Jersey. MSU funded two graduate students who are working on Allegheny woodrat projects as the focus of their thesis research. The students and AmeriCorps members have also helped with several other aspects of the woodrat project.
- ENSP has continued to implement a year-round roundworm mitigation plan at the Palisades habitat in collaboration with a researcher now at the National Wildlife Research Center. Thirteen dispensers, spaced approximately 1km apart above and below the Palisades cliffs along the length of the Palisades habitat area (Fig. 1), continue to be deployed for delivery of pyrantel pamoate-treated fishmeal/polymer baits to free-ranging raccoons. We also deployed an additional 3 dispensers along the NY/NJ border during the reporting period for more thorough coverage. All of the dispensers are re-loaded on a 6-8 week schedule with approximately 50 baits each, year-round. The baits each have approximately 150mg of pyrantel pamoate. In addition, ENSP, Montclair State University, AmeriCorps members, and volunteers collected and GPSed 98 raccoon scats at the Palisades between September 1 and 30, 2016, to evaluate the prevalence of *B. procyonis* egg loads in the scat. The scats were sent to Wheaton College for analysis. Just those collected in 2016 have been analyzed by the reporting date (N = 34) and 1/34 came back positive. Last year, 2/25 raccoon scat samples submitted came back positive.
- Standard trapping protocol was conducted at six separate talus slope sites at the base of the Palisades Interstate Park during October 3–5, 2016. Tomahawk TM Model 201 (5"x5"x16") Collapsible and Standard Single-door Live Traps were used for sampling. The traps were baited with apple slices and peanut butter.
    - Forty two traps were set for two consecutive days (10/3 and 10/4) for a total of 84 trap-nights of sampling effort.
    - Trapping success in 2016 was the highest it has been since 2006 with the capture of 27 unique individuals compared to just 10 last year. The capture index (# of

individuals captured/10 trap nights) was 3.21 in 2016 whereas it had been a maximum of 2.00 since 2006 (Fig. 2).

- Captured animals consisted of 12 adult males, 13 adult females and two sub-adult females.
- Two animals (females) were recaptures from 2013, two were recaptures from 2014 (1 male and 1 female), five animals were recaptures (4 males and 1 female) from 2015, and 18 animals were first time captures (6 males and 12 females). One of the individuals captured was the male translocated from Pennsylvania in July 2015.
- All captured animals were held for several minutes prior to their release to determine if they exhibited any symptoms of infection by *B. procyonis*. No animals displayed any symptoms. All animals were sexed, weighed and ear-tagged at the point of capture. An ear punch from each ear was taken from each newly captured individual.

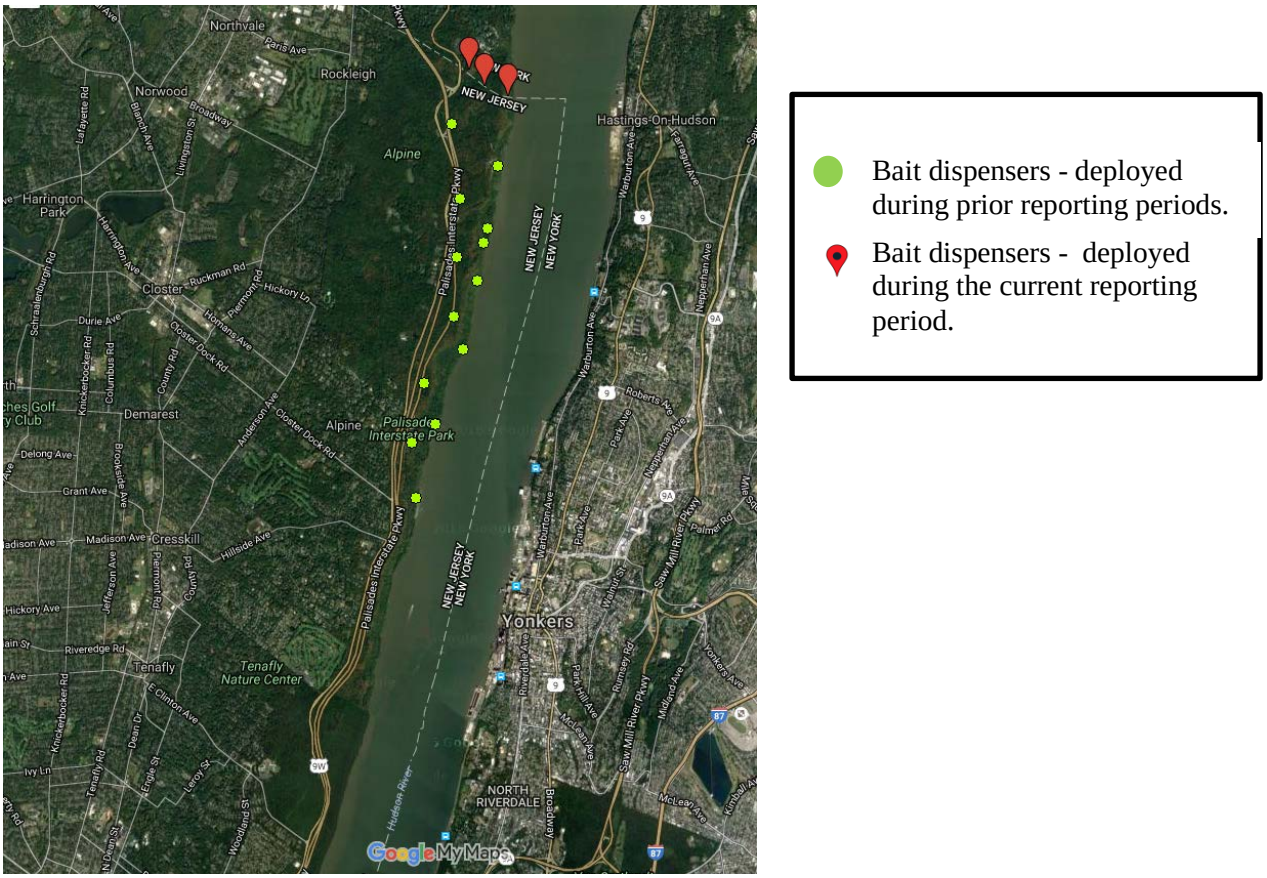

Figure 1. The distribution of the anthelmintic bait dispensers deployed for delivery of pyrantel pamoate-treated fishmeal/polymer baits to free-ranging raccoons in the Palisades Interstate Park.

