Interim Report
State Wildlife Grants
T-1-6
F10AF00503

Endangered, Threatened and Rare Wildlife Conservation Projects

Progress Report for Project Year
September 1, 2012 – August 31, 2013

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

Conserve Wildlife

EXECUTIVE SUMMARY

Project: **Bird Conservation**
Federal Aid Project: T-1-6 (State Wildlife Grants)
Segment dates: September 1, 2012 to August 31, 2013

JOB 1: Federal and State Listed Bird Species

OBJECTIVE: To halt or reverse the decline of endangered and threatened species populations through a coordinated approach of population and habitat monitoring, threat assessment, habitat protection and acquisition, management, research, education and environmental review.

JOB 1A: Bald Eagle Monitoring and Management Planning

Project leader: Kathleen Clark, Supervising Zoologist

OBJECTIVE: To conserve and manage a self-sustaining bald eagle population in New Jersey; to determine the threat of environmental contaminants to survival of bald eagles along the lower Delaware River and upper Delaware Bay; and to monitor and conserve the wintering population of bald eagles in New Jersey.

Key Findings:
Population monitoring:

- ENSP biologists monitored all nesting pairs known and continued the tracking in list format. Eighty eagle project volunteers conducted most of the monitoring in the state and reported on nests on a weekly or bi-weekly basis from January through fledging in July. This is up from 78 volunteers last year.
    - In 2013, 148 eagle nests were monitored during some or all of the season, of which 119 were active (exhibiting incubation), nine were territorial (maintaining a nest area), and 20 were unknown (pair or nest could not be found, or we lacked observation effort). Fourteen pairs were new in 2013.
    - During the 2013 nesting season, 96 of the 119 known-outcome nests were successful in producing 177 young, for a productivity rate of 1.49 young per active nest. This is somewhat higher than the ten-year median in New Jersey of 1.25 young per active nest. Overall nest success rate was 81%, above the average of 75%. These results mark a continuing growing population, but is also the first year that the number of active nests remained the same at 119.
    - Fourteen new eagle nests were discovered this season, down from 2012's discovery of 27 new nests. New pairs became active across the three regions of the state: the south with 7, central with one, and north with six new pairs. Just two of the state's 21 counties do not have known nests.
    - We documented 18 (15%) nest failures. Most had unknown causes, but one nest failed after an apparent attack by a (presumed) intruding eagle resulted in two nestlings killed and a third lethally injured. ENSP discovered this about one week later, attempted to treat the surviving eaglet, then fostered a replacement eaglet into the nest, where it fledged successfully. Evidence suggested the adults remained the same individuals throughout.
- ENSP biologists visited a sample of nests to band young with federal and color leg bands and to take blood samples. In 2013 we banded 24 eaglets at 12 nests. We took blood from 21 of the banded eaglets and stored it for future analyses.
- Relationships with landowners, whether private citizens, conservation organization, or public agencies, all required attention and directed management to ensure protection from disturbance or significant habitat alterations.
    - Most nests (58%) were located on private land, with the balance on state, federal, county, municipal and conservation-organization lands.
- ENSP biologists coordinated the Midwinter Eagle Survey that took place January 12-13, 2013. A total of 297 bald eagles was counted by volunteers and staff, down slightly from the previous three years (Figure 2).

Most eagles (264) were observed in southern New Jersey, primarily in the Delaware Bay region; northern New Jersey recorded 33 bald eagles on the Delaware River and on inland reservoirs. The weather during the count was relatively clear and seasonable, which are good conditions for the volunteer effort. The effort was slightly reduced from previous years due to financial cutbacks for survey coordination. Total figures also were reported to the USDOI Bureau of Land Management's Raptor Research and Technical Assistance Center, which compiles national winter eagle counts.

- Midwinter Survey location data was used to identify important wintering habitats. Locations were incorporated into Landscape Project critical habitat mapping. After five years of collecting detailed data on winter eagle locations, ENSP will be directing future wintering survey effort to identify winter roosts and concentrations areas.

Nest site protection:

- Nest areas were posted against trespassing in all cases where the nest is highly visible and where law enforcement officers specifically recommended.
- Staff provided assistance to owners and clients of cell towers, and distributed guidelines for managers of man-made structures (especially cell and transmission towers), who must deal with osprey and eagle nests on those structures.
- Staff revised the language on the sign for posting around eagle nest areas, including adding the reference to the Bald and Golden Eagle Protection Act statute, and purchased new, plastic signs.
- We plan to revise the brochure for landowners to provide additional, NJ-specific recommendations for nest and roost area protections.
- ENSP staff worked with Bureau of Law Enforcement to address specific problems at nest sites; most problems arose from people approaching nests that are highly visible. Law Enforcement officers were included in the pre-season eagle project orientation meeting held February 9, 2013, attended by approximately 35 project volunteers.
- In a separately-funded project, we attached a GPS-GSM transmitter to one of three eaglets in the Merrill Creek Reservoir nest. The reservoir owners paid for the equipment for a third year, which has enabled us to track the movements and locations of several eagles since 2011. The transmitters have resulted in new data on post-fledging and sub-adult eagle movements within and outside of the state. All tracking data is made public via website: http://www.merrillcreek.com/eagletracking.html.

Habitat protection and planning:

- All new nests found in 2012 were GPS'd using a Trimble unit in the non-nesting season and were added to the database. Revised Landscape Project mapping that included new nests was provided to DEP offices for use in environmental review.
- Habitat types were assessed for suitability based on Level III land use-land cover types, for nesting, foraging, wintering and roosting. The new assessment was included in the creation and publication of Landscape Project mapping (version 3.1) (see NJ T-9-R-2).
- NJ State-specific eagle nest management guidelines were drafted and provided to upper management for review. Site-specific habitat management plans were provided during the NJDEP permit review process on a few sites due to pending development applications.
- The status assessment portion of the proposed Bald Eagle Recovery Plan was not conducted due time limitations.

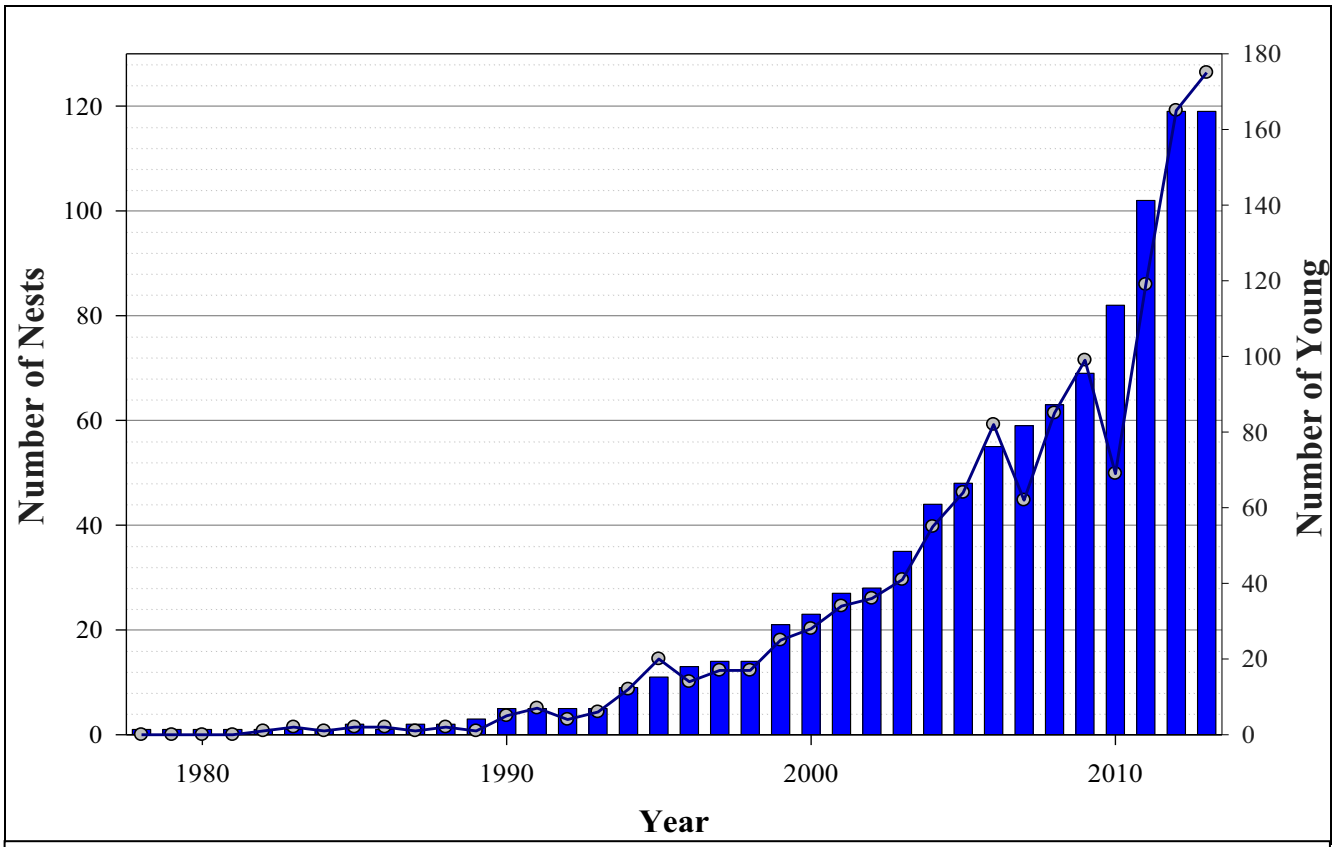


Figure 1. Number of active bald eagle nests (bars) and young produced (line) in NJ, 1978-2013. The number of active nests remained the same for the first time (at 119) but new territorial pairs were recorded in 2013.

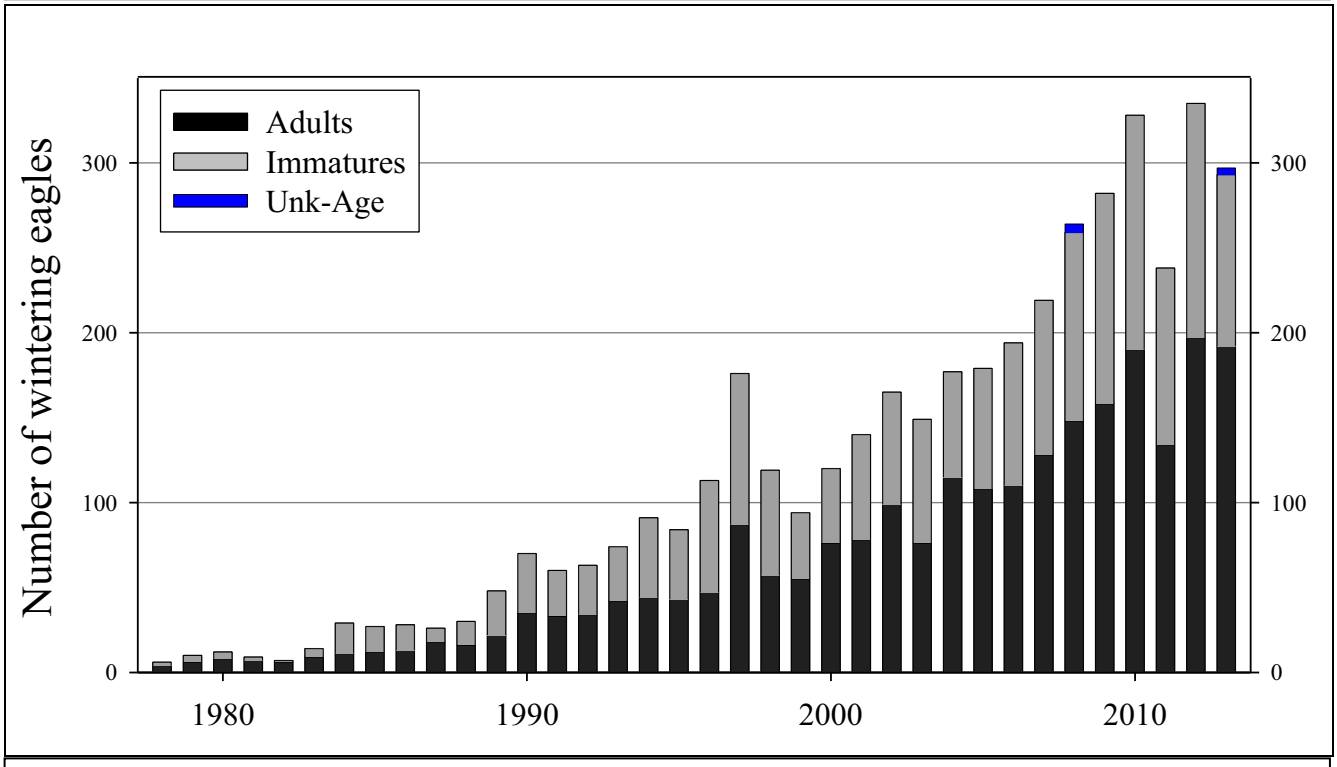


Figure 2. Number of bald eagles counted during the annual Midwinter Eagle Survey in NJ, 1978-2013. The effort was slightly reduced in 2013, and volunteers focused on the major wintering areas.

Conclusions:

- For the first time since recovery began, the number of known-active eagle nests did not increase. However, 14 new pairs were found in 2013, an increase over 10% from 2012. As the population has grown, averaging an increase of 17% per year since 2000, it has become more difficult to track all known nesting pairs to determine nest occupancy and nest success. While ENSP and partner Conserve Wildlife Foundation of NJ have been successful in determining the location and outcome of more than 80% of eagle pairs, the growing population has made it increasingly difficult to report on all nests in the list format. In 2013, about 10% of all known pairs had changed nest trees, and it is often difficult for observers to find the new nest locations. In 2013, the number of pairs with "unknown" status increased to 20, almost 14% of the total pairs and territories.
- The state's eagle population has been increasing as a result of 13 years of average productivity of 1.22 young per active nest (median=1.26 young/active nest), but population growth has been substantial only since 2002. Key to this success has been management that includes nest-site protection in cooperation with landowners. In 2013, 14 new eagle pairs were discovered, with eagles expanding into suitable but unoccupied habitat that is likely to continue for the foreseeable future.
- We documented four nests or nest trees that were destroyed as a result of Superstorm Sandy. Pairs relocated to unknown locations in two of those cases.
- Maintaining the eagle recovery depends on cooperation from private landowners, where most of the nests are located. Nest site protection has been a combination of local landowners and nest observers, Division law enforcement, and land use regulatory protection, all essential ingredients in the current recovery and necessary to sustain it. While many landowners have become staunch advocates for the eagles and work closely with the ENSP biologists, others may have other goals for their land that may threaten long-term habitat viability. With federal delisting and strengthening of the federal Bald and Golden Eagle Act, we have expanded our coordination with the USFWS in select cases to minimize disturbance and habitat loss to development and other activities.
- As the eagle population has increased, it has become more challenging to maintain the "list" of eagle nests and territories that is the basis for reporting the population to the USFWS under requirements of the post-delisting monitoring plan (USFWS 2009). With declining funding and staff time available, and an eagle population reaching recovered status, it is unlikely we will be able to continue this level of population monitoring far into the future.
- Disturbance is a major management issue at certain nests, especially those most visible. Posting and regular surveillance by staff and nest observers have been essential to ensuring or maintaining nest success.
- Remote-tracking of eagles using GPS technology has become a viable method of identifying habitats for eagles in the post-fledging, migration and wintering periods. Based on satellite data from four eagles (to date), we have identified habitats that we once thought marginally suitable, such as stream corridors that appear (on aerials) to be closed-canopy waters. This information is helping to change our habitat suitability measures that are applied in permit review and system-wide in the NJ Landscape habitat project mapping. Two eagles under study were recovered, one sick (positive for West Nile Virus) and one dead (vehicle strike); those eagles were found with the help of the transmitters, and added to our understanding of mortality threats to eagles in the region.
- Contaminants still affect nest success at several nests in the lower Delaware River region at a localized level. Regular nest failures often cause eagles to relocate to an alternate nest, making site management and habitat protection more complex, especially in the face of development pressure. Planning is necessary to manage for long term recovery as well as development needs.

Recommendations:

- Maintain efforts to monitor population size, nest activity and productivity through weekly or bi-weekly observations of nests by volunteers. Continue coordination with the U. S. Fish and Wildlife Service in accordance with the post-delisting monitoring recommendations, via conference calls and regional/subregional meetings.

- Scale-back the Mid-winter Eagle Survey effort to concentrate on identifying winter roosts and concentration areas. Identify and map those areas that may be significant to maintaining the local and regional population of bald eagles, and flag them for protection through habitat management and habitat acquisition.
- Seek partnerships to continue eagle telemetry that helps identify suitable habitats in migration and wintering areas to support long term planning for eagle population recovery.
- Continue to monitor population health indicators by visiting a representative sample of nests to band nestlings with USFWS bands and state color bands, take measurements and blood samples.
- Monitor for environmental contaminants in the population by 1) annually taking blood samples from nestlings and 2) testing eagle prey animals for contaminant exposure. Seek assistance with contaminant analysis from researchers interested in any and all aspects of contamination issues.
- Continue to work with Division of Law Enforcement, private landowners, nest observers, conservation organizations, and local governments to ensure protection of nesting and foraging sites.
- Work with the NJ Field Office of the USFWS to maintain essential nesting habitat free from disturbance, in accordance with state law and the federal Bald and Golden Eagle Act. Develop proactive planning to identify and conserve suitable bald eagle habitat in anticipation of a fully recovered eagle population.

Literature cited.

U.S. Fish and Wildlife Service. 2009. Post-delisting Monitoring Plan for the Bald Eagle (*Haliaeetus leucocephalus*) in the Contiguous 48 States. U.S. Fish and Wildlife Service, Divisions of Endangered Species and Migratory Birds and State Programs, Midwest Regional Office, Twin Cities, Minnesota. 75 pp.

Bald eagle nestling fitted with a solar satellite transmitter at Merrill Creek Reservoir, and tracked post-fledging through Sept 2013.

JOB 1B: Piping Plover Conservation – Inactive. Select tasks were added to Job 1C.

JOB 1C: Beach nesting Birds (Piping Plover, Black Skimmer and Least Tern)

Project Leader: Christina Davis, Senior Environmental Specialist

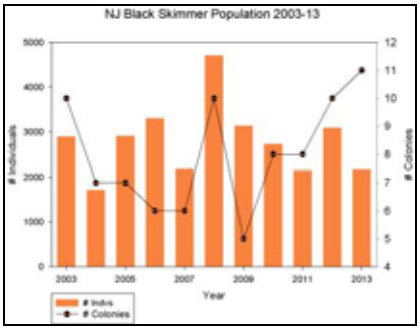
The portions of this job applying to Piping Plover are jointly supported by State Wildlife Grants and ESA Section Six funding.

OBJECTIVE 1: To determine statewide and site specific piping plover (*Charadrius melodus*), least tern (*Sternula antillarum)* and black skimmer (*Rynchops niger)* populations along the beach strand and marsh islands of the Atlantic coast. Record nesting success and productivity; and determine the nature and level of threats to populations and reproductive success. Reduce threats through implementation of various management strategies in order to advance species recovery both within the state and as part of the coordinated Atlantic coast recovery effort (where applicable).

Population and Productivity Trends

Key Findings:

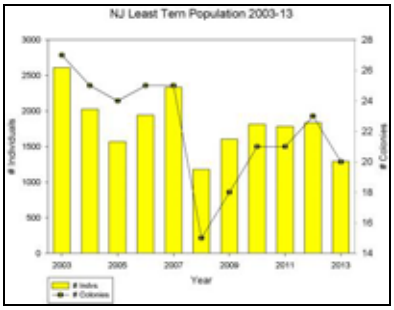
Black Skimmer



- Black skimmer breeding surveys were conducted approximately every two weeks from mid-May until the end of August/early September on barrier island beaches along the entire Atlantic coast and back bay islands in Barnegat Bay. Colonies were located at 11 nesting sites and observations were made at these locations for the duration of the nesting season. A total of 2,153 adults were present at these sites (based on a cumulative total of peak counts that occurred in the July 16-31 survey period). Once again, the majority (53%) of the known state's population was present at just one site during the peak count survey period, which was located at Seaview Harbor Marina (1,149).
- A peak count of 463 adult black skimmers was observed incubating. The incubation number was lower than might be expected given the number of adults present and was probably lower than what actually nested. There was severe predation at key sites and the renesting and relocating that took place as a result may have obfuscated biologist's ability to fully capture the number of incubating adults.
- Black skimmer productivity was very low, with just 118 fledglings produced statewide, or 0.25 chicks per pair (note: as detailed in previous bullet, the incubating number used to make this calculation was likely an underestimate which would make the productivity rate even lower than 0.25). Only three sites fledged young, with almost all the young (78%) produced at one site, Seaview Harbor Marina. Predation, tidal flooding and severe storms were responsible for poor reproductive rates at the other sites. Seaview Harbor Marina ended its moderate-high reproductive streak in 2013, succumbing to intense predation pressure. Its unique orientation still protected it from flooding events that destroyed colonies, but predators that ranged from laughing gull and peregrine falcon (both documented by photographs, clutching skimmer chicks in their bill or talons) to red fox ensured that the colony was not able to flourish as it has in recent years.
- Due to a reduction in funding, the contract for the Barnegat Bay skimmer surveys was not renewed and ENSP staff surveyed these sites as well as others in the back bay marshes throughout the state. ENSP, therefore,

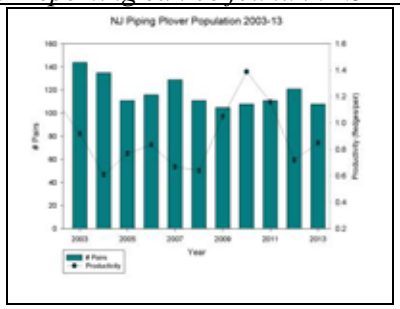
surveyed 15 additional sites in 2013 this year (not all had nesting so were not all included 11 active site figure cited), primarily by boat.

Least Tern



- Least tern breeding surveys were conducted approximately every two weeks from mid-May until the end of August at beaches along the entire Atlantic coast. Colonies were located at 25 nesting sites and observations were made at these locations for the duration of the nesting season. A total of 1,291 adults were present at these sites (based on a cumulative total of peak counts that occurred in the 16-30 June survey period). The population was distributed fairly evenly throughout the state, with nine colonies having >100 adults and three colonies >200. The largest colony was located in Strathmere, with 257 adults on its peak count followed closely behind by Sandy Hook – Critical Zone with 251 adults at its peak.
- A peak total of 654 adult least terns were observed incubating. Productivity was low for least terns with 214 fledglings produced statewide (0.33 chicks per pair, based on the peak number of incubating adults). Chick production was distributed throughout the state although no one colony did especially well. The primary limiting factors were predation and flooding, with notable predation events occurring at Strathmere (species unknown) and Cape May Meadows (fish crows).
- The least tern colony continued at Newark Airport. The biologists who manage this site took steps after the 2011 field season to reduce the attractiveness of this site to terns, since it is not a safe place for them to nest (air strikes have been known to occur and there is little/no cover for the chicks). The area is surrounded by a chain link fence that prevents human disturbance and easy access by mammalian predators, which may account for the attractiveness of this site. However, some of the terns remained undeterred and 9 nests and 3 fledges, for a reproductive rate of 0.43 fledges/pair, were tallied.

Piping Plover (*Full Piping Plover reporting can be found in NJ E-1-36*)



- One hundred eight (108) pairs of piping plovers nested in New Jersey in 2013, an 11% decrease from 2012 (121 pairs). 2012 marked an increase in pair numbers and ended the flat trend that was observed since 2008 (111, 105, 108, and 111 pairs from 2008-2011, respectively). Unfortunately, 2013 saw a return back to those lower figures. Given the lower productivity in 2012 this was not a surprise but still distressing. The 2013 population was below the average number of pairs for the years since federal listing (119 pairs) and well below the peak of 144 pairs in 2003.
- The total number of adults recorded for the entire nesting season (221) was higher than the count during the date-restricted survey conducted 1-9 June (203) and the number of pairs tallied during the entire nesting season (108) was higher than those counted during the date-restricted survey (85), which is a typical comparative survey result in New Jersey. Variations in the methodologies used by the USFWS–Edwin B.

Forsythe NWR in tabulating breeding pairs during the date-restricted survey accounted for most of the difference between the final season and the census pair counts. In addition, adults that may have recently lost nests or late nesters may have been missed on the census.

- Pairs nested at 21 sites, slightly down from 2012 (22 sites), and below the peak count of 30 sites recorded in both 2004 and 2005. ENSP monitored 12 of the active nesting sites (57% of the sites statewide), accounting for 29 nesting pairs (27% of the nesting pairs statewide). As in most years, ENSP monitored more than half of the state's *active sites* but the total number of *active pairs* monitored by ENSP remained far lower than would be suggested by the number of sites monitored. This continued downward shift in the percentage of pairs monitored is the result of multiple variables (including degraded habitat at some of the sites and the sharp jump in pairs at Sandy Hook, monitored by the National Park Service) some of which must be addressed (continued low productivity at nearly all ENSP-monitored sites).
- Statewide pair-nest success (the percentage of pairs that successfully hatch at least one nest) remained steady in 2013 compared to 2012 (67% vs. 67%, respectively), and average for the period since federal listing (66%). Looking at just ENSP-monitored sites, 2013 pair-nest success was lower than the statewide tally but fairly steady when compared to 2012 and 2011 (59% vs. 56% and 63% respectively) but was the same as for the period since federal listing (66%).
- The statewide fledging rate, which incorporates data collected by all the state cooperators was 0.85 fledges per pair, a slight increase from 2012 (0.71 fledges/pair). This is still was well below the 1.50 fledges/pair recovery goal, the 1.24 fledges/pair range-wide threshold for population maintenance established in the USFWS Recovery Plan for the Atlantic Coast population of piping plovers (USFWS, 1996) and the average for New Jersey for the period since federal listing (0.97 fledges/pair). In fact, it was only the second time it dipped below 1.00 fledges/pair since 2008 (2012 was the first). Productivity at ENSP-monitored sites (0.69 fledges/pair for 29 pairs) was poor and below the 2012 statewide average, but above the near-disastrous rate for ENSP-monitored sites in 2012 (0.44 fledges/pair).
- The final season of a two-year research project on flight behavior of breeding piping plovers (which was partially funded by ESA Section 6 monies) was completed in 2013. The results will be reported elsewhere when available in 2014 as they are not a SWG project, but of note were the 14 new piping plovers that were banded in Strathmere, Avalon and Stone Harbor Point that joined the 28 banded last year. These individuals were followed on a daily basis (as a separate initiative from the flight behavior study) to determine arrival (March-April) and departure dates (July – October) from breeding grounds. The data on this project is ongoing, but some interesting preliminary results included:
    - In 2012, some NJ breeding plovers remained in the state far longer than previously thought. Although the majority left in the anticipated months (July-August), 21% of the banded birds were still observed in September and 14% in October.
    - In 2012, one particular banded bird was last observed in October, 2012, and was resighted in March, 2013, which challenges some established notions of how long Piping Plovers are present on their breeding grounds.
    - In 2013, three of the four young that were banded in 2012 were observed on the breeding grounds (the fourth was never observed on either wintering or breeding grounds). One made a single appearance in July, apparently having not nested in the local area (but possibly elsewhere and went undetected or was doing a "practice" run up the coast), one returned to its natal site and paired with a female and engaged in "housekeeping" activities where they defended a territory and scraped, but never laid eggs so far as biologists could tell and the third successfully nested and fledged one chick at a site approximately 9 miles north of her natal site.

Conclusions:

- In 2012, the total **black skimmer** population was much higher than in previous years and in 2013 was somewhat lower. In fact, the statewide breeding population appears to have shrunk back to the lowest numbers seen since 2004. Biologists are not too alarmed, though, as site fidelity and the movements of skimmers from nesting areas year to year (particularly across among state boundaries) may play an important role in the fluctuation observed in New Jersey population trends.

- Black skimmer productivity was dismal this year (0.25 chicks per pair, which may still be an overestimate, as explained in key findings). This was due to predation pressure at the two main colonies, Seaview Harbor Marina (the recent stronghold of skimmers in the state) and Strathmere Natural Area (where a portion of the Seaview colony relocated after predator events). The predator issue must be resolved at both sites if they are to be successful in the future.
- 2013 marked a slight increase in the number of active black skimmer colonies in the state. Staff observed active nesting at 11 sites and some activity (birds present but not documented nesting – as the surveys only occur once/two week, staff may have just missed them) at 19 sites. It is not clear as to why more sites were active this year, though some of it may be related to survey effort. When staff took on the responsibility of Barnegat Bay colonies, they also expanded to survey back bay colonies in other parts of the state and this may have accounted for the increased number. Additionally, although Hurricane Sandy was destructive in many ways, it may have created additional habitat for this species.
- ENSP staff was able to absorb the additional boat surveys in 2013 with only moderate challenges. It was time consuming but since there were fewer piping plovers than years past, staff was able to adhere to a workable schedule. If the plover population increases as desired, it may be more difficult to fit in these surveys in future years.
- The statewide **least tern** breeding population was on par with, but lower than, recent years. Despite the relative stability of the statewide population, the population remains low with respect to the long-term trend. Productivity in 2013 (0.33 chicks per pair) was low and the major culprits were predation and predation. The predator issue requires more active management if positive gains are to be seen.
- The number of active least tern colonies (25) was an increase over 2012 (19). This is in line with long-term trends for least terns where over time numbers of colonies have ranged from the mid-teens to the mid-20s. As with skimmers, the increase may have something to do with improved habitat from Hurricane Sandy but this is an untested hypothesis.
- Seaview Harbor Marina's importance to all beach nesting species continued this year. In addition to housing the vast majority of the black skimmer adult and fledge numbers, it also hosted a least tern colony, a common tern colony and American oystercatcher and piping plover pairs. The overall proportion of skimmers using this site did start to shift this year, as some of the colony relocated to Strathmere Natural Area, as did the terns. This is a fairly normal pattern for skimmers in NJ and the locations of major colonies do tend to move around as conditions dictate. It is cause for some concern, however, since skimmers have historically done well at Seaview Harbor Marina and their foray to Strathmere Natural Area was rife with predation.
- After an encouraging increase in the **piping plover** population in 2012, poor productivity and other unknown factors led to a 11% decline in 2013, which placed the population more in line with the below-average trend of recent years. As is starting to become the norm, the larger federally managed sites (Sandy Hook, Holgate and Little Beach) held 72% of the state's pairs. Accordingly, all possible efforts to ensure the birds at these sites succeed should be paramount to the state's beach nesting bird program. However, increasing the number of pairs and raising the productivity level at other locations in the state will be the only way to meet regional recovery goals as the major sites reach capacity.
- The role of predation cannot be overemphasized in the low piping plover productivity of 2013. This was especially frustrating because although flooding has been a major limiting factor in recent years, this season was relatively quiet on that front. Coupled with the additional habitat created by Hurricane Sandy, biologists were optimistic for the season's potential. Over the course of the season, this sentiment evaporated as one predation event after another quickly whittled down the opportunities for a successful season. Documented predators included fish crows, laughing gulls, peregrine falcons, red fox, and cat as well as unidentified species.
- Predator exclosures have been used in the state for many years (in 2013, 59% of nesting attempts were exclosed) but recent research has shown that more judicious use may be necessary as they increase the likelihood of abandonment and adult mortality. NJ managers are now taking a close look at this issue and 2014 will likely mark a dramatic change in exclosure use. In the winter of 2013-14, regional managers will meet and work towards understanding the implications of this reduction and establish best management practices. A likely outcome of fewer exclosures is that plover nests will be more vulnerable than ever and that predator control management must be undertaken in a comprehensive, sustained effort.

- Hurricane Sandy was detrimental to many locations around the state but for beach nesting birds, the overall net impact to their habitat was positive. Cape May County saw little discernible difference in habitat, Ocean County (particularly areas of Island Beach State Park and Holgate NWR) saw gains and although Monmouth County experienced terrible erosion, the worst areas were not in active nest site locations. The new habitat, particularity at sites like Holgate, had many biologists predicting an upward tick in pairs in the state, as is often the case when novel habitat becomes available. This did not transpire, however, and left staff to surmise that there simply was not enough pairs in the system to have taken advantage of the new habitat, which was a sobering realization. Given the near-record low number of flooding events on the beach strand (but not the back bay, where flooding played a central role in colony destruction) it is also hypothesized that even in areas that visually looked the same as pre-storm conditions, sand distribution may have been such that some areas gained elevation, making them less prone to flooding.

Recommendations:

- Continue to annually monitor population and productivity at least tern and black skimmer nesting sites along the Atlantic Coast (as well as black skimmer colonies within back bays) about once every two weeks during the breeding season in order to make a statewide assessment of population trends.
- Periodically monitor (no less than once every three years) other back bay island complexes within the coastal region of the state to ensure that large numbers of skimmers are not nesting in these areas. When sites are identified through this or other means, such as the long-legged wader aerial survey, include them in the once every two weeks survey rotation.
- Investigate measures that can be taken to reverse the trend of Barnegat Bay becoming increasingly less important for nesting black skimmers.
- Continue to incorporate management strategies for piping plovers, black skimmers and least terns into comprehensive beach management plans being developed for municipalities in the coastal zone. Develop similar plans for state managed parks and natural areas.
- Create a comprehensive predator control plan to address this issue as it has become increasingly apparent that inaction on this front is going to prevent recovery of these species. It should specifically address fish crows at Cape May Meadows, red fox at North Brigantine Natural Area and make a dedicated effort to classify currently unidentified species at other key sites (such as Seaview Harbor Marina and Strathmere Natural Area). Work within and among DEP Divisions to obtain permission and create action plans for state lands, continue to encourage federal partners to do the same and work on initiatives to complete more comprehensive predator control on municipal lands.
- Continue intensive monitoring of piping plover populations and reproductive success, and continue monitoring to ascertain causes of nest failure and brood loss.
- Work with region partners, through in-person (such as the 2013 Predator Exclosure Meeting and the 2014 Atlantic Coast Piping Plover Recovery Team meeting) and conference calls to ensure that NJ is making the best decisions possible when it comes to predator exclsoures. What was once an important management tool may no longer so and NJ needs to reassess their use and determine future paths to reproductive success for piping plovers.
- Continue to raise piping plover nests in areas that are susceptible to flooding.
- Work with the NJ/NY Port Authority to continue to work towards solutions for least terns nesting at the Newark International Airport, including assessing the efficacy of past actions of and determining future deterrent options.
- Continue to follow the piping plovers that were banded in 2012-13. Monitor arrival and departure dates and local movements of all banded birds. Pursue records of observations of birds on their migratory stopover and wintering grounds through birding listservs, eBird and other online documentation tools. Enlist volunteers to help with survey efforts.
- Continue to coordinate management with municipalities, as well as county, state and federal landowners.
- Continue to incorporate breeding data into the Landscape Project and NJ DEP's Biotics database.

JOB 1D: Osprey Monitoring and Management Planning

Project leader: Kathleen Clark, Supervising Zoologist

OBJECTIVE: To conserve and manage the New Jersey osprey population at a self-sustaining level.

Key Findings:

- NJ Division of Fish and Wildlife biologists conducted the statewide census every three to four years until 2009, when the census documented 485 nesting pairs. We eliminated subsequent planned aerial surveys due to reduced funding. In 2013 we partnered with Conserve Wildlife Foundation of NJ and Center for Conservation Biology's Osprey-Watch to accomplish a census using volunteers and citizen watchers. That combined effort resulted in documenting 535 nesting pairs (Table 1).
- In 2013 approximately 75% of the population was checked by volunteers doing ground surveys, which allowed for productivity estimates for all major colonies (Table 1). The statewide estimate was 1.92 young per active nest, which is about twice the average required to maintain a stable population.
- During ground surveys, 488 nestlings were banded with USGS aluminum bands by licensed bird banders.
- Biologists and volunteers conducted ground surveys in June and July to document nest success and productivity at 401 nests (Table 1). We grouped nests by watershed or water-body areas to which they were closest. Nest success averaged 1.92 young per active nest, and was slightly higher on Delaware Bay (2.09 at 68 known-outcome nests) than in Atlantic coast colonies (1.89 at 333 known-outcome nests).
- Previous surveys have documented that most nests (approximately 80%) were along the Atlantic coast, where many new platforms have been erected over the past five years to increase nesting opportunities.
- Unhatched and inviable osprey eggs were collected during nest visits during the nestling-banding period. Eggs were collected only if they remained when nestlings were at least two weeks of age. Eggs were wrapped in aluminum foil and refrigerated, and will be opened and contents placed in chemically-clean jars and frozen. Eggshells will be rinsed and left to dry for $\geq$2 months.
- ENSP staff provided technical assistance and advice to the U.S. Coast Guard, the U.S. Army at Fort Monmouth, and many communications companies, to deal with osprey nests in hazardous or unsafe locations. We posted guidelines for managers of cell and power transmission towers on the Division website.
- All nest locations were maintained in Excel and GIS databases. Those databases were used to update the state's Biotics database, which is the basis for the Landscape Project critical habitat mapping. The Osprey-Watch portal allowed us to collect nest occupancy data from volunteers, but is not the single, streamlined data-handling system that we need to implement. Banders provide the majority of nesting results, and most of them provided their data in Excel format.
- ENSP partner, the Conserve Wildlife Foundation of NJ, built and installed 20 structures, and inspected and repaired ten structures after Superstorm Sandy and before the April nesting season.

Conclusions:

- This year's ground surveys documented the NJ population at a minimum of 535 nesting pairs, partly thanks to an outreach effort through Conserve Wildlife Foundation of NJ inviting people to submit sightings to Osprey-Watch.org. Nesting success was high at 1.92 young per active nest. Weather conditions during the nesting season were rainy but relatively mild.
- ENSP's coordination of volunteers and licensed banders has made it possible to accurately track occupied nests and nest productivity at the major colonies as a measure of population stability. One CWF-NJ biologist facilitated data collection via Osprey-Watch.org, and coordinated volunteer banders who surveyed nests, but a more streamlined electronic system would make data collection and tracking easier. Center for Conservation Biology's Osprey-Watch may be the vehicle for such a system in the future.
- ENSP's partnership with the Conserve Wildlife Foundation of NJ has improved the availability of functional nest platforms for ospreys, which directly supports the stability and growth of the osprey population in the state. The future of the osprey population is heavily dependent on the long-term maintenance of suitable nest structures, given that trees are a limited resource in the barrier island regions.

