

**Interim Report  
State Wildlife Grants  
T-1-6**

**Endangered, Threatened and Rare Wildlife Conservation Projects**

**Progress Report for Project Year  
September 1, 2011 – August 31, 2012**

**NJ Department of Environmental Protection**

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



## EXECUTIVE SUMMARY

<b>Project:</b>	<b>Bird Conservation</b>
Federal Aid Project:	T-1-6 (State Wildlife Grants)
Segment dates:	September 1, 2011 to August 31, 2012
Total Project Expenditures:	\$636,432 (\$413,432 Federal, \$222,617) ('11-'12 year only)

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### **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. Seventy-eight 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 73 volunteers last year.
  - In 2012, 135 eagle pairs were monitored during some or all of the season, of which 119 were active (exhibiting incubation) and 10 were territorial (maintained a nest area). An additional two pairs were probably active but their nests could not be observed to confirm; four other pairs were categorized as unknown due to lack of observations.
  - During the 2012 nesting season, 100 nests were known to be successful in producing 165 young, for a productivity rate of 1.39 young per active nest. This is slightly higher than the ten-year median in New Jersey of 1.25 young per active nest. Overall nest success rate was 84%, above the average of 74%. These results marked a slight upturn in nest success and fledging after a poor year in 2010 and average year in 2011.
  - Twenty-seven new eagle nests were discovered this season. New pairs became active across the three regions of the state: the south with 15, central with two, and north with ten new pairs. Just three of the state's 21 counties do not have known nests.
  - We documented 15 nest failures. Most had unknown causes, but one nest failed when the three nestlings perished following an intense rainstorm from which, we presumed, the adults could not keep all three (4-week-old) nestlings dry.
- ENSP biologists visited a sample of nests to band young with federal and color leg bands and to take blood samples. In 2012 we banded 23 eaglets at 11 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 14-15, 2012. A total of 335 bald eagles was counted by volunteers and staff, up from 2011 and near the 2010 count of 333 (Figure 2). Most eagles (290) were observed in southern New Jersey, primarily in the Delaware Bay region; northern New Jersey had 45 bald eagles on the Delaware River and on inland reservoirs. The weather during the count was relatively clear and cool without precipitation, good conditions for the volunteer effort. Surveyors recorded detailed data on eagle locations, and those data were compiled to help document critical eagle wintering habitat. Total figures also were reported to the USDOJ 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. Continued surveys of these sites during annual Midwinter Surveys will help track their use over time and the condition of wintering habitats can be tracked as land use/land cover mapping is updated.

#### 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 created 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.
- We plan to revise the brochure for landowners to provide additional, NJ-specific recommendations for nest and roost area protections.

#### Habitat protection and planning:

- All new nests found in 2011 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.
- 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 11, 2012, attended by approximately 35 project volunteers.
- 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 but were not finalized due to a lack of time. Site-specific habitat management plans were necessary on a few sites due to pending development permit applications.
- No action was taken on comparing management practices for efficacy. Currently, management is designed for specific nest sites to address on-site issues in the context of site conditions (habitat and other).
- The status assessment portion of the proposed Bald Eagle Recovery Plan was not conducted due time limitations.