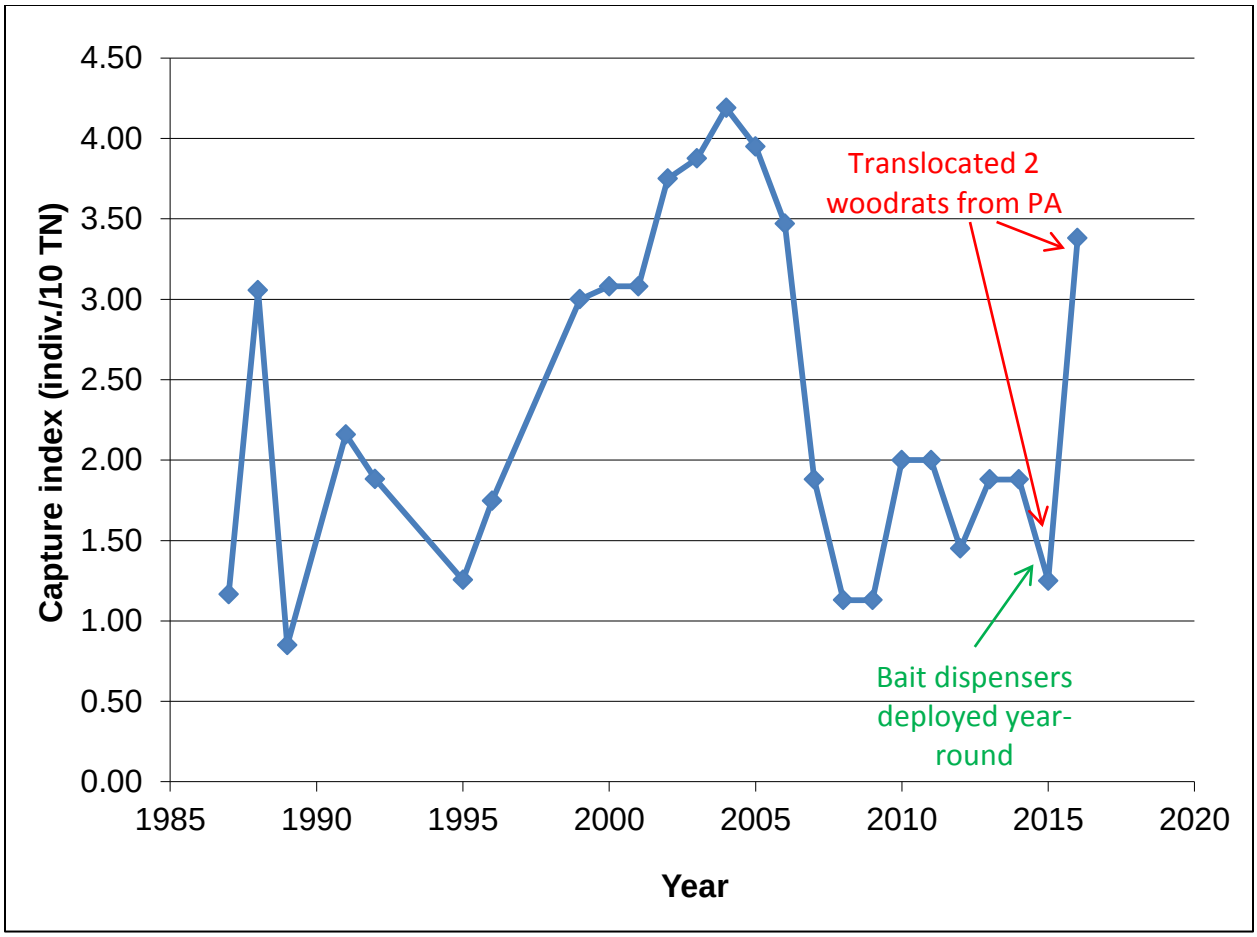

Figure 2. The results of ENSP's trapping effort in the Palisades over the last several years, setting 42 traps for two consecutive days in six trap areas in the fall, for a total of 84 trap-nights of sampling effort.

- Monitoring of the translocated male from 2015 and female from 2016 has continued throughout the year with two motion-triggered cameras positioned where the animals were last located with telemetry before we removed their collars. We believe the male from 2016 either died or dropped his collar in the fall 2016 because the signal did not move for several days and we were not able to pick him up on camera. We removed the cameras from the female translocated in 2015 because we had not picked her up on the cameras for a few months at that location. As mentioned, we captured the male from 2015 during the annual trapping effort and he appeared healthy and continued to pick him up on camera. The female from 2016 was visible on camera throughout the year and had two young woodrats with her in the spring of 2017 indicating successful breeding.
- A third translocation effort was conducted in early August.
    - ENSP, in collaboration with Montclair State University, AmeriCorps, and biologists from the Pennsylvania Game Commission trapped two sub-adult Allegheny woodrats (a male and a female) over one trap night at two active woodrat sites in Huntingdon County, Pennsylvania, on August 9 and 10, 2017. The Allegheny woodrats inhabiting the two sites were previously determined to be the best option, genetically, for the translocation by researchers at Purdue and