- ENSP's partnership with the Conserve Wildlife Foundation of NJ has also improved the recruitment and management of volunteers who report on nest sites, nest success, and carry out banding of young. This partnership comes at minimal cost to ENSP or the USFWS.

Recommendations:

- Maintain monitoring of the major nesting colonies to identify problems in nest occupancy and nest success. Expand the volunteer and citizen-watcher effort to track nesting statewide, using Osprey-Watch.org, as this method will eliminate the need for expensive aerial surveys.
- Maintain integrated databases on the population and nest locations on an annual basis, so they can inform habitat mapping and land-use regulations. Develop our electronic data-recording system to ease data handling.
- Continue to collect addled and unhatched eggs to archive for monitoring contaminant levels regionally and statewide. ENSP has recently partnered with Southern Illinois University for contaminant studies of raptors, and they may be the partner to analyze our archived osprey eggs.

Table 1. Osprey nesting and productivity in 2013 in all major nesting areas. Productivity was determined by ground surveys in June-July. Productivity rates in 2010-2012 provided for comparison.

						Previous Years		
Nesting Area	**# Nests**	**Known-Outcome Nests**	**# Young**	**# Banded**	**Production 2013**	**2012**	**2011**	**2010**
Delaware R. & North Jersey	2			n/a			n/a	n/a
Hackensack-Hudson Rivers	5	4	6	n/a	1.50	2.67	2.67	n/a
Raritan Bay area	39	24	43	6	1.79	2.00	1.54	1.64
Monmouth County	27	15	30	18	2.00	2.20	2.00	1.86
Barnegat Bay	76	50	94	60	1.88	1.94	1.88	1.91
Sedge Islands WMA	25	15	30	27	2.00	2.10	2.38	1.29
Great Bay to Atlantic City	72	53	95	33	1.79	1.68	2.12	2.05
Great Egg Harbor/Ocean City	62	54	113	96	2.09	1.32	2.43	2.38
Sea Isle City	23	19	32	14	1.68	1.78	1.91	2.07
Avalon/Stone Harbor Bays	62	56	100	73	1.79	1.75	2.02	1.88
Wildwood--Cape May	54	43	86	37	2.00	2.13	1.50	1.50
Maurice R. & Est. marshes	63	58	123	120	2.12	2.09	2.06	2.10
Salem Co./ Art. Island /DB	25	10	19	4	1.90	1.62	2.38	2.50
TOTAL of Study Areas	**535**	**401**	**771**	**488**	**1.92**		**2.07**	1.97
Atlantic Coast only	447	333	629	364	1.89		2.07	1.92
Delaware Bay only	88	68	124	124	2.09		2.10	2.18
Nests Checked Statewide	**535**	**401**	**771**	**488**	1.92	--		486

JOB 1E: Colonial Waterbirds (Inactive)

Project Co-leaders: Christina Davis, Senior Environmental Specialist, and Dave Jenkins, Chief

Inactive in T-1-6. This is active in PR grant, NJ W-70-R-1

JOB 1F: Shorebirds - Conservation of Red Knot, Delaware Bay, New Jersey, USA

Project Leader: Amanda Dey, Principal Zoologist

OBJECTIVE 1: Protect critical habitats and resources on the Delaware Bay stopover for migratory shorebirds: continue regional collaboration with state and federal agencies to recover horseshoe crab and shorebird populations, reduce anthropogenic disturbance to shorebirds, enhance/create coastal habitat and impoundments for crab spawning/shorebird foraging and roosting.

OBJECTIVE 2: Assess recovery of red knot and other shorebird species: monitor mass gain and adult survival through resightings of marked individuals; monitor stopover population size through baywide aerial survey and mark-and-resighting methods.

OBJECTIVE 3: Assess recovery of the horseshoe crab egg resource: monitor horseshoe crab egg densities on Delaware Bay beaches.

Note: Three tasks, described herein, were funded in 2013 by a USFWS Section 6 grant.
Objective 1: Beach Closures (volunteer coordinator and Shorebird Steward stipends)
Objective 2: Delaware Bay aerial shorebird survey
Objective 3: Delaware Bay horseshoe crab egg survey

Objective 1: Protect critical habitats and resources on the Delaware Bay stopover for migratory shorebirds
Key Findings:

- **Beach Restorations & Human Disturbance** - In October, 2012, Superstorm Sandy destroyed 50-70% of suitable horseshoe crab spawning beaches in New Jersey. The NJ Division of Fish and Wildlife (DFW) and NGO partners played an integral role in obtaining funds (National Fish and Wildlife Foundation and Community Foundation of New Jersey) and permits to restore five important spawning beaches before crabs and shorebirds returned in May, 2013. The spawning beach restoration was successful -- all beaches received spawning and shorebird activity similar to or above previous years (Niles et al. 2013). The success of the restoration project was amplified when the majority of red knots and other shorebirds were observed in NJ (Figure 1).
- **Beach Closures (Delaware Bay, spring migration)** – 2013 marked the 11th year of beach closures during the shorebird stopover on Delaware Bay (May 7–June 7). Thirteen sites on Delaware Bay and portions of two sites on the Atlantic coast were temporarily closed to allow shorebirds to forage and roost undisturbed by humans, dogs, vehicles (www.njfishandwildlife.com/ensp/beachclozmap.htm). As surface egg densities were still well below historic levels, closure of the most productive spawning beaches helped red knots and other shorebirds optimize foraging and significantly reduced disturbance to roosting flocks. Closed beaches were staffed by Shorebird Stewards who educated the public about shorebirds, horseshoe crabs and the need for closures. DFW conservation officers patrolled beaches and assisted Shorebird Stewards as needed. Shorebird Steward stipends and volunteer coordinator were funded in 2013 by USFWS Section 6 grant under E-1-36.
- **Beach closures (Atlantic Coast, fall migration)** – Some Atlantic Coast beaches provide fall migrant shorebirds, especially red knots, with short-term stopover and partial overwintering habitat. Two important areas (Stone Harbor Point and North Brigantine Natural Area) were afforded protection in 2013. However, some important foraging/roost areas remained unprotected (e.g., Avalon, North Wildwood).
- **Disturbance studies (Atlantic Coast, fall migration)** – In the fall of 2010 and 2011, ENSP participated in studies by Rutgers University and Conserve Wildlife Foundation of NJ on human disturbance and shorebirds (Burger and Niles, 2013a; Burger and Niles 2013b). The focus of the studies was to develop an adaptive management framework that included stakeholder participation. A management manual has yet to be developed. In the first study, a majority of beach users (60%) were positive about the study and beach closures to protect shorebirds. Spatial use by shorebirds depended on whether the beach was open or closed, especially for red knots that spread out over the entire beach when closed and contracted to a protected area when the beach was open. In the second study, recreationists differed in their responses (i.e., to voluntarily avoidance of foraging flocks) with ORVs and joggers less compliant than anglers, walkers and birders. This

could exacerbate disturbance as these former two groups tend to use the harder, wet intertidal areas for driving and jogging and may be present in greater number in fall when beach bathing has subsided but shorebird use is increasing. Shorebird species differed in their response to disturbance with red knots and black-bellied plover taking the longest to return. These results will be useful in the development of a variety of techniques to manage disturbance that are appropriate to the site, its physical features, and types of users (which varied at the two study sites).

Objective 2: Assess recovery of red knot and other shorebird species

Key Findings:

- **The peak count of red knots on Delaware Bay in 2013 was 25,596 individuals.** This abundance was consistent with peak numbers in three of the last five years (Figure 2). The improvements in the number of red knots may be a result of improved ground and aerial counts and possibly reflect a real increase because of good Arctic productivity in 2009 and 2010 (based on anecdotal observation of juvenile birds in some winter and stopover locations [G. Morrison and L. Niles, pers. comm.]). ***This survey was funded in 2013 by Federal Section 6 grant under E-1-36.***
- **The peak count of ruddy turnstones in 2013 was 20,268 individuals.** This abundance was higher than the previous four years but is consistent with lower counts of the last five years, (Figure 3). This species is likely to be in severe decline as documented by comparison of 2011 counts of its main wintering area in northern Brazil (D. Mizrahi and R.I.G. Morrison, pers. comm.) to counts from the Atlas of Nearctic Shorebirds (Morrison and Ross 1989).
- **In 2013, 46% of red knots achieved weights equal or exceeding 180 grams, the threshold necessary to successfully migrate and breed** (Figures 4, 5a and 5b). The availability of horseshoe crab eggs improved over the last five years with unusually settled weather and, in some years, early warming of bay water that fostered early and more widespread spawning. Coupled with beach closures, these conditions improved the ability of red knots to gain weight.
- **The Atlantic Coast survey was not performed due to lack of funding**. A complete coastwide survey would help improve estimation of flyway stopover population size and help validate mark-resighting population estimates (Lyons 2012).

Objective 3: Assess recovery of the horseshoe crab egg resource

Key Findings:

- **Baywide horseshoe crab egg densities have not substantively improved over nine years of survey.** The baywide egg survey is a direct index of foraging conditions for shorebirds. NJ egg densities remained low but may be improving; the significant positive trend in 2013 owes much to high egg densities at one site (Moore's Beach) in 2012, which declined in 2013 (Fig. 6). The beach front of Moore's was restored in 2013, which may have attracted spawning crabs away from the interior creek where egg are sampled annually.

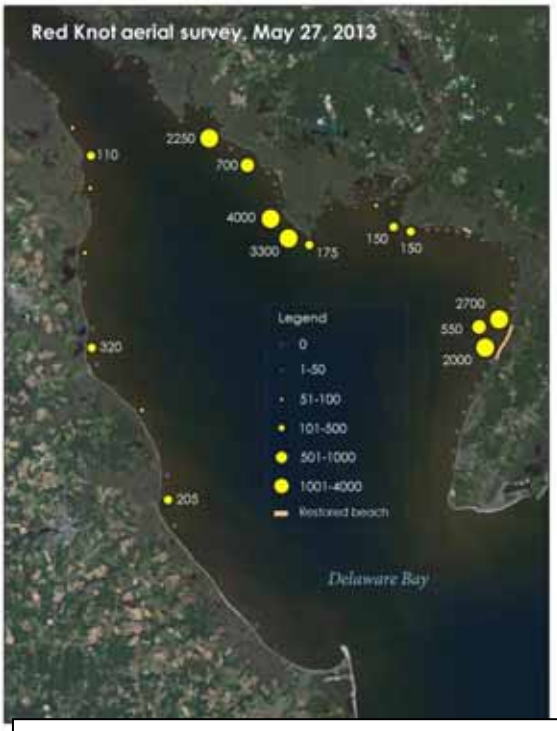


Figure 1. Red knot abundance from one aerial survey on 27 May, 2013. This does not include additional birds counted in simultaneous ground counts on this date.

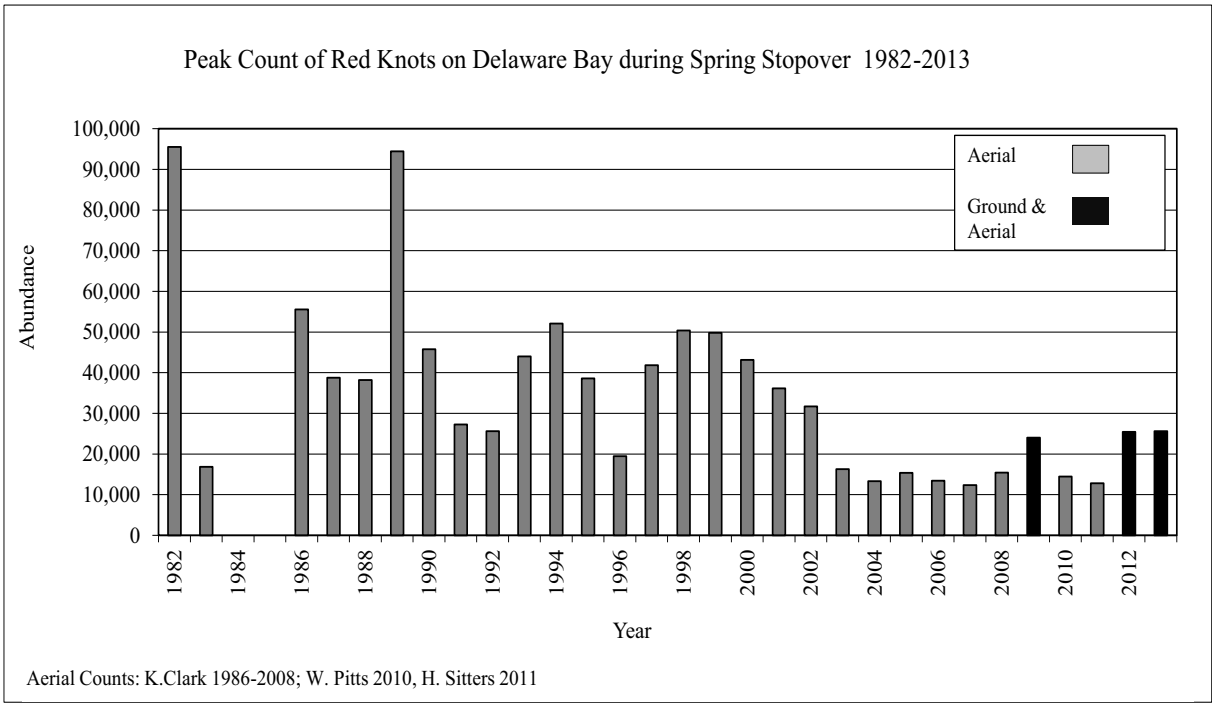


Figure 2. Peak counts of red knots on Delaware Bay, 1982-2013. Sources: Dunne et al. (1982), Kochenberger (1983); NJ and DE Divisions of Fish and Wildlife (unpubl data).

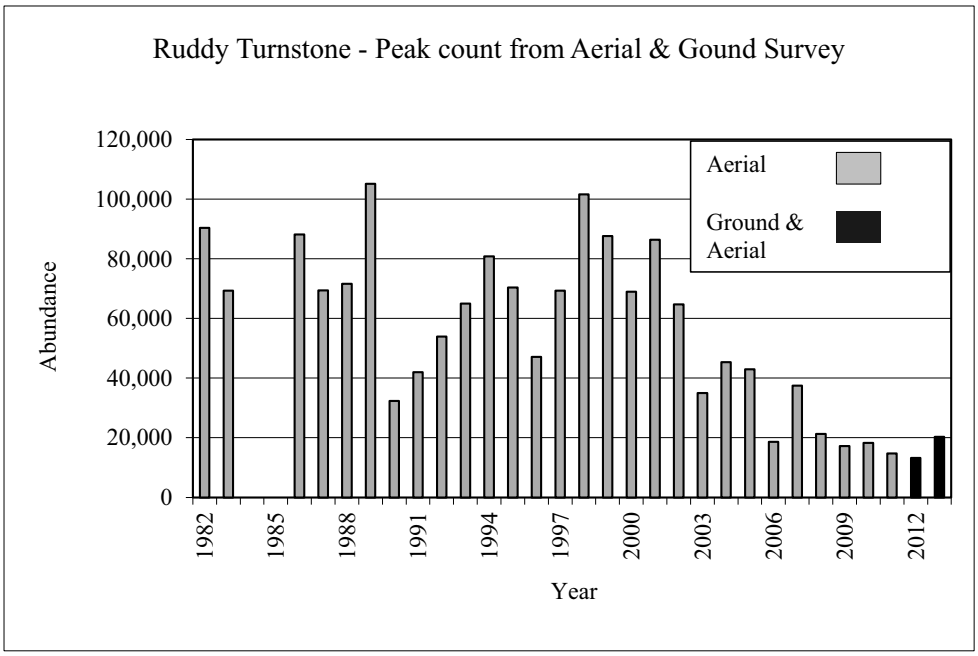


Figure 3. Peak counts of ruddy turnstones on Delaware Bay, 1982-2013. Sources: Dunne et al. (1982), Kochenberger (1983); NJ and DE Divisions of Fish and Wildlife (unpubl data).

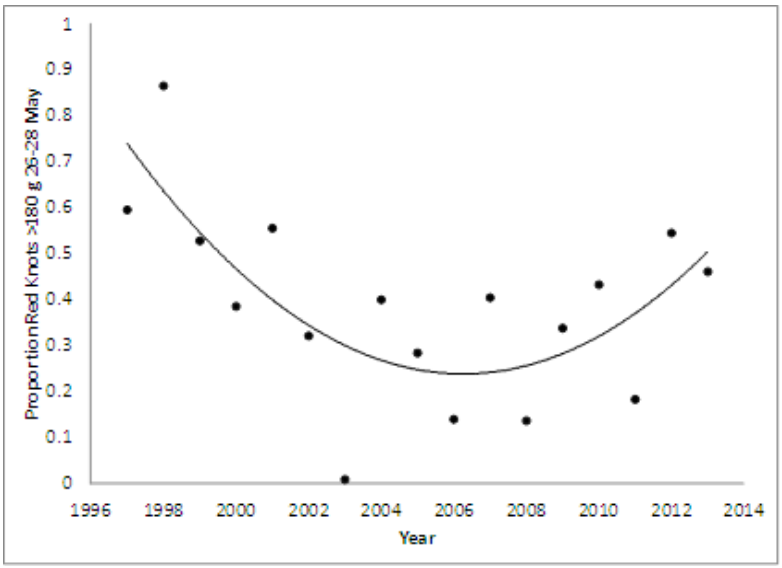
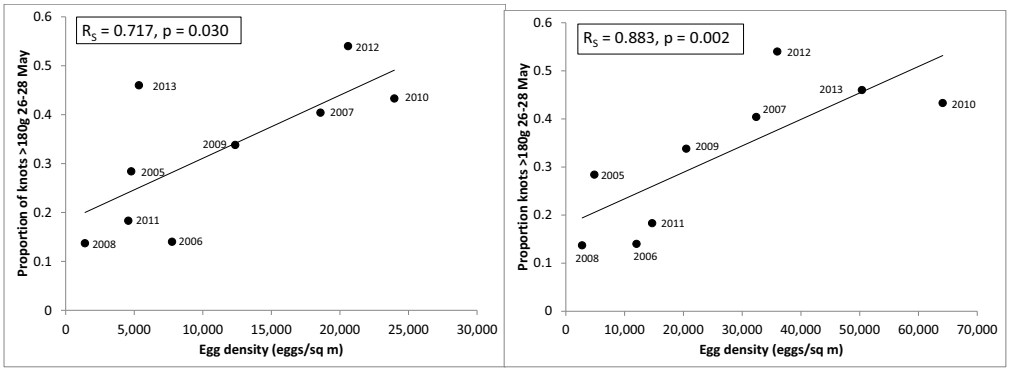


Figure 4. Proportion of red knots in the >180 g body-mass category in Delaware Bay near the usual departure time each year (26-28 May), 1997–2013. The line shows a significant quadratic trend over 1997–2012 (the trend line ±95% confidence intervals in respect of the line, not the variation in the data) fitted using binary logistic regression of body mass >180g (1=yes, 0=no) on year (negative, $p<0.001$) and year^2 (positive, $p<0.001$). The strength of the quadratic trend owes much to the very low proportion recorded in 2003, but it is still significant if the 2003 data are omitted. Source: NJ & DE Divisions of Fish and Wildlife.



Figures 5a & 5b. The proportion of red knots ≥180g in cannon-net catches during 26-28 May 2005-2013 plotted against mean egg densities during survey weeks 3 and 4. Fig. 5a includes Mispillion, DE, while Fig. 5b excludes Mispillion, DE. Source: NJ & DE Divisions of Fish and Wildlife.

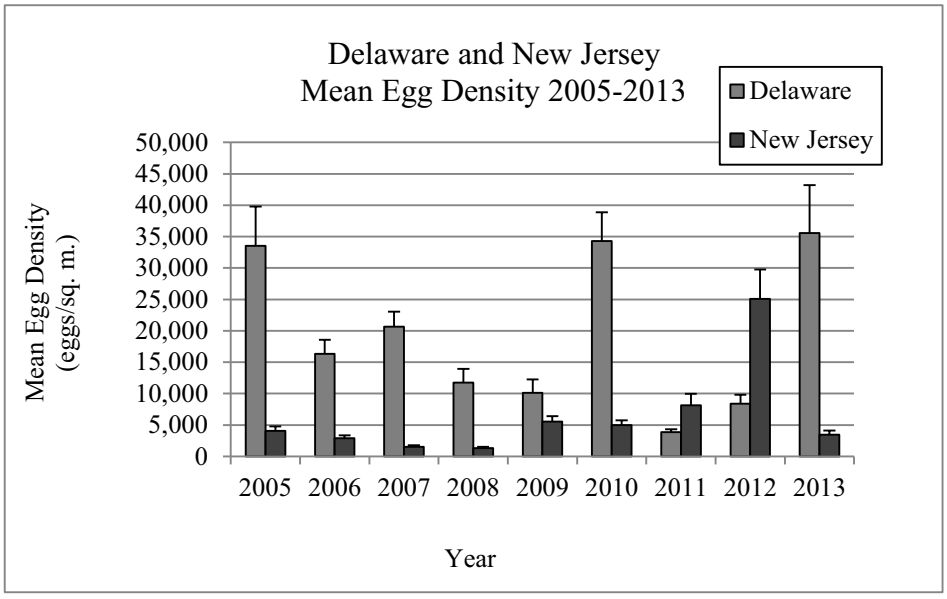


Figure 6. Mean horseshoe crab egg densities in the top 5 cm of sand (available to shorebirds). NJ data show positive trend (slope = 1,357, SE=28,200, P<0.001); DE no trend (slope = -841, SE=57,990, P= 0.105). Source: NJ and DE Divisions of Fish and Wildlife (unpubl data).

Conclusions and Recommendations:

- Full and partial beach closures have aided the ability of red knots and other shorebirds to gain adequate mass on Delaware Bay in spring and provide safe roost, foraging and molting sites on the Atlantic Coast in fall and winter. Cooperative efforts to reduce disturbance must continue; public involvement and public outreach via volunteer shorebird stewards is critical to the success of management efforts.
- Beach restoration efforts on Delaware Bay may play a role in restoring horseshoe crab spawning capacity thereby supporting shorebird populations.

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JOB 1G: Peregrine Falcon

Project leader: Kathleen Clark, Supervising Zoologist

OBJECTIVE: To conserve and manage the New Jersey Peregrine Falcon (*Falco peregrinus anatum*) population at a self-sustaining level.

Key Findings:

- The 2013 New Jersey peregrine falcon population remained stable with 26 known pairs occupying suitable nesting habitat across the state. The population exhibited good nest success with all but two pairs successfully fledging at least one young. A total of 24 nests produced 57 young for a success rate of 92% and a productivity rate of 2.19 young per active nest (Table 1). A brief summary of data collected during the 2013 nesting season follows.
  - ✓ Fifteen pairs utilizing towers and buildings continued to be the core of the nesting population, producing 37 young, for a productivity rate of 2.47 young per active nest, which is close to the long term average for towers and buildings since the state's population stabilized in 1986. We treated <2-week old hatchlings with bird lice spray at two tower sites (Swan Bay WMA and Tuckahoe WMA) to reduce infestations of parasitic flies (*Carnus hemapterus*). These flies have caused mortality of young hatchlings in recent years. With treatment no chicks were lost to fly infestations this season.
  - ✓ Four pairs were known to occupy territories in natural cliff habitat in northeastern NJ. Two of the four pairs were successful in fledging young (3 and 2, respectively). The remaining two pairs exhibited territorial behavior, but no evidence of young was observed in June or July. We did not see ravens nesting in that territory, as we did in 2011.
  - ✓ Seven pairs of falcons were known to nest on bridges this year. Four of those bridges lie completely within the boundaries of NJ, while three span the Delaware River between NJ and PA and are monitored by NJ. All bridge pairs fledged a total of 15 young for a productivity rate of 2.14 young per active nest. As has been the case in previous years, nesting can be difficult to confirm, as the nest sites are often located out of sight or on inaccessible sections of the bridge. The pair nesting on the Burlington-Bristol Bridge fledged all four of its young, while the Tacony-Palmyra and Betsy Ross bridges fledged three and one, respectively. Three pairs of falcons nesting on smaller bridges in urbanized areas of northern New Jersey produced a total of four fledglings. A seventh bridge-nesting pair occupied the new Ocean City-Longport Bridge, and went undetected until three fledglings were observed at the bridge. One pair, which had previously nested on the Great Egg Harbor Parkway bridge in 2012, relocated to a new structure on Drag Island, less than 300m away, that was provided by Conserve Wildlife Foundation as part of the bridge replacement plan. Some previously occupied bridges (e.g., Trenton and Newark Bay) were not tracked due to insufficient staff or volunteers. Other bridges may have been occupied, but the program lacked monitors in northern NJ to document all possible sites.
- After donating young peregrines to West Virginia's recovery project between 2006 and 2011, that project was concluded. Falcons that originated in NJ have been confirmed nesting in southern WV and western VA.
- We banded 44 of the 57 young produced this year, using both a federal band and an auxiliary, bicolor band with an alpha-numeric code following Bird Banding Lab protocol.
- Eleven addled eggs were collected from six different nest sites this season. In an agreement with Dr. Da Chen of Southern Illinois University, we provided him with 88 eggs collected between 1990 and 2013 for

toxicological analysis. Dr. Chen's research will focus on the accumulation and effects of flame retardants, but he will also provide the organochlorine analysis that will allow us to report on trends in a range of environmental contaminants.

- We continued to use remote, motion-activated cameras to photograph peregrines at nests. Using this method we read the leg bands on 15 breeding adults at nine nest sites. An additional five adults were identified using optics. The oldest female identified was a 16-year old that nests in Atlantic City. This bird did not lay eggs this year and may be beyond her reproductive age. Three different 8-year old males were identified at three nest sites this year, representing the oldest known males known this season. The average age of seven males was 6.0 years, while the average of 13 females was 9.0 years. The information that these identifications provide is immensely valuable for relating peregrine origin and age to nest success, site fidelity and turnover rate in the population.
- In addition to the resightings we recorded at NJ nest sites, we received reports of peregrines from elsewhere. A female banded at Margate, NJ (A/01) in 2008 was observed with a tiercel at a cliff site in Connecticut in 2012 and 2013. In an interesting swap, a CT female (band V/24) nested on the Route 1 Bridge in New Brunswick, NJ in 2012 (and probably in 2013 as well). A male (36/AP) banded at the Ben Franklin Bridge in PA in 2011 nested at a Paulsboro, NJ, refinery; he replaced the 2003 Jersey City tiercel that had nested there previously. A female (17/AN) banded at Tuckahoe, NJ, in 2011 was resighted in Stone Harbor, NJ, in November of 2012. A female (37/AN) banded in Stone Harbor in 2012 was recaptured at a banding station in Assateague National Seashore (VA) on two different dates – Sept. 29, 2012 (when she was likely moving through, going south) and Sept. 28, 2013, as an adult and possibly living in the area. Four other banded peregrines were reported dead: a third-year bird (10/AN from Sedge Island) at Atlantic City Airport in April 2013; a hatching-year bird (04/AN, Elizabeth) at a CT airport in Oct. 2011; a second-year female rehabbed after being found injured, found dead on a highway in DE; and a third-year bird (a fall migrant) found dead in Burlington County.
- In February of 2013, CWF-NJ constructed a new nest tower on Drag Island adjacent to the Garden State Parkway Bridge that spans Great Egg Harbor Bay. Peregrines nested on the bridge in 2012, but we think all the young were lost to the bay at fledging. Further, proposed bridge construction and modification prompted us to request the new tower as a more suitable and protected nest site for the birds to use. The new tower had an immediate impact on the nesting success of this pair, as they were able to fledge four young this year. We also erected a new nest tower at Stone Harbor marsh in July, 2013, to replace the osprey nest platform they had occupied; the pair was observed perched on the new tower just days after its completion.
- The ENSP, with Conserve Wildlife Foundation of NJ as a partner, maintained the webcam at the Jersey City peregrine nest (with non-federal funds). The website continued to be a very popular page on the Division's website.
- New sites were added to the Biotics database, along with an updated record of existing sites.

Conclusions:

- The peregrine population increased slightly in 2013, with above-average nest success and productivity. Across all sites – towers, buildings, bridges and cliffs – nest success was 92% and produced 2.19 young per active site, figures that are both well above average (Figure 1). The tower and building nest sites are the consistent center of the population in NJ, without which the population would fluctuate widely year to year. Management of nest sites, mainly to provide safe, undisturbed nesting environments for the birds, continues to be the predominant factor in a stable and productive population.
- Nest success at cliff sites was slightly improved over recent years, but it remains difficult to get thorough observations and identify sources of failures. The highly variable nest success at the cliff territories continues to be a problem if we consider occupancy of historic habitat important to a fully recovered population. Targeted investigation of the cause of those losses is necessary to guide future management.
- Management of nesting pairs and nest sites is essential to maintain peregrines in New Jersey. Bridge-nesting birds are especially vulnerable to nest-site problems, and many other pairs occupy human-constructed sites. With site management and the cooperation of bridge and building staff, these sites can contribute to population viability and stability, but proper site management takes staff time and attention.

Recommendations:

- Continue to monitor the peregrine falcon nesting population to maintain the database of nest site occupancy and nest success.
- Investigate cliff-nesting sites to determine causes of nest losses and improve nest sites where possible. Deployment of cameras would be the best means of getting a better level of monitoring.
- Continue the identification of adult nesters to track breeding population turnover, age structure and origin of successful nesters. The relation of the age structure to nest success and contaminant levels will inform conservation decisions regarding species status and recovery planning.
- Continue the investigation of contaminants in unhatched, salvaged eggs, as well as the close monitoring of nesting pairs to detect problems. Partner with Dr. Da Chen at Southern Illinois University to characterize the threat of organochlorine pesticides and brominated fire-retardant chemicals (polybrominated diphenyl ethers) in NJ peregrines.
- Conduct nest maintenance to reduce or eliminate parasitic flies from nests by cleaning nest substrate during the non-nesting season. Reduce mortality of nestlings by monitoring nestlings in their first two weeks and treating infested young with an anti-lice spray.

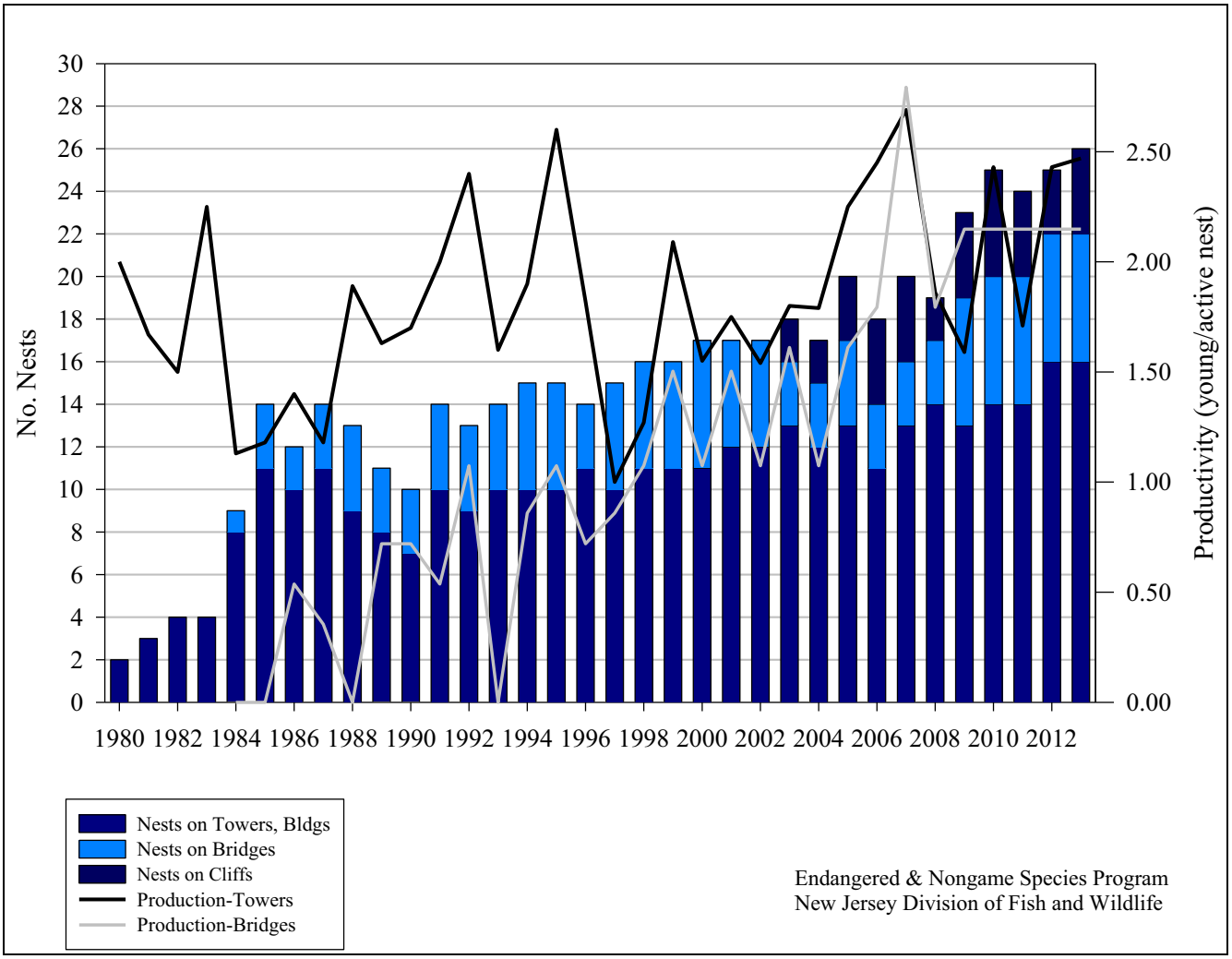


Figure 1. Nesting and productivity of peregrine falcons in New Jersey, with comparisons between towers/buildings, cliffs and bridges

Table 1. Site-specific results of peregrine falcon nesting in New Jersey, 2013

Site Name	Occupied	Active	Eggs	Young Hatched	Young @ Band Age	Young Fledged	Comments
101 Hudson, Jersey City	Y	Y	4	1	1	0/1	Original hatchling died; foster chick from Sea Isle
Atlantic City – North end water tower	Y	Y	U	3	2	3	
Bayside Prison Water Tower	U	U	-	-	-	-	
Drag Island	Y	Y	4	4	4	4	New tower; built 2/2013
Egg Island WMA	Y	Y	4	2	2	2	
Elizabeth-Union County Court House	Y	Y	4	3	3	3	Collected 1 egg
Forsythe NWR/Barnegat Tower	Y	Y	4	3	3	3	
Forsythe NWR/Brigantine Tower	Y	Y	4	2	2	2	First clutch (1 egg) failed
Great Bay WMA/Water Tower	N	N	-	-	-	-	
Heislerville WMA Tower	Nest box removed (2012), box installed at Bayside water tower						
Hilton/The Grand Casino	N	N	-	-	-	-	Female is 16-years old
Margate Marsh	N	N	-	-	-	-	
Marmora WMA/Sea Isle Tower	Y	Y	4	4	3	4/3	1 chick fostered @101 Hudson
Ocean Gate (AT&T) Tower	Y	Y	4	1	1	1	Collected 3 eggs
Paulsboro Refinery	Y	Y	4	4	4	4	
Sedge Island WMA Tower	Y	Y	3	1	1	1	Collected 2 eggs
Sewaren Generating Station	Y	Y	U	3	0	3	Unable to band
Stone Harbor Marsh	Y	Y	4	2	2	2	
Swan Bay WMA Tower	Y	Y	4	3	3	3	Collected 1 egg
Tuckahoe WMA Tower	Y	Y	3	2	2	2	
SUBTOTAL: TOWERS & BUILDINGS	***15***	***15***	***50***	***38***	***33***	***37***	***Total of 10 eggs collected***
Delaware Water Gap (NJ Side)	U	U	-	-	-	-	
Natural Site C-1 (Alpine)	Y	Y	U	2	0	2	Unable to band
Natural Site C-2 (Englewood)	Y	Y	4	3	3	3	Collected 1 egg
Natural Site C-3 (Carpenter Cir-Ross Dock)	N	N	-	-	-	-	
Natural Site C-4 (Bombay Hook area)	Y	Y	-	-	-	-	
Natural Site C-4 (Ruckman-State Line)	Y	Y	-	-	-	-	
Natural Site C-5 (Tenafly-Greenbrook)	N	N	-	-	-	-	
SUBTOTAL: NATURAL SITES	***4***	***4***	***4***	***5***	***3***	***5***	***Total of 1 egg collected***
Ben Franklin Br. (Delaware River)*	Y	Y	U	2	2	2	PA side/PA monitored
Betsy Ross Bridge (Delaware River)	Y	Y	3	1	1	1	
Brigantine Bridge (Atlantic City)	U	U	-	-	-	-	
Burlington-Bristol Br. (Delaware River)	Y	Y	4	4	4	4	
Commodore Barry Br. (Delaware River)*	Y	Y	U	3	3	3	PA side/PA monitored
Geo. Washington Bridge (Hudson River)*	U	U	-	-	-	-	NY side/NY monitored
Great Egg Harbor-Parkway Bridge	Pair now nesting on the Drag Island tower						
Newark Bay Bridge (NJTP or Conrail)	U	U	-	-	-	-	
NJ-PA Turnpike Br. (Delaware River)*	Y	Y	U	3	3	3	PA side/PA monitored
North Trenton-Scudders Falls Bridge*	Y	Y	U	2	0	2	PA side/PA monitored
Ocean City-Longport Bridge	Y	Y	U	U	0	3	Found post-fledging
Route 1 Br./Raritan-New Brunswick	Y	Y	U	1	0	1	Not banded; fledgling observed
Route 3 Br./Hackensack (NJDOT)	Y	Y	U	1	0	1	Not banded; fledgling observed
Route 35 Bridge/Belmar	U	U	-	-	-	-	
Route 46 Br./Little Ferry-Ridgefield Pk	Y	Y	U	2	0	2	Unable to band
Secaucus-Kearny NJTP Bridge	U	U	-	-	-	-	

Tacony-Palmyra Br. (Delaware River)	Y	Y	4	3	3	3	
Trenton RR Bridge	U	U	-	-	-	-	
Vince Lombardi – NJTP Bridge	U	U	-	-	-	-	
Walt Whitman Bridge (Delaware R.)*	Y	Y	U	1	1	1	PA side/PA monitored
SUBTOTAL: BRIDGES (NJ only)	***7***	***7***	***≥11***	***≥12***	***8***	***15***	
TOTALS (NJ Only)	**26**	**26**	**≥65**	**≥55**	**44**	**57**	**57 yng/26 known-outcome nests=2.19 young per nest**

JOB1H: Grassland Birds

Project leader: Kim Korth, Senior Zoologist

OBJECTIVE 1: To evaluate grassland management techniques implemented on grasslands enrolled in incentive programs on grassland nesting bird species : grasshopper sparrow (*Ammodramus savannarum*), vesper sparrow (*Pooecetes gramineus*), bobolink (*Dolichonyx oryzivorus*), Henslow's sparrow (*Ammodramus henslowii*), savannah sparrow (*Passerculus sandwichensis*), upland sandpiper (*Bartramia longicauda*), horned lark (*Eremophila alpestris*), eastern meadowlark (*Sturnella magna*) and northern harrier (*Circus cyaneus*). Based on results, modify management techniques as necessary.