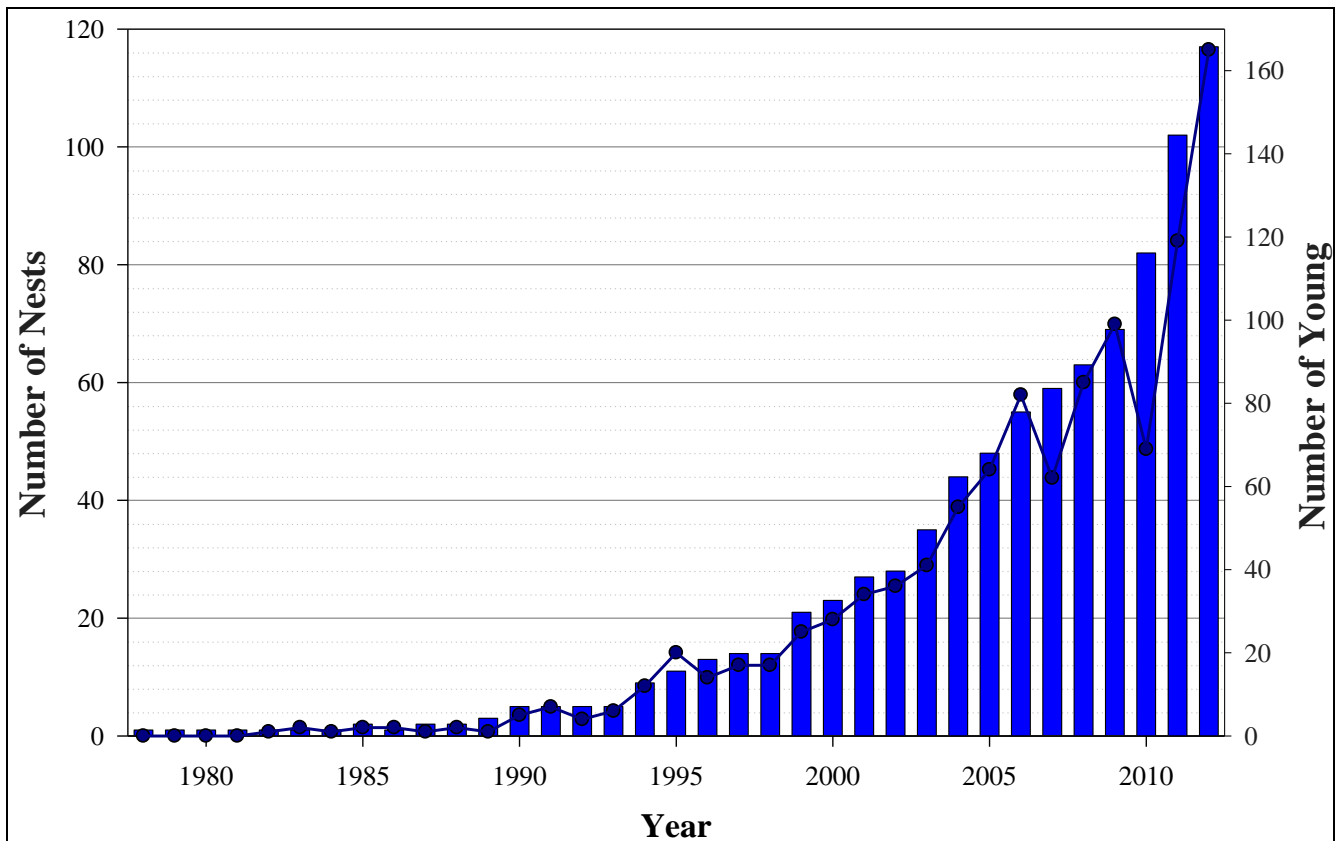


Figure 1. Number of bald eagle nests (bars) and young produced (line) in NJ, 1978-2012.