Indiana University of Pennsylvania, and also would be able to sustain the loss of two sub-adults.
    - The two sub-adults were transported to New Jersey on August 10 and received a health assessment by a wildlife veterinarian, ear tags were put in, ears were unique notched for easier identification on camera, they were fitted with ATS telemetry collars, and genetic samples were obtained from each.
    - The two individuals were released in the Palisades on August 11, 2017 into sites with suitable habitat known to be occupied by woodrats, but with no visible active latrines and, were locations with potential unoccupied dens.
    - ENSP, in collaboration with Montclair State University and AmeriCorps members closely monitored the two individuals the same way we have done the last two years after the release with telemetry (locations were recorded) and by setting up and moving as needed, four motion-triggered cameras (two at each site where telemetry indicated the individual was located) set to capture 10 second videos when triggered. The telemetry and video review took place every day for the first week, and then every 2-3 days until the woodrats settled into an area and we were able to trap and remove collars. The two translocated woodrats were identifiable on the videos by their collars and unique ear tags and notches. Both individuals move up to areas we have not previously monitored. The male went up toward the base of the cliffs within the first two days and died within about a week of releasing him. We located his collar and fur and bones. The female took approximately three weeks to settle into an area where we consistently have located her through the end of the reporting period. We successfully trapped her in early October to remove her collar. She had gained approximately 60g in weight since release and appeared healthy.
- A student from Montclair State University, as part of her thesis research, GPSed the perimeters of and monitored 10 suitable talus slope sites within the Palisades range, but outside of the six sites ENSP has trapped annually, for woodrat presence. She set up 4-5 motion-triggered cameras at each site and baited the rock in front of the cameras with peanut butter suet. The cameras were deployed for two weeks, and batteries, memory cards, and bait were refreshed after 1 week. She is still analyzing the results, but at least one camera at 6 out of 10 of the sites, had a video of a woodrat. She is documenting all species observed on camera. She also collected any fresh woodrat scat she found at each of the sites for genetic analyses. The student expects to defend her thesis at the end of the spring 2018 semester.
- A second student from Montclair State University, also as part of her thesis research, is evaluating the food availability, prevalence of *B. procyonis* egg loads in raccoon scat, and presence of terrestrial wildlife species using baited motion-triggered cameras at 4 historic woodrat sites. The 4 sites are located along the same ridge system in northern New Jersey and were known historic sites with evidence of woodrats until about the mid-1980s. She is still analyzing her results, but she unfortunately did not pick up any woodrats on camera. The student expects to defend her thesis at the end of the spring 2018 semester.
- A new collaboration began between ENSP and a geneticist at Towson University who worked with the geneticist we had been working with at Purdue University, but who has taken another position elsewhere that won't allow him to pursue woodrat genetic work.

The Allegheny woodrat genetic library, including all NJ Palisades samples taken in the past, was transferred to the geneticist at Towson University.

- The geneticist has sequenced and annotated the Allegheny woodrat genome and used the analyses to design a SNP panel incorporating hundreds of gene-associated and neutral markers. The tool promises to alleviate the issue of not being able to reliably distinguish between individuals due to the inbred nature of woodrat populations and the reliance on small panels of microsatellite markers (Castleberry et al. 2002; Smyser et al. 2013) that has previously plagued studies of Allegheny woodrat genetics.
- She successfully genotyped 29 woodrat tissue samples collected during the 2015 and 2015 annual trapping effort in the Palisades were successfully genotyped, as well as tissue samples from the 4 woodrats translocated from PA in 2015 and 2016. Two of the 15 scat samples with the highest quality DNA were also successfully genotyped. The genotypes from the samples were high quality with an infinitesimally small likelihood of mistaking two different individuals for the same individual (P_{ID} of 1.4×10^{-30}), meaning that SNP genotyping can be used to genetically "fingerprint" individuals and also indicating that it is appropriate for assigning offspring to parents.
- Parentage analysis indicated that one of the subadults captured in 2016 was fathered by the male translocated from PA in 2015.
- DNA concentrations were high for the 15 scat samples analyzed, but only two produced high-quality genotypes indicated that DNA from other organisms was present, which could have potential for other analyses related to woodrat diet.

Conclusions:

- The collaborative efforts with Montclair State University and AmeriCorps have been very valuable in accomplishing a great deal of work that ENSP would not otherwise have been possible.
- The anthelmintic bait coverage now extends the length of the Palisades woodrat habitat area including the NY/NJ border and is being implemented year-round, providing a thorough temporal and spatial coverage of roundworm de-worming to keep this serious mortality factor at bay. It is also important to give the translocation/genetic rescue efforts conducted the past 3 years every chance of success. The de-worming effort has been effective as measured by relatively low prevalence of roundworm eggs in raccoon scat collected at the Palisades woodrat sites, with only one positive sample recorded this year.
- Allegheny woodrat captures were at the highest level in the past ten years, which is a good indicator that the roundworm mitigation and translocation efforts may be having a positive effect on the population.
- ENSP has coordinated for three consecutive years, with the PA Game Commission, the translocation of Allegheny woodrats from PA to the last remaining population in New Jersey. Confirmation of successful breeding by the translocated individuals included 1) The female translocated in 2016 was photographed in the spring with two young, and 2) captured subadult was genetically identified as offspring of the male translocated in 2015; such breeding should lead to an increase in the genetic diversity of this isolated population. Our use of telemetry and cameras to track movements, behaviors, and confirm survival has been effective to measure results of the translocations. Furthermore,

several of the translocated individuals settled into areas not previously monitored by ENSP, which is an added benefit of closely monitoring movements of individuals.

- The camera monitoring work of one of the MSU graduate students is helping to identify and document the distribution of woodrats in the Palisades range, and the genetic analysis of the woodrat scat she has collected at the sites, in combination with the genetic results from the trapping effort, may help us achieve a "minimum number alive" estimate for the Palisades range for the first time.
- The habitat evaluation and camera monitoring work that the other MSU graduate student is conducting on four historic sites will help confirm the suspected absence of woodrats at those sites and offer an evaluation of the suitability of the sites.
- The new collaboration with the geneticist at Towson University has been very successful in designing a SNP panel, which has proven successful at being able to reliably distinguish between woodrat individuals, and to assign offspring to parents. The successful genotyping of two woodrat scats, though a low percentage of those tried (13%) was a good first attempt at a noninvasive technique to genotype individuals in the population with improvements in mind, and also the discovery that there was DNA from other organisms present in the scat has led to ideas about further analyses that could be conducted to use scats to evaluate diet using genetic techniques.