OBJECTIVE 2: To develop long-term population monitoring and distribution approaches, particularly on grasslands enrolled in incentive programs, for endangered, threatened, and special concern grassland-nesting birds in collaboration with other states in the Northeast (see above for list of species) to evaluate grassland management projects and determine population trends in the Northeast.

OBJECTIVE 3: To create predictive models using landscape variables related to grassland bird species presence and vegetation structure to identify areas to target adaptive management for specific grassland bird species (see above list of species). These models will be used to guide management techniques on several grassland properties currently enrolled in the Landowner Incentive Program or publicly owned land and evaluated by conducting targeted point counts.

Key Findings:

- New Jersey Audubon (NJA) conducted limited grassland bird surveys in 2013 to maintain volunteer involvement; while the data will be provided to ENSP for inclusion into Biotics, these data were not used for our present analysis. NJA deployed >80 trained Citizen Scientist volunteers to conduct 339 bird surveys on approximately 60 project and control sites.
- Staff completed the evaluation of the effectiveness of management techniques (delayed mowing, WSG, CSG, etc.) on LIP and other sites actively managed for grassland birds using control and pre- and post-treatment surveys. Only LIP and control sites were used in the evaluation. Differences in treatment were summarized (see below).
- Conserve Wildlife Foundation and ENSP staff are currently finalizing a habitat model using landscape variables (total acres, core area, proximity to other open habitat, etc.) for target grassland bird species. Rather than being predictive, this model will allow us to determine priority areas for grassland establishment and management. We expect that this analysis will also inform our development of Best Management Practices for individual species.
- Although there were no regional grassland bird meetings (NE CBM Grassland Working Group) during this reporting period, staff continued to coordinate with NJA for final evaluation of Landowner Incentive Program.
- We identified, developed and implemented restoration plans on two public land sites. The Princeton Nursery site restoration was completed in 2013 so no surveys were conducted. Staff made

recommendations for adaptive management strategies for select species at Burlington County Fairgrounds and the practices were put out to bid in 2013; thus no results will be reported here.

- Due to lack of staff and resources, we did not undertake analysis to determine the effectiveness of the 2011 increased bird survey effort at the larger LIP sites. We will provide those data to NJA who will explore the possibility of conducting this analysis.
- Due to weather and lack of resources, we did not survey a sample of sites using simplified microhabitat methodology in 2013.
- Staff determined that evaluating potential temporal and spatial differences in herbaceous growth rates using 2010-2012 data would be onerous and instead we will conduct analysis to determine if any differences can be detected regionally by year and by bird usage.
- ENSP staff did not complete development of specific BMPs for grassland birds, but we made progress by working with NJDFW Bureau of Lands Management to manage for grassland birds based on survey and habitat data. We expect the final evaluation analysis will allow for more prescriptive BMPs in the coming years.

LIP Evaluation

Note: Species richness and abundance from the 2006-2012 surveys (N=836) did not have normal distributions and, unless otherwise noted, were compared between LIP and control (roadside) sites using the Kruskal-Wallis nonparametric test (SAS Institute).

The evaluation of the effectiveness of the Landowner Incentive Program (LIP) was completed and we conclude that LIP was a success in the management of grassland dependent species: LIP sites consistently had a greater abundance of target grassland bird species, particularly grasshopper sparrows and possibly eastern meadowlarks.

- No difference was detected in species richness between the LIP and control sites, but a difference was detected in species abundance (χ^2=5.68, P=0.017). Although the species abundance was greater in LIP sites, no significant difference was detected in the slopes of species abundance between LIP and control sites (Fig 1).
- Year Effect: The year of the survey did not have significant effect on species abundance on both LIP and control sites, but did have significant effect on species richness (χ^2=18.28, P=0.006), most notably within LIP sites (χ^2=14.41, P=0.025) (Fig. 2). However, based on logistic regression there was no interaction between the year and whether the site was LIP or control. The 2011 survey year was the only year where a significant different in species richness was detected between LIP and control sites (χ^2=5.23, P=0.022).
- Target Species: Three of the twelve target species abundances were significantly different between LIP and control sites: Eastern Meadowlark, Grasshopper Sparrow, and Savannah Sparrow. However, of these three species only the Grasshopper Sparrow did not show a significant year effect (Table 1). LIP sites consistently contained a greater abundance of Grasshopper Sparrows than control sites, and the slopes of the trend analyses were similar (Fig. 3). For Eastern Meadowlarks (Fig. 4) and Savannah Sparrows (Fig. 5), where year also affected the abundance per point, the disparity between control and LIP sites were most prominent in earlier years and the slopes are not as similar, but the magnitude of difference between the slopes was not great enough to be detected using a T-test.
    - *Year effect*. –Looking within only control or only LIP sites, the survey year had a significant effect on the abundance of three of the 12 target species, but the only species common between the sites was the Savannah Sparrow (Table 2). Within each year, however, the abundance of half of the target species differed significantly between sites (Table 3).

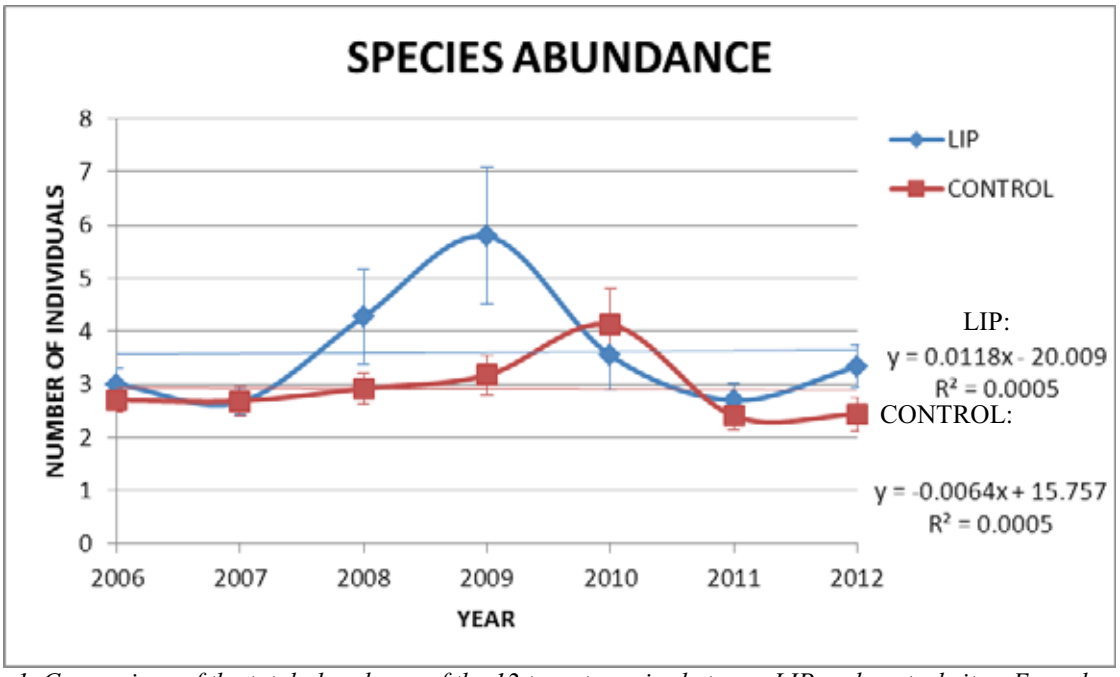


Figure 1. Comparison of the total abundance of the 12 target species between LIP and control sites. Error bars calculated with standard error.

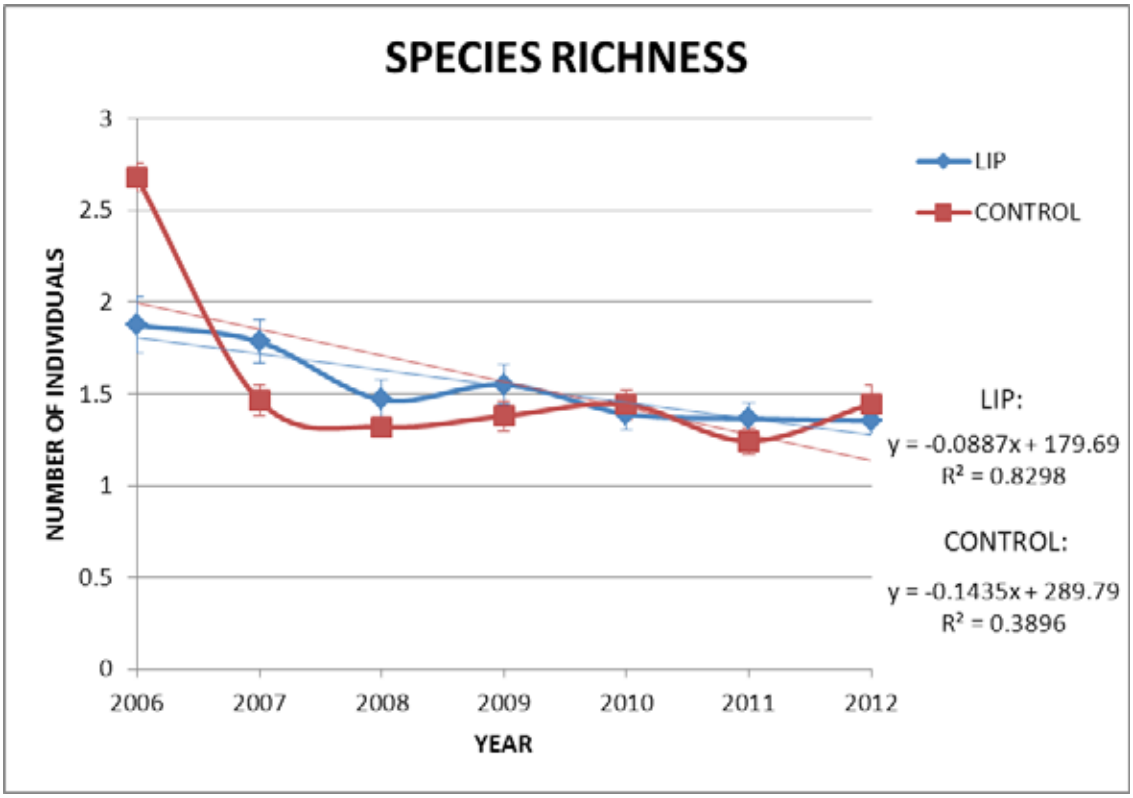


Figure 2. Comparison of the total richness of the 12 target species between LIP and control sites. Error bars calculated with standard error.

Table 1. Results of Kruskal-Wallis nonparametric analysis of the abundances of individual target species vs. site (LIP vs Control) or year (2006-2012).

Common Name	Site		Year	
	χ^2	P-value	χ^2	P-value
American Kestrel	2.482	NS	5.475	NS
Bobolink	1.229	NS	0.403	NS
Dickcissel	0.080	NS	8.715	NS
Eastern Meadowlark	**7.345**	**0.0067**	**13.431**	**0.0367**
Grasshopper Sparrow	**26.839**	**<0.0001**	5.432	NS
Horned Lark	2.726	NS	3.487	NS
Northern Bobwhite	0.801	NS	**13.077**	**0.0418**
Northern Harrier	0.050	NS	**21.647**	**0.0014**
Savannah Sparrow	**4.560**	**0.0327**	**29.691**	**<0.0001**
Vesper Sparrow	0.919	NS	8.120	NS
Upland Sandpiper	0.706	NS	6.464	NS
Yellow-breasted Chat	0.061	NS	12.184	NS

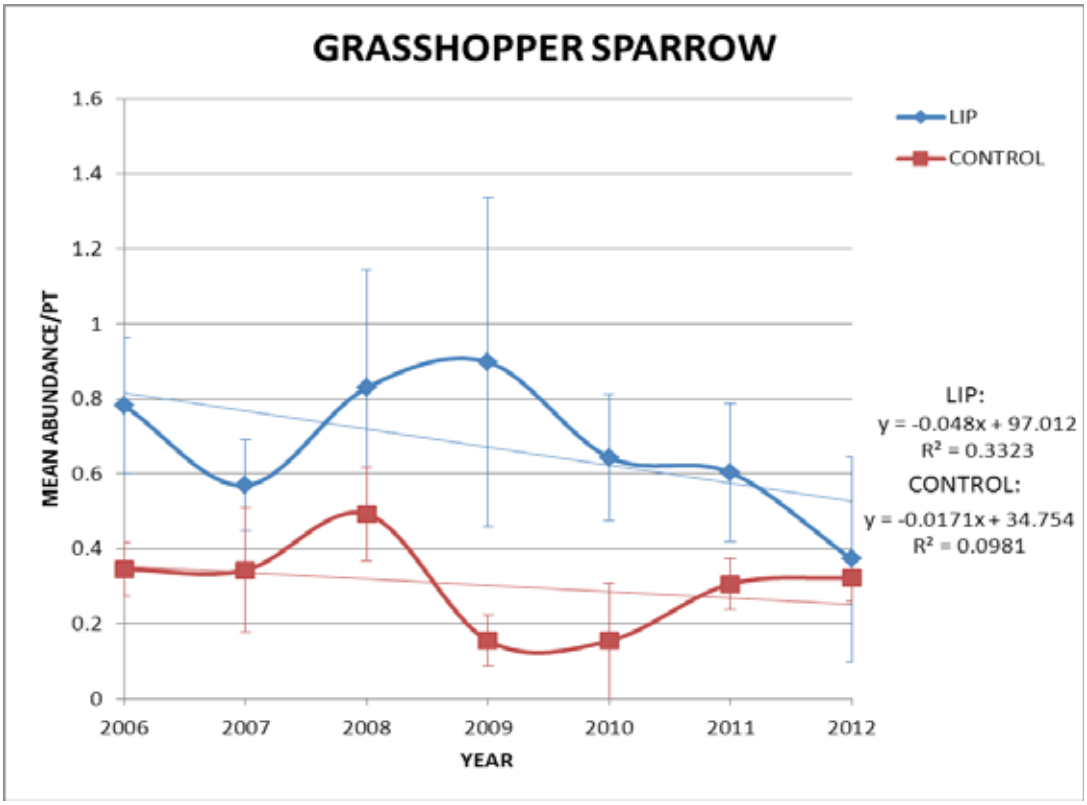


Figure 3. Comparison of the total abundance (per point) of Grasshopper Sparrows between LIP and control sites. Error bars show standard error of sample.

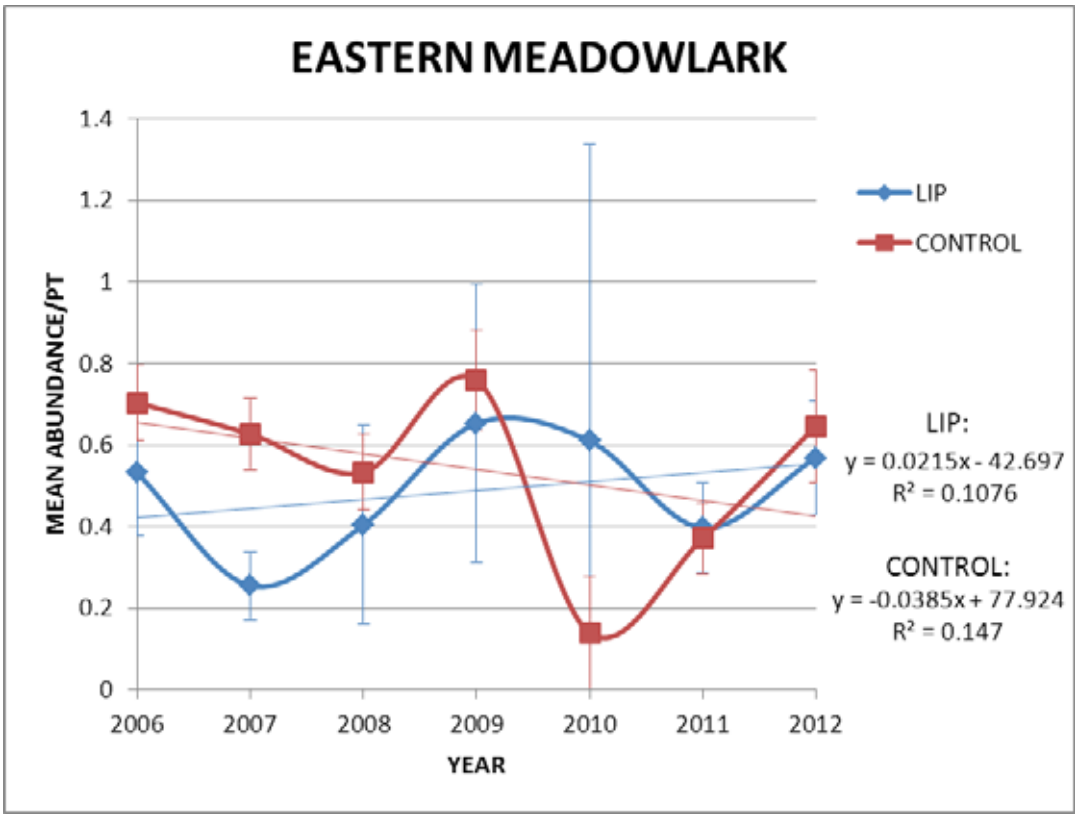


Figure 4. Comparison of the total abundance (per point) of Eastern Meadowlarks between LIP and control sites. Error bars show standard error of sample.

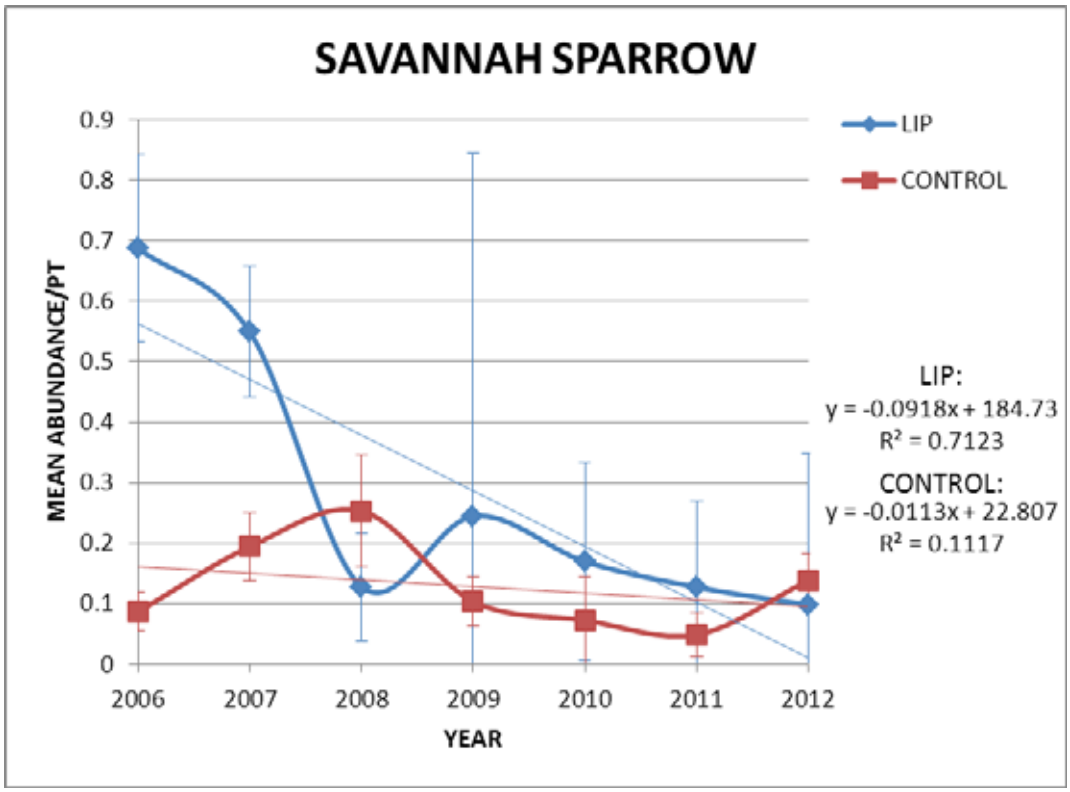


Figure 5. Comparison of the total abundance (per point) of Savannah Sparrow between LIP and control sites. Error bars show standard error of sample.

Table 2. *Results of Kruskal-Wallis nonparametric analysis of the abundances of individual target species vs. year (2006-2012) within each site.*

	Control		LIP	
Common Name	χ^2	**P-value**	χ^2	**P-value**
American Kestrel	6.1025	NS	10.7487	NS
Bobolink	2.8531	NS	6.66	NS
Dickcissel	**12.6527**	**0.0489**	6.0612	NS
Eastern Meadowlark	**14.5194**	**0.0243**	5.5109	NS
Grasshopper Sparrow	12.2749	NS	7.4014	NS
Horned Lark	2.5782	NS	**15.6244**	**0.0159**
Northern Bobwhite	8.2508	NS	**17.7273**	**0.007**
Northern Harrier	11.6357	NS	10.3192	NS
Savannah Sparrow	**12.6437**	**0.0491**	**50.1737**	**<0.0001**
Vesper Sparrow	5.7756	NS	3.5434	NS
Upland Sandpiper	4.9756	NS	0	NS
Yellow-breasted Chat	6.3134	NS	5.7843	NS

Table 3. *Results of Kruskal-Wallis nonparametric analysis of the abundances of individual target species vs. site (Control, LIP) within each year.*

	2006		2007		2008		2009	
Common Name	χ^2	**P-value**	χ^2	**P-value**	χ^2	**P-value**	χ^2	**P-value**
American Kestrel	1.5037	NS	2.5575	NS	0.9435	NS	3.5477	NS
Bobolink	0.0146	NS	0.1537	NS	0.2288	NS	0.0501	NS
Dickcissel	0	NS	1.5355	NS	1.5306	NS	0	NS
Eastern Meadowlark	0.9424	NS	**8.4736**	**0.0036**	1.3721	NS	2.2942	NS
Grasshopper Sparrow	**6.567**	**0.0104**	**11.7223**	**0.0006**	**3.9221**	**0.0477**	**13.3271**	**0.0003**
Horned Lark	1.2597	NS	1.4692	NS	0.0445	NS	0.4245	NS
Northern Bobwhite	0	NS	0.7612	NS	**6.2742**	**0.0123**	0.0227	NS
Northern Harrier	0.0668	NS	0	NS	0.0005	NS	0	NS
Savannah Sparrow	**19.0441**	**<0.0001**	**11.0942**	**0.0009**	2.1092	NS	0.0022	NS
Vesper Sparrow	0.3659	NS	0.0378	NS	0.6533	NS	0.2165	NS
Upland Sandpiper	0.3659	NS	0	NS	0	NS	0	NS
Yellow-breasted Chat	0	NS	0.0378	NS	0	NS	0	NS

	2010		2011		2012	
Common Name	χ^2	**P-value**	χ^2	**P-value**	χ^2	**P-value**
American Kestrel	2.9873	NS	0.0138	NS	0.5291	NS
Bobolink	0.7779	NS	0.0031	NS	**5.8298**	**0.0158**
Dickcissel	0	NS	0	NS	0	NS

Eastern Meadowlark	0.3297	NS	0.7536	NS	0.0077	NS
Grasshopper Sparrow	1.3413	NS	**4.4297**	**0.0353**	0.3217	NS
Horned Lark	**4.025**	**0.0448**	1.7278	NS	**6.5479**	**0.0105**
Northern Bobwhite	1.5047	NS	0	NS	0	NS
Northern Harrier	0	NS	0	NS	0	NS
Savannah Sparrow	1.16	NS	2.5724	NS	0.955	NS
Vesper Sparrow	0.5267	NS	0	NS	0	NS
Upland Sandpiper	0	NS	0	NS	0	NS
Yellow-breasted Chat	0	NS	0	NS	0	NS

Differences of treatments within LIP

- To evaluate the bird response of treatments within LIP sites, we calculated the percentages of cool season grass and warm season grass within a 400-meter radius of each survey point. We labeled the treatment cool season grass (CSG) to those points that had at least 2x the amount of CSG than warm season grass (WSG), and vice-versa for WSG. For those points that had a nearly even amount of WSG and CSG (<2x of either one) we labeled as "MIX".
    - Basic summary analysis shows differences in the mean abundances of three target grassland bird species: Bobolink, Eastern Meadowlark, and Horned Lark. Of these, only Horned Lark was more abundant in WSG treatments, which is likely due to the existence of bare ground prior to planting. The abundance of all three species in the MIX treatments indicates the need of a mosaic of grassland types for grassland dependent bird species.

Table 4. *Summary of the bird response in LIP sites according to predominance of warm season grass (WSG), cool season grass (CSG) or mixed grasses (MIX).*

		Landscape Area (Acres)			Landscape Core Area (acres)			Total Richness			Total Abundance		
Treatment	N	Mean	SD	SE	Mean	SD	SE	Mean	SD	SE	Mean	SD	SE
CSG	71	864.88	952.98	113.098	227.41	306.82	36.413	1.11	0.96	0.114	2.61	5.11	0.606
MIX	21	947.20	1113.83	243.058	327.18	470.97	102.773	1.00	0.71	0.154	3.29	5.85	1.276
WSG	52	1365.50	1262.23	175.040	484.67	496.26	68.820	0.96	0.71	0.099	2.52	6.88	0.953

		BOBO Abund.			EAME Abund.			HOLA Abund.		
Treatment	N	Mean	SD	SE	Mean	SD	SE	Mean	SD	SE
CSG	71	1.324	4.305	0.511	0.493	0.826	0.098	0.070	0.425	0.050
MIX	21	1.095	2.737	0.597	0.238	0.539	0.118	1.381	5.445	1.188
WSG	52	0.250	0.837	0.116	0.058	0.235	0.033	1.385	6.968	0.966

Conclusions:

- Delayed mowing practices during grassland breeding season significantly increased bird abundance, as evidenced by higher abundance of all grassland bird species on LIP sites than control sites.
- Restoration practices (conversion of crop to grassland) likely increased species richness on LIP sites over time, as indicated by a significant year effect. In 2005 and 2009 the Landowner Incentive Program added a large number of sites into the program, a majority of which were restored from cropland to warm season or cool season grass. Newly established cool season grasses may take one year to become established while warm season grass may take up to three years. The difference in growth rates and establishment provide a mosaic of habitat that provides key requirements for different species. The micro-habitat analysis will help us quantify those differences.
- Basic summary analysis of LIP treatment (CSG, WSG, mix) highlighted that Bobolink and Eastern Meadowlark both used the mixed treatment more than the cool or warm season grass treatment. This again could be explained by the mosaic of habitat provided by a mixed treatment versus a majority of warm season or cool season grasses.
- The use of Citizen Scientists for grassland bird surveys is a necessary and efficient method to collect data.
- Collecting microhabitat data on a spatial and temporal sample of sites is important to understand the conditions of the fields as they change and the corresponding bird response. Using these data in our future analyses will likely help explain bird preference. Analyzing the microhabitat data at a regional scale will allow us to better determine if there is a spatial and temporal difference among growth rates in New Jersey. These analyses will be utilized in our future publications.

Recommendations:

- Complete the analysis of LIP treatment on bird usage and submit a manuscript for publication.
- Use the results of the analysis to develop best management practices for grassland birds; incorporate those BMPs into those Wildlife Management Areas that target grassland bird management.
- Conduct bird surveys at Princeton Nursery and Burlington County Fairgrounds to determine bird usage trends and use those results to inform adaptive management recommendations.
- Use Citizen Scientist volunteers to conduct point count surveys for target grassland bird species at Princeton Nursery and Burlington County Fairgrounds.
- Consider collecting baseline vegetation and bird data every 3 years. Survey a sample of sites using simplified microhabitat methodology; ensure sample represents all management practices are adequately represented.
- Complete the predictive habitat model using landscape variables (# total acres, core area, proximity to other open habitat, etc.) for grassland bird species.

JOB 1J: Raptors: Inactive

Project co-leaders: Kathleen Clark, Supervising Zoologist and Kris Schantz, Principal Zoologist

JOB 1L: American Kestrel

Project leader: Peter Winkler, GIS Specialist

OBJECTIVE 1: To halt and reverse the decline of the proposed to be listed American kestrel through a coordinated approach of population and habitat monitoring, threat assessment, habitat protection, management, research and education.

OBJECTIVE 2: To evaluate effectiveness of nest box program on increasing/managing American kestrel numbers.

Key findings:

- In February of 2012, the American kestrel was formally listed as a State Threatened species.
- Prior to listing and in response to declining numbers, ENSP recreated a predictive American kestrel patch model (patch sizes 0-250 ha, 250-1,000 ha, and >1,000 ha.) to investigate suitable kestrel habitat in NJ using the NJDEP 2007 Land Use Land Cover data and compared this model across all available years (1986, 1995, 2002 and 2007).
    - For the 21-year period (1986-2007) the model results show a fragmenting of potential kestrel habitat
        - ~75,402 ha of potential kestrel habitat was lost (~4,000 ha/year) (Fig. 1)
        - Overall, the number of patches increased; however, in the top 2 categories (>250 ha, preferred kestrel habitat) the number of patches, sum and average patch size all decreased (Fig. 2).

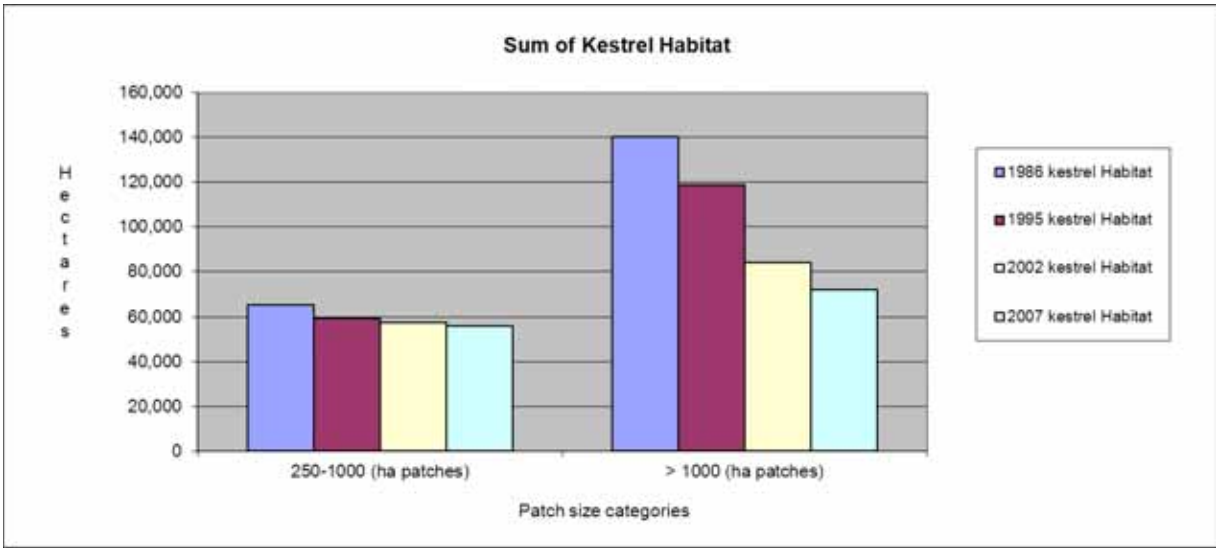


Figure 1. Total habitat for the top two categories, 250-1000 ha and > 1000 ha.

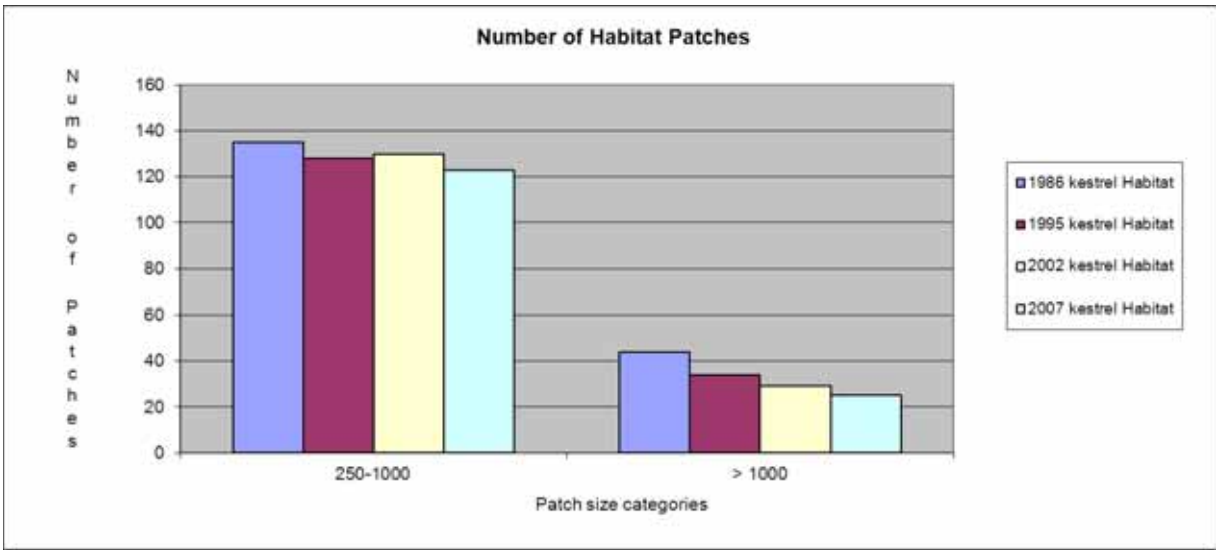


Figure 2. Number of habitat patches for the top two categories, 250-1000 ha and > 1000 ha.

- Suitable sites for American kestrels were identified using the GIS predictive model based on the NJ Department of Environmental Protection's 2002 Level III Land Use/Land Cover data layer (LU/LC) in conjunction with kestrel occupancy data from Dr. Smallwood of Montclair State University. Areas of contiguous kestrel habitat were again divided into three patch sizes: 0-250 ha, 250-1,000 ha, and >1,000 ha.
- Nest boxes placed in the top two patch categories, 250-1,000 ha and >1,000 ha, accounted for the majority of active nest boxes throughout the study (Table 1).

Table 1. Percentage of active nest boxes in patches >250 ha (NJDEP 2007 LULC source for patches) in size for all study years (2006-2013).

Study year	Percentage of active nest boxes in patches >250 ha
2006	67%
2007	67%
2008	74%
2009	77%
2010	82%
2011	80%
2012	73%
2013	72%

- For the 2013 season, ENSP targeted 141 nest boxes for monitoring. The majority of the nest boxes monitored was from the original 275 boxes with 24 additional nest boxes in our new study area in southern New Jersey. This new study area expands the nest box program to a key habitat area for kestrels while maintaining some representation within all study areas (Clinton, Amwell Valley, Assunpink, and Southern NJ). Our monitoring efforts now are focused on the most productive areas. We determined the subset by selecting boxes that had been used by kestrels at least once in the previous four seasons. Boxes not identified for monitoring included those that were in suboptimal locations, where volunteer help was lacking, where landowner support was lacking, or where nest boxes failed (box broke or the supporting structure fell down).
    - A total of 141 nest boxes were monitored every 12-15 days from April through August, 2013. Of those 141 nest boxes, 47 (33%) were occupied by American kestrels. One nest box had 2 nesting attempts, resulting in 1 failure and 1 success. Of the 48 nesting attempts, 32 (67%) were successful, defined by the nest attempt resulting in nestlings that reached bandable age of 14-22 days. Sixteen nesting attempts (33%) resulted in failures.

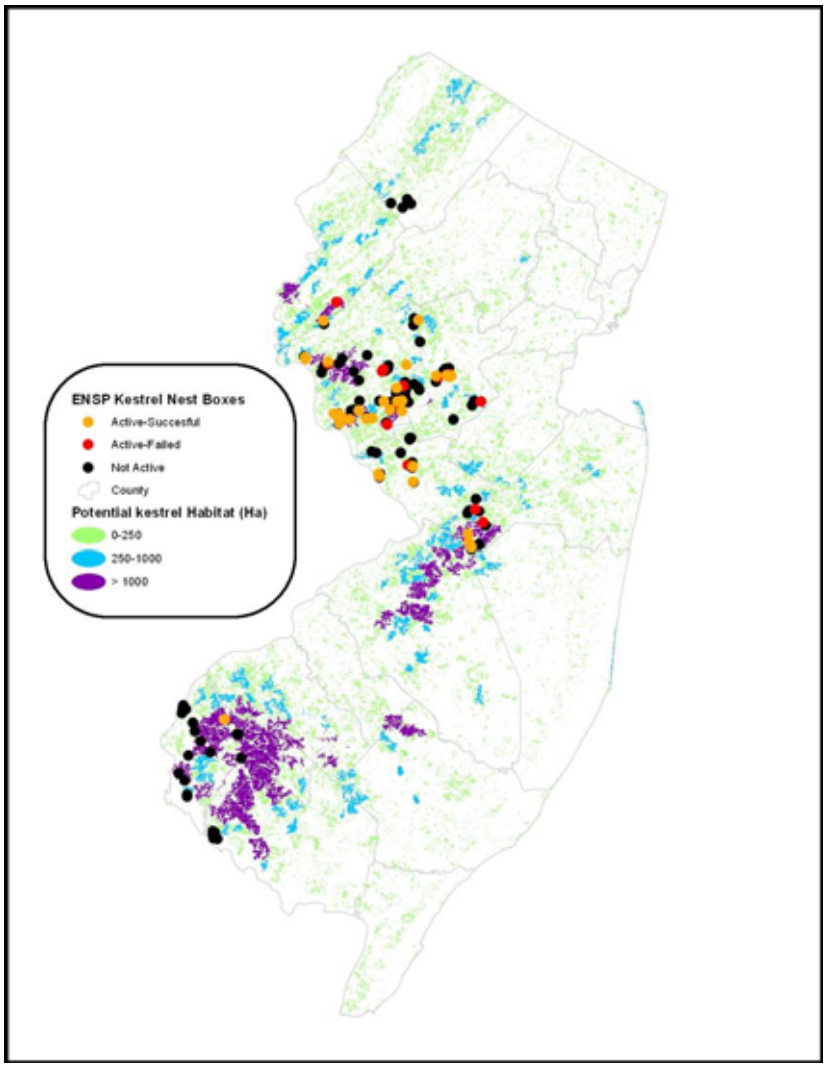


Figure 3. ENSP American kestrel nest boxes in 2013.