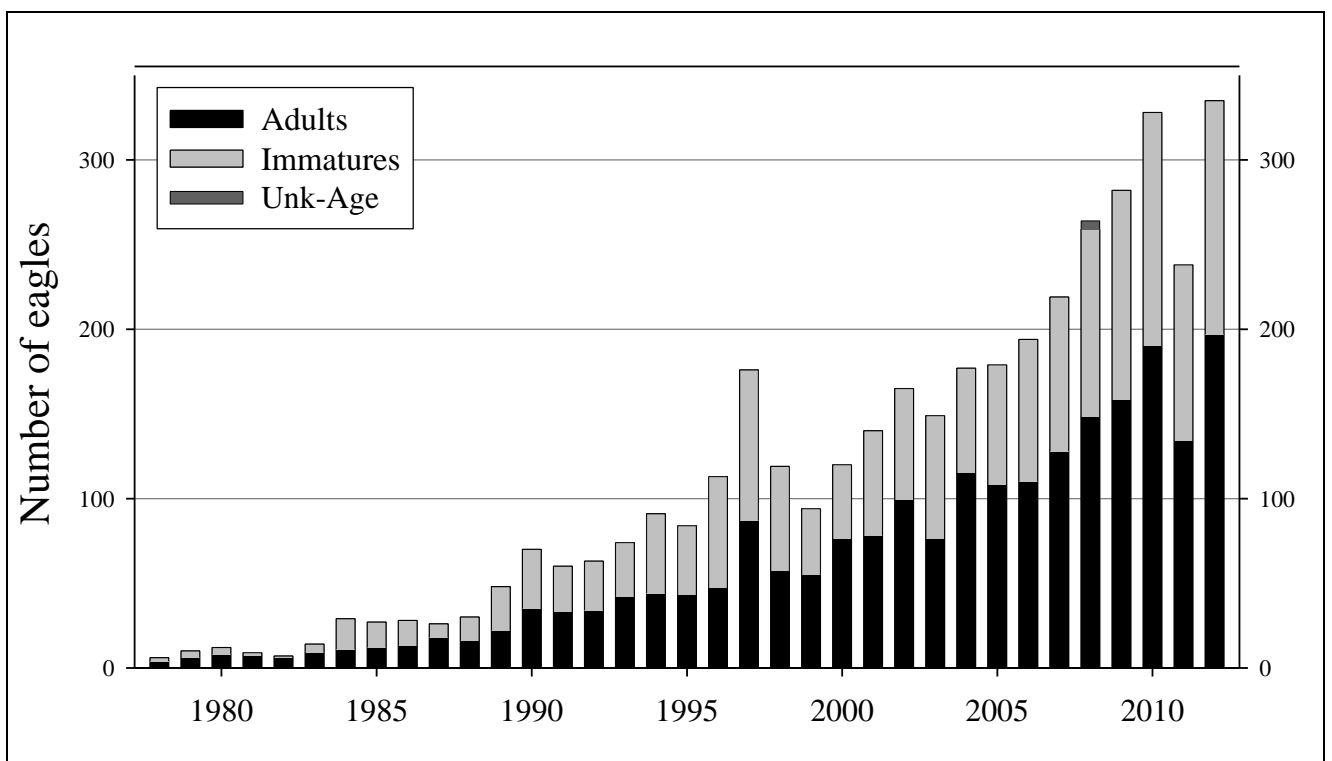


Figure 2. Number of bald eagles counted during the annual Midwinter Eagle Survey in NJ, 1978-2012.

#### Conclusions:

- The New Jersey bald eagle population has increased an average of 17% per year since 2000, following the momentum from average productivity of 1.18 young per active nest (median=1.26 young/active nest). The state's eagle population has been increasing since the late 1980's, when one nesting pair existed in the state, but population growth has been substantial only since 2002. Management that includes nest-site protection in cooperation with landowners has been essential to success in NJ. In 2012, 27 new eagle pairs were discovered, so we are seeing continued expansion into suitable but unoccupied habitat that is likely to continue for the foreseeable future.
- In 2012 eagles continued a rebound from an extremely poor season in 2010. Weather conditions were relatively mild throughout the nesting season, with just a few storms to disrupt nesting in isolated areas in April and late June.
- Maintaining the eagle recovery depends heavily 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). It remains important to continue our standardized monitoring for the foreseeable future to measure nest occupancy and success.
- Disturbance is a major management issue at many nests, and posting and regular surveillance by staff and nest observers are essential to protecting nests and ensuring the chance of success.
- Contaminants may be affecting 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:

- Continue to monitor population size, activity and productivity through weekly or bi-weekly observations of nests. 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.
- Continue to monitor the New Jersey wintering population through the annual Midwinter Eagle Survey, in coordination with regional and national efforts.
- 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) regularly testing eagle prey animals for contaminant exposure.
- 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.

## **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 2 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 nine nesting sites and observations were made at these locations for the duration of season. A total of 2,839 adults were present at these sites (based on a cumulative total of peak counts that occurred in the August 1-15 survey period). Once again, almost all (96%) of the known state population was present at just one site during the peak count survey period, which was located at Seaview Harbor Marina (2,739).
- A peak count of 871 adult black skimmers was observed incubating. The incubation number is nearly always an underestimate because vegetation obstructs the observer's view. However, in 2012, this seemed to be less of an issue than in other years and the true number of birds sitting is likely closer to the observed tally than in other years.
- Black skimmer productivity was moderate, with at least 801 fledglings produced statewide, or 0.92 chicks per pair. Five sites fledged young, with almost all the young (93%) produced at one site, Seaview Harbor Marina. Tidal flooding and severe storms were responsible for poor reproductive rates at the other four sites. Seaview Harbor Marina continued to flourish despite weathering the same storms, and some degree of predation (feral cat). It is believed that its geographic orientation (toward the south) protects it from the more destructive flooding events that took place elsewhere.
- The contractor from the Barnegat Bay surveys reported that this was the worst year for black skimmers (and, incidentally, common terns, which are also surveyed on that project) in her 30+ years of surveying because they were unable to find wrack mats high enough to avoid flooding events. As with the previous few years, about 2/3 of the skimmers that were successful nested on *Spartina patens*, a high marsh plant species that the birds have started using for nesting material, perhaps in response to the rising waters of the bay.