Recommendations:

- Continue the collaborative efforts with Montclair State University, AmeriCorps, and Pennsylvania to conduct research and develop management plans for the conservation of woodrats.
- Research suggests that *B. procyonis* infection in Allegheny woodrat populations is a serious mortality factor and can result in rapid population declines for the intermediate host (LoGuidice 2000, McGowan 1993). Therefore, continue to implement the year-round raccoon roundworm mitigation effort and collect and analyze raccoon scat for *B. procyonis* egg prevalence on an annual basis at least as well as opportunistically when in the field at the Palisades to monitor the effectiveness of the strategy.
- Genetic testing has indicated that inbreeding depression is a serious threat to the population. The three translocations of subadults from nearby Allegheny woodrat populations have gone well so far. Continue to monitor and document the movement, condition of, and survival of the translocated individuals as long as possible throughout the upcoming year. Finish analyzing the genetics samples collected from the Palisades and translocated woodrats in 2017, and continue to collect genetic samples from all individuals trapped during the next annual trapping effort, and compare them to the baseline samples collected in 2015, as well as to previously collected samples of the population to evaluate the trend in genetic variability of the population and to track whether heterozygosity increases following the introduction of translocated individuals. Continue to run parentage analyses to specifically identify if translocated woodrats continue to breed. Continue to collaborate with the regional team of experts to decide on a plan forward regarding future translocation efforts.
- Continue to collect woodrat scat samples and send to be genetically analyzed so that additional laboratory procedures can be experimented with to hopefully increase the scat genotyping success rate to the point where genotyping noninvasively collected scat could be used to inform our understanding of the minimum population size in the Palisades.

Also explore techniques to evaluate non-woodrat DNA found in scats to evaluate that as a technique to identifying particular dietary items.

- Continue the assessment of historic woodrat sites using baited motion-triggered cameras.
- Continue collaborating with the Montclair State University graduate students, and use their research findings to inform our conservation and management planning. Also encourage MSU to support other graduate students focusing on woodrat research.

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JOB NUMBER AND TITLE: 1C. Small Mammal Survey

Prepared by: Gretchen Fowles

OBJECTIVE: To develop survey and habitat sampling protocols for several species of terrestrial small mammal that can be used for sampling statewide.

Key Findings:

- Due to staff limitations, ENSP biologists have not had the capacity to complete the surveys that ultimately are needed to better understand the status of many small species in the state.

STATE: New Jersey **PROJECT NUMBER:** W-71-R-2

PROJECT TYPE: Research and/or Management

PROJECT TITLE: SGCN Mammal Research and Management

STUDY NUMBER AND TITLE: 1. Mammals

PERIOD COVERED: September 1, 2016 to September 30, 2017

JOB NUMBER AND TITLE: 2A. Bat Conservation and Management
Prepared by: MacKenzie Hall

OBJECTIVE 1: To identify, characterize and monitor summer bat colonies roosting within man-made structures and to provide guidance for proper management of those sites, especially where the federal endangered Indiana bats roost or maternity colonies exist.
OBJECTIVE 2: To identify, characterize, and monitor important winter habitats of New Jersey's bat species, including the federal endangered Indiana bat; and to gather Indiana bat winter population counts to contribute to USFWS database.
OBJECTIVE 3: To identify, characterize and monitor summer roost selections and maternity colonies of White-nose Syndrome affected bat species, including the little brown bat, Indiana bat, and the newly federally listed northern long-eared bat.

Note: Most of ENSP's staff time and contracted services for bat survey efforts ended up being funded by the US Fish and Wildlife Service's White-nose Syndrome Grants to States program during the period from Sept 1, 2016 to Aug 1, 2017. However, Pittman-Robertson funding (W-71-R-2) covered all supplies and equipment needed for these projects and will be our primary funding source for dedicated staff and contractors for the remainder of the current project period (i.e., Sept 2017 through Dec 2018).

Key Findings:

- ENSP's contractor, the Conserve Wildlife Foundation of NJ, coordinated the 2017 Summer Bat Count with funding from Grants to States. Students and volunteers performed emergence counts every other week at 5 roosts of special interest, where colonies of Little Brown Bats occur in houses, bat boxes, and other structures. We are awaiting data from one site, but preliminarily, colonies of this highly impacted species have now declined by more than 90% at the monitored locations since White-nose Syndrome (WNS) arrived in New Jersey in 2009, but colonies have remained relatively stable – and some have even grown – over the past few years.
- A significant (re-)discovery was made in 2016 of a bat colony roosting in the expansion joints beneath a bridge in Passaic County, NJ (Figure 1) when our volunteers confirmed bats exiting the roost at dusk. The colony was originally documented by Dr. Lance Risley of William Paterson University, who radio-tracked a pregnant female Northern Long-eared Bat to the location in the late 1990s. That year, Dr. Risley counted "hundreds" of bats during an emergence survey (a precise number was not recorded). The site had not been revisited until 2016. A series of emergence counts with acoustic

detectors were done in June and July 2017, confirming as many as 113 bats of the *Myotis* genus still using this roost. An initial attempt to capture bats from beneath the bridge on Aug 8, 2017 proved challenging, since the underside of the bridge spans the deep, open water of Monksville Reservoir, approximately 7 feet above water level. ENSP was able to catch four of the bats with a net by kayak (two escaped before they could be handled). The two bats that we handled were Little Browns; both reproductive adult females. ENSP and Dr. Risley's team also set 3 mist nets (1 triple-high and 2 double-high) along a forested trail paralleling the reservoir just south of the bridge as a "backup" effort to catch bats exiting the bridge. Two Big Browns were captured, inspected and released, but no *Myotis* bats were caught by this method.

Figure 1. Bridge over the Monksville Reservoir, where more than 100 *Myotis* bats were found roosting in the expansion joints. Note the obvious urine marks along the most occupied joint.