- For the 2013 season, four new nest box volunteer monitors were recruited and trained. ENSP also partnered with DuPont and their Habitat Team (6 members). Through a collaborative effort, five nest boxes were placed on DuPont's Deepwater facility in Gloucester County.

- The 2013 nest box field season resulted in the following:
  - 132 kestrels were banded: 108 nestlings (62 female, 46 male, 15) and 24 adults (19 female, 5 male) at 42 nest boxes.
  - Eleven previously banded adults were recaptured (10 female, 1 male).
  - Twelve volunteers monitored 105 nest boxes while staff monitored 36 boxes.
- All data collected was continuously entered online through a Google documents online interface following each check.
- All banding data was supplied to the Bird Banding Lab via BandIt.
- All 2006-2011 nest box data were entered into NJ DEP's Biotics database.
- A comprehensive report (2006-2012) was completed and posted to the program website.
  - The website has been updated with a report on the Kestrel survey from 2004. (http://www.state.nj.us/dep/fgw/ensp/pdf/kestrel_survey04.pdf)
  - An American kestrel fact sheet was created for the website (http://www.state.nj.us/dep/fgw/ensp/pdf/end-thrtened/kestrel.pdf).

- Comprehensive report, New Jersey American Kestrel Nest Box Project 2006-2012 (http://www.state.nj.us/dep/fgw/ensp/pdf/kestrel_project_summary06-12.pdf).
- Figures 4-6 below summarize the work done on the kestrel project over the past 8 seasons.

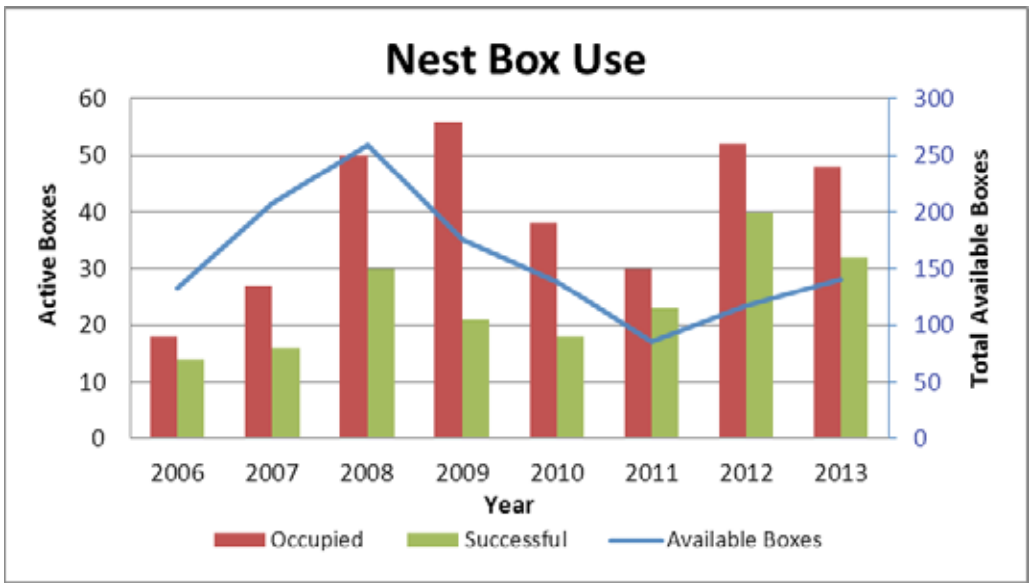


Figure 4. American kestrel nest box use 2006-2013.

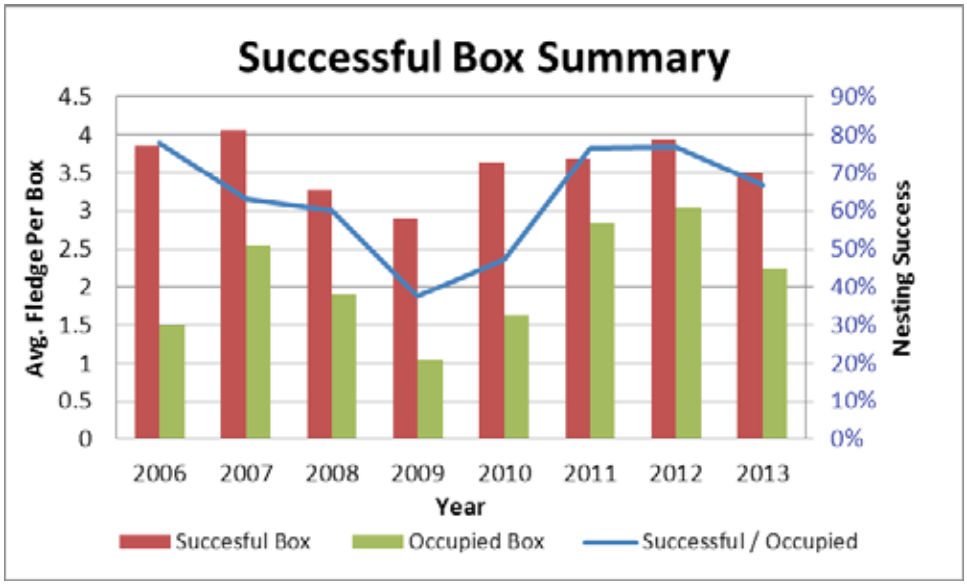


Figure 5. Average number of fledglings per available versus occupied nest box, and overall success of boxes occupied 2006-2013.

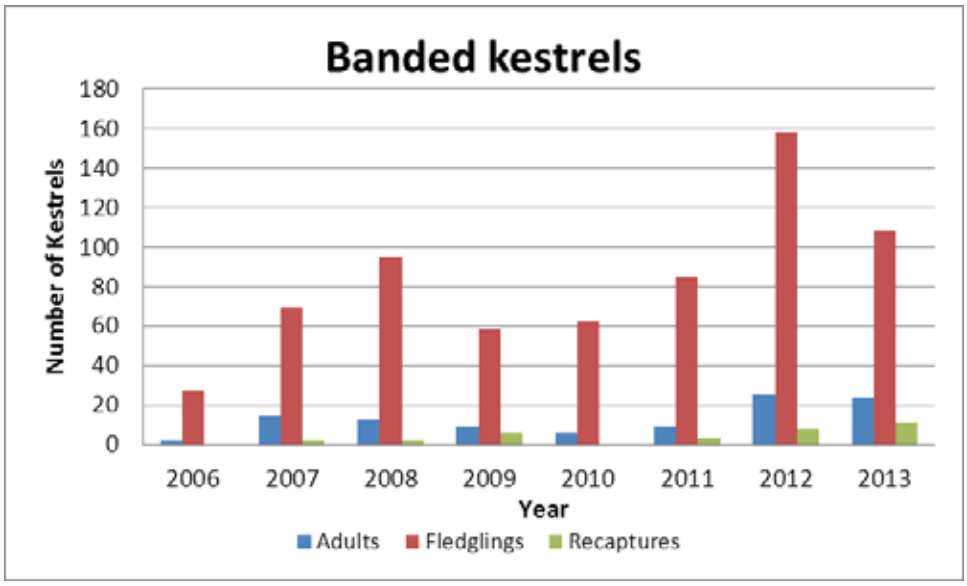


Figure 6. American kestrels banded, 2006-2013.

- GIS data has been compiled to investigate use of and potential loss of kestrel migration habitat in New Jersey and nationwide. The National Land Cover Database will be used to evaluate habitat along the four major North American flyways. Currently there are two comparable eras available, 2001 and 2006. The 2011 NLCD has an anticipated release date of December 2013.
- ENSP requested and obtained American kestrel encounter data from the USGS Bird Banding Lab. The encounter data will be used to develop migration route maps for evaluating potential habitat loss.
- ENSP collaborated and served as the Project Beneficiary for two Eagle Scout Projects. Both projects built nest boxes while one of the projects also installed some of the nest boxes they created. These Eagle Scout projects benefitted both organizations. The project supplied ENSP with well-constructed nest boxes and the Eagle Scouts benefitted by completing there long journey of becoming an Eagle Scout.
- ENSP collaborated with the Conserve Wildlife Foundation of New Jersey on a project to deploy 15 light-sensing geolocators on American kestrels nesting within our study areas. The geolocators were deployed this past breeding season with an anticipated return in the 2014 breeding season. Geolocator data will shed light on the migration paths and wintering areas of New Jersey's kestrel population.

Figure 7. Female American kestrel with geolocator attached.

- Based on the accuracy of current geolocator technology, ENSP created expected accuracy mapping along a potential kestrel Atlantic Coastal Flyway.

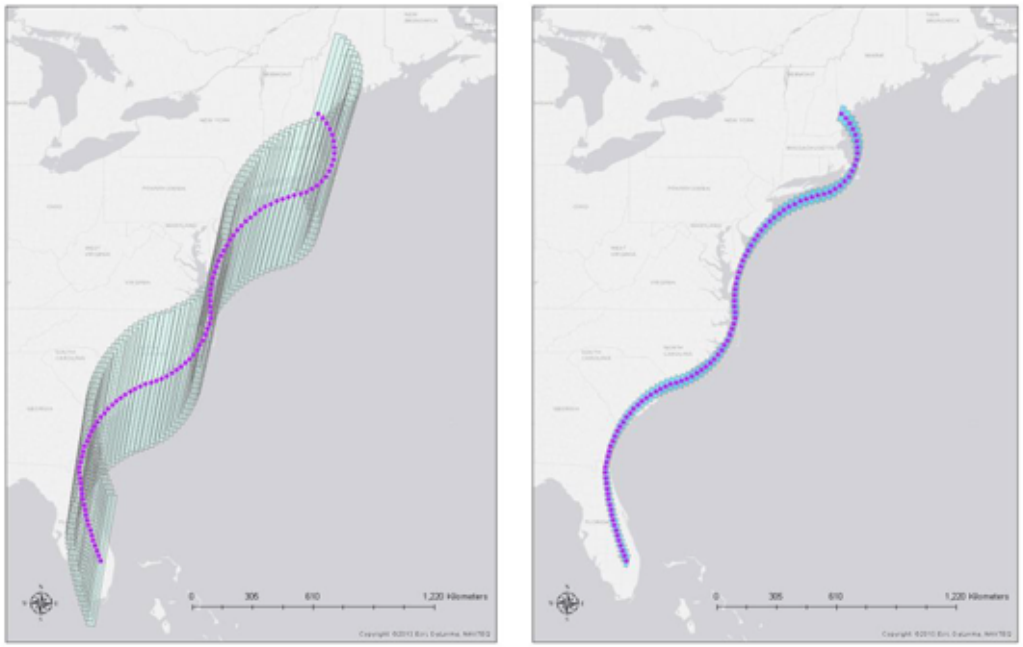


Figure 8.Maxium and minimum accuracy associated with current geolocator technology. Points represent kestrel migration route. Rectangles represent expected max/min error associated with the route.

- ENSP and New Jersey Audubon have been collaborating on grassland bird point count surveys throughout New Jersey since 2005. Below is a summary of American kestrels observed. 2005-2012. An average of 12.125 kestrels were observed over the 8 year survey period.

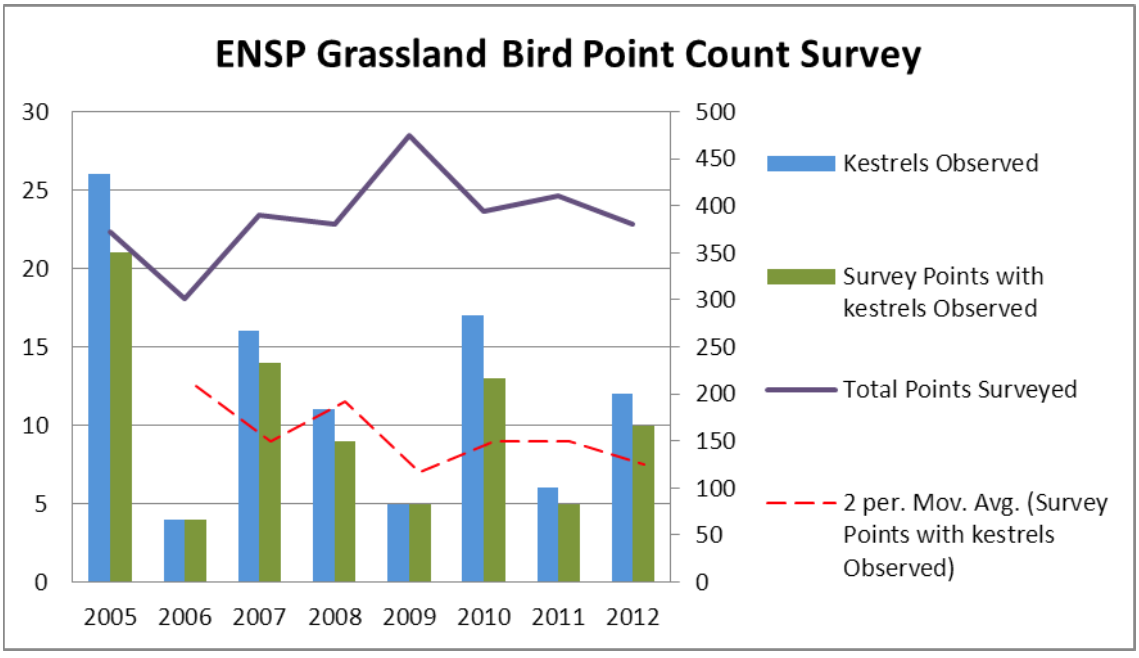


Figure 9. American kestrels observed during ENSP Grassland bird point count surveys

- Project staff won an award ("People's Choice Award") for a poster, *American Kestrel Habitat Loss and Fragmentation* submitted at the 2012 ESRI Mid-Atlantic User Conference held in Baltimore, MD.
- Project staff attended the first meeting of the Peregrine Fund's American Kestrel Partnership. Using the NJDEP's Go to Meeting software, ENSP broadcasted the meeting as a webinar.
- Due to lack of staff time and resources ENSP did not create a nest box manual.
- Staff concluded the use of cameras to be too costly in terms of funding and manpower. Additionally, the resulting data would be too time consuming to analyze and not likely to provide useful information.
- Due to lack of staff time and the focus on monitoring nest boxes, the call playback survey results were not utilized to develop other surveys or survey protocols for the environmental review process for American kestrels.

Conclusions:

- Nest box placement has been successful; we have determined that open habitat patches >250 ha are most suitable and should be the priority for kestrel management.
- Volunteers are a critical component for successful monitoring and data collection. ENSP must work on maintaining volunteer relationships because we do not have the staff resources to adequately monitor the current nest box program.
- Banding chicks and adults provides good baseline data for tracking survival, turnover and nest area fidelity in the NJ population. This data may help identify problems related to population declines.
- ENSP monitored fewer nest boxes but maintained a high success rate and almost the same total number of successful breeding pairs by concentrating on the most productive areas identified in previous years. This change allowed us to maximize staff and volunteer time as well as the number of pairs monitored.

Recommendations:

- Identify a sample of nest boxes in the most productive areas in ENSP study sites to determine occupancy (by kestrels and competitors), kestrel productivity, and causes of mortality and nest failures.
- Remove unoccupied nest boxes in unsuitable habitat and relocate to locations in the largest patch size categories and on properties that are permanently protected from development to maximize use by kestrels.
- Continue to evaluate effectiveness of nest box program to improve kestrel reproductive success.
- Recruit and train a group of dedicated Citizen Scientist volunteers to monitor nest box activity throughout the breeding season.
- Increase efforts to capture and band adult kestrels and maintain efforts to band all nestlings to enable evaluation of survival and site fidelity.
- Use 2014 results of geolocators (fielded in 2013) to determine the effectiveness of geolocator technology to identify migration and wintering areas, which may enable evaluation of threats to survival of kestrels away from their nesting areas.
- Develop framework and funding to investigate use of and potential loss of kestrel migration and wintering habitat in NJ.
- Develop survey protocols to determine habitat use by kestrels that may be recommended for use in environmental review process.

JOB 1M: Secretive Marsh Birds

Project co-leaders: Christina Davis, Senior Environmental Specialist, Sharon Petzinger, Senior Zoologist

OBJECTIVE 1: To determine the efficacy of the acoustic monitoring of secretive marsh birds in New Jersey. ***IN PROGRESS***

OBJECTIVE 2: To determine the relative abundance and distribution of New Jersey's marsh birds, particularly those that are state-listed and of regional and continental concern (black rail, Virginia rail, king rail, sora, common moorhen, least bittern and American bittern). ***INACTIVE***

Key Findings:
After conducting an in-house investigation of acoustic data collected in 2011 and 2012 (see prior years reports), in 2013 ENSP entered a contract with the Biodiversity Research Institute (BRI), who have professional expertise in bioacoustical analysis. The purpose of this work is to determine if their results differ from the ENSP ones derived from in-house staff. If they are more comprehensive, it may be worth the additional expense to outsource the analysis of the recordings. If they are similar to ENSP's, more confidence can be given to internal analysis and the extra cost can be avoided.

Conclusions:
BRI's final report is due to ENSP in late December 2013 and results will be summarized in the 2013-2014 report.

Recommendations: None at this time.

JOB 2: Species of Special Concern

OBJECTIVE: To conserve populations of birds having Special Concern status in New Jersey, and prevent declines that would necessitate listing through a coordinated approach of population and habitat monitoring, threat assessment, habitat protection and acquisition, management, research, education and environmental review.

JOB 2B: Scrub-shrub/Open Field Passerines

Project leader: Sharon Petzinger, Senior Zoologist

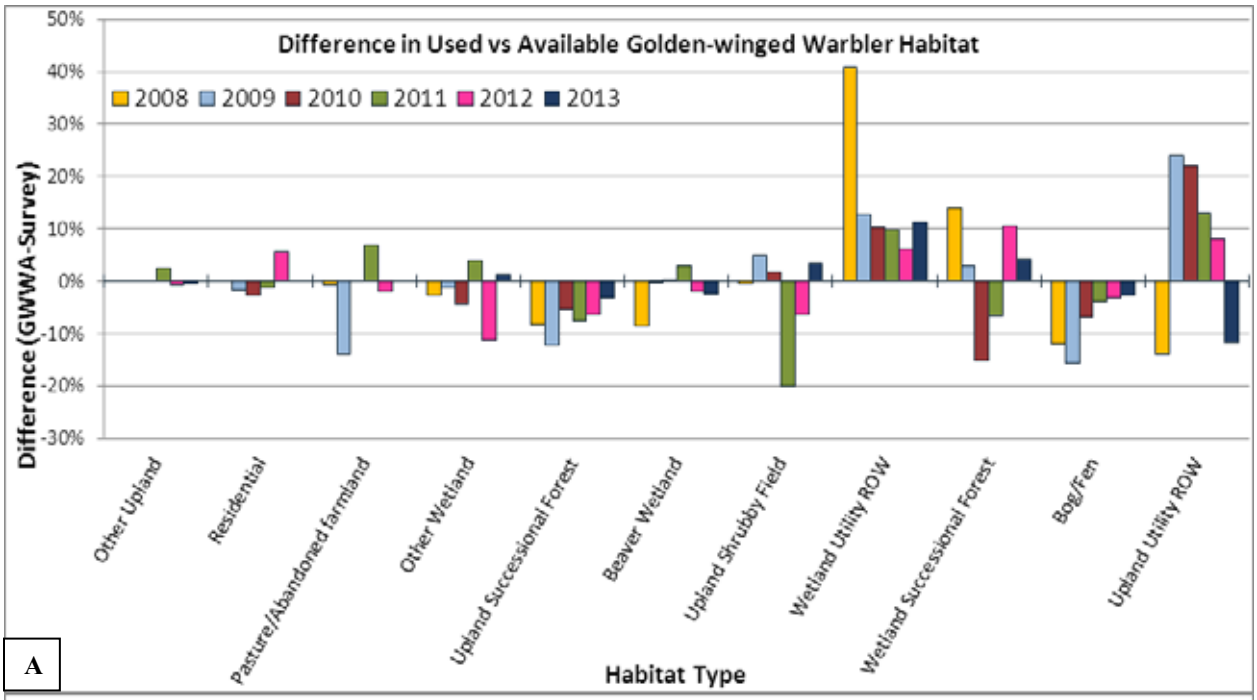
OBJECTIVE: To stabilize and reverse the decline in scrub-shrub/open-field nesting birds of special concern and regional priority, both those that migrate through New Jersey and, in particular, those that breed in NJ. Goals include: inventorying and monitoring species populations, (specifically those not covered by the Breeding Bird Survey), the identification and preservation of critical habitat, the identification of specific threats at these sites, and the provision of guidance/recommendations to land managers and landowners. In 2009-2010: To determine the characteristics of source habitat for golden-winged warblers occupying utility ROWs in New Jersey as well as golden-winged warbler response to certain management techniques used by the utility companies and create, implement, and evaluate habitat management guidelines for the creation of source golden-winged warbler habitat in NJ.

- Data on golden-winged warbler occupancy and habitat were collected in 2013 contributing to the 2013 Golden-winged Warbler Atlas run by Cornell Lab of Ornithology. Biologists surveyed 115 points (110 points in northwestern NJ and five points in southern NY) for golden-winged warblers in potential habitats (utility ROW, shrub swamp, successional forest, old field) to aid in the

identification of priority areas for golden-winged warbler management. Fifty of the 115 points surveyed were new (not surveyed in 2008-2012) and 65 were repeated from 2008, 2009, 2010, 2011, and/or 2012. NJ Audubon surveyed an additional 101 points, using a similar protocol, within select spans of PSEG's utility ROW and provided ENSP with eight possible additional locations where golden-winged warblers were observed. No other data (other species, habitat) were provided.

- General habitat data were collected at 194 survey points in 2013**.** Approximately 40% of the survey points were in predominately wetland habitat, and 60% of the points were in predominately upland habitat.
  - The majority of the survey points were in upland utility ROWs (46%), wetland successional forests (15%), upland shrubby fields (12%), and shrub wetlands (10%). The remainder of the survey points were in beaver wetlands (6%), wetland utility ROWs (4%), upland successional forests (3%), bogs or fens (3%), and other upland (1%) (Fig. 2B-1).
  - Most (95%) of the survey points contained <50% tree cover, with the majority (69%) containing 25-50% tree cover (Fig. 2B-2).
  - Most (86%) of the survey points contained <50% herbaceous cover with the majority (68%) containing 25-50% herbaceous cover (Fig. 2B-2).
  - Most (90%) of the survey points had 35-50% shrub cover with the majority (80%) containing 25-50% shrub cover (Fig. 2B-2).
  - All of the survey points contained <25% dead vegetative cover with the majority (96%) containing no dead vegetative cover (Fig. 2B-2).
  - The height of the vegetation at survey points was <2 m tall at most (69%) points and 31% of the points had vegetation >2m tall (Fig. 2B-3).
  - The majority of points (72%) had swamp or wet ground present; 12% had no water visible (Fig. 2B-4).
- Twenty-five golden-winged warblers, four hybrids, and 56 blue-winged warblers were observed in the 194 survey points in 2013 (Fig. 2B-5). Twenty-three golden-winged, 55 blue-winged, and all the hybrid observations were in NJ. All four hybrids observed were Brewster's males. Nine of the observations were golden-winged pairs and one observation was a female golden-winged mated to a blue-winged warbler male. Overall, between 19 and 23 different golden-winged warbler "pairs" were observed in NJ in 2013.
  - Only five of the 13 golden-winged warbler males and one of the two females banded in 2012 were observed in 2013. Three of the five banded males occupied the same territory in 2013 from where they were banded in 2012. The 2013 observations of the remaining two banded males and banded female were between 1200-2000 m from where they were banded in 2012. One male and two female golden-winged warblers were mist-netted and color-banded in 2013.
  - General habitat data were collected for all 25 golden-winged warblers observed in 2013. Half were in predominately upland habitat and half in predominately wetland habitat; half within utility ROWs and half were outside ROWs.
    - Nine golden-wings (35%) were observed in upland utility ROWs, five (20%) were in wetland successional forest, four (15%) in wetland utility ROWs, four (15%) in upland shrubby fields, three (11%) in other wetlands, and one (4%) in beaver wetlands (Fig. 2B-1).
  - Specific habitat data were collected for 23 golden-wing observations in 2013. Most (87-96%) of the golden-winged warblers were observed in areas with 25-50% herbaceous cover and shrub cover. All golden-winged warblers were observed in areas with <50% tree cover and <25% dead vegetation cover. The majority of the GWWAs (74%) occurred in areas where the average vegetation height was 0-2 m. Most (83%) of the GWWAs occurred in areas where a swamp or wet ground was observed (Fig. 2B-2).
  - Less than ten percent (4/50) of new (non-repeated) survey locations in 2013 were occupied by golden-winged warblers, 38% by blue-winged warblers, and 4% by a hybrid (Fig. 2B-6).

        - Five of the 21 (24%) 2012 survey locations occupied by golden-winged warblers were not occupied in 2013 (Fig. 2B-7).
- Management of selected ROW spans for golden-winged warblers was still held up due to permitting issues. However, staff collaborated with NJ Audubon to assess the ROW spans for golden-winged warblers.
- Guidance for managing lands for golden-winged warblers were provided and surveys conducted for a variety of land managers:
    - Public Lands
        - Management for golden-winged warblers on Sparta Mountain Wildlife Management Area was completed. Post-management surveys were conducted in May of 2012 and 2013 (Table 2B-1), showing that bird abundance increased by 18% but species richness declined from 25 to 23 species. The species composition, however, is shifting towards early-successional species such as chestnut-sided and blue-winged warblers, which corresponds with a regenerating forest after two growing seasons.
        - The second set of cuts on Sparta Mountain were delayed but completed late winter 2013. Plans are being made for a third cut on Sparta Mountain
        - A forest stewardship plan was created for Weldon Brook Wildlife Management Area to create about 30 acres of golden-winged warbler habitat every five years. The 2013-14 practice plan has undergone multiple revisions as a result of public opposition and concerns about impacts to other rare species present on the WMA.
    - Working Lands for Wildlife (WLFW). In 2013 ENSP's participation in this program was not funded under any other federal funding except State Wildlife Grants.
        - Eleven landowners applied for WLFW in 2013 and ten went to contract. In addition, the two applicants from 2012 that did not go to contract were contracted in 2013, resulting in at about 120 acres of land approved to be managed for golden-winged warblers for the next 10 years. This brings the total amount of WLFW managed lands for golden-winged warblers to over 200 acres.
        - Sites of all the applicants were visited and surveyed for breeding golden-winged warblers if suitable habitat was already present on site. Of the four sites with suitable habitat present, one site had a golden-winged warbler along with two blue-winged warblers, another site had a Brewster's warbler along with two blue-winged warblers, and the third and fourth sites each had a blue-winged warbler.
        - Guidance was provided to NRCS biologists and landowners, on a site-by-site basis, for site locations and management techniques to have the greatest probability of achieving golden-winged warbler habitat.
        - ENSP and NJ Audubon will share a NFWF grant in 2014 and 2015 to create, restore, and manage critical breeding golden-winged warbler habitat through the WLFW program in NJ by providing technical and financial support to private landowners to overcome obstacles that would otherwise prevent landowners from enrolling. In NJ, these obstacles would include, but are not limited to, a weak industry for forest products, vast public misperception about the benefits of forest management, and a lack of forestry expertise relative to the creation of high quality golden-winged warbler breeding habitat.
- Staff attended the Appalachian Mountain Joint Venture Technical Meeting in Mansfield, GA, August 12-14, 2013.
- The Golden-winged Warbler Working Group did not meet this year. However, staff worked with other biologists to write the "Best Management Practices for Golden-winged Warbler Habitat on Utility Rights-of-way in the Appalachians," which was published by the Golden-winged Warbler Working Group and released on the gwwa.org website in September 2013.
- The data will be submitted for entry into the NJ DEP's Biotics database by mid-November.



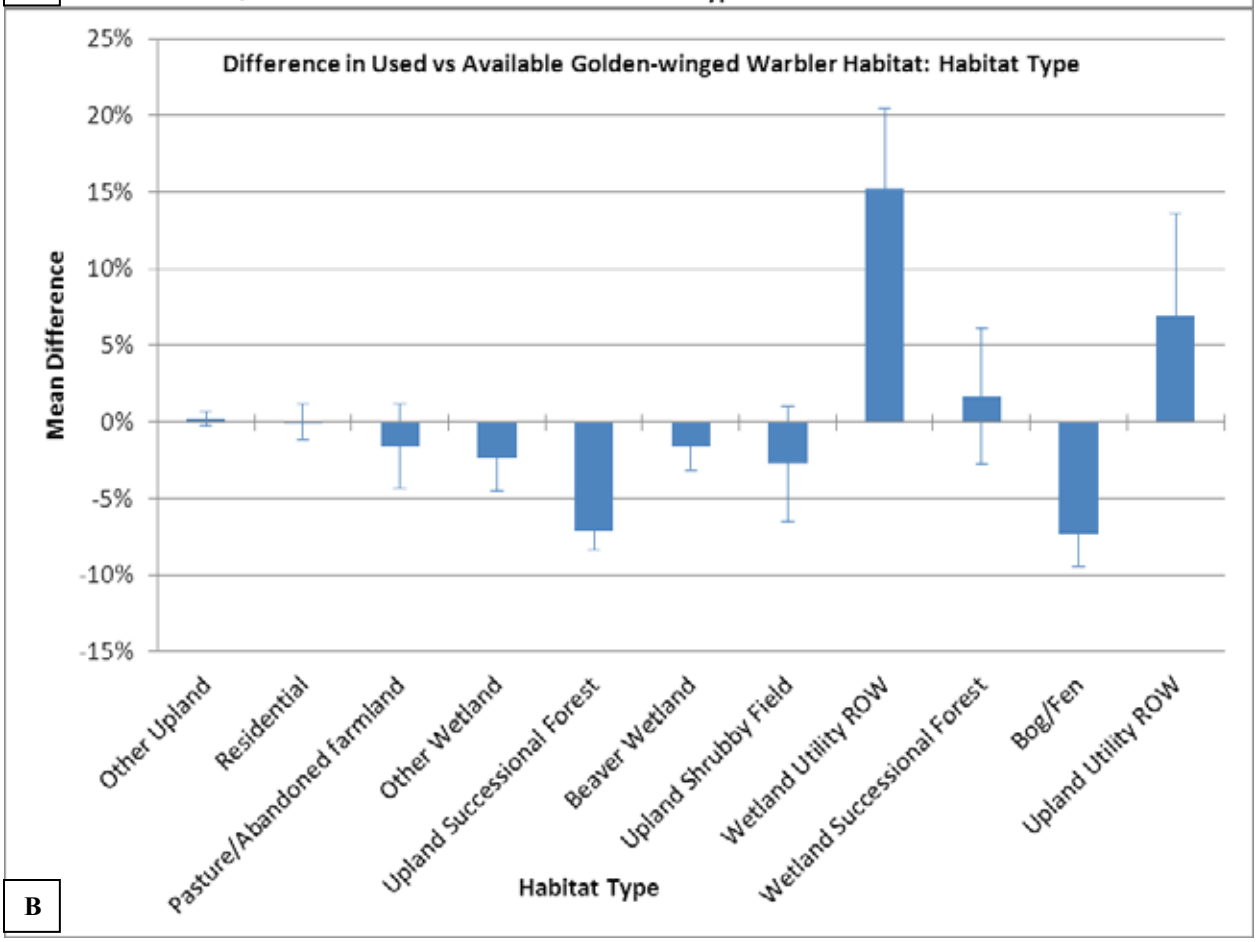
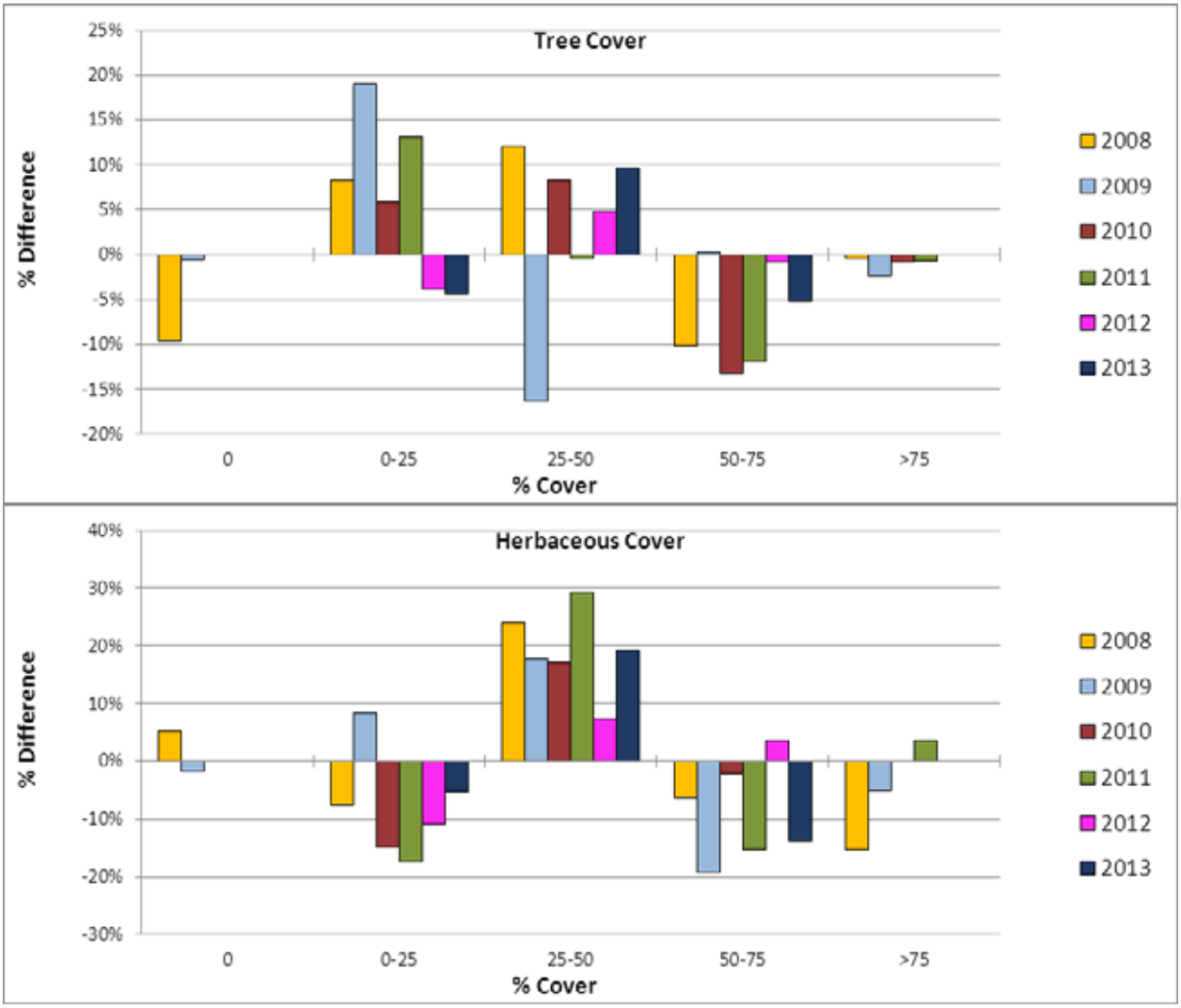
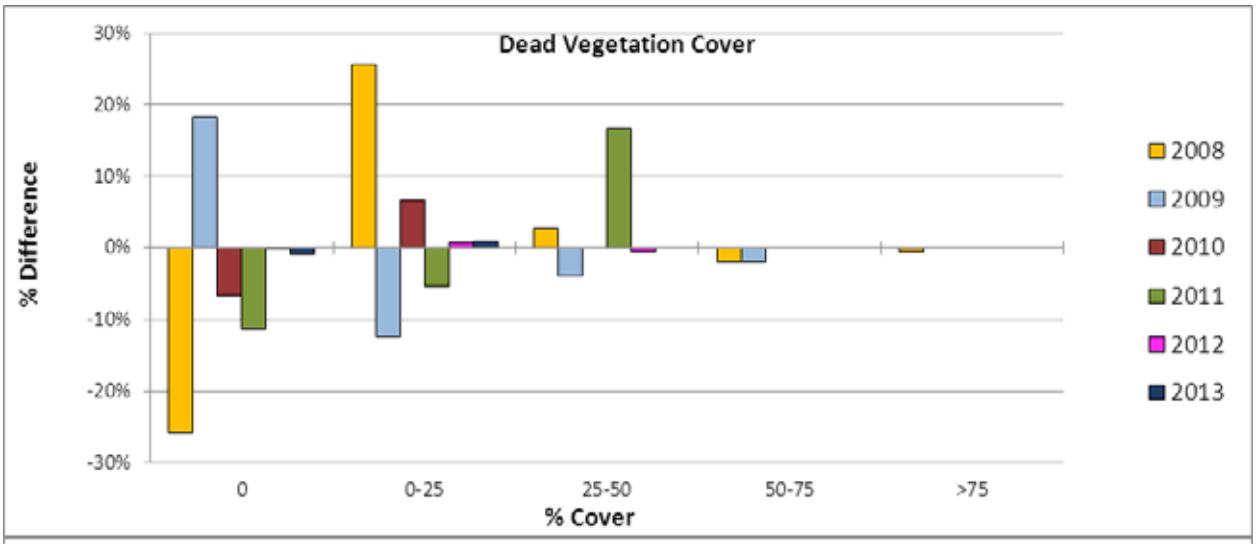
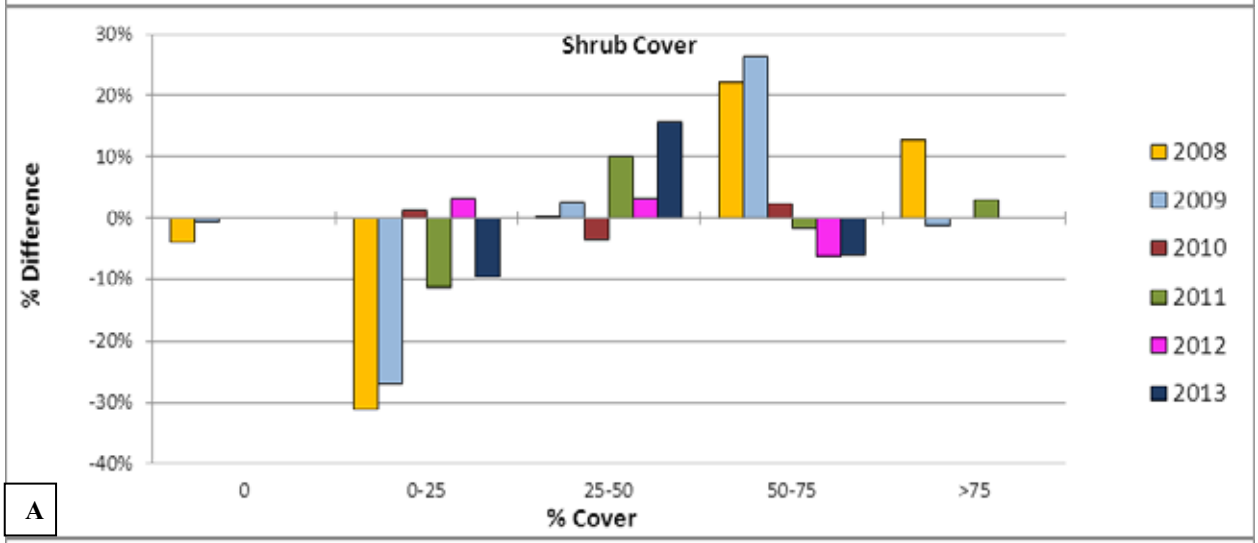


Figure 2B-1. Difference between percentage of each habitat type within all points surveyed and the percentage habitat type within survey points occupied by golden-winged warblers during each of the

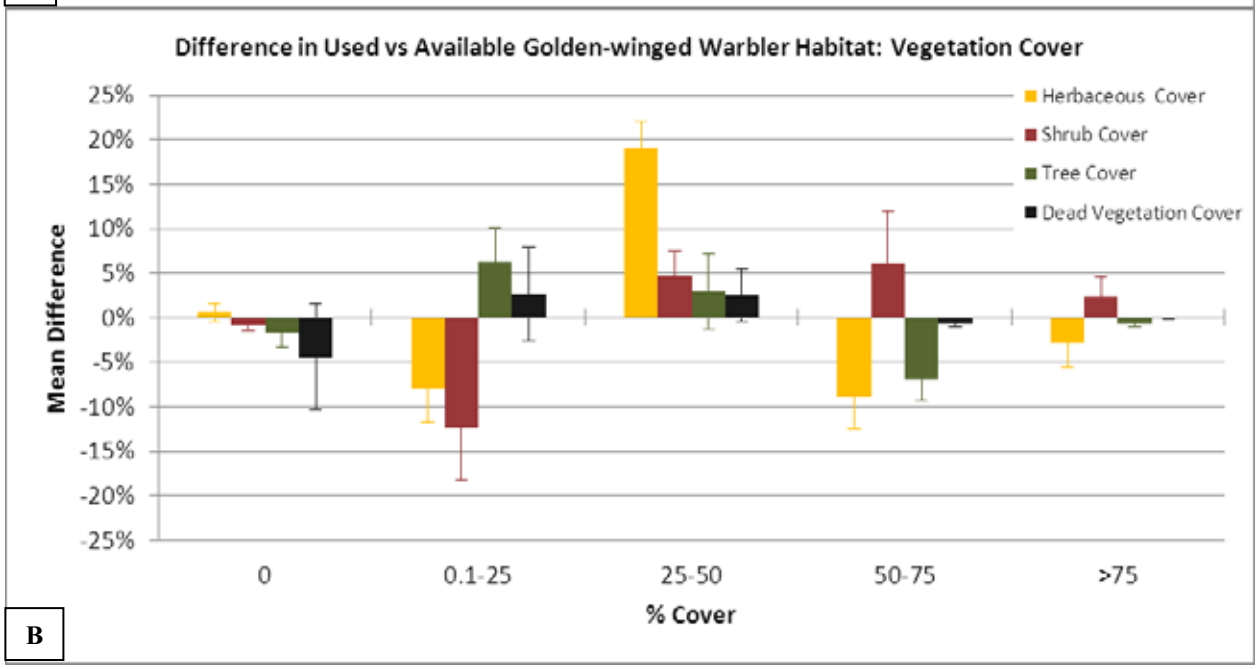
2008-2013 surveys **(A)** and the mean of all years with standard error **(B)**. Positive values (i.e. wetland utility ROW) indicate a positive correlation of the likelihood of golden-winged warbler occupancy to that habitat type. Negative values (i.e. upland successional forest) indicate a negative correlation of the likelihood of golden-winged warbler occupancy to that habitat type. The years where survey efforts were focused heavily on utility ROWs (2008 and 2013) were not consistent with other years that had a more balanced distribution of habitat types, indicating that habitat type is not the only factor involved with golden-winged warbler habitat choice.