##### 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 19 nesting sites and

observations were made at these locations for the duration of the nesting season. A total of 1,148 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 seven colonies having >150 adults and three colonies >200. The largest colony was located in Strathmere, with 295 adults on the peak count.

- A peak total of 623 adult least terns were observed incubating. The number of incubating adults varied widely at individual sites across the survey periods due to a combination of problems with predation and disturbance.

Productivity was moderate for least terns with 538 fledglings produced statewide (0.86 chicks per pair, based on the peak number of incubating adults). Chick production was confined largely to the colonies in the southern portion of the state. The primary limiting factor in the northern part of the coast was flooding. Predation was still a factor and crows were again especially detrimental at Cape May Meadows. This continued to be a frustrating issue, since this site was the recipient of a restoration project for beach nesting birds (which was very successful in attracting nesters) and ENSP has thus far been unable to reduce the damage predators cause.

- The least tern colony continued at Newark Airport. The biologists that 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 to 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 7 nests were detected by mid-June, with 7 nests and 4 fledges, for a reproductive rate of 0.57 fledges/pair.
- Least terns returned to Ocean City–North for the first time since 2003. This area has been a major nesting locale in years past, but severe erosion in the 2000s limited its suitability for the birds. The habitat has started to accrete in the past few years and the return of this species to the site bodes well for its reestablishment as a major beach nesting bird site in the near future.

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

- One hundred twenty-one (121) pairs of piping plovers nested in New Jersey in 2012, a 9% increase over 2011 (111 pairs). This year marked the increase in pair numbers that was expected last year and ended the flat trend that was observed since 2008 (111, 105, 108, and 111 pairs from 2008-2011, respectively). The 2012 population was just above the average number of pairs for the years since federal listing (120 pairs) but still well below the peak of 144 pairs in 2003.
- The total number of adults recorded for the entire nesting season (253) was higher than the count during the date-restricted survey conducted 1-9 June (235) and the number of pairs tallied during the entire nesting season (121) was higher than those counted during the date-restricted survey (106), which is a typical comparative survey result in New Jersey. Slight 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 and late nesters may have been missed on the census.
- Pairs nested at 22 sites, down from 2011 (24 sites), and below the peak count of 30 sites recorded in both 2004 and 2005. NJDFW monitored 12 of the active nesting sites (50% of the sites statewide), accounting for 36 nesting pairs (29% of the nesting pairs statewide). Although in most years NJDFW monitors at least half of the state's active sites (i.e., sites where nests are located), the total number of active pairs monitored by NJDFW in 2012 remained one of the lowest percentages of the state total since federal listing. This continued downward shift in the percentage of pairs monitored is the result of habitat conditions becoming unsuitable at some of the sites monitored by NJDFW, and the sharp jump in pairs at Sandy Hook (monitored by the National Park Service). NJDFW also regularly monitored 16 other potential breeding sites; breeding behavior was observed at almost half (7) of those sites, although no nests were located.
- Statewide pair-nest success (the percentage of pairs that successfully hatch at least one nest) was down in 2012 compared to 2011 (67% vs. 77%, respectively), and average for the period since federal listing

(66%). Looking at just NJDFW-monitored sites, pair-nest success dipped in 2012 compared to 2011 and 2010 (56% vs. 63% and 79% respectively), and was lower for the period since federal listing (67%).

- The statewide fledgling rate, which incorporates data collected by all the state cooperators was 0.71 fledges per pair, a precipitous decline from 2011 (1.18 fledges/pair). The 2012 statewide productivity rate was also 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 (0.98 fledges/pair). In fact, it was the first time it dipped below 1.00 fledges/pair since 2008. Productivity at NJDFW-monitored sites (0.44 fledges/pair for 36 pairs) was dismal and well below the 2011 statewide average, as well as below the rate for NJDFW-monitored sites in 2011 (0.77 fledges/pair).
- A research project on flight behavior of breeding piping plovers (which was partially funded by ESA Section 6 monies) was begun in 2012. There are no results to report on at this time (and they will be reported in E-1-36 when available in 2014), but of note were the 28 piping plovers that were banded in Avalon and Stone Harbor Point. These individuals were observed on a daily basis (as a separate initiative from the flight behavior study) to determine departure dates from breeding grounds. Key findings and results will be reported on in next year's report, but preliminary information is proving to be valuable.