- A second colony of "bridge bats" was discovered by a NJ Department of Transportation worker during an inspection of a bridge over State Route 55 in Maurice River Twp, NJ, in late Aug 2017 (prior to bridge repair work). By the time a surveyor could be deployed to investigate with a bat detector on Sept 6, nighttime temperatures were beginning to drop below 50°F, and the bats had evidently left the roost for the season.
- In addition to the Monksville Bridge colony, we conducted a maternity capture survey at one other high-yielding location in 2017 – a bat house on a Morris County Park preserve. This was our third annual survey of this colony since the bats were identified as Little Browns in 2015. We captured 15 bats, including 12 adult females, 9 (75%) of which appeared to have been nursing young. Eight (66.7%) of the adult females were recaptures from our surveys in 2015 and 2016 (2 bats have been caught all 3 years), and 3 of the 5 female pups banded in 2016 returned to raise young of their own in 2017 – an excellent return rate considering that half of the colony escaped capture in 2017. Of these 3 re-sighted bats (juveniles from 2016), just one had a slight amount of wing scarring

suggestive of WNS damage. No adult bats had a WNS Wing Index greater than 0 (minor faint scarring only).

- As a result of our summer banding efforts (and use of uniquely anodized (colored) bands), another bat from NJ was discovered hibernating out-of-state by biologists in NY. A gold-banded Little Brown Bat was photographed by NYS biologists during a winter bat survey of a mine in Rosendale, and enough of the inscription could be read to identify it as a female from a maternity colony in Milford, NJ (approx. 100 miles south of Rosendale), banded in August 2012.
- Our only known house colony of Indiana Bats in recent years has been at a residence in Chester, NJ, where as many as 36 bats have been counted exiting a rocket box bat house in the backyard of a private home since its installation in 2012. We have been monitoring the colony annually, but the owners were unreachable in 2016, and in June 2017 a new owner answered the door and, unfortunately, had no knowledge of the bat house.
- Shortly after learning about the Chester rocket box's removal, ENSP was asked by the Nature Conservancy to give a public presentation about bats at a Morris County Park property less than 2 miles from the Chester house. We offered to install a rocket box as part of the program, and the Park happily agreed. Figure 2 shows the rocket box that we installed near the edge of a large meadow, adjacent to forest land and within approx. 1,000 ft of the Lamington River.

Figure 2. Rocket box installed at Morris County Park.

- During the project period (Fall 2016), 3 additional Northern Long-eared Bats were received by the NJ Department of Health Rabies Lab from buildings (all tested negative for Rabies). These bring the total number of rare *Myotis* bats received by the Lab to 14

within a single year. The majority of these bats were Northern Long-eared Bats. Of the 4 individuals submitted during late winter (Feb-March), 2 showed signs of WNS involvement in the wings (as seen under Ultraviolet light), while the other 2 did not. All occurrences have been submitted for inclusion in ENSP's rare species tracking database, called Biotics. All specimens were also categorized by age class, sex, reproductive status, and forearm measurement, to the extent we could tell. We have begun a GIS analysis of these Rabies Lab-derived bats to characterize the habitats surrounding the buildings where they were found (including distance to tree line and percent forest cover within 2 km). By April 2017, both Rabies Lab techs had retired, leaving the NJDOH without the capacity to perform its own Rabies testing services. Temporarily, NJDOH is outsourcing these services to a lab in Pennsylvania, during which time ENSP does not have access to specimens. NJDOH is committed to continuing our data-sharing partnership once their Rabies Lab is operational again.

- ENSP has not yet accomplished our goal of performing surveys in/around the buildings where Northern Long-eared Bats and Little Brown Bats from the Rabies Lab originated. We did reach out to 5 homeowners with wintertime bat occurrences to ask if they knew of other bat incidents or colonies in the home. Only one home was known to have had a large colony in the past - prior to WNS - and welcomed us to visit. Another - an owner of a gymnasium where a Northern Long-eared Bat was found in Feb 2016 - was agreeable to a survey. One owner was unable to be reached, another declined our request to survey due to their house being up for sale, and the last owner had only just moved into their house and had no historic info about any bat colony. We intend to follow up with all homeowner contacts this winter (2017-2018) and to perform visual surveys and/or acoustic monitoring to determine if their bat encounters were isolated or connected to colonies.
- Outreach to Nuisance Wildlife Control Operators (NWCOs) and homeowners with bat issues was funded by Grants to States during this reporting period, but will be covered under W-71-R-2 for the remainder of the project period. ENSP provided direct consultation to more than 40 NWCOs and homeowners during this reporting period. We posted a new Bat Conservation webpage under the NJ Division of Fish and Wildlife, including a subpage about bats in buildings to provide guidance to NJ residents and NWCOs. Please see http://www.state.nj.us/dep/fgw/ensp/bat.htm.
- During this report period, ENSP established a statewide mobile and stationary acoustic monitoring program following the North American Bat Monitoring Program (NABat) framework. W-71-R-2 funded all equipment and supplies needed to get this program up and running, including full-spectrum bat detectors (Pettersson D500x model), internal and external long-term batteries, data cards, mounting poles and car-mount supplies, SonoBat v4.2.2 auto-classifier software, etc. The Conserve Wildlife Foundation of NJ helped establish and implement this acoustic program under contract. We adopted 12 randomly generated, suitable grid cells across NJ (Figure 3) for long-term monitoring at 2 stationary points and 1 mobile transect (25 to 48 km in length) for each grid cell.