Dead Vegetation Cover
% Difference
30%
20%
10%
0%
-10%
-20%
-30%
0
0-25
25-50
50-75
>75
% Cover
2008
2009
2010
2011
2012
2013

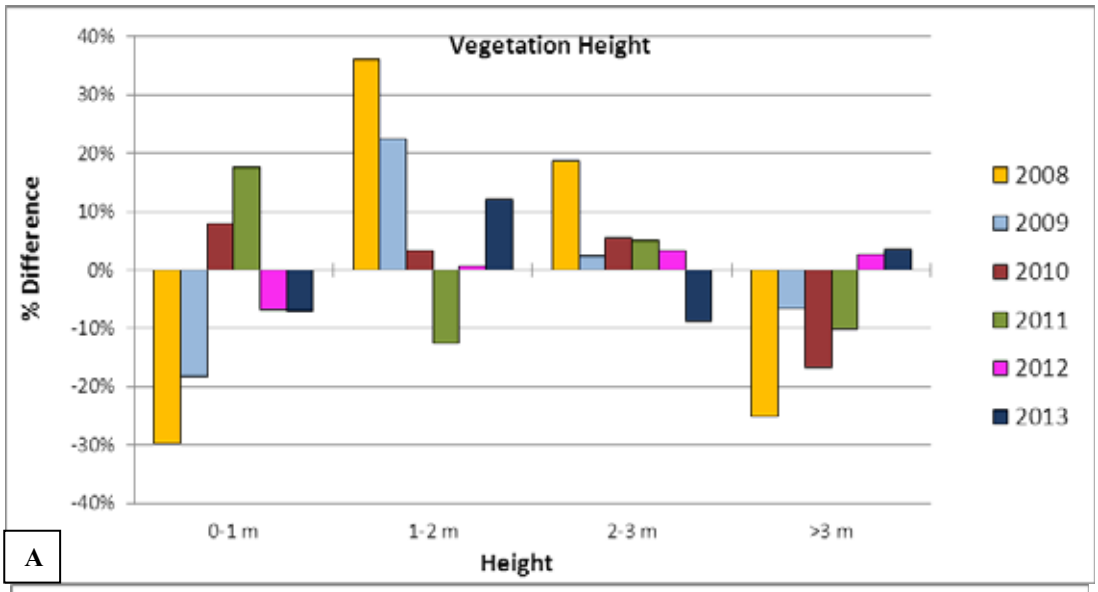

Shrub Cover
% Difference
30%
20%
10%
0%
-10%
-20%
-30%
-40%
0
0-25
25-50
50-75
>75
% Cover
2008
2009
2010
2011
2012
2013

A


Difference in Used vs Available Golden-winged Warbler Habitat: Vegetation Cover
Mean Difference
25%
20%
15%
10%
5%
0%
-5%
-10%
-15%
-20%
-25%
0
0.1-25
25-50
50-75
>75
% Cover
Herbaceous Cover
Shrub Cover
Tree Cover
Dead Vegetation Cover

B

Figure 2B-2. Difference between percentage of each category of habitat cover type within all points surveyed and the percentage of each category of habitat cover type within survey points occupied by golden-winged warblers during each of the 2008-2013 surveys **(A)** and the mean of all years with standard error **(B)**. Positive values (i.e. 25-50% herbaceous cover) indicate a positive correlation of the likelihood of golden-winged warbler occupancy to that category of habitat cover type. Negative values (i.e. 50-75% tree cover) indicate a negative correlation of the likelihood of golden-winged warbler occupancy to that category of habitat cover type. In summary, these graphs show that golden-winged warblers were more likely to consistently occupy areas with <50% (but not 0%) tree cover, 25-50% herbaceous cover, 25-75% shrub cover, and the amount of dead vegetation cover is irrelevant under 50% cover.



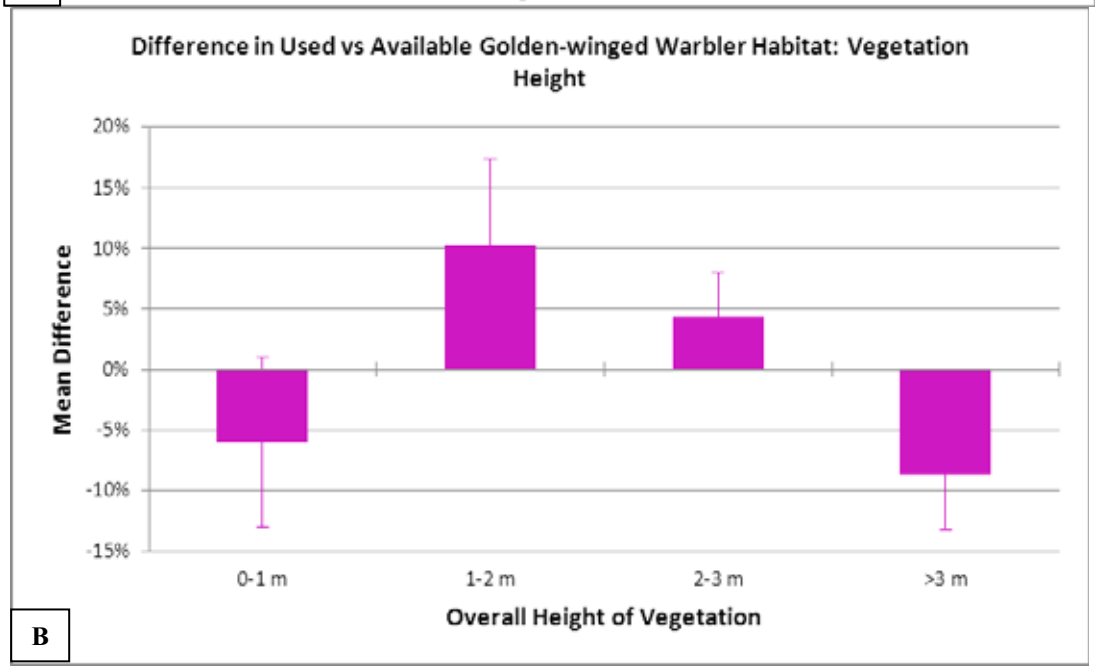


Figure 2B-3. Difference between percentage of the category of overall vegetation height within all points surveyed and the percentage the category of overall vegetation height within survey points occupied by golden-winged warblers during each of the 2008-2013 surveys **(A)** and the mean of all years with

standard error **(B)**. Positive values (i.e. 2-3 m) indicate a positive correlation of the likelihood of golden-winged warbler occupancy to that category of overall vegetation height. Negative values (i.e. >3 m) indicate a negative correlation of the likelihood of golden-winged warbler occupancy to that category of overall vegetation height. In summary, this graph shows that golden-winged warblers were more likely to consistently occupy areas where the overall height of vegetation is between 1 and 3 m.

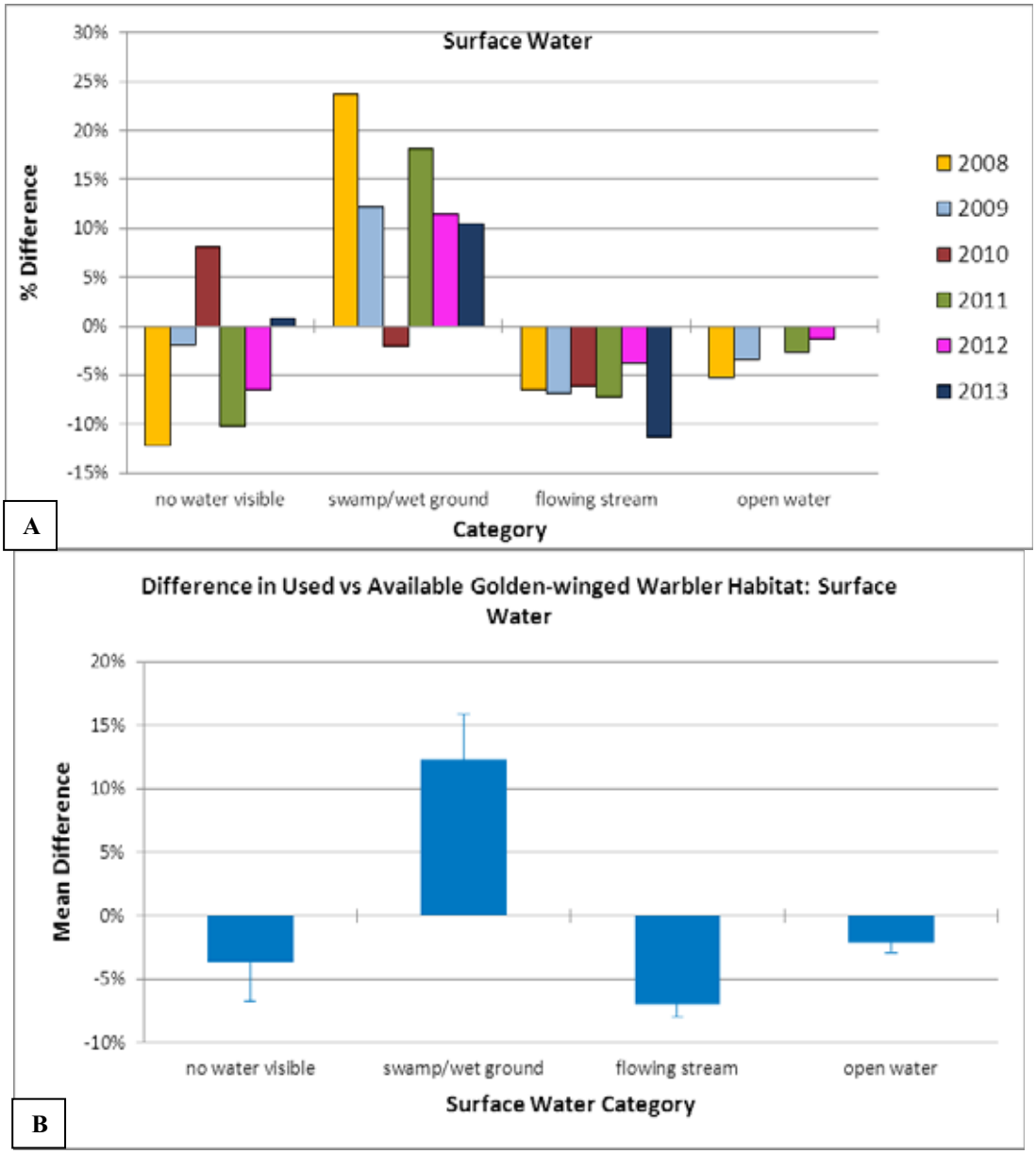


Figure 2B-4. Difference between percentage of the type of surface water present within all points surveyed and the percentage of the type of surface water present within survey points occupied by golden-winged warblers during each of the 2008-2013 surveys **(A)** and the mean of all years with standard error **(B)**. Positive values (i.e. swamp/wet ground) indicate a positive correlation of the likelihood of golden-winged warbler occupancy to that type of surface water. Negative values (i.e. flowing streams) indicate a negative correlation of the likelihood of golden-winged warbler occupancy to that type of surface water. In summary, this graph shows that golden-winged warblers were more likely to consistently occupy areas where swamp or wet ground is present.

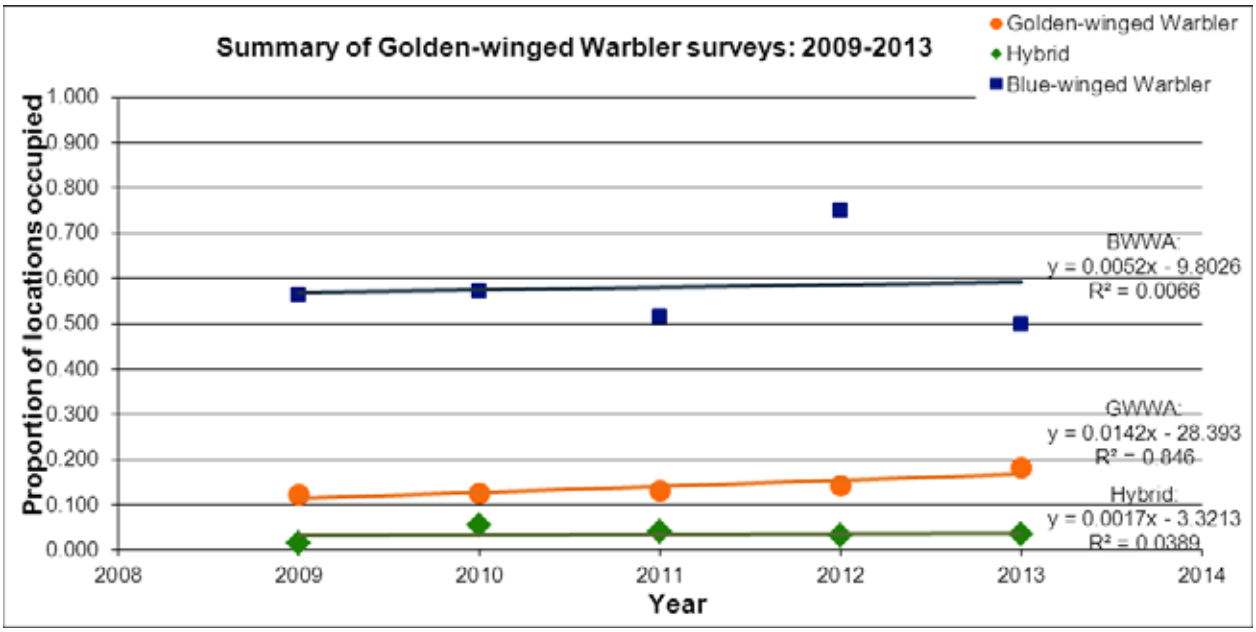


Figure 2B-5. Proportion of golden-winged warblers, blue-winged warblers, and hybrids observed per survey location during the 2009 (n=179), 2010 (n=117), 2011 (n=151), 2012 (n=161), and 2013 (n=110) surveys. The survey from 2008 was not included due to low detectability and a large sample size.

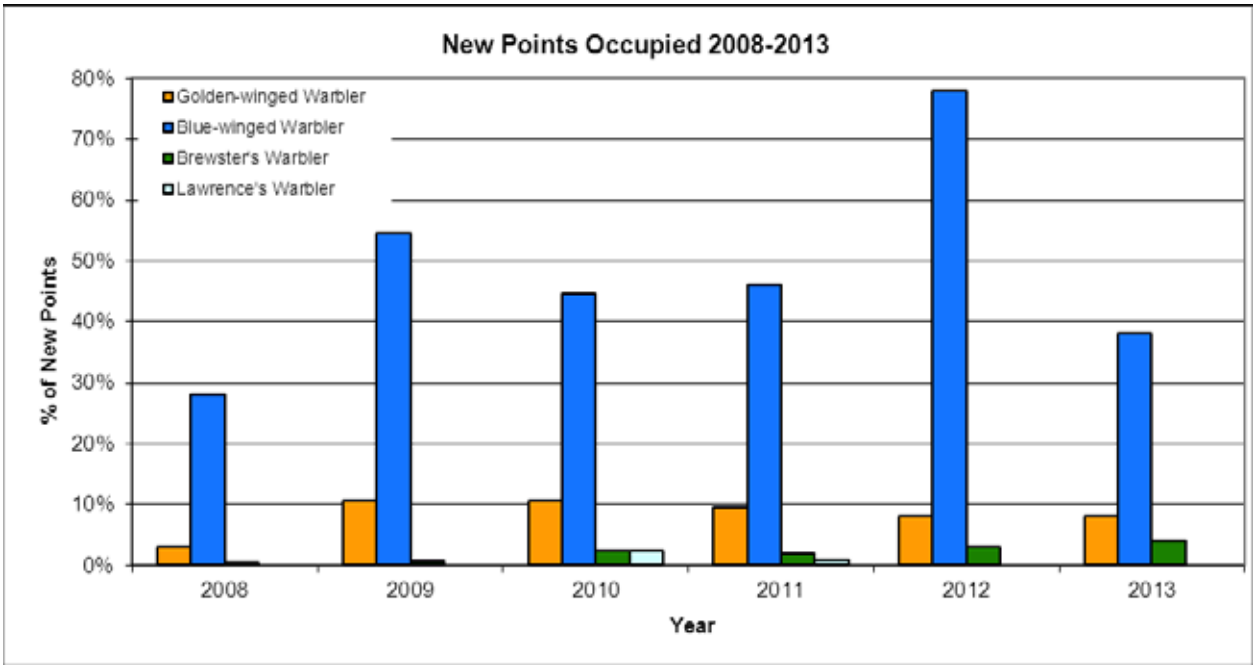


Figure 2B-6. Percentage of new (non-repeated) survey locations occupied by golden-winged warblers (gold), blue-winged warblers (blue), or hybrids (green) during 2008 (n=405), 2009 (n=141), 2010 (n=85), 2011 (n=104), 2012 (n=104), and 2013 (n=50) surveys. Golden-winged warblers have been observed in about 10% of new locations surveyed, whereas blue-winged warblers are more commonly, but less consistently observed in new survey locations.

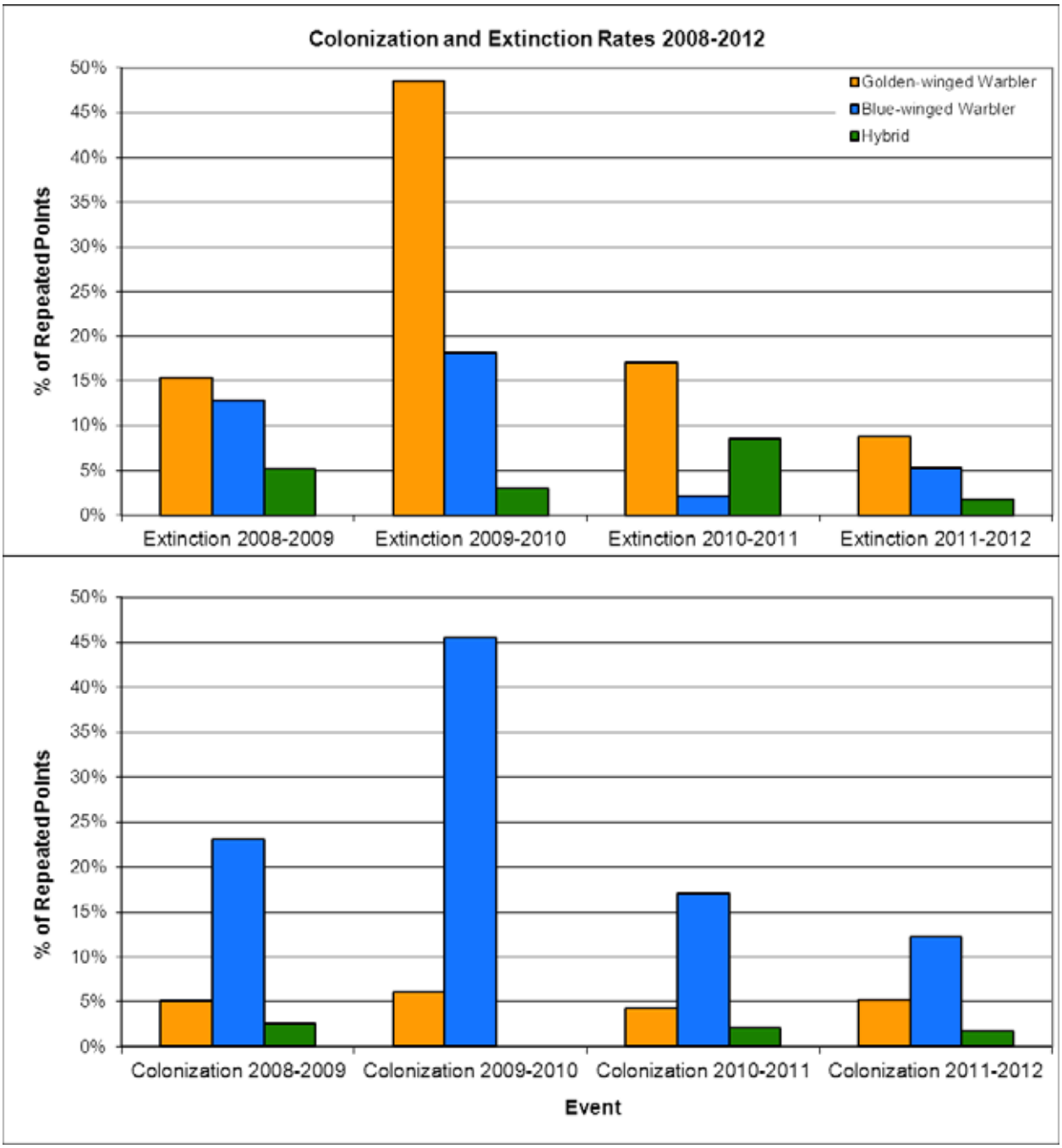


Figure 2B-7. Percentage of golden-winged warbler (gold), blue-winged warbler (blue), and hybrid (green) locations undergoing colonization or extinction events at each survey location repeated during 2008-2009 (n=39), 2009-2010 (n=33), 2010-2011 (n=47), 2011-2012 (n=57), and 2012-2013 (n=63) surveys.

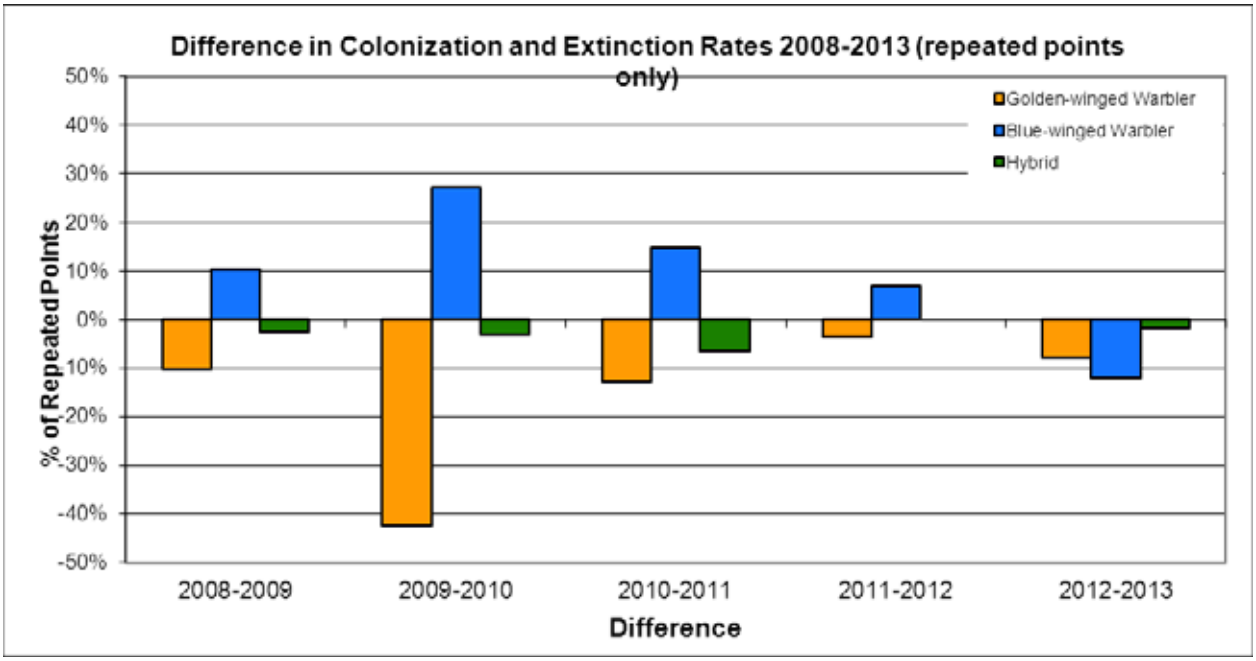


Figure 2B-8. Difference in extinction and colonization events (extinction – colonization) per timespan for percentage of golden-winged warbler (gold), blue-winged warbler (blue), and hybrid (green) locations repeated during 2008-2009 (n=39), 2009-2010 (n=33), 2010-2011 (n=47), 2011-2012 (n=57), and 2012-2013 (n=63) surveys. In summary, this graph demonstrates the continued decline in golden-winged warbler populations and/or amount of suitable habitat in previously occupied sites and the vast difference between blue-winged warbler populations and/or suitable habitat.

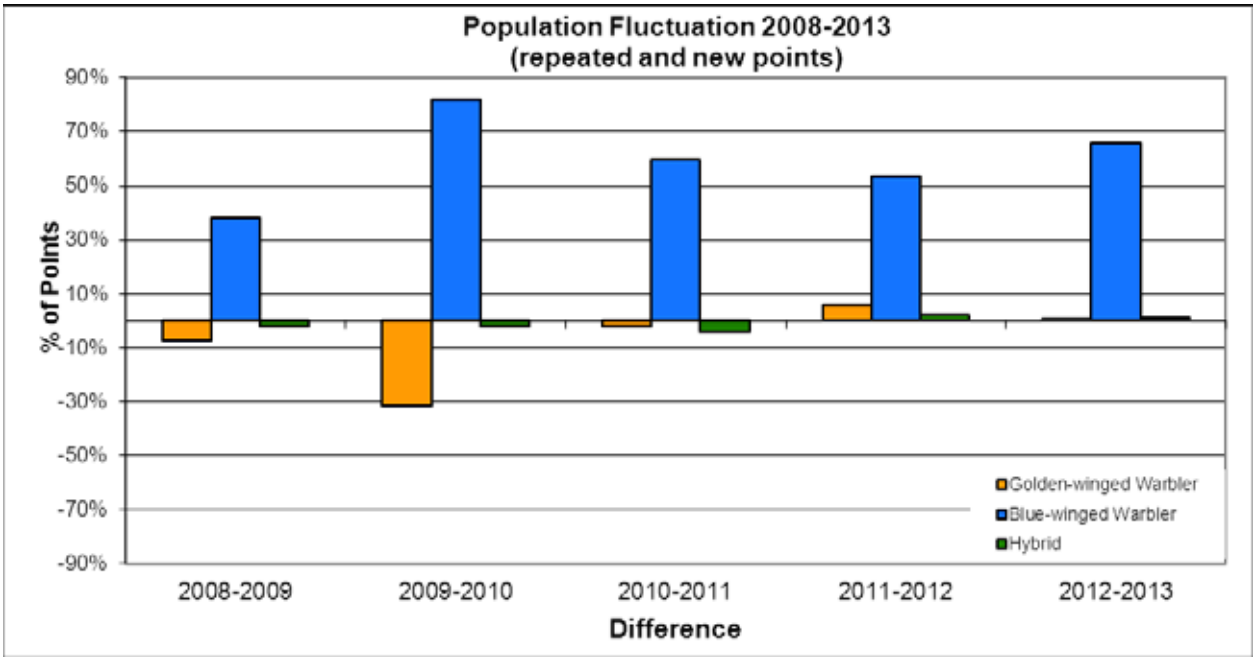


Figure 2B-9. Difference in percentage of golden-winged warblers (gold), blue-winged warblers (blue), or hybrids (green) undergoing colonization or extinction events per timespan at each repeated survey location (Fig. 2B-8 above) with the percentage of new (non-repeated) survey locations occupied by golden-winged warblers, blue-winged warblers, or hybrids (Fig. 2B-6 above) added to it. In other words, add the % of new locations surveyed with golden-winged warblers to Figure 2B-8 to

see the overall picture of what's happening to the populations in NJ. This graph shows that the slightly increasing trend in the golden-winged warbler population (Fig. 2B-5) is due to fewer extinction events over time instead of an increase in new locations.

Table 2B-1.Post-management survey results from Sparta Mountain Wildlife Management Area (total # points surveyed = 3).

Species	2013		2012	
	# Points Detected	# Individuals	# Points Detected	# Individuals
American goldfinch	1	1	0	0
American redstart	2	2	2	3
American robin	3	3	1	1
Baltimore oriole	0	0	2	2
black-capped chickadee	0	0	0	0
blue jay	1	1	0	0
blue-winged warbler	1	1	0	0
blackpoll warbler	0	0	2	2
brown-headed cowbird	0	0	3	3
cedar waxwing	1	1	1	1
chipping sparrow	0	0	1	1
chestnut-sided warbler	2	2	0	0
common yellowthroat	3	4	1	1
eastern bluebird	2	2	3	3
eastern towhee	2	2	2	2
eastern wood pewee	2	2	2	2
field sparrow	2	2	1	1
great-crested flycatcher	3	4	2	2
indigo bunting	3	3	1	2
ovenbird	2	2	1	1
prairie warbler	2	4	3	4
red-eyed vireo	2	2	1	1
rose-breasted grosbeak	0	0	1	1
scarlet tanager	2	2	1	2
song sparrow	2	2	0	0
swamp sparrow	0	0	1	1
veery	0	0	1	1
white-breasted nuthatch	1	1	1	1
wild turkey	1	1	0	0
yellow warbler	3	3	1	1
yellow-rumped warbler	1	1	1	1
yellow-shafted flicker	0	0	1	1
TOTAL ABUNDANCE	44	48	37	41
TOTAL RICHNESS		23		25

Conclusions:

- The breeding golden-winged warbler population in NJ appears to be stabilizing as the number of sites undergoing extinction declines and the number of new occupied sites remaining stable. However, without the maintenance of existing sites and/or creation of new breeding habitat specifically for golden-winged warblers, the population will again begin to decrease.
- Blue-winged warbler populations are still on the rise. The difference between blue-winged and golden-winged warbler populations in NJ could be due to the higher tolerance level of blue-wingeds for fragmented forest in the surrounding landscape.
- Utility ROWs are still the most utilized habitat for golden-winged warblers, but the preference in 2013 was wetland forest (ROW P_{occ} = 0.99; Wet Forest P_{occ}=1.68). They showed no preference for upland shrubby fields (P_{occ} = 0.99), and shrub swamps were the least preferred (P_{occ}=0.81). The lack of continuity in habitat preference through the years may be due to succession, but could also be biased by the ratio of new sites surveyed vs. existing sites. When combining all years, however, wetland ROWs, upland ROWs, and wetland successional forest are more likely to be occupied by golden-winged warblers than any other habitat type surveyed.
- Golden-winged warblers are most likely to occupy sites with 25-50% herbaceous cover, >25% shrub cover, and <50% tree cover. Dead vegetation, or slash, is tolerated as long as it is in <50% of the area. The distribution of vegetation cover correlates with the vegetation height of 1-3 m that golden-winged warblers are most likely to occupy; 3m is the threshold in distinguishing between tree and shrub cover.
- In addition to utilizing ROWs and wetland forest with a few trees and a mix of shrub and herbaceous cover, the presence of swamp or wet ground, separate from streams, ponds, and/or lakes, within or adjacent to an occupied site is most likely to be occupied by golden-winged warblers.

Recommendations:

- Analyze the amount of forest cover around each survey point and correlate it to the presence of golden-winged warblers.
- Create a publishable version of management recommendations for golden-winged warbler habitat based on the analyses of 2003-7 and 2008-2013 data and in coordination with the Golden-winged Warbler Working Group.
- Continue to provide technical assistance pertaining to forest management for golden-winged warblers on private and public lands, including WLFW.
- 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.
- Complete the status assessment and draft species recovery plan for golden-winged warblers in NJ.

JOB 2C: Monitoring Avian Productivity and Survivorship (MAPS)

Project leader: Sharon Petzinger, Senior Zoologist

OBJECTIVE: To provide data to the Institute for Bird Populations that will help describe temporal and spatial patterns in the vital rates of target species. Identify causes of population declines, formulate strategies to reverse declines and maintain healthy populations, and evaluate effectiveness of strategies.

Key Findings:

- The MAPS banding station at Bear Swamp was inactive in 2013 due to loss of trained volunteers coupled with limited staff time and funding. It was also decided to keep this project inactive for at least the next two years or until more funding, staff, and/or volunteers become available.

Conclusions:

- Although the overall trend for both species abundance and richness at Bear Swamp are stable, there has been a consistent downward trend since 2008 (Fig. 2C-1) and productivity is below the mean of the last 19 years (Fig. 2C-2). This may be due to a natural cycle in bird population numbers, a result of continued forest succession arriving above a threshold for some breeding birds, weather events, or a combination of the factors mentioned.
- The dominant species at Bear Swamp has consistently included ovenbirds, worm-eating warblers, and/or wood thrush every year since 1994 (Table 2-1). According to the breeding bird survey trends in the New Jersey between 2001 and 2011, populations of tufted titmice, worm-eating warblers, and Acadian flycatchers have been increasing, wood thrush, Kentucky warblers, and common grackles have been decreasing, and ovenbirds have been fluctuating but declining
- Trends from the Breeding Bird Survey (BBS) can partly explain the lower numbers of banded wood thrush and Kentucky warblers as well as the higher numbers of tufted titmice the last few years, but no other BBS trends have been reflected in changes in species composition at Bear Swamp.

Table 2C-1. Most dominant three species mist-netted at Bear Swamp, 1994-2012.