#### Conclusions:

- The statewide **black skimmer** breeding population appears to have increased substantially this year. The peak adult total is the highest posted since 2009. This is welcome news and not altogether unexpected, since the past few field seasons have seen an increase in productivity and with that we would expect an eventual population increase. That said, site fidelity and the movements of the 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 moderate this year (0.92 chicks per pair). It is not well understood why the number of chicks produced at the main nesting colony, Seaview Harbor Marina, was not higher, as it did not have major flooding issues and its one predation problem, feral cats, was halted before too much destruction took place.
- The small number of known black skimmer colonies in the state continues to be of some concern and the lopsided proportion of so many birds in one colony is of great concern. The loss of suitable habitat (due to flooding, erosion and lack of marsh mat nesting material) in Barnegat Bay has led to historically low numbers in that region, which denotes a significant change in the distribution of skimmers throughout the state since the birds have been tracked in the mid-1970s.
- The statewide **least tern** breeding population in 2012 was similar to that recorded in 2011 (1,146 vs. 1,274 total adults, respectively), and on par with recent years. Despite the stability of the statewide population over the past five years, the population remains relatively low with respect to the long-term trend. Productivity in 2012 (0.86 chicks per pair) is thought to be high enough to produce increases in the population, so hope for an increase in future years remains strong.
- The number of active least tern colonies (19) was similar to 2011 (20). 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, with a few outliers on either end.
- Seaview Harbor Marina's importance to all beach nesting species continued this year. In addition to hosting 96% 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 oystercatcher was able to fledge young but unfortunately, the least terns and piping plovers did not fare as well.
- New Jersey's **piping plover** population finally saw the increase that had been expected from prior years' relatively high reproductive success. This increase was most notable at Holgate, once again highlighting the importance of the Holgate/Little Beach/North Brigantine Natural Area portion of the coastline. Along with Sandy Hook, these areas comprise 70% of the state's population. Accordingly,



all possible efforts to ensure the birds at these sites succeed should be paramount to the state's beach nesting bird program. Additionally, 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.

- Although the factors that limit productivity continued to vary by site and region, and across years, flooding has been a major cause of nest loss in recent years. Whether this is related to sea-level rise or just part of cyclical weather patterns is not clear, although it does raise concerns moving forward - even a small change in sea-level rise or increased storm events could have significant flooding impacts on a beach (ground) nesting bird. Even so, flooding is not the only factor impacting reproductive success in New Jersey. Predator activity, as it causes direct nest and brood loss, nest abandonment, and adult mortality, plays an equally large role in many years. Finally, although management actions have successfully minimized most of the direct impacts of human disturbance/activity, it still plays a significant indirect role.
- New Jersey's piping plover population made noticeable gains immediately following federal listing in 1986, in part due to increased survey intensity (and detection of pairs) and to increased management actions, such as limiting human access into nesting areas (through fencing and signage) and use of predator exclosures. However, since these initial gains, the population has not significantly increased. Given the high level and intensity of threats to piping plovers in New Jersey, population maintenance is commendable; but the range-wide goal is species growth and recovery. Some regions in the Atlantic Coast breeding range have achieved population recovery objectives; however, productivity goals remain more difficult, and have been particularly elusive in New Jersey. The state has employed management techniques and tools similar to those used successfully throughout the breeding range and our initiative developing site-specific beach management plan is considered a model. Nonetheless, these efforts have not resulted in consistently strong productivity or long-term population growth in New Jersey. Additional research is needed to identify impediments to achieving these conservation goals.