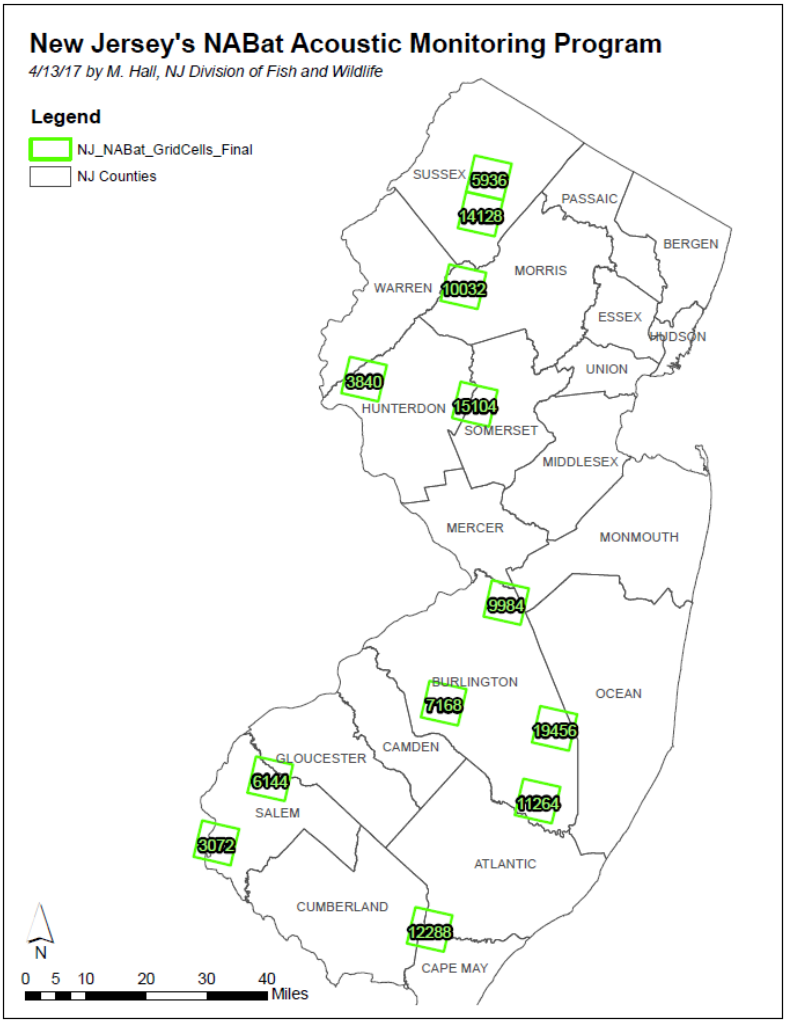

Figure 3. NJ's long-term acoustic monitoring grid cells.

Surveys of all newly established routes and points were completed for the first time during June and July 2017. Mobile routes were run twice each by staff and volunteers and generated approximately 435 total bat call files. Stationary acoustic points were passively monitored for 4 suitable weather nights each and generated approximately 11,400 bat call files in total. The overall species composition of bats recorded during the mobile surveys (Figure 4) favored Big Brown Bats (48.7% of recordings), followed by Eastern Red Bats, Silver-haired Bats, and Hoary Bats, as determined by the SonoBat auto-classifier software. As is typical with acoustic results, nearly a third of the calls were unable to be classified to species. Somewhat surprisingly, not a single *pulse* from any of the call files were from any WNS-vulnerable species (Little Brown, Northern Long-eared, Tri-colored, Indiana, or Small-footed Bats). During manual vetting, only one file was found to potentially contain high-frequency pulses characteristic of a smaller-bodied *Myotis*/*Perimyotis* bat.

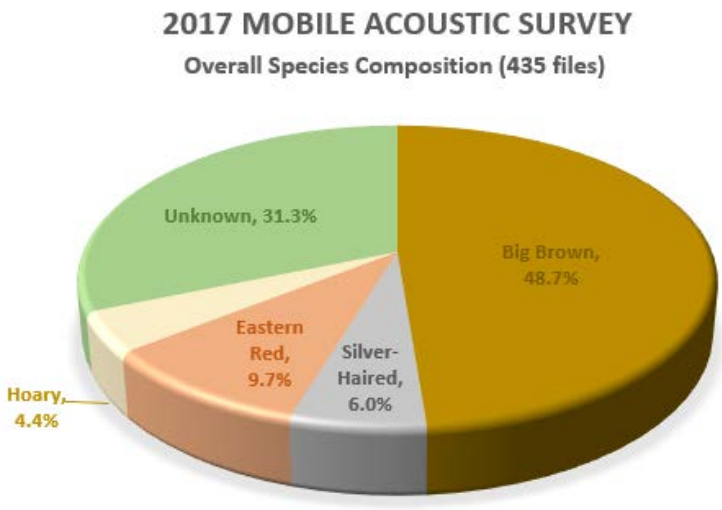

Figure 4. Overall mobile survey results (auto-classification by SonoBat).

Stationary points were chosen to represent the variety of habitat types preferred by different bat species across the landscape, such as pond edges, stream corridors, forest gaps, and meadows. And unlike with mobile monitoring, where nearly every encounter is with a unique individual bat, stationary surveys may record the same individuals over and over in popular foraging spots. The results of 4-night monitoring therefore can vary significantly from site. This survey is not meant to be a comparison of one site to another, although that type of comparison is possible; rather it is a way to track changes in bat populations at given sites over time. Figure 5 shows the SonoBat auto-classifications (also manually vetted) for 8 of the 24 survey points. Note that, due to the rarity of WNS-vulnerable bats and the special interest in tracking their populations, we created a "Hi Freq" category to capture these bats in instances where a confident species identification is not possible. Their high-frequency call patterns have so much overlap that species identification is very often impossible, especially among bats of the *Myotis* genus.

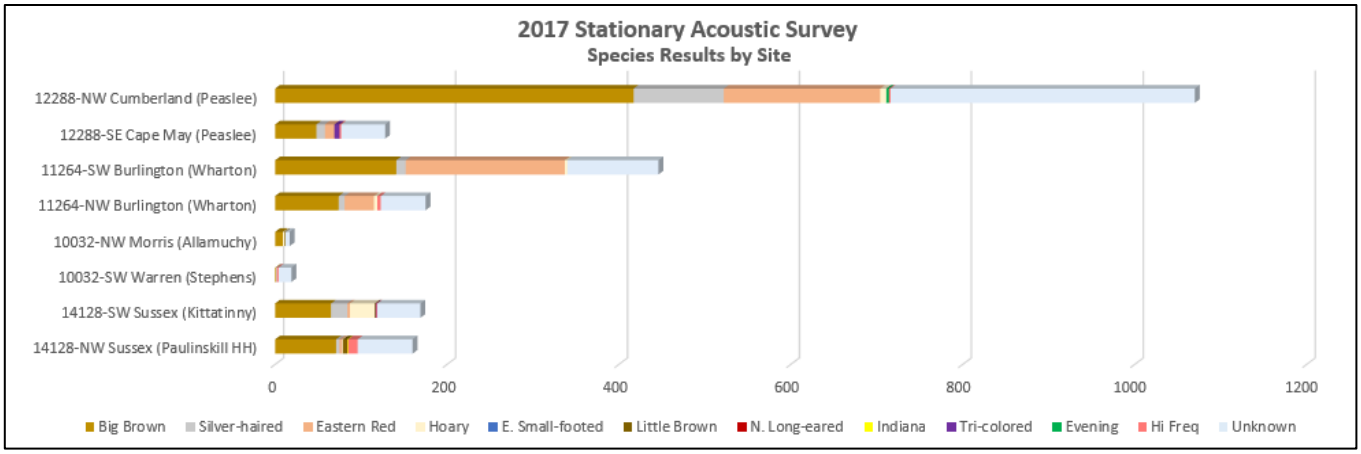

Figure 5. Stationary acoustic survey results for 8 of 24 points.