Year	Dominant Species		
1994	Gray Catbird	Ovenbird	Wood thrush
1995	Ovenbird	American redstart	Acadian flycatcher
1996	Ovenbird	American redstart	Worm-eating warbler
1997	Ovenbird	Worm-eating warbler	Kentucky warbler
1998	Ovenbird	Acadian flycatcher	Worm-eating warbler
1999	Worm-eating warbler	Ovenbird	Wood thrush
2000	Ovenbird	Worm-eating warbler	
2001	Worm-eating warbler	Kentucky warbler	Ovenbird
2002	Ovenbird	Worm-eating warbler	Wood thrush
2003	Ovenbird	Wood thrush	Worm-eating warbler
2004	Wood thrush	Ovenbird	Worm-eating warbler
2005	Wood thrush	Worm-eating warbler	Common grackle
2006	Wood thrush	Ovenbird	Tufted titmouse
2007	Common grackle	Wood thrush	Ovenbird
2008	Ovenbird	Worm-eating warbler	Wood thrush
2009	Ovenbird	Wood thrush	Worm-eating warbler
2010	Ovenbird	Tufted titmouse	Common grackle
2011	Ovenbird	Worm-eating warbler	Common grackle
2012	Ovenbird	Tufted titmouse	Worm-eating warbler

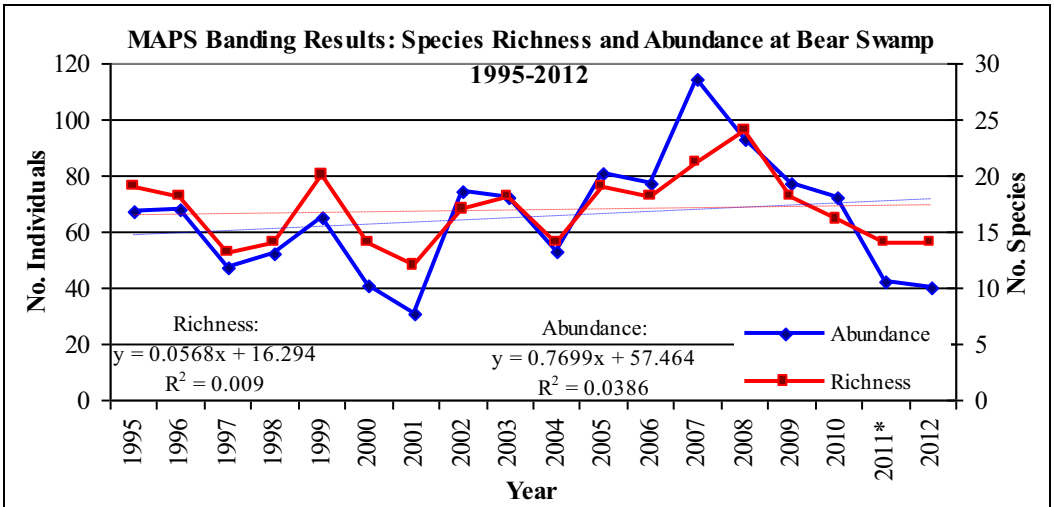


Figure 2C-1. Species richness and abundance at the Bear Swamp banding station 1995–2012 (1994 banding results were omitted due to inconsistencies/bias of the first year).
* Period 9 was missed in 2011 due to inclement weather

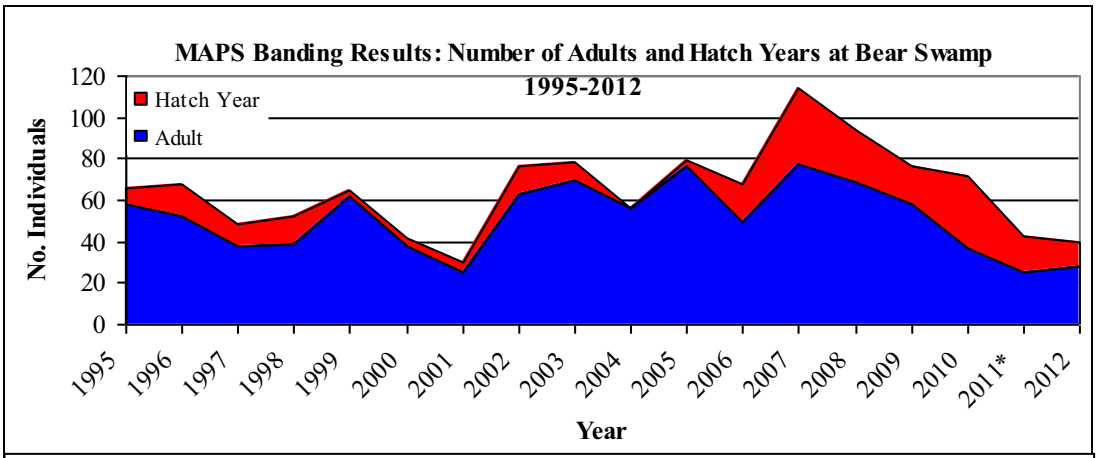


Figure 2C-2. Number of adults and hatch-year birds at the Bear Swamp banding station 1995–2012 (1994 banding results were omitted due to inconsistencies/bias of the first year).
* Period 9 was missed in 2011 due to inclement weather

Recommendations:

- We do not recommend continuing this project in 2014 or 2015 but will examine re-instating it for 2016 based on availability of trained volunteers, staff time, and funding.

JOB 2D: Region-based Breeding Landbird Surveys

Project leader: Sharon Petzinger, Senior Zoologist

Inactive

JOB 3: Species of Regional Priority

OBJECTIVE: To monitor and conserve populations of birds having a Regional Priority status in the northeast, and prevent declines that would necessitate listing.

JOB 3A: American Oystercatcher

Project leader: Christina Davis, Senior Environmental Specialist
Inactive.

JOB 3B: Regional & National Bird Coordination

Project leader: Sharon Petzinger, Senior Zoologist

OBJECTIVE: To continue active participation in regional/national meetings, planning, and surveys including the Breeding Bird Survey, Coordinated Bird Monitoring, Partners in Flight, Atlantic Flyway Council, Nongame Technical Section and other working groups pertinent to bird research.

Key Findings:

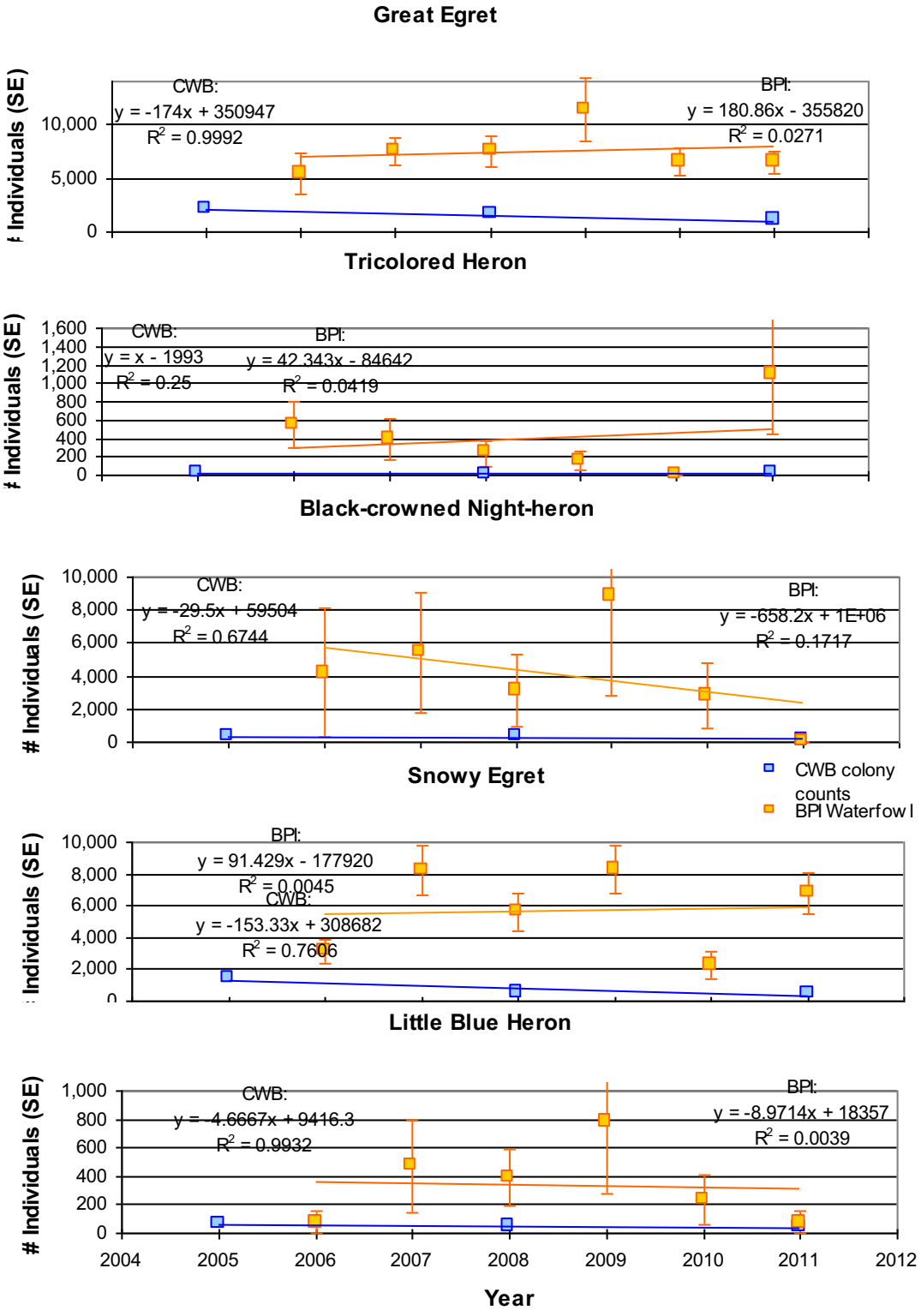
- Staff attended the Appalachian Mountain Joint Venture Technical Meeting in Mansfield, GA from August 12-14, 2013. The project leader presented on how to create golden-winged warbler habitat in the face of public opposition to forest management.
- Twenty-one out of 28 routes were assigned in 2013 with 17 volunteers and 1 staff and all 21 routes were run.
- No ENSP staff conducted waterfowl surveys in 2013 because ENSP's participation in the waterfowl breeding population index was officially phased out.

Conclusions:

- Collaboration with other states and regions is critical for large-scale bird monitoring and should be a high priority for the state of New Jersey.
- Colonial waterbird trends cannot be adequately measured from the BPI due to discrepancies in protocol and analyses (randomized area ground search for population index versus systematic aerial colony count for species with a clustered distribution).

Recommendations:

- Continue to participate in the Northeast Coordinated Bird Monitoring Working Groups and other regional coordination efforts.


Great Egret
CWB:
y = -174x + 350947
R2 = 0.9992
BPI:
y = 180.86x - 355820
R2 = 0.0271
# Individuals (SE)
10,000
5,000
0
Tricolored Heron
CWB:
y = x - 1993
R2 = 0.25
BPI:
y = 42.343x - 84642
R2 = 0.0419
1,600
1,400
1,200
1,000
800
600
400
200
0
Black-crowned Night-heron
CWB:
y = -29.5x + 59504
R2 = 0.6744
BPI:
y = -658.2x + 1E+06
R2 = 0.1717
10,000
8,000
6,000
4,000
2,000
0
Snowy Egret
CWB colony counts
BPI Waterfowl
BPI:
y = 91.429x - 177920
R2 = 0.0045
CWB:
y = -153.33x + 308682
R2 = 0.7606
Little Blue Heron
CWB:
y = -4.6667x + 9416.3
R2 = 0.9932
BPI:
y = -8.9714x + 18357
R2 = 0.0039
1,000
800
600
400
200
0
2004
2005
2006
2007
2008
2009
2010
2011
2012
Year

EXECUTIVE SUMMARY

Project: **Mammal Conservation**
Federal Aid Project: T-1-6 (State Wildlife Grants)
Segment dates:
Total Project Expenditures:

ALL JOBS IN THE MAMMAL PROJECT WERE INACTIVE IN T-1-6, BUT WERE ACTIVE UNDER NEW JERSEY W-71-R.

EXECUTIVE SUMMARY

Project: **Reptile and Amphibian Conservation**
Federal Aid Project: T-1-6 (State Wildlife Grants)
Segment dates: September 1, 2012 to August 31, 2013

JOB 1: Federal and State Listed Reptiles and Amphibians

OBJECTIVE: To develop comprehensive, landscape-level conservation and management plans for all federal and state-listed reptiles to ensure long-term viability of populations.

JOB 1A: Bog Turtle

Project leader: Brian Zarate, Senior Zoologist

OBJECTIVE: To monitor and conserve populations of the federally threatened and state endangered bog turtle *(Glyptemys muhlenbergi)* on public and private lands.

Key Findings:

- For the past two field seasons management of bog turtle by ENSP has been split between a northern and southern zoologist. B. Zarate continued to serve as the project lead and B. Pitts assisted in coordinating work in the southern region. The project leader's time was primarily spent coordinating site access to private lands for volunteers, reviewing Scientific Collecting Permits, and field training ENSP and CWF staff. B. Pitts coordinated project work at eight sites in his region, including visual or habitat surveys and assessments at all eight sites, habitat management and/or coordination at five of the sites, in addition to coordination of WRP easements at two of the sites.
- During the 2012-2013 segment, ENSP volunteers were assigned to the same 46 sites as in 2011-2012 to conduct visual surveys and suggest habitat restoration needs. No data were received as of November 30, 2013. Many project volunteers were contracted to do other herp work in 2013, limiting their availability to conduct volunteer work. Also, those working under NJ scientific collecting permits have until January 31, 2014, to report data, which may also explain the lack of data received.
- B. Zarate joined two new initiatives related to bog turtle conservation. 1) A bog turtle database design team; much of the work related to this team was not initiated until the end of this segment. Team goals will be to help inform the design and testing of a regional bog turtle database. ENSP hopes to use the database structure to capture data on other species as well, and will coordinate with the design team to ensure compatibility. 2) A bog turtle programmatic consultation: The FWS initiated the development of the programmatic to improve coordination between transportation planners and bog turtle conservationists at the state and federal levels. During this segment, an initial meeting was held to introduce the project to NJDOT and identify partners and their roles. The final product is expected to be available by the third or fourth quarter of 2014. Federal Highway Administration will fund ENSP's role in the project, but to date this work has been conducted under the T-1 bog turtle job.
- As reported last period, a study with Hofstra was starting to use telemetry to monitor habitat use pre- and post-habitat management. Hofstra completed the telemetry work in the 2013 field season, but ENSP has not yet received a final report on this. Coordination between ENSP and the Lands Management bureau stalled on the habitat management tentatively planned for fall 2013/winter 2014. We will consider the restoration plan for next winter after evaluating and analyzing the telemetry project results.

- Due to the development of a regional bog turtle database all NJ bog turtle data analysis was put on hold until the database is complete and the NJ data is entered.
- No bog turtle nests were found by ENSP or CWF staff in the 2013 field season so no nests were protected using a modified predator exclusion nest design.
- No surveys were done this reporting period with the dog-handler team.

Conclusions:

- Time spent on other program priority projects, such as Habitat Connectivity, has minimized B. Zarate's time on bog turtle field work for surveys, habitat restoration, or habitat monitoring. Zarate will continue to coordinate the overall project and activities related to volunteers and partners, while B. Pitts will continue to develop his field techniques and coordinate work in the southern region.
- The SWG reporting deadline does not coincide well with reporting deadlines for volunteers, per the Scientific Collecting Permit language. This discrepancy leads to a minimal amount of information to report in some years (e.g., NJ T-1-6 2011-2012 and this report).

Recommendations:

- B. Zarate will prioritize his 2014 field time for training conservation partners in survey techniques and habitat assessments to benefit the project implementation and monitoring components of USDA-NRCS WLFW and WRP projects.
- Begin design of bog turtle summary tables that are updated and presented in each SWG report, to reflect comprehensive data at that time. Doing so may help with the reporting of data received after the report deadline and serve as a standard to track statewide recovery process.
- Evaluate the Hofstra telemetry data and determine need for habitat restoration. Design and coordinate implementation of a management plan for the winter of 2014.

JOB 1B: Wood Turtle

Project leader: Brian Zarate, Senior Zoologist

OBJECTIVE: To determine wood turtle (*Glyptemys insculpta*) productivity, recruitment and mortality factors for adults, juveniles and nests, as well as home range sizes and habitat selection. Use this information to develop conservation strategies for viable populations.

Key Findings:

New Jersey staff participated in the Regional Conservation Needs (RCN) Wood Turtle Project. For fall, 2012, surveys:

- ENSP staff coordinated the New Jersey RCN surveys as outlined by Mike Jones from the University of Massachusetts, Amherst. We contacted potential volunteer surveyors and administered the approval of scientific collecting permits in NJ. Eight volunteers participated and surveyed 1-km time-constrained transects in five different counties. The results from these surveys were submitted through a web portal directly to the regional project coordinator, Mike Jones, and ENSP does not yet have access to the results.

For spring, 2013, surveys:

- ENSP staff coordinated the New Jersey RCN surveys as outlined by Mike Jones from the University of Massachusetts, Amherst. We contacted potential volunteer surveyors and administered the approval of scientific collecting permits in NJ. Eight volunteers participated and surveyed 1-km time-constrained transects in four different counties. The spring surveys were different from the fall surveys in that participating states were assigned randomly generated 1-km transects. Five random transects were sampled by three of the volunteers. The other five volunteers surveyed the same transects they did in the fall. The results from these surveys were

submitted through a web portal directly to the regional project coordinator, Mike Jones, and ENSP does not yet have access to the results.

Additional Actions

- No work began on a species status assessment or recovery plan. Recent staff discussions have tabled work on these products for wood turtle until a later date.
- No work was done to identify local populations where augmentation through nest creation and/or protection may benefit wood turtle recovery or long-term stability.

Conclusions:

- New Jersey's participation in the regional RCN project provides a structured framework in which to assess wood turtle populations and information gathered as part of the project will help inform a regional status assessment. A finalized regional status assessment will be useful in creating a NJ-specific statewide status assessment and be an informative resource for species status reviews.

Recommendations:

- Based on the final results of the RCN report (final draft by early 2014), continue to implement standardized survey protocol.
- Identify key habitat regions or specific metapopulations for wood turtle in the state. Work with Bureau of Land Management to proactively manage for the species.

JOB 1C: Timber Rattlesnake

Project leader: Kris Schantz, Principal Zoologist

OBJECTIVE: To conserve NJ's timber rattlesnake *(Crotalus horridus)* populations through a coordinated approach of population and habitat monitoring, threat assessment, habitat protection and acquisition, management, research, education and environmental review, and to identify timber rattlesnake dens and critical habitat use in the Highlands, Pinelands, and along the Kittatinny Ridge where data gaps exist.

Key Findings:

- During this segment, 118 rattlesnake sightings were entered into NJ DEP's Biotics database (Biotics) and an additional 54 rattlesnake sightings were entered into ENSP's tracking database and will be reviewed by ENSP staff over the next year for entry into the Biotics database. In addition, 31 timber rattlesnake observations were reported by State-approved venomous snake monitors working on a large project sites in northern New Jersey and are under ENSP review.
- The Biotics database was updated with sighting records for timber rattlesnakes for use in Landscape Project habitat mapping.
- No radio transmitters were implanted in or attached to timber rattlesnakes during this segment. All snake observations could be connected to documented dens or were random observations reported by citizens.
- No further work was conducted on the rattlesnake status assessment (which would contribute to the development of a recovery plan) due to staff time constraints.
- Snake Fungal Disease: ENSP biologists, with the help of volunteers and Wildlife Conservation Society (WCS) personnel, targeted known timber rattlesnake dens and transient basking habitats in the northern region and Pinelands sites for potentially infected snakes.
    - Pinelands' surveys included three documented gestation/birthing areas surveyed regularly throughout the gestation period (mid-July through early September):
        - One corn snake was confirmed positive for *Ophidiomyces ophidiiocola* (photos 1a-1d).

        - Two female timber rattlesnakes were observed by a volunteer at a gestation site exhibiting sign of necrotic facial tissue and lesions. Subsequent surveys failed to relocate the females and they were not captured. No photos available.
        - Results can be found in Table 1 and photographs 2a-2c for additional reference.
    - Northern Region surveys included eight documented timber rattlesnake dens/den areas (seven in the Highlands Region, one within the Kittatinny Ridge and Valley). Four of these den areas were visited five times during emergence, one was surveyed twice and three were surveyed once. Two of these den areas were sites where ENSP personnel had observed and/or collected potentially infected snakes in 2012.
        - Two timber rattlesnakes from one den area in the Highlands (referenced as "Den 3" in *NJ T-1-6 interim report, 2011– 2012*) were confirmed positive for *O. ophidiiocola*. No photographs available.
        - Timber rattlesnake (W-53-13): In 2012, the rehabilitator submitted a scab to the National Wildlife Health Center (NWHC) for testing. Since NWHC does not accept sheds for diagnostic testing as they are unable to conduct histopathology on such samples, the scab was taken in for research assessment only. They had isolated *O. ophiodiicola* from the piece of shed using culture techniques but could not test for fungal invasion in the living layers of the skin, so they were unable to make a final diagnosis. Once the snake was submitted to WCS, testing revealed he was negative for *O. ophiodiicola,* although Dr. Jean Pare (WCS) believed he was positive based on clinical symptoms and NWHC's findings (Photos 3a and 3b).
    - Results can be found in Table 1 and photographs 4 and 5 for additional reference.
    - Not reflected in Table 1 and prior to ENSP's partnership with WCS, one black rat snake and one black racer had been collected in 2012 from the Highlands Region for testing and observation, respectively. While the black racer had been released after shedding and supportive care during summer 2012, the black rat snake was euthanized by a licensed rehabilitator due to the extensive damage to its eyes and face. The rehabilitator submitted the body to the USGS National Wildlife Health Center (NWHC) in March 2012 for testing. In September 2012, NWHC reported that fungal isolation techniques detected *Chrysosporium* sp. (later renamed *O. ophidiiocola*).

<u>RESEARCH AND CONSERVATION – Pinelands Region</u>

- ENSP continued to partner with NJCF to identify timber rattlesnake critical habitats in the Pinelands.
    - In September 2012, ENSP and NJCF attached an external transmitter to a small, gravid timber rattlesnake (suspected to be having her first litter based on her size). She shared the gestation/birthing site with another gravid timber rattlesnake. Between the two, 13 neonates were observed and based on the neonates' proximity to each female, NJCF staff attributed 3-4 of the neonates to the transmittered female. NJCF tracked her for the remainder of the season to a previously undocumented den. The transmitter remained attached through hibernation and fell off shortly after spring emergence (not shed off). Surgical tape showed no sign of potential injury to the female.
- ENSP biologists did not conduct further work in the Pinelands due to the difficulty of locating dens in the predominantly sandy substrates within timber rattlesnake range. Significantly more resources, including radio telemetry, will be required to be effective in this part of their range. Efforts focused on surveying for snakes potentially infected with the snake fungal disease (as described above).
- Venomous Snake Response Team (VSRT):
    - Staff held five VSRT trainings in September, 2012, training 21 newly-recruited participants.
    - No trainings were held in 2013 due to staff time constraints.
    - Of the 29 documented members of the Venomous Snake Response Team (excluding federal personnel but including the 2012 new recruits), only 26 are considered active members in the southern region. Of those, only three submitted timesheets reporting their 2012-2013 response activity in time for this report and an additional 22 participants provided documented in-kind service through training sessions.

RESEARCH AND CONSERVATION – Highlands and Kittatinny Ridge

- ENSP biologists decided to focus on the snake fungal disease component, as opposed to the highly intensive work to establish a scientifically sound estimate of a den population. We focused on surveying documented timber rattlesnake dens and documenting presence and recruitment in addition to collecting any snakes exhibiting sign of infection (see Statewide section above).
- Venomous Snake Response Team (VSRT):
  - Staff held three VSRT trainings in September, 2012, training four new people and retraining one participant.
  - No trainings were held in 2013 due to staff time constraints.
  - Of the 105 documented members of the Venomous Snake Response Team (excluding federal personnel), only 51 are considered active members in the northern region. Of those, only 19 submitted timesheets reporting their 2012-2013 response activity in time for this report; an additional four participants documented in-kind service through training sessions. Responders removed 14 timber rattlesnakes (and 4 northern copperheads) from private lands and/or public recreation areas. Two additional snakes were reported as timber rattlesnakes by the landowners, but the snakes were not visible to (and not confirmed as rattlesnakes by) the responders.
- No further work was conducted on the rattlesnakes' 2009 den model due to staff time constraints.
- Radio-telemetry: No timber rattlesnakes were located in questionable areas warranting radio-telemetry efforts.

HABITAT RESTORATION – Pinelands Region

- ENSP reviewed and discussed with other timber rattlesnake researchers potential clearing sizes required to achieve 6-8 hours of sunlight. There was no conclusive decision, but to minimize the amount of area cleared (to prevent species sinks, illegal off-road vehicle use and to prevent drawing attention by collectors), test sites would need to be created and assessed, and if needed expanded to improve day-lighting efforts.
- No sites for habitat alteration were visited during this segment, but in August 2013, ENSP coordinated field site meetings (post-September 1) with a State Forest Superintendent, conservation partner (NJCF) and rattlesnake researchers (Reinert, Zappalorti and Mooney) to identify suitable areas for habitat management and discuss management strategies, including selective habitat management to open the canopy within specific areas while maintaining shade in others.

HABITAT RESTORATION – Highlands and Kittatinny Ridge

- ENSP focused on continuing to survey for and assess potential basking habitats in need of habitat management (i.e., tree felling to open the canopy) for either enhancement or creation. On-the-ground management won't occur until fall-winter 2013-2014 and therefore, monitoring of these managed sites won't begin until 2014.
  - Due to on-going pipeline construction activities, we avoided the Ringwood State Park/Ramapo Mountain Preserve area to minimize conflicts with construction and delays to ENSP surveyors. Wawayanda Mountain range was not a focal area in 2013, but other State (5) and County (1) lands were targeted for assessment. Of the 724 acres (293 ha) surveyed, 31% were within County lands and the remainder on State lands.
  - Surveys identified three sites for potential management that have optimal features for basking and gestation, including shelter rocks, ground vegetation, minimal overstory trees, felled logs, distance from recreational trails (two sites approximately 100 m from trails, the third site <100 m).

Conclusions:

- A few New Jersey snakes have been confirmed as positive for *Ophidiomyces ophidiiocola*: two timber rattlesnakes in northern New Jersey, and one corn snake in the Pinelands. The infected snake in the Pinelands was located at a commonly used basking, gestation, and birthing site for multiple snake species including timber rattlesnakes, so it is likely that other snakes have been infected.
- Although fungal cultures on three timber rattlesnakes in the Highlands and Ridge & Valley were negative for *O. ophidiiocola*, Dr. Jean Pare (WCS) believed these snakes were infected as the clinical symptoms were the same as those of infected snakes in New Jersey and other states.
- Volunteers on the Venomous Snake Response Team play an important role in protecting NJ's rattlesnakes and citizens, provide important rattlesnake distribution data, and are essential in educating the public about the conservation of this species. However, documenting volunteer time via completed timesheets continued to be challenging. The Team continued to be effective at rapidly responding to requests for assistance with timber rattlesnake (and northern copperhead) presence on private properties and public recreation areas, and providing locational data for the Biotics database. Due to staff time constraints, ENSP had limited communication and interaction with the response team in 2013; regular communication may be a necessary measure to ensure the responders have the information they need, are confident they are supported by ENSP, and contribute their data and time sheets to ENSP.
- Increasing development and roads, in addition to land alteration continue to impede and/or threaten travel between habitats, isolate populations, and limit habitat use.
- Due to limited resources, ENSP relies on conservation and research partners to help protect and improve rattlesnake habitat in the Pinelands region.

Recommendations:
- Continue to maintain and expand the Venomous Snake Response Team (VSRT). Create a VSRT packet of information for all participants that summarizes capture techniques and snake behavior, reporting requirements, and necessary data and time sheets.
- Focus surveys of spring emergence and gestation/birthing sites on currently documented dens and gestation/birthing/nesting areas in search of potentially infected snakes with a focus on rare species. Collect the snakes for transfer to the Wildlife Conservation Society, Bronx Zoo, to undergo testing and medical treatment.
- ENSP should work with appropriate State authorities to propose habitat management strategies in the Pinelands and northern regions through DEP's Land Management Review Process. Where sites are approved, ENSP will define habitat management strategies.
- When appropriate ENSP personnel are available, review and test additional landscape-scale features to refine the 2009 den model.
- Continue to implant transmitters in suitable adult and sub-adult male timber rattlesnakes located in areas where they cannot be linked to documented dens, to identify new, undocumented dens.
- Continue to assess sites for the enhancement or creation of basking areas on public lands in the Highlands and Ridge & Valley regions and include some method of long-term monitoring to evaluate the management success.

Photographs 1a-1d: Snake W-8-13, Corn Snake

Photos by Michael Bisignano, 2013

Photographs 1a and 1b: Corn Snake upon captivity in May 2013. Necrotic facial tissue; crusty appearance

Photos courtesy of Woodlands Wildlife Refuge, 2013

Photographs 1c and 1d: Corn Snake prior to release in June 2013 after multiple sheds and supportive care. Not exhibiting any sign of necrotic facial tissue.

Photographs 2a-2c: Snake W-33-13, Northern Pine Snake

Photo by Bryan DuBois, Teidnet Environmental, Inc., 2013

Photograph 2a: Northern Pine Snake upon captivity in May 2013. Necrotic and crusty ventral scales.

Photos by NJDEP, 2013

Photographs 2b and 2c: Northern Pine Snake in June 2013 after one shed cycle and supportive care. He remained in captivity for a second shed cycle and then was released.

Photographs 3a & 3b: Snake W-53-13, Timber Rattlesnake

Photograph 3a: Timber Rattlesnake in August 2013 when released to WCS. Necrotic and crusty facial scales, open lesion. No photographs are available from his original capture in 2012 or during his care at the wildlife rehabilitator's facility.

Photograph 3b: Timber Rattlesnake in September 2013 upon release. Open lesion scarred over after shed cycle.

Photos by NJDEP, 2013

Photograph 4: Snake W-38-13, Timber Rattlesnake

Timber Rattlesnake in June 2013 exhibiting sign of necrotic facial tissue around eye, and eye scale had not shed off with previous shed cycle. Biopsies collected and released to wild with transmitter without treatment.

Photograph 5: Snake W-39-13, Timber Rattlesnake

Timber Rattlesnake in June 2013 exhibiting sign of necrotic facial tissue and early stage lesions on face and neck. Biopsies collected and released to wild with transmitter without treatment.

Table 1. Results of snakes collected in 2013 suspected of snake fungal disease currently attributed to *Ophidiomyces ophidiiocola.*

Region	Field ID (WCS)	Species	Age class	Sex	PIT tagged	Weight at capture (or upon release to WCS)	Comments	Ophidiomyces ophidiiocola results	Other infections or illness	Initial examination and biopsies	CBC and chemical profile	Fungal culture	Molecular work	Processing and reading biopsies	Housing & care	Treatment-no housing
Pinelands	W-8-13	Corn Snake	Adult	Undetermined	No	133	Upon capture, appeared to have extensive scale (and possibly facial) deformation, but shed within 48 hours of capture and showed significant improvement. Was held for subsequent shed cycles and provided supportiive care.	positive	No	yes	yes	yes	yes	yes	no	no
	none (NJ ID: NJ1304)	Black Rat	Juvenile	Undetermined	No	-	Held over winter by rehabilitator after being stepped on (head scales showing sign of injury). In the spring, he continued to exhibit signs of necrotic facial scales on the cheek and around the eye and was transferred to WCS. Due to his small size, WCS tested his skin sheds.	negative	No	yes	yes	yes	yes	yes	no	no
	W-33-13	Northern Pine Snake	Adult	Male	No	1530	Shed @ ENSP 6/11/13 awaiting test results from WCS. After shed, his appearance significantly improved.	negative	No	yes	yes	yes	yes	yes	no	no
	none (NJ ID: NJCF-HK13)	Northern Pine Snake	Adult	Female	n/a	n/a	Skin shed tested	negative	n/a-no blood work	no	no	yes	yes	yes	no	no
Highlands	W-12-13	Timber Rattlesnake	Adult	Female	Yes	906	Minimal necrotic facial scales upon collection; post-shed (initial) got worse but then improved with subsequent sheds	positive	No	yes	yes	yes	yes	yes	yes	no
	W-13-13	Timber Rattlesnake	Juvenile	Undetermined	Yes	118	Minimal necrotic facial scales upon collection; improved with sheds	positive	Intra-erythrocytic Hepatozoon sp. gamonts	yes	yes	yes	yes	yes	yes	no
	W-38-13	Timber Rattlesnake	Adult	Female	Yes through another study	-	Left eye appears to have eye scale "stuck" (i.e., didn't come off with last shed); showing signs of necrotic facial tissue around eye. Biopsies collected (no blood); released to wild with transmitter (no treatment or medical care).	negative	n/a-no blood work	yes	no	yes	yes	yes	no	no
	W-39-13	Timber Rattlesnake	Adult	Female	Yes through another study	-	Showing signs of necrotic facial tissue and early stage lesions on face and neck. Biopsies collected (no blood); released to wild with transmitter (no treatment or medical care).	negative	n/a-no blood work	yes	no	yes	yes	yes	no	no
	none (NJ ID: NJ1306)	Garter Snake	Adult	Undetermined	No	n/a	Upon submittal to WCS, Dr. Pare's examination revealed a broken tooth and infection. The tooth was removed and the snake was administered sub-cu fluids and antibiotics. Snake was transferred to wildlife rehabilitator but died the following day.	n/a	Broken tooth resulted in absess in mouth and snake was dehydrated. Other findings undetermined as no blood work was conducted.	yes	no	no	no	no	no	yes
	W-53-13	Timber Rattlesnake	Adult	Male	Yes	601	Originally captured April 2012, remained under care of wildlife rehabilitator receiving supportive care and occasional medicine. Rehabilitator reported the snake had been making improvements but was underweight and having problems with his jaw and unwillingness to take prey. ENSP transferred the snake to WCS on 31 July 2013 for further assessment and testing. Dr. Pare recommended snake remain in captivity until next shed (due to open facial scales and light weight; no concerns over jaw stretching or prey base)	negative	Fecal direct exam and float conducted; revealed a lot of coccidia, and a few incidental mouse tapeworm ova (Hymenolepis sp.). Treated for coccidian with ponazuril. Other findings undetermined as no blood work was conducted.	yes	no	yes	yes	yes	yes	no

JOB 1D: Northern Pine Snake

Project leader: Kim Korth, Principal Zoologist

OBJECTIVE: To develop a recovery plan, identify life-history requirements, and conserve habitat for the state-threatened northern pine snakes *(Pituophis melanoleucus melanoleucus)*. Identifying critical habitats, monitoring trends in populations and habitat, and evaluating meta-population issues are key components of this job.

Key Findings

1. **Stafford Forge Study**: In 2012-2013 the Endangered and Nongame Species Program worked with its research partner, Herpetological Associates (HA), to complete the seventh of a 7-year study designed to evaluate the movements and habitat use of northern pine snakes on, and around, the Stafford Forge Wildlife Management Area. Twelve pine snakes were radio-tracked as part of this study. Six of these snakes were moved from their natural den site in 2006 when a permitting decision was made to move the snakes to accommodate the capping and closure of a "leaky" landfill. The other eight snakes were captured in the area where the translocated snakes were moved and have been considered a "control group" (non-moved) group in this study. This year we also carried out data analysis on the 2012 field season. Details of these activities are summarized below.

    - ***Data Collection During the 2013 Field Season****:* As in previous years (beginning in 2007), we determined the location of each study snake roughly every other day throughout the 2013 field season. Habitat characteristics such as percent cover, soil type, distance to nearest tree, and vegetative community composition were recorded each time a snake was relocated. As of October 2013, data collection for this field season was still ongoing and, therefore, data analysis has not yet been carried out on the 2013 field data.
    - ***2012 Data Analysis Conducted During 2013****:* During this reporting period data were analyzed on telemetry data collected in the 2012 field season. A total of 12 pine snakes were radio-tracked during the active field season (April through October). These included four original "shifted snakes," six "non-shifted" snakes, and two recaptured 2006 hatchlings. Of the four "shifted" pine snakes tracked by HA at the start of 2012, two snakes (both males) remain alive and healthy. Of the six non-shifted snakes, four (three males and one female) remain alive and healthy and two are currently missing and unaccounted for due to unexpected transmitter failures. The two radio-tracked 2006 hatchlings (one male and one female) remain alive and healthy. The total number of telemetry relocations made in 2012 is unavailable due to a researcher losing data from flooding. As in previous years, most re-locations were made in pine or pine oak forests (Figure 1).
    - ***2012 Hatchlings:*** In 2012, HA captured 12 hatchlings by random searching and den trapping. Ten of the hatchlings were caught attempting to enter one of the artificial den traps in the management fields during the fall ingress. All of these hatchlings were processed, PIT tagged and released at their point of capture, except for one. One of the hatchlings in the traps had two severe lacerations to its body when captured; individual was taken to the laboratory for treatment. The snake overwintered in HA's laboratory and was released at its point of capture in the spring of 2013.
    - ***Transmitter Surgeries in 2012:*** A total of six pine snakes were pulled from the field for re-implantation surgery in 2012. All snake surgeries were completed before August 15, 2012. Time frames for snake re-implantation and eventual release varied with the condition of each individual as HA staff assessed the overall health of each snake. Five of the six snakes successfully had their old transmitters removed and replaced. Unfortunately, one study snake died due to an enlarged heart condition.

- ***Hibernacula:*** Over the course of this study, HA has found and identified 45 different natural hibernacula in Stafford Forge WMA. This is a land-area of approximately 7,546.8 acres (3,054.2 hectares) which supports at least three meta-populations. One new den was found in 2012.