All of NJ's 9 resident bat species were detected via stationary surveillance except the Eastern Small-footed Bat, whose habitat preferences for rocky/talus slopes, cliffs and boulder fields were not directly captured by our survey point selections. Ten sites from 9 different counties returned calls from WNS-vulnerable species, although cumulatively these Myotis/*Perimyotis* bats accounted for just 1.0% of all stationary acoustic files (Figure 6). Four recordings (from 2 southern NJ points) were classified by SonoBat as Evening Bats. While one reproductive female Evening Bat has been documented in NJ (in northern NJ in 2014), this species' calls do overlap with other species, so these classifications cannot be taken as confirmation of presence.

Total # of 2017 Stationary Bat Call Files	Big Brown	Silver-haired	Eastern Red	Hoary	Small-footed	Little Brown	N. Long-eared	Indiana	Tri-colored	Evening	Unknown
11396	4384	919	1109	921	0	78	15	7	13	4	3946
% of total files	38.5%	8.1%	9.7%	8.1%	0.0%	0.7%	0.1%	0.1%	0.1%	0.0%	34.6%

Figure 6. Bat species records from the 2017 stationary acoustic surveys, based on SonoBat auto-classification.

- In July and early Aug 2017, our contractor Dr. Lance Risley (William Paterson University) and his team completed 8 nights of mist-netting on 5 different State properties, targeting Northern Long-eared Bats (at southern locations) and Indiana Bats (at northern locations). This effort was supplementary to ENSP's mist-netting efforts, which were funded by Grants to States in 2017. Dr. Risley's team was not successful in capturing any of the rare species (nor were we), but they did catch 42 bats, including:
    - 32 Big Brown Bats – of which 12 were adult females (6 were reproductive), 12 were adult males, and 8 were juveniles (5 females, 3 males)
    - 9 Eastern Red Bats – of which 1 was an adult male and 8 were juveniles (7 females, 1 male)
    - 1 Hoary Bat – a juvenile male
- One recommendation in our Final Segment Report of W-71-R-1 was to monitor prospective mist-netting locations with acoustic detectors, to "pre-screen" for presence of target species. We began implementing this strategy in 2017 by placing full-spectrum detectors out at prospective netting sites for at least one full night prior to netting; however due to procurement issues we were not able to purchase the software needed to *review* the call files until the summer netting season was over. We are now fully capable of using acoustics as a tool to pre-screen netting sites in the future.
- Monitoring of Indiana Bats and other cave-hibernating bats in and around the Mt. Hope Mine (Morris County, NJ) continued for the sixth consecutive year during the fall swarm, from late Aug to Oct 2016, with volunteer services provided by Sanders Environmental and EcolSciences, Inc. Sanders conducted 8 nights of harp-trapping and netting around the mine shaft entrance, following the same methods that they developed in 2011 for annual monitoring at the site. Their results showed a 33.9% dip in Indiana Bat numbers since 2015 (but still 15.5% more Indiana Bats than the post-WNS low point in 2014). Small-footed Bat captures were higher than the previous year and on par with 2013 and 2014 numbers. Little Brown Bat captures dropped to an all-time low of just 27 bats (27% fewer than in 2015). Northern Long-eared Bat captures (14) were the highest they've been in the post-WNS era and nearly tripled the 2015 count. A fall 2017 survey has been conducted and will be reported on in the final report for W-71-R-2.

Figure 7. A male Indiana Bat caught by Sanders Environmental during fall surveys outside the Mt. Hope Mine.

- Consultants from EcolSciences, Inc. volunteered time and equipment to do acoustic monitoring outside the Mt. Hope East shaft (which has not been surveyed in recent years and is not suitable for human entry) as well as the Elizabeth haul shaft on adjacent Township open space land (also inaccessible for internal surveys). The goal was to find out whether these shafts may be serving as hibernacula or as entryways to connected tunnels below ground. A significant number of *Myotis* bat calls (approx. 1,000 files, including more than 330 Indiana Bat calls) were recorded along a flyway adjacent to the fenced-off East shaft between Sept 22 and Oct 2, 2016. At the Elizabeth shaft, only a dozen or so Hoary Bat calls and one possible Silver-haired Bat call were recorded between Sept 28 and Oct 30, 2016. No cave-hibernating species were detected.
- Consultants from EcolSciences volunteered to do acoustic monitoring outside an abandoned railroad tunnel in Warren County, NJ, to follow up on a Sept 2015 observation by ENSP of a *Myotis* bat foraging at the tunnel entrance. Monitoring began on Sept 28, 2017 and will be reported on in the final report for W-71-R-2.
- ENSP and our contractors performed an air flow modification and re-gating at the Hibernia Mine (Morris County, NJ) in September 2017 with funds from a Regional Conservation Needs grant. Air flow into the site was improved by removing an old concrete wall from the mine entrance. Our contractor installed an air control wall with removable panels about 30 feet father inside the mine so that air flow may be managed if necessary. We re-deployed about 25 temperature & humidity loggers throughout the mine tunnel in Sept 2017 in order to detect changes in the internal climate resulting from increased cold air flow in winter. We will be monitoring the distribution of bats throughout the tunnel during the winter (2017-2018) as well, to determine whether temperature preferences appear to exist across the hibernation season.
- We continue entering bat data from consultant report into GIS shapefiles for entry into ENSP's Biotics database.
- Justifications for selection of Land Use/Land Cover types are in progress for seven bat species based on extensive literature reviews. They will be completed by the end of the

project period. These justifications will provide the framework for ENSP's Landscape Project mapping of these species.
- ENSP's attendance at the annual Northeast Bat Working Group (NEBWG) has been funded through Grants to States in recent years (including this report period). Starting in 2018 we will fund our travel to regional meetings using W-71-R-2.