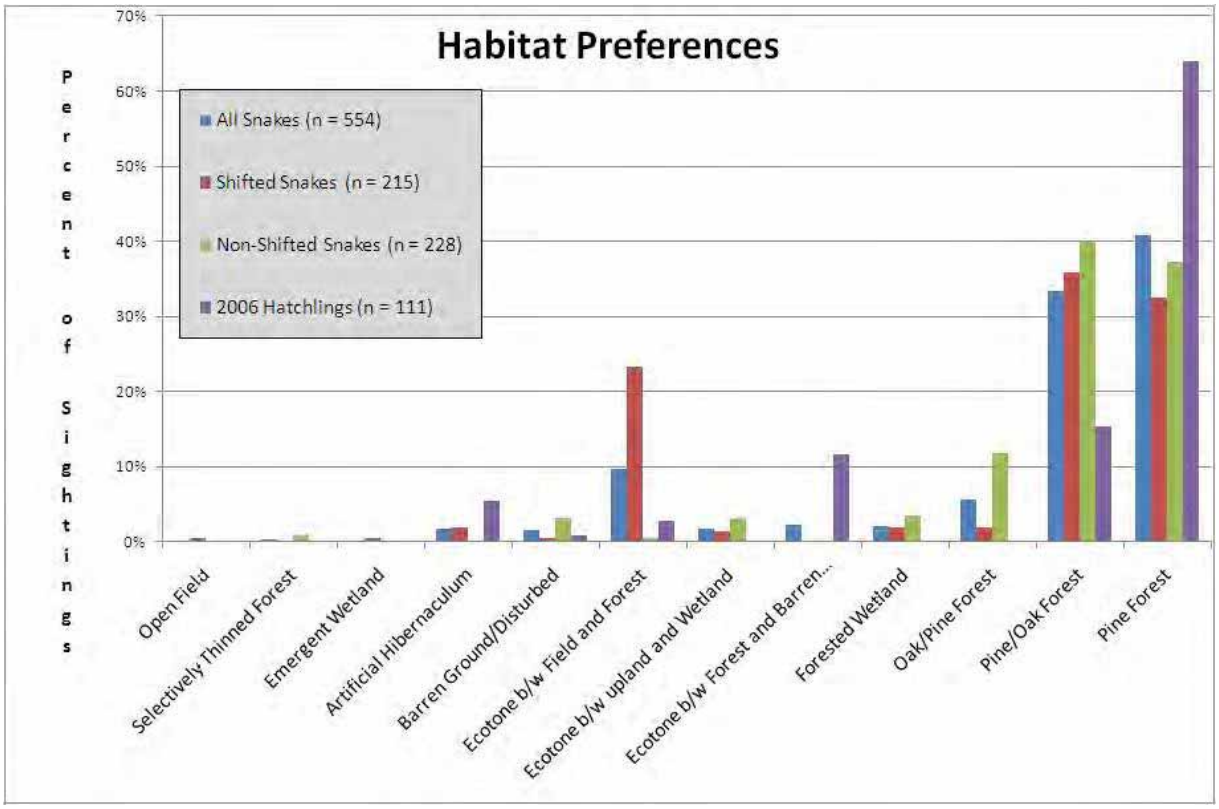


Figure 1. Frequency of habitats selected by radio-tracked pine snakes.

2. **Drexel University Collaboration**: ENSP staff partnered with Drexel staff on several innovative projects including substrate movement analysis, neonate basic history work, and genetic analysis.
   - Drexel and HA staff collected new data at Warren Grove Range (WGR) and Stafford Forge as part of their on-going projects however movement analysis was not conducted due to limited staff resources.
   - Staff did not compare differences in hibernacula density between WGR and Stafford sites; Drexel students are currently looking at this analysis but it has not been completed.

   - ***Substrate Movement Analysis***
     - Adult snakes had the fastest rate of movement across sand ($\bar{x}$=0.12m/s) compared to paved substrates: asphalt (0.09m/s) and concrete (0.07m/s).
     - Sub-adult snakes were fastest across sand (x=0.11m/s) compared to paved substrates: asphalt (0.09m/s) and concrete (0.06m/s).
     - All substrate types were significantly different in adult trials ($p < 0.0001$). Only the concrete substrate was different for sub-adults ($p < 0.0001$).
     - Snakes at the height of their activity season can experience up to 31 cars in one attempt to cross a road in a perpendicular manner.

- ***Landscape Genetic Project:*** Drexel staff surveyed and sampled the Manumuskin River Preserve for genetic samples (N=10); Hovananian Preserve and Miller Airpark (N=7), Warren Grove Gunnery Range (N=12), Ed's Place (N=14), and east of the Garden State Parkway (N=0).

- ***Neonatal Ecology Study:*** Four nest sites were corralled using silt fencing and checked every 24 hours; 69 neonates hatched from those four nests. Eight of the neonates were implanted with radio transmitters and radio-tracked daily until ingress into hibernacula in November 2012.
  - Neonate pine snakes remain and den within ~300m of their nest, some as close as 35m.
  - Neonates are capable of multiple meals in first season, including adult rodents.
  - Neonates den communally with other neonates, individually, or with adults (heterospecific and conspecific black racers). Some of these hibernacula are known multi-year sites for adult hibernation.
  - Adult black racers are predators of neonates; a radio telemetered neonate was tracked to a black racer. The racer, upon capture, regurgitated the neonate and transmitter.
  - More 2013 field data will be reported in January 2014.

Conclusions

- The 2012 report on research at Stafford Forge by Herpetological Associates was submitted to ENSP and Pinelands Commission. The 2013 report is being finalized by the consultants.
- Given substrate experimentation data, roads act as serious barriers to Northern pine snake movement. In 2013, 12 dead on road northern pine snakes were documented along Route 72 and Route 539. Understanding how road substrate affects pine snake movement will enable us to develop better BMPs for road construction and re-surfacing.
- Radio-tracking pine snake neonates is an effective way to expand the knowledge of early life habitat use and behaviors. These new data will be useful in making conservation recommendations concerning nesting and neonate ecology.
- Expansion of the Northern Pine Snake Status Assessment into a full recovery plan for this species in New Jersey was not completed due to insufficient staff resources.
- A majority of past observation data has been entered into Biotics. Our effort to carry out meta-analysis of northern pine snake data for population estimates, habitat preference and model development, is on-going but not completed at this point. Consultants have submitted data in a format that is more easily accepted and entered into Biotics; entry into the database is on-going. We expect to receive all the 2013 project partner data in the near future and 2013 data from consultants will be provided prior to approving collection permits for the 2014 field season. Those data will be entered in the Biotics database.
- Due to limited staff resources at ENSP and Drexel, we were unable to create a pine snake habitat model using the underlying principles of HEP modeling.

Recommendations

- Work with Drexel staff to analyze population data and refine and validate model to estimate the northern pine snake population size in New Jersey. Develop an extrapolation model to estimate pine snake population size for Warren Grove; address assumptions including homogenous landscapes that may influence differences in abundance and distribution and validate the model. Consider working with experts to create a pine snake habitat model using the underlying principles of HEP modeling. Explore possibility of ENSP staff conducting or coordinating movement and hibernaculum density analysis.
- Encourage completion of road surface study. Report submitted by Drexel (if they continue this project) will identify seasonal differences in movement rates across different simulated road surface

substrates and develop recommendations. These recommendations will be presented to the Habitat Connectivity group for incorporation into road crossing Best Management Practices.
- Complete the genetics work; analyze blood and tissue samples to elucidate differences in population genetic structure. Use analysis to identify genetic bottlenecks and where barriers (e.g., roads) maybe reducing gene-flow.
- Complete the recovery plan for the Northern pine snake.

1E: Northern Copperhead

Project leader: Kris Schantz, Principal Zoologist

OBJECTIVE: To determine the distribution of and conserve NJ's northern copperhead *(Agkistrodon contortrix mokeson)* populations through a coordinated approach of population and habitat monitoring, threat assessment, habitat protection and acquisition, management, research, education and environmental review, and to identify northern copperhead dens and critical habitat use.

Key Findings:
- During this reporting period 6 northern copperhead sightings were entered into NJ DEP's Biotics database (Biotics). Sixteen additional northern copperhead sighting was entered into ENSP's tracking database (preliminary database used prior to entry into the Biotics database) and will be reviewed by ENSP staff for entry into the Biotics database.
- As reported in 2011 (see *NJ T-1-6,* September 1, 2010-August 31, 2011), the partnership with Turtleback Zoo was discontinued. No formal plans have been made to move forward with the originally proposed radio-telemetry project.
- One adult male copperhead was found by personnel from Herpetological Associates (HA) in northern NJ in an area where ENSP is lacking den data. HA volunteered to work with ENSP, donating a transmitter, coordinating the transmitter implant (following procedure described by Reinert and Cundall, 1982), and tracking the snake throughout the season.
    - Within this segment, HA relocated the snake 50 times within a 45-acre area, using a variety of habitats including "hardwood forest, open rocky and grassy sections along and within a right-of-way, Phragmites wetland and small pond, and fallen trees in a forest patch" (pers. comm., Robert Zappalorti, 2013).
- Venomous Snake Response Team: (*See Timber Rattlesnakes job for additional details)*. Venomous Snake Response Team members removed 2 northern copperheads from private land.
- Due to staff constraints, we solicited new data from the Venomous Snake Response Team but not from conservation organizations or the Division of Parks and Forestry.

Conclusions:
- Northern copperhead observations are still lacking:
    - There continues to be few reported or confirmed copperhead observations on public and private lands.
    - Obtaining sighting observations for this species using "alternative methods" continues to present challenges for two main reasons: 1) Lack of awareness of copperhead presence or a hesitation to share location data, and 2) ENSP staff's time constraints limiting our ability reach out to potentially knowledgeable parties. ENSP staff continues to be constrained by an unexpected and inordinate amount of involvement in permit reviews and providing technical assistance on projects submitted through the State permitting process. These activities are reported in T-11-9-2 grant report, but the unexpected workload detracted from this project.

Recommendations:

- Continue to maintain and expand the Venomous Snake Response Team.
- Focus spring emergence and gestation/birthing site surveys on documented dens and gestation/birthing areas in search of potentially infected snakes. Collect the snakes for transfer to the Wildlife Conservation Society, Bronx Zoo, to undergo testing and medical treatment.
- Continue to obtain northern copperhead location data. If time and resources permit, this may be accomplished by reaching out to conservation organizations, NJ Division of Parks and Forestry staff and the Venomous Snake Response Team members.
- Conduct radio-telemetry on copperheads observed in areas that cannot be linked to a known den to identify undocumented den locations and develop/implement protective management strategies.

JOB 1F. Identify and Mitigate Threats to Sea Turtles in NJ Waters

Project leader: Jeanette Bowers-Altman, Principal Zoologist

Objective:

To identify and address major threats to sea turtles associated with power plant impingements and interactions with commercial fishing gear.

Key Findings:

- Conserve Wildlife Foundation (CWF) staff continued entering sea turtle impingement/sightings data from the Oyster Creek Nuclear Generating Station (OCNGS) into the ENSP's Biotics database as it became available. The ENSP receives copies of all incidental "takes" reported to the National Marine Fisheries Service (NMFS) by AmerGen Energy. Data included date and time of impingement/take, species, carapace length, weight, condition (live vs. dead), intake of impingement (circulation water intake vs. dilution water intake), number of pumps running (cwi vs. dwi) and water temperature. Conserve Wildlife Foundation staff have now compiled and entered data for three sea turtle species (Atlantic Green, Atlantic Loggerhead, and Kemp's Ridley) impinged at the OCNGS between 1992 and 2013.
- We continued analysis of sea turtle impingements recorded at the OCNGS versus weather/meteorological factors with the goal of developing a predictive model that would determine when captures are most likely to occur at the power plant. Data from 2012-2013 were analyzed separately, and then combined with the existing dataset to cover 1992–2013. We used Microsoft Excel graphing and regression software to analyze data and identify trends.
- The following factors were used during the analyses in comparison to available capture data from the OCNGS: 1) wind speed and direction 2) air temperature parameters, including mean daily temperature, maximum daily temperature, minimum daily temperature, daily Delta T (max minus min), daily Delta T from two days prior to capture 3) thermal minima and maxima effects (i.e., cold shock, heat shock) 4) hurricanes 5) nor'easter storms 6) intervals of vulnerability (i.e., periods of abundance) 7) direct human interaction (i.e., boating effects) and 8) moon phase (2012-2013 only).
- We identified weather parameters associated with each sea turtle capture using weather recorded by www.wunderground.com at the Atlantic City airport. Air temperature was used in the analysis because sea surface temperature was not available. We presumed that air temperature was indicative of sea surface temperature, or an indirect measure of surface coastal water transport through Barnegat Inlet, or bay water transport toward the Forked River intake canal through which cooling waters are channeled.

Conclusions

- Factors associated with sea turtle takes at OCNGS during 2012-2013 included the following 1) high east winds and falling air temperatures (9 of 15 takes); 2) high wind gusts (2 takes); 3) rapid air

temperature drops (2 takes); 4) a rapid drop of barometric pressure (1 take); and 4) none (unexplained; 1 take).

- For 2012-2013, there were no apparent effects from July 4th boat traffic. Although earlier analyses (when stratified by month) indicated a correlation between July 4th boat traffic and sea turtle takes, the lack of a relationship in 2012 and 2013 may be due to the following: 1) in 2012, July 4th fell on a Wednesday; in addition, it rained the day before and during the holiday, with winds reaching 29 mph for 3 days in a row. Because of these factors, we would expect that boat traffic in the bay would have been lower and resulted in fewer collisions with sea turtles; 2) in 2013, many of the boats that would have been used in the bay had been damaged or destroyed by Superstorm Sandy. Further, it is possible that boating traffic declined as a result of fewer rental properties available in the area after Sandy, although we have no data to show this.
- For 2012-2013, analysis of the effects of moon phase showed no correlation with sea turtle take.
- For 2012-2013, there was only one take in June, a reversal of the trend outlined in last year's report. In previous years, takes were occurring earlier in June, probably in response to earlier warming of the coastal water mass. It now appears that during the last two years, June temperatures have actually been getting cooler.
- For 2012-2013, no hurricane effects were noted. Despite hurricanes and nor'easter storms showing an effect on takes in earlier analyses, no sea turtles were impinged at the plant during Superstorm Sandy (30 October 2012). The OCNGS was shut down for refueling, with no pumps operating, beginning 22 Oct, which most likely protected turtles during the event. Sea turtles were apparently in the area during this time; there were anecdotal accounts of sea turtles found dead in the sand in Holgate, Long Beach Island, plus a verified report of six sea turtles found inside St. Rose High School in Belmar, NJ.
- There were 10 sea turtle takes reported this year (with the possibility of additional reports coming into the office during early November) making 2013 the second highest year for sea turtle takes at the plant. Similarly, there were two sea turtle takes at the Salem Nuclear Power Plant in southern NJ this year, the first time since a sea turtle has been reported there since 2001. A high number of turtles present at the OCNGS and the take of two sea turtles at Salem may provide insight as to coastal sea turtle abundance. More research is necessary to determine if increased captures is a reflection of increasing abundance or increasing range, or is due to other factors such as climate change or location of the Gulf Stream and its associated gyres. According to the National Marine Fisheries Service (NMFS), nesting numbers for many sea turtle species in the southeast are up (J. Crocker, NMFS, 2013, pers. comm.). In addition, there are recent reports of attempted nesting by sea turtles along mid-Atlantic beaches, including in NJ and DE.
- It is also perhaps worth noting that the effects of Superstorm Sandy could have changed the dynamics in and around Barnegat Inlet to allow for easier passage of sea turtles into the bay. According to J. Vouglitois (NJDEP, pers. comm.), no sea turtles had been reported at OCNGS prior to 1992, when a major dredging project by the Army Corp of Engineers (ACOE) occurred in the inlet. Reconfiguration of the south jetty in 1991 combined with the 1992 dredging of a 91 m wide x 3 m deep channel increased the tidal prism to what it was in the 1930's, increasing flow efficiency (Kennish 2000.). It is possible that once the stabilization and dredging occurred, it allowed sea turtles easier access to the bay. Similarly, Superstorm Sandy could have created even more of a pathway through the inlet, however, the scenario has yet to be investigated.
- Sea turtle catch at the OCNGS is primarily affected by local abundance and distribution. Gusty east winds, especially during storms, may drive turtles into the intake canal, but there are many more instances where despite such winds, no turtles are captured, presumably because they are not the area at that time. According to Tatham et al. (1977), northeast winds (particularly storm conditions) coincided with greater impingement at the plant. These findings, specific to finfish and macroinvertebrates, concur with the findings of this project; whether turtles are pushed along with wind-blown currents, or whether they are following prey items into the intake canal (or a combination

of the two) has yet to be determined. Another possibility is that it may be extremely difficult for plant personnel to actually spot turtles during certain conditions (e.g. during increased turbidity and/or high influxes of detritus such as eelgrass or sea lettuce that can be blown in from the bay during storms and/or east winds).

- The OCNGS will remain in operation until 2019. Given the remaining life of the plant, combined with increased catches of sea turtles for whatever reason, strategies to help further reduce take could potentially prevent injury/mortality to > 30 individuals. In addition, application of our methods at the Salem plant and other coastal energy facilities with water intakes may be feasible and worth further investigation.

Recommendations:

- Continue compiling data for OCNGS sea turtle impingements and enter in the Biotics database.
- Continue analysis of sea turtle impingements vs. variables such as proximity to Gulf Stream, species movements coastally, and prey abundance and distribution. Discontinue using moon phase as a variable in the analysis.
- Build files to show surface oceanic temperatures along sea turtle migration routes over time through 1992-present; in addition, build files to measure distance from Barnegat Light to Gulf Stream during times of turtle takes in order to examine whether the variable has any impact on catch.
- Continue with model development; test with impingement data from 2014. Investigate whether the approach can be applied to sea turtles and listed species (e.g. sturgeon) at Salem Nuclear Power Plant in southern NJ and at other power facilities along the east coast.
- Continue to gather information from the NMFS to determine coast-wide population trends.
- Schedule meeting with OCGNS staff to present preliminary results and discuss protocols that could be easily implemented during predicted times of likely sea turtle occurrence. Possible protocols aimed at minimizing sea turtle impingements may include a) increased inspection and cleaning of the trash racks at dilution water and circulatory water intakes b) increased inspection of canals by boat c) inspection of intake and discharge canals from bridges along Route 9 and d) video camera surveillance of the intake canal.

Literature Cited:

Kennish, M.J. 2000. Barnegat Inlet, NJ: a case study of stabilization impacts. Bulletin of the NJ Academy of Science 44:1-13.

Tathem, T.R., Danila, D.J., and D.L. Thomas and Associates. 1977. Ecological Studies for the Oyster Creek Generating Station: Progress Report for the Period September 1975 – August 1976. Volume One, Fin and Shellfish. Report for Jersey Central Power and Light Company. Ichthyological Associates, Inc. 354 pp.

JOB 1G: Turtle Harvest Investigations

Project leader: Brian Zarate, Senior Zoologist

OBJECTIVE: Two species of turtle that are native to New Jersey are open to harvest through fishing and commercial permits. Uncertainty exists on whether or not these harvests are sustainable and if adequate reporting exists on actual take and take locations. ENSP will initiate a process of collecting pertinent information and data on how to reduce take or eliminate harvest if the species' populations cannot remain viable under current harvest rates.

Common Snapping Turtle

- No changes in harvest regulations have been made based on recommendations from past reporting period.
- ENSP continued to coordinate with a Montclair State University PhD student on examining toxicity in snapping turtle meat, population estimate studies, and general information on the species.
- The number of harvest permits issued by the Bureau of Freshwater Fisheries continued to increase (Figure 1).
- Commercial harvest numbers remain above 5,000 individuals annually (Figure 2). For comparison, other traditional game species were less harvested during the 2012/2013 seasons
    - 3,073 spring gobbler turkeys.
    - 287 black bear.
    - Estimated fur trapping harvest 2012-2013 (Table 1)
- Seven states in the U.S. designate the snapping turtle as a species of greatest conservation need, including New York (Nanjappa and Conrad 2011).
- New Jersey has the most liberal snapping turtle harvest regulations than any surrounding state (Table 1; Nanjappa and Conrad 2011).

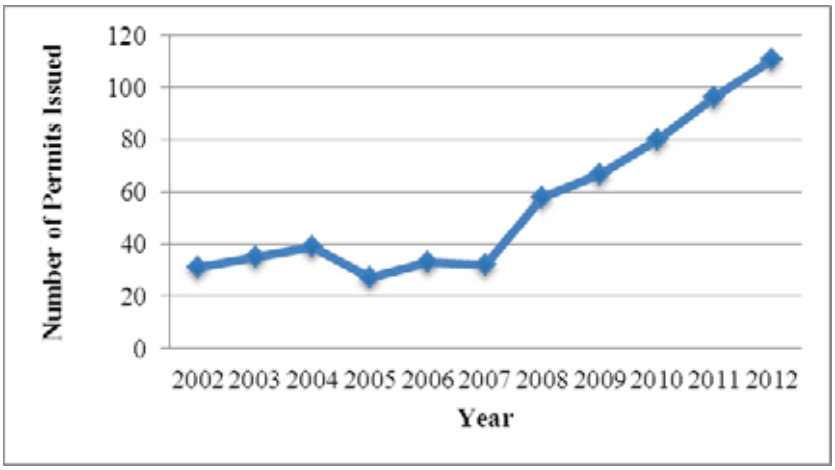


Figure 1. Commercial harvest permits issued in New Jersey for snapping turtle in a 10-year period.

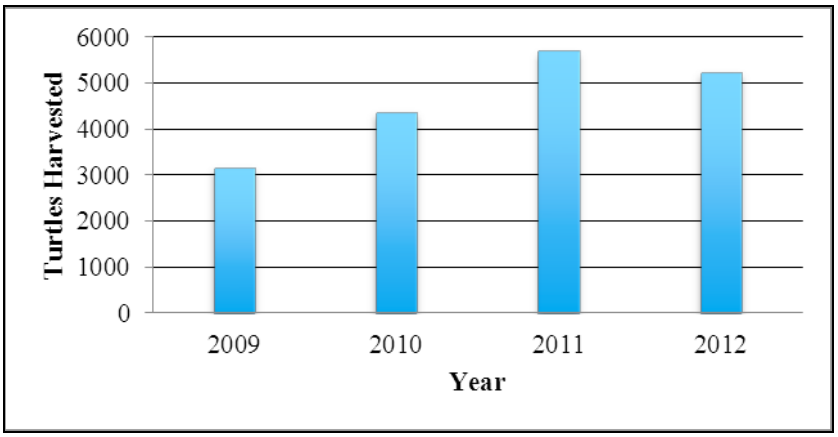


Figure 2. Number of reported snapping turtles harvested in NJ under commercial permit.

Table 1. New Jersey estimated fur trapping harvest, as derived from New Jersey Trapper Harvest Surveys

Muskrat	Raccoon	Fox	Mink	Opossum	Beaver	Otter	Skunk	Coyote
21,229	6,231	6,131	1,086	1,121	708	52	295	243

Table 2. Snapping turtle harvest regulations from surrounding states.

	Species	Daily Bag	Annual Bag	Aggregate	Size	Age Class
New Jersey	Snapping turtle	Unlimited	Unlimited	Unlimited	Any	Any
New York	Snapping turtle	5	30	30	≥ 12" carapace	Adult
Pennsylvania	Snapping turtle	15	NS	30	Any	Any
Delaware	Snapping turtle	Unlimited	Unlimited	Unlimited	At least 8" carapace	Any

- *Northern Diamondback Terrapin*
  - No investigations were made into the harvest of northern diamondback terrapins.

Conclusions:
- The number of commercial applications for snapping turtle harvest has increased since 2007, which could be an indirect result of more restrictive harvest regulations in neighboring states.
- Reported harvest numbers for some traditional game species are much lower than harvested snapping turtles.
- New Jersey has no restrictions for harvest based on age, size, or daily/annual bag limit and have the loosest regulations compared to all neighboring states.

Recommendations:
- Request data from Bureau of Freshwater Fisheries on past year's snapping turtle harvest.
- Continue to coordinate with Montclair State University graduate student on snapping turtle research.

Literature Cited:
Nanjappa, P. and Conrad, P.M. (Eds.) 2011. State of the Union: Legal Authority Over the Use of Native Amphibian and Reptiles in the United States. Version 1.03. Association of Fish and Wildlife Agencies, Washington, DC.

JOB 2: State-Listed Amphibians

OBJECTIVE: To develop comprehensive, landscape-level conservation and management plans for all state-listed amphibians to ensure long-term viability of populations. These plans will contain concise delineations of critical breeding habitats, terrestrial habitats, and dispersal corridors, strategies and techniques for addressing threats, and long-term monitoring protocols for assessing population status over time.

JOB 2A: Longtail Salamander - Inactive

JOB 2B: Amphibian Crossing – Inactive (but a sub-job in T-11-T-2)

JOB 2C: Eastern Tiger Salamander

Project leader: Kim Korth, Principal Zoologist

OBJECTIVE: To protect individual breeding sites, populations, and population connections, and to enhance breeding habitats to assure long-term viability of the Eastern tiger salamander *(Ambystoma tigrinum tigrinum)* and Southern gray treefrog (*Hyla chrysoscelis*).

Key findings

- Water level and salinity measurements were taken every 4 months at sites most susceptible to sea-level rise. Monitoring pre- and post- Superstorm Sandy did not show an increase in salinity levels but water levels were elevated after the storm.
- Surveys were minimal during this reporting period due to limited staff time and high water levels.
- Surveys by volunteers and/or partners resulted in 5 new eastern tiger salamander sightings. These results were added to the Department's Biotics database and will be included in the Landscape Project's 2014 update.
- A total of 12 egg masses were collected for the headstarting and enclosure study from a single site (MS- large) with over 100 egg masses. Staff collected masses that were considered at greatest risk of desiccation (i.e., masses deposited high in the water column unlikely to survive water and temperature fluctuations during development or masses laid in shallow ruts along the road) or at greatest risk of failure (i.e., egg masses laid directly on the bottom of pond).
- Two eggs from each mass were collected for genetic samples for long-term genetic monitoring and provided to Montclair State University for analysis; collection of eggs avoided mortality of larvae.
- Herpetological Associates confirmed that they submitted the outstanding "Bayshore Mall" data years ago; ENSP staff are working with Biotics staff to find the report (HA will re-submit in 2014).

Habitat Enhancement and Restoration

- *USFWS Refuge and Division of Fish and Wildlife lands*: Although the creation of vernal pools along Atlantic City Electric (ACE) right-of-way on and near USFWS refuge property was not completed by this reporting segment, Conserve Wildlife Foundation (CWF) was awarded a private grant to focus on this project. CWF staff coordinated the creation and execution of a Memorandum of Understanding which was signed by Atlantic City Electric (ACE), Division of Fish and Wildlife and USFWS Refuge to create and manage a series of vernal pools on the ACE right-of-way on Refuge property. Vernal pool construction is expected to take place either late winter 2013 or early spring 2014.
    - CWF and ENSP staff identified additional potential sites within ACE right-of-ways on Refuge land as well as on Division of Fish and Wildlife Lands. Staff are exploring the possibility of developing proposals for pond creation on these lands.

- *Rio Grande*: ENSP and CWF staff met with a wetland mitigation organization to discuss restoration and enhancement of this degraded site. Staff proposed a plan and we expect an answer from the organization sometime in 2014. The mitigation company would undertake the restoration at no cost to the state.

Figure1. Map of proposed activities for restoration and enhancement of Rio Grande E. Tiger Salamander pond.

Monitoring and Evaluation

- *Lizard Tail Swamp WMA*: In January 2013 eastern tiger salamander egg masses were surveyed in the constructed ponds. Due to extremely high water levels, no egg masses were detected. Larvae were detected in many of the ponds which indicated that successful breeding had occurred. One adult male tiger salamander was also found in the ponds. Four masses were laid in tire ruts (certain to freeze), so two of these egg masses were collected from these ruts and deposited in the Belleplain pond.
- *Rio Grande:* This site is extremely difficult to survey due to tannins in the water. Visual surveys in January 2012 did not detect egg masses, although eggs and adults were found using dip-netting. Due to limited staff time and high water levels, this site was not surveyed in 2013

Egg Enclosure and Headstarting Projects

- *Egg Enclosures:* Six egg masses were placed inside enclosures in the ponds at Lizard Tail Swamp. Four cages could not be used because the anchoring poles were submerged due to the very high water level; the egg masses were instead simply placed in those ponds.
    - The percentage of larvae released from the egg stage ranged from a low of 44% to a high of 80% with an average of 67% hatch rate. These percentages are conservative because some of the masses in the enclosures had not fully hatched (both egg and larvae were released into ponds).

Table 1. Number of egg or larvae at time of collection and at time of release for each enclosure cage.

Enclosure	1-1		1-2		1-3		1-4		1-5		2-1		2-2		2-3		2-4		2-5	
2012	-	-	-	39	-	58	-	43	-	-	-	7	-	25	-	72	-	74	-	65
2013	104	46	54	38	31	23	-	-	-	-	-	-	96	77	73	51	59	36	-	-

2012: No egg masses were placed in cage 1 or 5. No egg count was taken at collection, only at release of larvae.
2013: 6 egg masses introduced, due to high water level 4 attachment poles were submerged

- *Headstarting:* Two small egg masses were provided to Cape May Zoo (the Zoo) to continue the headstarting project. Eighteen large larvae were released including 1 metamorph (1 additional metamorph died in transit).
    - Results:
        - 75% hatching success (48 collected eggs, 36 larvae, 12 unviable eggs).

- 37.5 % survival from egg mass to metamorph/subadult (36 larvae hatched, 18 were released).
- Released larvae varied between 5 and 7 cm.

Figure 2. Left to right: headstarted larva, educational headstarting display at Zoo, floating egg enclosure cage

- Protocol: After poor results last year, ENSP, CWF and the Zoo changed the protocol to decrease the number of individuals in each tank and increase amount of food provided. Although we established different treatments (size of tank and number of larvae in each tank), staff at the Zoo were unable to adequately record data due to limited resources and therefore we are unable to draw conclusions about treatment differences.
  - Due to the increasing concern of disease, ENSP used a decision tree for biosecurity risk assessment (Pessier & Mendelson 2010) and recommended that the Zoo isolate the native eastern tiger salamanders from non-native captive species. The goal of this recommendation is to minimize the risk of transmission of infectious disease between non-native and native captive species and introduction of non-native disease into the environment. The Zoo followed these procedures.

Conclusions:

- ENSP's management efforts for tiger salamanders are focused on suitable habitat within the species range on protected land and outside of areas at risk to sea-level rise. This focus may hold the most value to maintain the long term persistence of tiger salamanders in New Jersey in the face of habitat threats.
- Identification and remediation of threats to eastern tiger salamander populations remains important, especially those sites at lowest risk to sea-level rise.
- Egg enclosure and headstarting are effective methods of improve hatching and metamorph/subadult success when establishing new breeding populations. Both methods reduce the natural high mortality in the egg and larval stages, which yields new breeders to newly created ponds. As ENSP is focusing on creating habitat linkages between known breeding ponds these methods can be utilized as an immediate and cost effective method of establishing breeding adults.
- Headstarting results in higher survival from egg mass to metamorph/subadult compared to natural conditions and produces very robust larvae prior to release into ponds. Large food supply appears to be key in robust development of larvae, so addition of tadpoles as a food source likely increased growth rates.
- Because headstarting E. tiger salamanders requires many large tanks and space is limited, we are only able to release a relative few individuals. Therefore, headstarting alone may not be an effective method to secure and increase populations. The public education component of this project is an important benefit: the Zoo has used this project as an educational opportunity to

engage the public in the efforts to protect and mitigate treats to this vernal species. This project allows the public to identify with a species they likely did not realize existed and totally depends on the region to persist.

- Long-term genetic monitoring will help identify the source populations of surviving populations. Genetic testing of salamanders at our study ponds can be done in the future and compared with stored genetic samples. However, genetic testing comes at a financial cost that this project cannot afford at this time.

Recommendations:

- Continue with the egg enclosure project in newly created ponds; explore possibility of expanding use of egg enclosures to existing ponds that do not appear to have a robust breeding population (e.g., Belleplain).
- Headstarting will continue with the Zoo in 2014 with a simplified datasheet and assistance from staff and partners with setup. Staff will participate in the development of educational material as necessary.
- Begin working with a Master's student to conduct a mark-recapture study at Costa Preserve and Belleplain to assess current populations using drift fence during the winter and minnow traps in late spring; implement protocol that ensures no harm to adults or metamorphs.
- Continue working with CWF on vernal pool construction at USFWS Refuge anticipated to begin in early 2014. Explore options to build additional ponds on public lands and restore degraded ponds.
- Continue to work with partners to monitor pools and encourage amateur herpetologists to submit sightings.
- Collection of genetic material will no longer be undertaken due to lack of funding for analysis.

Literature Cited

Pessier AP and JR Mendelson (eds.). 2010. A Manual for Control of Infectious Diseases in Amphibian Survival Assurance Colonies and Reintroduction Programs. IUCN/SSC Conservation Breeding Specialist Group: Apple Valley, MN.

JOB 2D: Presence and Distribution of Chytrid Fungus in NJ Amphibians

Project leader: Bill Pitts, Assistant Zoologist

OBJECTIVE: To determine the distribution of *Batrachochytrium dendrobatidis* (*Bd* or "chytrid fungus") in New Jersey's amphibian population.

Key Findings

- Background and Past Findings
    - Montclair State University began monitoring for *Bd* in 2009 with funding from ENSP's competitive small grants (state funds from Conserve Wildlife license plates). *Bd* was detected in 2 out of the 27 samples that were screened during the pilot project in 2009. These samples were taken from just two ponds, therefore a more extensive and widespread monitoring effort for this pathogen was needed in New Jersey.
    - Between 2011 and 2012, a total of 905 samples were delivered to Montclair University for detection of *Bd* using Real Time Polymerase Chain Reaction (RT-PCR) analysis. Previous T-1 grant reports stated that 907 samples were collected in 2011 and an additional 310 were collected in 2012, however this turned out to be inaccurate. There were 549 samples collected in 2011 and 356 collected in 2012.

    - Due to a malfunction with the PCR machine in 2012, some samples still have not been analyzed, and we are awaiting final results.
    - Concurrent with *Bd* sampling, 426 samples were opportunistically collected and delivered to Montclair for detection of Ranavirus using traditional PCR analysis. Three sites, Stafford Business Park, Tuckahoe, and Hay Pond had confirmed incidents of Ranavirus between 2011 and 2012.
- New Findings
    - No new work was planned for this project for 2013; however, new results have become available which are presented in this report.
    - Conserve Wildlife Foundation of New Jersey (CWF) sampled five amphibian crossing locations in 2012, mostly in the Upper Delaware watershed. These locations were not reported in 2012, and they accounted for about half of the samples collected last year.
    - Of the 20 DEP HUC11 watersheds in New Jersey, 16 have been sampled, leaving only four unsampled: Hackensack, Lower Passaic, North & South Branch Raritan, and Wallkill. Despite the identification of these unsampled watersheds, no new locations were surveyed for *Bd* in 2013. Unsampled watersheds are highlighted in red in Figure 1 below, while green dots in Figure 1 represent all of the known sampling locations at the time of the writing of this report. To date, over 50 sites have been surveyed for *Bd* detection in New Jersey.
    - Of the 905 total samples that were collected for *Bd* testing, 598 have been lysed for *Bd* detection, and 399 have been analyzed using RT-PCR. To date, none of these samples have tested positive for *Bd*. However, there are still over 500 samples to be analyzed.
    - Of the 436 samples collected for detection of Ranavirus, 200 have had DNA extracted, and 160 of those have been analyzed using traditional PRC. In addition to the three previously confirmed incidences of Ranavirus, one more location in Sussex County tested positive for this pathogen. There are still 276 samples to be analyzed for Ranavirus.

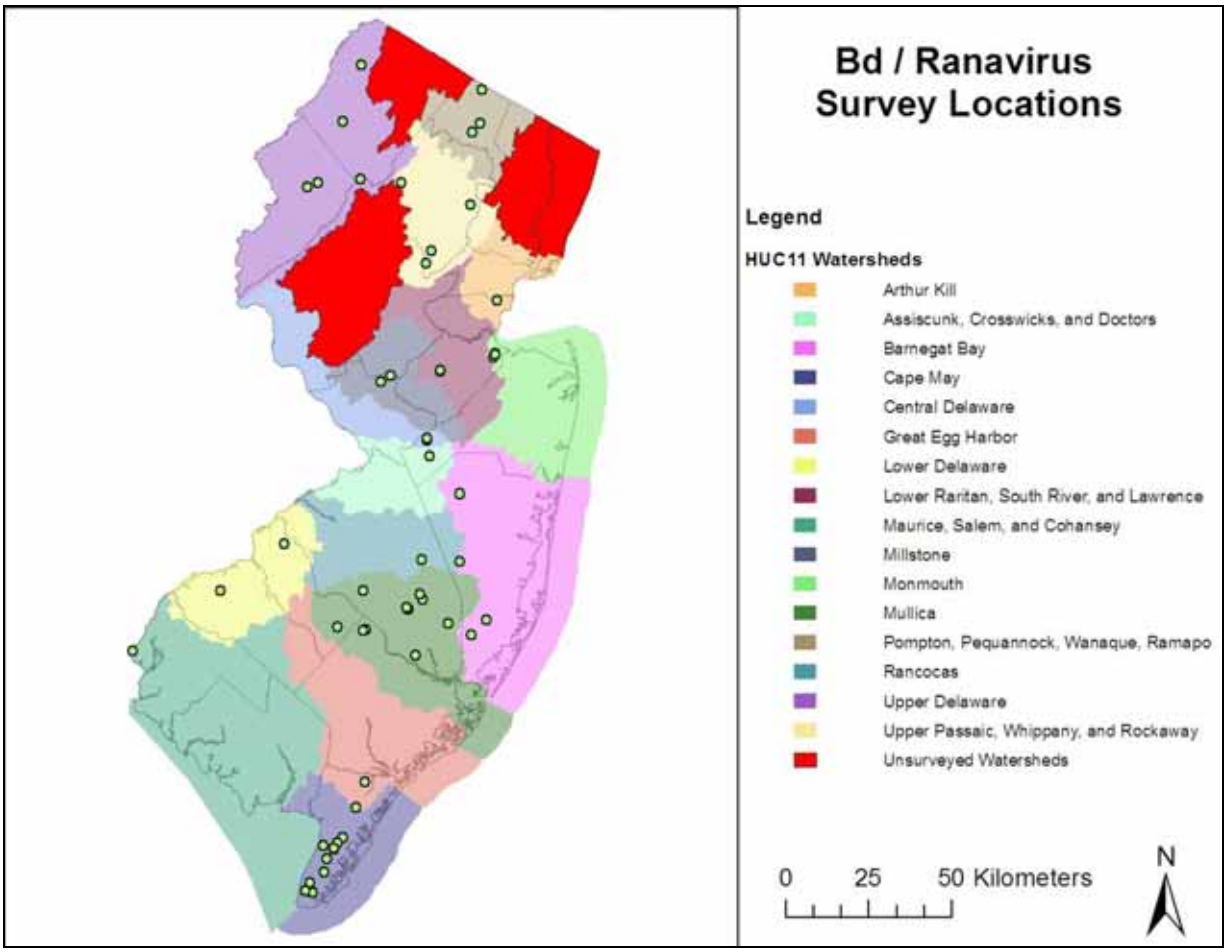


Figure 1. All sampling locations stratified by HUC11 watershed.