Conclusions:

- Maternity colonies of WNS-affected bats seem to be stabilizing, although our sample size of known-occupied roosts is too small to determine overall trends with confidence.
- The newly (re-)discovered Monksville Reservoir bridge colony is now one of the largest known remaining colonies of Little Brown Bats (and possibly other *Myotis* bats) in New Jersey in the post-WNS era. This colony was a hopeful discovery and shows that large, healthy colonies still exist and remain to be found.
- Our only known summer colony of Indiana Bats in a man-made structure (a bat house) appears to have been lost due to a change in homeowner. A new rocket box has been installed on public land 2 miles away in hopes of providing a more stable roost for Indiana Bats.
- Bridges may be an untapped resource for our summer bat monitoring efforts, as we have not yet done a survey targeting bridges. With the recent adoption of a Range-wide Programmatic Agreement between the Federal Highways Administration and the USFWS requiring bat inspections prior to bridge repairs or modifications that may affect Indiana Bats or Northern Long-eared Bats (i.e. bridges throughout virtually all of NJ), we can expect additional reports of bats roosting in bridges.
- ENSP's data-sharing partnership with the NJDOH Rabies Lab contributed significantly to our database of statewide Northern Long-eared Bat occurrences. It also documented several wintertime occurrences of this species in buildings, which has seldom been documented and suggests that these typical cave-hibernating bats may also be utilizing man-made structures for hibernation. We will re-establish the Rabies Lab partnership when the Lab is operational again (hopefully in Spring 2018).
- Wing scarring indicative of WNS damage continues to be seen in a subset of second-year bats, but overall, scarring is less extensive and less severe compared with the earlier years of WNS exposure. This may indicate a growing resistance or resilience to the disease.
- Absence of WNS-vulnerable bats from the mobile acoustic routes, failure to catch any during our annual summer mist-netting efforts (compared to 4 Northern Long-eared Bat captures by our team in 2016 and 4 Northern Long-eared Bats and 1 Little Brown Bat captures by our team in 2015) shows, as we know, that these species are now exceedingly rare across New Jersey's landscape and may be dwindling further with each year.
- Stationary acoustic monitoring provided an abundance of bat call data across a variety of habitats throughout NJ and was successful in documenting species of interest at 10 sites, in addition to the common species that dominated both our stationary surveys and mobile transects. This first year of NABat-guided acoustic surveillance will serve as NJ's baseline for long-term monitoring.
- At the Mt. Hope Mine, this period saw the continued steady drop in Little Brown Bat captures and an increase in Northern Long-eared Bat captures. Small-footed Bats and Indiana Bats appear to be relatively stable over the past few years at this hibernaculum. Because the mine interior is no longer safe for mid-winter censusing, these fall swarm

trapping efforts are our best tool for following trends in the bat population, despite being a less precise/more variable method of counting bats.

- We now have evidence of Indiana Bats and other *Myotis* species active in the vicinity of the Mt. Hope East shaft. This confirmation is not surprising given its proximity to the known-occupied West shaft just a few hundred yards to the west, but it does serve as a starting point for investigating the importance of the East shaft.
- Acoustic surveillance at an abandoned Warren County railroad tunnel has the potential to confirm fall *Myotis* bat activity (indicative of winter hibernation) at another location.

Recommendations:

- Continue annual, biweekly summer emergence counts at Little Brown Bat colonies - and other colonies of interest - to help ascertain trends in WNS-affected bat populations.
- Continue maternity catches and banding surveys at colonies of interest – such as the Morris County Park bat house and the Monksville Reservoir bridge – to gather information on reproductive success, survivorship of individuals, and WNS condition of bats, as well as to afford us the chance to make more connections to winter hibernacula in NJ and beyond.
- Having attempted a first "catch" of the bats roosting beneath the Monksville Reservoir bridge, return for another survey in July 2018 with an improved method (i.e., by larger boat anchored in place and with two or more surveyors to flush bats from the expansion joints, capture them in nets/harp trap bags, and transfer them to holding bags for processing). With the known history of at least one Northern Long-eared Bat using this roost, we should attempt to document whether this species is still roosting among the Little Brown Bats, and whether any bats have been previously banded at a hibernaculum or other summer roost.
- Revisit the Route 55 bridge in Maurice River Twp during the 2018 maternity season to confirm the number and species of bats roosting there.
- Investigate with NJ Department of Transportation whether a database of bridges could be accessed to target bat surveys at similar structures as the two now known to house bats (i.e. those with concrete undersides and expansion joints).
- Reach back out to the new homeowners in Chester, and offer to install a new bat house for them in hopes of re-homing the now-displaced colony of Indiana Bats. This colony has been displayed before, when the former owners excluded the bats from the house eaves in 2010. The bats returned soon after our rocket box was installed in the backyard. We are disappointed that the former owners did not consult us before removing the rocket box and did not consider the possibility that the next owners might appreciate sharing their property with bats as well.
- Use results of the NABat stationary monitoring program to focus netting efforts for species of interest/concern, like the Northern Long-eared Bat, Tri-colored Bat and Indiana Bat, in order to confirm the species' presence, radio-track bats to their roosts, and locate colonies for further monitoring. For example, Point 3840-SW in Hunterdon County returned 68 of the 78 Little Brown Bat calls recorded during the 2017 stationary monitoring program, and Point 19456 in Burlington County returned 13 of the 15 Northern Long-eared Bat calls.
- Continue annual fall trapping at the Mt. Hope West shaft to track populations of Indiana Bats over time, and further investigate the possible use of the East shaft by bats via

comparative acoustic surveys and other methods yet to be considered. If the East shaft is found to harbor bats, it should be considered for stabilization and gating, similar to the approach taken at the West shaft ten years ago. The nearby Elizabeth shaft does not appear to be used as a hibernaculum currently.