Conclusions:

- Increased partnerships in 2012 allowed us to collect more samples than we would have otherwise, but we still failed to sample all 20 of New Jersey's HUC11 watersheds.
- About 44% of the samples that were collected for detection of *Bd* in New Jersey have been fully analyzed without any testing positive.
- About 37% of the samples that were collected for Ranavirus have been fully analyzed and four samples have come back positive.
- *Bd* and Ranavirus have both been positively identified in New Jersey and we are awaiting final results from Montclair.
- In addition to this study, 20 sites were sampled for Ranavirus as part of the Northeast RCN, and the information from that analysis will add to this body of information.

Recommendations:

- Once all samples have been analyzed, create a distribution map of *Bd* in New Jersey that can be shared with other Northeastern states and inform further research.
- ENSP should continue to partner with other organizations on emergent amphibian diseases in the state as time and funding become available.

JOB 3: Herp Atlas Database

Project leader: Bill Pitts, Assistant Zoologist

OBJECTIVES:

1.To document distribution and relative abundance of New Jersey's reptiles and amphibians through comprehensive citizen-based surveys and to integrate these atlas findings into the Landscape Project.

2. To compile and summarize data on reptile and amphibian species for use in the assessment of species statuses.

Key Findings

- Background and Past Findings
    - At the end of 2011, staff changes dictated the need to alter this job. We decided to put the Herptile Atlas Monitoring Program on hiatus, while continuing the Calling Amphibian Monitoring Program (CAMP). CAMP data ultimately contributes to the Herp Atlas database.
- New Findings
    - 22 CAMP volunteers were recruited throughout New Jersey in 2013, and 24 of a possible 63 routes were surveyed
    - All data from 2001-2012 was pulled from the NAAMP online database, and ENSP created a local database to store this data and create queries to prepare the data for entry into the Biotics database. Over 1,200 records of SGCN anuran species have been identified, and they now need to be reviewed for acceptance into Biotics.
    - 2012 data was gathered from the North American Field Herping Association (NAFHA), evaluated and accepted for entry into Biotics.

Conclusions

- While a formal Herp Atlas program is on hold, data on non-SGCN species are still collected and catalogued through a variety of other initiatives, such as CAMP, NAAMP and NAFHA. These data will ultimately contribute to the Herp Atlas database should it be reinstituted.

Recommendations

- Once data is compiled, entered and mapped, it should be used to inform range maps revisions for an update to the Field Guide to Reptiles and Amphibians of New Jersey.
- Review of NAAMP SGCN data needs to be completed so that is can be incorporated into the Biotics database.
- Review and mapping of all NAAMP data needs to be completed to assist in development of maps for upcoming Delphi species status review.

JOB 4: Vernal Pools

Project leader: Brian Zarate, Senior Zoologist

OBJECTIVE: Vernal habitats are a regulated wetland type in New Jersey. Data collected by NJDEP staff and WCC volunteers are stored in an independent vernal pool database and then data is exported and integrated into ENSP's Biotics Database. Existing and new data collected on vernal pool conditions and species' occurrences will be used by NJDEP departments to regulate and protect these critical ecosystems.

NEED: ENSP's vernal pool project began in 2000 and special regulations for these important habitats were adopted by NJDEP in 2001. Due to a loss of funding, however, ENSP's role in vernal pool mapping and data integration has been minimal in recent years. This has resulted in an extreme backlog in vernal pool data entering the Biotics Database. To remedy this situation we are proposing that a staff member be assigned to oversee an intern or seasonal employee in organizing this database and conducting field visits/pool surveys as necessary.

Key Findings:

- No new vernal pool information was submitted to ENSP during this reporting period. Existing data is as follows and has not changed from the last report.
    - Potential vernal pools mapped (total): 14,095
    - Vernal pools meeting physical and hydrologic criteria (total): 4,155
    - "Certified" vernal pools meeting physical, hydrologic and biological criteria (total): 1,340
- No volunteer vernal pool surveys were performed this reporting cycle.
- NJDEP joined NatureServe in applying for North Atlantic LCC funding to assemble mapping of vernal pools across the region. If awarded, funding for a redesign of New Jersey's vernal pool database will come from this source.
    - ENSP staff is also discussing whether to integrate vernal pool mapping and species data reporting into the Biotics database upon the upgrade to Biotics 5, which may negate the need to redesign the existing database.

Conclusions:

- For the purposes of Biotics data entry and Landscape Project Mapping revisions, annual updates to the vernal pool database are acceptable.
- Integration of the vernal pool database into Biotics may be the best path forward, rather than maintaining a separate, independent database. Vernal pools are a data feature in the state's Landscape Project mapping and several vernal pool species are considered SGCN.

Recommendations:

- Await decision to see if NALCC funds the NatureServe proposal which will support the design of a vernal pool database, with possible integration into the new, upcoming Biotics 5 database.

JOB 5: Italian Wall Lizard Survey

Project leader: Bill Pitts, Assistant Zoologist

OBJECTIVE: Determine the current distribution of the breeding population of Italian Wall Lizards in New Jersey.

Key Findings:

- Background and Past Findings
    - In 2007, ENSP determined that a breeding colony of Italian Wall Lizards had established itself in New Jersey due to the release of 120 lizards in Burlington County by a herp enthusiast trying to control an insect problem on his property. As with any introduced species, it was important to determine its "baseline" distribution and estimate its abundance in order to ascertain if, and at what rate, its population was spreading or growing.
- New Findings
    - In August 2012, Dr. Matthew Bealor from Rowan University captured 29 Italian wall lizards for a trial run of a PIT (Passive Integrated Transponder) tagging project. Individuals responded well to subcutaneous injection of PIT tags and were released 48 hours after

capture. One hundred-thirteen individuals were captured and 88 of them were tagged between August and October 2012.

- In 2013, Rowan researchers captured an additional 155 individuals and marked 135; seven were recaptured. These results are very similar to the results from the 2011 mark/ recapture study.
- Italian wall lizards were encountered in areas along Roberts Ln. in 2012 where they were not encountered in 2011 (see Figure 2).
- In October 2012, a confirmed observation of an Italian wall lizard was reported in Oradell, Bergen County, NJ.
- In June of 2013, Rowan students encountered a Mt. Laurel resident who informed them that a family member was capturing and releasing lizards in Howell, Monmouth County, NJ, but this was not confirmed.

Conclusions:

- Additional populations of this non-native lizard are present in the state. At this time, it does not appear that Italian wall lizards are in direct competition with native New Jersey species, but new observations should continue to be tracked as they are reported.
- Given the similarities of the 2011 mark-recapture study and the 2012 study, it is apparent that this population has grown well beyond the original 120 lizards that were released. The low recapture rates in both studies also suggest that the lizards have a high turnover rate.

Recommendations

- Dr. Bealor should to continue to use Rowan students to monitor the Mt. Laurel population with minimal involvement from ENSP. Additionally, the survey area should be increased from 2 km to 3 km from the original release site.
- A follow-up survey of Howell should be conducted next spring when lizards become active to verify whether or not a new population has become established disjunct from the Mt. Laurel population.

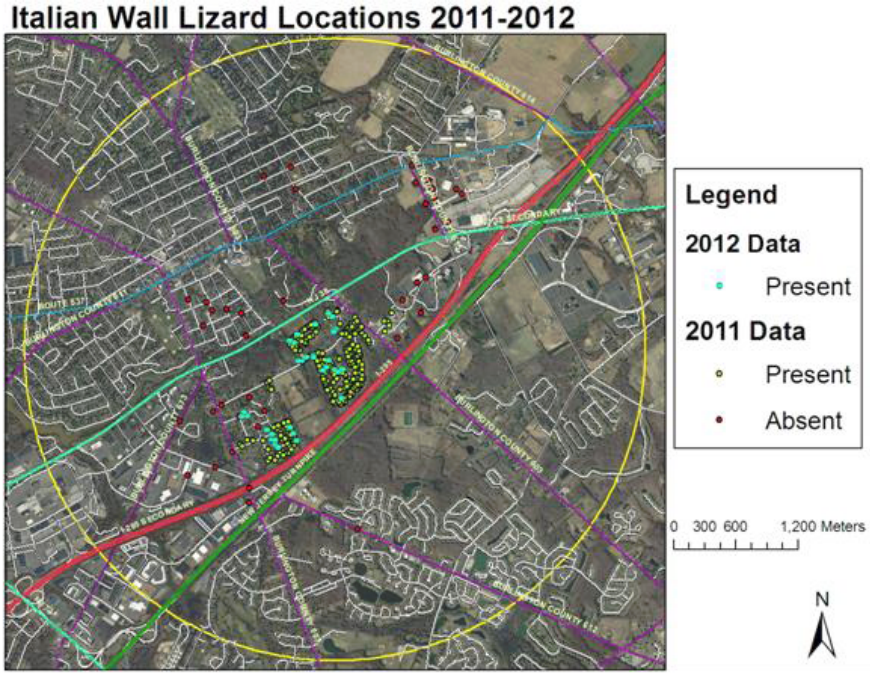


Figure 2. Observation of Italian wall lizards in Mt. Laurel, NJ within 3 km buffer area.

EXECUTIVE SUMMARY

Project: **Invertebrate Conservation**
Federal Aid Project: T-1-6 (State Wildlife Grants)
Segment dates: September 1, 2012to August 31, 2013

Project 4: Invertebrate Conservation

JOB 1: State Listed Mollusks

Project leader: Jeanette Bowers-Altman, Principal Zoologist

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:

- The 2013 field season was dominated by poor weather conditions and staffing shortages. A late, cold spring was followed by precipitation throughout June, raining on 17 out of 30 days. The rainy June was followed by one of the hottest Julys on record. Rain and high water of June, and then unprecedented (and unsafe) high temperatures severely limited survey efforts.
- We surveyed five stream sites and one lake site in five counties for listed freshwater mussels. Timed searches for mussels were conducted at historic locations and/or previously unsurveyed suitable habitats. In addition, four sites were surveyed in Wickecheoke Creek, Hunterdon County, for evidence of the invasive Chinese Pond Mussel.
- We performed habitat assessments and/or preliminary searches at 12 additional sites to determine if larger surveys were warranted.
- EPA Habitat Assessment Field Data Sheet scores (high and low gradient combined, excluding Wickecheoke Creek sites) ranged from 123 (Pequest River, Warren County) to 155 (Barton Run, Burlington County), 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.
- We conducted an analysis of freshwater mussel data collected between 2000-2012. By comparing individual habitat characteristic scores from EPA Habitat Assessment Field Data sheets (including but not limited to epifaunal substrate/available cover, sediment deposition, bank stability, and riparian width) with freshwater mussel abundance and species richness, we found that 1) abundance is most closely associated with total habitat score and total bank stability score and 2) species richness is most closely associated with total bank stability, total vegetative cover, and total mean riparian width score. We are currently incorporating 2013 information into the analysis.
- We continued testing a new type of sampling gear we designed in 2011. It is essentially a rake with a cross sectional opening 12 inches wide and 2 and ¼ inches deep. A steel-meshed basket was welded to the rake opening with diamond-shaped mesh openings of ¼ inch by ¾ inches. Our new gear type is designed to facilitate sampling fine to coarse sediments that are used by particular species of mussels. Rake testing in the Pequest River (n = 73 passes) yielded a single fresh shell of a juvenile Creeper (SC) and three live juvenile Eastern elliptio. Preliminary findings when comparing the rake to 0.25 m quadrats suggest that the rake is actually more effective at finding early life stage mussels.
- Water quality values were as follows: pH ranged from 7.2 to 8.2, water temperatures ranged 17–25 Celsius, dissolved oxygen ranged from 6.9 - to 8.5 ppm.

- Catch per unit effort (CPUE) for all species combined during time searches was highest in Barton Run, Burlington County, with 4.19 live mussels/minute. The Barton Run site has one of the densest mussel populations we have encountered in the state.
- The ENSP and volunteers found eleven species of freshwater mussels during field activities, including the Triangle floater, Eastern pondmussel, Eastern elliptio, Eastern floater, Alewife floater, Paper pondshell, Tidewater mucket, Eastern lampmussel, Dwarf wedgemussel, Creeper and Lilliput. The Eastern elliptio was by far the most prevalent and widespread mussel species documented. Species richness was highest in Salem Creek, Salem County, with seven species recorded. Significant findings included a live Triangle floater in Barton Run, Burlington County, live Eastern lampmussels in the Ramapo River, and fresh shells of Dwarf wedgemussel and Creeper in the Pequest River, Warren County.
- We continued searches for the Chinese pond mussel in Wickecheoke Creek. In 2010, we documented the first North American occurrence of the highly invasive Chinese pond mussel (*Sinanodonta woodiana*) from ponds owned by the 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. Genetic testing by Dr. Arthur Bogan and staff of the North Carolina Natural History Museum confirmed the species identification. Despite a rotenone treatment and lowering of all the ponds on site over the winter, we found fresh Chinese pond mussel shells alongside four of the ponds (n=9), and one fresh shell about 10 m from the outlet of the last pond, in Wickecheoke Creek. In addition, we found two fresh Chinese Pondmussel shells downstream at the nearest road crossing. Despite searches at two additional downstream sites, no mussels or shells were found.
- We found two fresh Lilliput shells in Salem Creek. The species appears to be limited in NJ to this particular site. Despite numerous survey efforts above and below the known location, we have been unable to find live individuals or shells outside of a small stretch (200 m) of the creek.
- Volunteers surveyed the Cohansey River, downstream of Seeley Lake, Bridgeton, Cumberland County, to determine impacts of 2011 flooding on the Eastern pondmussel population. Hurricane Irene hit the east coast during late August 2011, causing unprecedented flooding in southern NJ. There was much freshwater mussel mortality associated with August flooding in the Cohansey River, as well as in other southern NJ waterways. Water appeared to be lower (by two to three feet) in the stretch where the Eastern pondmussels occurred, probably due to the loss of the Sunset Lake dam in Bridgeton during the abovementioned flooding event. No live Eastern pondmussels were found in the occurrence area. Only a single live Eastern elliptio was recorded. There appeared to have been structural changes to the stream, along with a change in substrate from sandy/gravel to stretches of mud and silt. A single Eastern pondmussel shell was found much higher in the stream, close to where the failed dam once stood.
- Wildlife Conservation Corp volunteers continued surveys in the southern half of the state. Areas searched included sections of the Cohansey River, Menantico Creek, and Barton Run.
- All new locations found to have federal and/or state listed freshwater mussels from these surveys and others (e.g., private consultants, USGS, etc.) have been/ are in the process of being incorporated into the Biotics database. These locations, along with sightings from previous surveys, will be used in next version of the Landscape Project mapping to identify critical areas for listed mussel populations.

Conclusions:

- Based on habitat suitability assessments and preliminary searches, seven out of 12 sites warrant further survey work to determine freshwater mussel species composition and abundance.
- Habitat characteristic analyses, once refined, may eventually provide resource managers with important information regarding species' habitat requirements.
- The rake sampler shows great promise in sampling fine and coarse sand substrates that have no embedded tree branches or cobble. Preliminary results for finding smaller species like the Dwarf

wedgemussel indicate that the rake is a useful sampling tool if the goal is to document either small juveniles or rare species.

- The Chinese pond mussel may have escaped from the fish farm ponds into Wickecheoke Creek. This creek, although intermittent and fairly unsuitable to support freshwater mussel populations, contains pockets of deeper, stagnant pools, a preferred Chinese pond mussel habitat type. In addition, there are a number of privately owned ponds that feed into the creek that could very well contain Chinese pond mussel populations. It is undetermined whether the species is living in the creek, and if so, has been washed down (or carried via hosts fishes) to the Delaware River or D & R canal.
- Flooding that occurred in 2011 during Hurricane Irene severely impacted the Eastern pondmussel populations and other mussels in the Cohansey River. To date, we have not documented lasting damage from Superstorm Sandy on freshwater mussels.

Recommendations:

- Continue surveys for listed species in previously unsurveyed suitable habitats to document distribution; monitor populations in known locations.
- Continue analyzing habitat data to compare listed species abundance with individual habitat parameters. Develop protocol that will apply findings to stream restoration techniques to help manage for listed mussels.
- Develop and implement a more scientifically sound sampling design for rake testing. Begin using rake in areas with appropriate substrates during surveys.
- Enlist volunteers from the New Jersey Invasive Species Strike Team to assist with efforts to eradicate Chinese pond mussels and prevent the spread of this invasive species.
- Continue surveys in the Cohansey River to determine whether Eastern pondmussels near the Seeley Lake location were redistributed downstream of the occurrence area.
- Continue working with the DEP's Water Monitoring and Standards to recommend stream classification upgrades in areas with listed mussels. Participate in internal stakeholder's group as requested. Continue refining methodology for selecting potential Category 1 stream segments using listed freshwater mussels and other aquatic obligate species
- Continue work on atlas and solicit assistance from additional Wildlife Conservation Corp (WCC); train volunteers to identify and survey for mussels; assign specific areas for survey work where data are lacking. Finalize and publish field guide online.

JOB 2: Federal and State-Listed Lepidoptera
Project leader: Robert Somes, Senior Zoologist

OBJECTIVE: To identify, survey, protect and manage for listed Lepidoptera populations and habitats in New Jersey. Species include Arogos Skipper, Mitchell's Satyr, Bronze Copper, Appalachian Grizzled Skipper, Checkered White, Silver-bordered Fritillary, Hoary Elfin, Harris' Checkerspot, Hessell's Hairstreak, and Frosted Elfin.

Job 2A: State Listed Lepidoptera
Project leader: Robert Somes, Senior Zoologist

Key Findings:

- The 2013 spring and summer field season was complicated by poor weather conditions and staffing shortages. A late, cold spring and then heavy rainfall throughout June (precipitation occurred on 17 out of 30 days) hampered survey efforts. Also, before the field season began, we moved funding away from research contracts, eliminating assistance that provided survey work in previous field

seasons. In spite of limiting the work to one staff biologist, a large portion of the proposed work was completed.

- Surveys for Silver-bordered Fritillary (*Boloria selena*) were conducted in central and northern New Jersey totaling 14 survey days for five known sites and two new/potential sites. None were observed at any of our historic locations. Poor weather conditions could have been the cause for the lack of observations, and a large number of common butterfly species either flew late during this season or had diminished populations. This species is also notoriously eruptive in NJ with large numbers observed on one day followed by none the following day.
- A habitat management plan for Silver-bordered Fritillary was developed in conjunction with a development application near one of the central New Jersey populations. A housing development was planned immediately adjacent to the site and through the environmental review process, a habitat protection and maintenance plan was developed to insure the protection for the species at this site.
- Surveys for Helicta (Georgia) Satyr were conducted over the course of four days at five sites including two known and three potential locations. The species was present at the two known sites and was discovered in large numbers in three new locations on Federal government property, which probably represent a large metapopulation.
- Surveys for Leonard's Skipper at historic locations and in potential habitat failed to locate the species in southern NJ. Multiple surveys at the two known sites in northern NJ located only one individual at one site.
- Numerous surveys were conducted and data collected by State volunteers in conjunction with several different butterfly and outdoor clubs in NJ. All data are being compiled, entered into the Biotics database and mapped in GIS. Preliminary work was also begun to organize data to initiate an updated status review of NJ's rare butterfly species.

Conclusions:

- Silver-bordered Fritillary and Leonard's Skipper appear to be declining Statewide over the last two years.
- The potential exists to find more Georgia (Helicta) Satyr populations in previously unsurveyed but suitable habitat and the possibility exists for a large metapopulation to be present on Federal property in the NJ Pinelands region.

Recommendations:

- Conduct targeted surveys for Silver-bordered Fritillary and Leonard's Skipper during 2014 field season in order to better determine their present population statuses.
- Expand surveys for Georgia Satyr in the Pinelands region to better understand their habitat needs and overall distribution.

Job 2B: Frosted Elfin

Project leader: Robert Somes, Senior Zoologist

Key Findings:

- During September 2012, 2,000 *Baptisia tinctoria* (foodplant) seedlings were planted over a five acre area at two known elfin sites on Division of Fish and Wildlife (DFW) property that had been heavily damaged by off road vehicle use and flooding during the previous year. Control and eradication of *Phragmites australis* was also initiated in conjunction with DFW-Lands Management staff. We met with the utility company in several elfin sites in this area, and devised a proactive mowing program to benefit elfins on their rights-of-way.

- Follow-up surveys in April and May, 2013, found that over 50% of the *Baptisia* plantings survived the winter. The areas that had been mowed and become devoid of *Baptisia* contained extensive areas of it.
- Due to the late cold spring, frosted elfins flew three to four weeks later than the average of the previous four years. However, the species was found widely distributed over the restoration sites and observed ovipositing on some the planted *Baptisia*.

Conclusions:
- The southeastern populations of Frosted Elfin seem to be persisting but none were observed at several western sites nor at the previously successful Woodbine Airport site north of the habitat enhancement area. Surveys should be continued during 2014 to assess the habitat management efforts and to better document the status of some the sites that appear to have declined.
- Five acres of habitat enhancements were successful with a minimum of time and effort via the targeted use of mowing.

Recommendations:
- Continue targeting mowing and habitat enhancement at sites found to be declining due to succession of invasive species.
- Conduct intensive surveys to better document the status of populations that appear to be in decline and continue monitoring habitat management sites to monitor the impact on the Forested Elfin populations at these sites and to monitor the density and distribution of *Baptisia*.

Job 2C: Northern Metalmark
Project leader: Robert Somes, Senior Zoologist

Key Findings:
- During the winter of 2013, habitat management and invasive species control was initiated at two different sites. Ten acres of habitat were enhanced on State and County Park property with the assistance of volunteers and The Nature Conservancy (TNC) staff. The habitat management included mechanical thinning of vegetation and the tree canopy as well as the creation of gaps and connecting corridors between suitable sites. Many sites have declined due to succession and shading that eliminates the nectar sources that the adult butterflies depend on and decreases the productivity and density of the foodplant/Round-leaved Ragwort (*Packera obovata*). Dispersal of this ragwort between sites has also been diminished due to invasive vegetation and succession.
- Surveys during September 2013 found Northern Metalmark larvae on ragwort that had established itself in new areas managed during the previous season. Adult surveys during the summer of 2013 were conducted at all of the restoration sites. Adult metalmarks were found distributed over a wider area than previously documented (over 40 adults observed) and were also found to have dispersed to new sites >1,000 m away that have lacked metalmarks for 10 years.
- Surveys of known and potential sites elsewhere in northern New Jersey found the species to still be present at three historic sites and found at one new site.

Conclusions:
- Manual thinning and removal of invasive species, opening of the forest canopy and the creation of connecting corridors, has appeared to have improved connectivity and dispersal at several sites.
- Several smaller sites appear to have declined but it is hoped through better management efforts that these sites will be recolonized.

Recommendations:

- Monitoring at restoration sites should continue in order to determine the impact on the populations at these sites. Follow up vegetation management should be continued in order to keep invasive species and canopy closure under control.
- Habitat management should continue and be expanded around core sites in order to improve dispersal and connectivity between sites and encourage the recolonization of satellite sites.

Job 2D: Arogos Skipper-North
Project leader: Robert Somes, Senior Zoologist

Key Findings:
- Limited staffing reduced surveys for this species in northern New Jersey to just two days during poor weather conditions. Five sites were surveyed over two days with only one worn Arogos Skipper observed. Most other species that fly at the same time as Arogos also appeared to be heavily worn and the peak flight was possibly missed.

Conclusions:
- Data from this survey season were inconclusive. Suitable habitat was found to still exist at many sites and Arogos Skipper should still be extant at these locations

Recommendations:
- Surveys of the northern New Jersey sites should be a priority during the next field season in order to determine the status of several of the sites where the species was not observed.

Job 2E: Arogos Skipper-South
Project leader: Robert Somes, Senior Zoologist

Key Findings:
- Extensive surveys were conducted for Arogos Skipper on federal property in southern New Jersey. Three known and two potential sites were surveyed over the course of two days. Arogos Skipper was found at two new sites that contained large areas of potential habitat. The three known sites had grown up extensively and no Arogos Skippers were observed. The Department of Defense will work to initiate forest fire management at the sites that have grown up in order to help to improve the habitat and maintain the sites. All of the adults that were observed were extremely fresh and likely the start of an emergence/flight. Unfortunately, we were unable to survey at a later date in order to catch the peak flight.
- An area of approximately 300 acres of potential habitat was managed through prescribed fire on private property adjacent to the Penn State Forest Arogos Skipper sites. This work was conducted by the New Jersey Forest Fire Service and greatly improved the habitat in and around one of our historic Arogos sites. Arogos Skipper was not observed at this location during two different survey days during the summer flight but it is hoped that through further habitat management, the site will be recolonized.

Conclusions:
- Extensive areas of suitable but unsurveyed habitat were studied this year within the Pinelands and were found to have Arogos Skipper populations in them.

Recommendations:

- Further prescribed fire management should be targeted on both the State and Federal property Arogos Skipper sites to insure the persistence and suitability of these sites. Surveys should be targeted at the managed sites to assess the impacts of our habitat management activities on the Arogos Skipper populations at these sites.

JOB 3: Rare Odonata Conservation
Project leader: Robert Somes, Senior Zoologist

OBJECTIVE: To evaluate the status of rare Odonata species in New Jersey and proceed with the state listing process for those species that warrant the status of threatened or endangered. Routine surveys for the rare Odonata species will be an important component of the long-term protection of rare Odonata in New Jersey. This project will also investigate the role of hydrological and water quality issues that may affect habitat suitability and population trends. Management will involve integrating habitat needs into forestry, farming and other land use practices, combined with habitat restoration and protection of concentration areas.

Job 3A – Gray Petaltail Conservation
Project leader: Robert Somes, Senior Zoologist

Key Findings:
- Due to insufficient staff and resources, monitoring of the reintroduction site did not occur during this field season. Funding for the contract biologists that provided survey staff was reallocated to cover staff expenses prior to the start of the field season.

Recommendations:
- Discontinue this job unless sufficient funding can be secured.

Job 3B: Statewide Surveys and Monitoring of Listed Odonata:
Project leader: Robert Somes, Senior Zoologist

Key Findings:
- Due to insufficient staff and resources, surveys for State-listed Odonata were greatly reduced during this field. Heavy rainfall and poor weather greatly reduced the amount of surveys that could be conducted. Many NJ streams were constantly at a high level through the flight of many species of dragonfly and hampered our survey efforts.
- Surveys for Gray Petaltail were conducted at the recently rediscovered Campgaw Mountain population over the course of two days with one Gray Petaltail observed. Poor weather conditions hampered our survey efforts. Surveys for suitable breeding sites were conducted in the habitat surrounding the known site and we discovered extensive areas of potential breeding seeps.
- Surveys for Brook and Maine Snaketail were conducted at two potential new locations over the course of three days with no individuals observed of either species. Individuals of one of these species were observed during the previous field season and surveys were targeted in an attempt to determine which species is present at this site.
- A habitat restoration project was conducted at a public/private site immediately adjacent to one of our known Brook Snaketail sites on the lower Musconetcong River. This project involved the restoration of the stream corridor at the site of an old dam and impoundment. The project was designed to create and maintain substrate suitable for Brook Snaketail.

- A habitat restoration project was designed to restore a stream corridor that encompasses another Brook Snaketail site on the upper Musconetcong River. Plans were designed to insure that there would be no negative impacts to the current Brook Snaketail population and to create and maintain suitable substrate at other locations along the corridor.
- Surveys for Brush-tipped Emerald were conducted at four sites over the course of three days. Brush-tipped Emeralds were documented at two new locations that contained potential habitat.

Conclusions:
- There is a large amount of interest and work going on the field of dam removal and stream restoration in NJ with several projects having come up during this survey year. This will provide the potential for future research looking at restoring Odonata habitat in impaired streams and monitoring the impact of this work on the local Odonata populations.
- Surveys of suitable habitat for listed species continue to document new populations of rare Odonata species.

Recommendations:
- Odonata surveys and population monitoring should be targeted at stream restoration areas in order to evaluate the impacts of the habitat work on the stream habitat/structure and its Odonata diversity and populations.
- Surveys for Grey Petaltail should be a high priority to determine the size and distribution of the recently rediscovered NJ population.
- Surveys for other rare Odonata species should continue in order to better document the populations of rare Odonata in NJ.

Job 3C – Occurrence Area Buffer Delineation
Project leader: Robert Somes, Senior Zoologist

OBJECTIVE: Develop information to determine range distances for priority species from breeding waters.

Key Findings:
- Due to insufficient staff and resources work on the Occurrence Area Buffer Delineation were not completed during the field season.

Recommendations:
- Discontinue this job unless sufficient funding can be secured.

JOB 4. Rare Coleoptera Conservation
Project leader: Robert Somes, Senior Zoologist

OBJECTIVE: To determine the status and distribution of New Jersey's native Coleoptera species, particularly those that may be rare or threatened on a state or global level, and take steps to stabilize and recover species as necessary.

Key Findings:
- Due to insufficient staff, Coleopteran research was greatly reduced during this field season in favor of completing the work related to listed Lepidoptera and Odonata species.

- Surveys for Clay-bank Tiger beetle (*Cicindela limbalis*) in northern New Jersey documented a new population found in the northeastern portion of the known site and we found that the population covered a larger area than previously observed.
- Surveys for Cobblestone Tiger beetle (*Cicindela marginipennis*) were conducted in the Delaware Water Gap at three different locations; we observed one individual of this species at one known site.

Conclusions:
- Clay-bank Tiger beetle appears to have a self-sustaining population in NJ and has been found over multiple years now.
- Cobblestone Tiger beetle still occurs in NJ but apparently in very low numbers at our survey locations.

Recommendations:
- Surveys for Cobblestone Tiger beetle should be expanded throughout the Delaware Water Gap in order to better determine the overall size and distribution of the population found there.
- Surveys for other rare tiger beetles should be continued in order to better determine baseline population data with the goal of conducting a species status assessment during the next several years.

JOB 5. Impact of Dam Removals on Macroinvertebrates

Project leader: Jeanette Bowers-Altman, Principal Zoologist

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:
- We continued working with NJDEP's Bureau of Dam Safety and Flood Control (BDSFC) to identify the dams (large and small) slated for removal within the next two years. In May 2013, staff at BDSFC identified one small dam in Hunterdon County as slated for removal, and several dams along the Musconetcong River in the feasibility stage. In addition, we learned Old Forge dam, Burlington County, will not be removed due to rehabilitation by the lake homeowners; thus we will stop monitoring at that site. Odonata monitoring at the Mine Brook site did not occur this year due to cuts in contract work.

- The Finesville dam on the Musconetcong River was immediately downstream of one of the only Brook Snaketail sites in this region. After removal of the dam in 2011, a restoration project was developed and implemented to restore natural stream morphology to the old dam impoundment. Numerous surveys were conducted during this field season to insure that there was no breeding/larvae habitat in the restoration area. There was no suitable Brook Snaketail larvae habitat found in the restoration area.
- Several meetings were held with the project managers to develop a restoration design that would create fish and invertebrate habitat and restore natural morphology to the stream at this location. Upon completion of the restoration, several large areas of suitable substrate were created for breeding dragonflies that will hopefully be colonized by the nearby Brook Snaketail colony. The

site will be monitored during the future to inventory the invertebrate population at the site and to determine if the site is colonized by the nearby Brook Snaketail population.

- The restoration project also created large areas of habitat suitable for freshwater mussel colonization. Prior to the restoration work, there were no freshwater mussels documented at or near the site, and there was no suitable mussel habitat prior to the restoration work.

- Both the Roberts Street and Nevius Street dams along the Raritan River were removed during the last two years. They are adjacent to each other in the same section of river. Staff limitations and poor weather and water conditions limited our work at these sites. In our surveys we found decreased numbers of the common pond species of dragonfly (Common White-tail, Blue Dasher, etc.) and increased numbers of stream species (Stream Bluet, Powdered Dancer, etc.). The site now contains more suitable habitat for a wider variety of stream dragonfly species that occur along natural stretches of the river in this area. Both sites will be surveyed for freshwater mussels in the next segment.
- We continued surveys in Barton Run to determine if Eastern pondmussels occur in other locations of the stream, or if removal of the Kenilworth Lake dam eliminated the only population of this threatened species within the system. Despite intensive surveying at three sites downstream of Kenilworth Lake (which is no longer a lake), no Eastern pondmussels were found.

Conclusions:

- Biodiversity drops off rapidly upstream and downstream of the Finesville dam. Removal of the dam will ultimately lead to improve stream connectivity and inevitably will allow more sensitive species from other segments to re-colonize the area. This has proved to be the case along this river in Hackettstown where two small impoundments have been recently removed.
- With the removal of the Finesville dam, it is entirely possible that the documented colony of Brook snaketail may be negatively impacted. Ultimately the benefits of restoring natural flow to this river out-weigh the potential loss of one colony of this rare species. If anything it is possible that the river will be colonized by other indicator species once it has stabilized to a more natural flow regime. Also, Brook Snaketail occurs upstream of the target site in Warren County. With stream connectivity restored it likely that larvae will eventually drift downstream to colonize larger segments of this river. We are hopeful that the Brook Snaketail will colonize the restoration site, which will help us determine if targeted habitat restoration is a tool for mitigating impacts of dam removals.
- Since only one year has passed since the removal of the Nevius and Robert's streets dams along the Raritan River, it is unlikely for the species composition to have changed significantly. It will most likely take several years for more Odonata species to colonize these sites.
- Removal of the dam in Evesham Township may have contributed to the mortality of an Eastern Pondmussel population in Kenilworth Lake. More surveys are needed to determine whether the species occurs elsewhere in the system, especially within several hydrologically connected lakes. The suspected loss of this Threatened species population underscores the need for long-term research into the effects of dam removal on mussels using deeper water habitats above dam sites.

Recommendations:

- Monitor Odonata following removal of the Mine Brook Reservoir dam as a small suite of forest species are likely to colonize this stream segment once natural flow is restored. In addition, conduct freshwater mussel surveys prior to dam removal to determine if species other than the eastern floater are present and if monitoring is warranted.
- Monitor the Finesville dam site as well as the restoration area to thoroughly document changes to Brook snaketail and other Odonata populations. In addition, conduct freshwater mussel surveys in recently created habitat to document and monitor mussel populations over time.

- Continue monitoring of Odonata and freshwater mussels at the Nevius and Roberts streets dam removal sites in the Raritan River.
- Continue surveys conducted in 2011 in Barton Run to determine if Eastern pondmussels occur in other locations throughout the stream, or if removal of the Kenilworth Lake dam eliminated the only population of this threatened species within the system.
- Work with the BDSFC to determine up-to-date 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.
- Investigate methods to mitigate dam removal impacts on freshwater mussels, Odonata, and other macroinvertebrates (e.g. crayfish). 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.

EXECUTIVE SUMMARY

Project: **Species Status Review**
Federal Aid Project: T-1-6 (State Wildlife Grants)
Segment dates: September 1, 2012 to August 31, 2013

JOB 1: Species Status Review and Listing

Project leaders: Mick Valent, Principal Zoologist and Jeanette Bowers-Altman, Prin. Zoologist

OBJECTIVE: Determine the status and distribution of endangered and threatened wildlife, and wildlife species of special concern.

Key Findings:

TERRESTRIAL NONGAME MAMMALS:

- The statuses of 39 terrestrial mammal species were reviewed using the Delphi process in 2011-2012 All indigenous, terrestrial nongame mammals were included in the status review. Seven reviewers participated, including experts from the Division of Fish & Wildlife, Rutgers University (NJ), the NJ State Museum, Montclair State University (NJ), and Union College (NY).
- We reported in 2012 that the review resulted in consensus for statuses of 37 out of 39 species (see NJ T-1-6, 2011-2012 report). Five bats were recommended for endangered status, and four more as special concern. Two species were unresolved after four rounds of review, and were categorized by a vote of the Endangered and Nongame Species Advisory Committee at their March, 2013, meeting. The southern bog lemming was categorized as Unknown-Undetermined, and the meadow jumping mouse as Special Concern (Table 1).
- It remains upon the ENSP to make the status changes official through rulemaking in 2014 or 2015.

OTHER SPECIES TAXA:

- ENSP biologists discussed the next taxa of species up for status reviews in 2014. The likely species groups for review will be freshwater fish, reptiles/amphibians, butterflies, and birds.

Conclusions:

- The recommendations for status changes of terrestrial mammals were made ENSAC and the NJ DEP and await action in rulemaking.

Recommendations:

- Begin status reviews of reptile/amphibian group, freshwater fish, butterflies and birds. .
- Proceed with new status assignments through the regulatory (rulemaking) process.

Table 1. Results of the Terrestrial Mammal Status Review for species determined to be endangered, threatened, special concern (and two species categorized after no consensus was reached in the Delphi review).

Scientific Name	Common Name	Current NJ Status	Consensus Reached Round #	Consensus Status
Lynx rufus	Bobcat	Endangered	3	Threatened
Eptesicus fuscus	Big brown bat	None	3	Special Concern
Lasionycteris noctivagans	Silver-haired bat	None	3	Special Concern
Lasiurus borealis	Red bat	None	3	Special Concern

Lasiurus cinereus	Hoary bat	None	2	Special Concern
Myotis leibii	E. small-footed myotis	None	3	Endangered
Myotis lucifugus	Little brown bat	None	3	Endangered
Myotis septentrionalis	Northern long-eared bat	None	3	Endangered
Myotis sodalis	Indiana bat	Endangered	2	Endangered
Perimyotis subflavus	Tri-colored bat	None	3	Endangered
Neotoma magister	Allegheny woodrat	Endangered	1	Endangered
Synaptomys cooperi	Southern bog lemming	None	4	None (Unknown)
Zapus hudsonius	Meadow jumping mouse	None	4	None (Special Concern)