#### 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, particularly Barnegat Bay) 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 predator control plan to address crows at Cape May Meadows and other sites to reduce the impact of this species on nesting birds. This became even more important in 2012 since direct predation of piping plover chicks at Cape Meadows was observed.
- Continue intensive monitoring of piping plover populations and reproductive success, and continue monitoring to ascertain causes of nest failure and brood loss.
- Continue use of predator exclosures (and electric fence) to protect piping plover nests where they are likely to reduce predation, but also continue to assess their usage to minimize the risk of abandonment.
- Continue to raise nests in areas that are susceptible to flooding.
- Continue and possibly increase use of targeted predator removal measures where exclosures and/or electric fence are not effective or feasible and where use will benefit all beach nesting species. Predator

management targeting red fox at Sandy Hook is correlated with the dramatic increase of plovers at that site, and may be a key to improving productivity and increasing piping plovers statewide.

- Continue to logistically and financially support the flight behavior study in Avalon and Stone Harbor in 2013. 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.
- 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 conduct the statewide census every three to four years, and the 2009 census documented 485 nesting pairs. No statewide aerial survey was done in 2012 but with new nests found since 2009, we estimate the population is above 540 nesting pairs (Table 1).
- In 2012 approximately 70% of the population was checked by volunteers doing ground surveys, which allowed for productivity estimates for the major colonies and the state as a whole (Table 1). During ground surveys 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 331 nests (Table 1). We grouped nests by watershed or water-body areas to which they were closest. Nest success averaged 1.81 young per active nest, continuing a long trend of above-average productivity. Nest productivity was slightly higher on Delaware Bay than in Atlantic coast colonies (1.97 vs. 1.76 young/active nest).
- Previous surveys documented that most nests (approximately 80%) were along the Atlantic coast, where many new platforms have been erected over the past four years to increase nesting opportunities. In recent years, more than 100 nest platforms have been installed with funding by private donations.
- Eleven 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.
- Fifty-four feather samples were collected during banding visits, on behalf of the Philadelphia Academy of Natural Sciences, to contribute to a study of osprey diet using stable isotope analysis. This was the third year and NJ samples in the study now total 235.
- ENSP staff provided technical assistance and advice to the U.S. Coast Guard, the U.S. Army at Fort Monmouth, and communications companies, to deal with osprey nests in hazardous or unsafe locations. We drafted guidelines for managers of cell and power transmission towers and posted them on the Division website.
- All nest locations were maintained in Excel and GIS databases, tracking all occupied nests. Those databases will be used to update the state's Biotics database, which is the basis for the Landscape Project critical habitat mapping. The osprey habitat model for use in Landscape Project was also updated with new information, and expanded to identify habitat for nesting and foraging separately. We have identified the need for a more streamlined data-handling system, and made progress on a new online data entry approach for banders.
- No new volunteers were recruited for banding, but partner Conserve Wildlife Foundation of NJ organized volunteers to install 14 new nest platforms along the Atlantic Coast.

#### Conclusions:

- This year's ground surveys by volunteers and cooperators documented one of the highest nest success rates recorded in a coast wide survey, for a population estimated over 540 pairs. Weather conditions during the nesting season were relatively mild, although one major storm caused many nest failures in Atlantic County when chicks were 3-5 weeks old.
- ENSP's coordination of volunteers and licensed banders has made it possible to accurately track occupied nests and nest success at the major colonies as a measure of population stability. While one CWF-NJ biologist coordinated the data from volunteers, a more complete electronic system would make the job easier and needs to be investigated.
- 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 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:

- Conduct a population census every three to four years (next survey in 2013) to monitor population changes statewide and regionally. We plan to recruit and field volunteers to canvass the state, and thus minimize the need for expensive aircraft surveys.
- Maintain integrated databases on the population and nest locations on an annual basis, so they can inform habitat mapping and land-use regulations.
- Continue to measure annual productivity of ospreys to monitor regional conditions and changes (e.g., Atlantic vs. Delaware Bay regions, and Atlantic subregional comparisons). Continue to recruit and train volunteers to conduct nest checks. Expand 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. Seek partners to accomplish the analysis.

Table 1. Osprey nesting and productivity in 2012 in all major nesting areas. Productivity was determined by ground surveys in June-July. Productivity rates in 2009-2011 provided for comparison.

Nesting Area	# Nests	Known-Outcome Nests	# Young	# Banded	Production 2012	Previous Years		
						2011	2010	2009
Delaware River & North Jersey				n/a		n/a	n/a	n/a
Hackensack-Hudson Rivers	3	3	7	0	2.67	2.67	n/a	n/a
Raritan Bay area (w/Cheesequake)	31	17	34	15	2.00	1.54	1.64	1.54
Monmouth County	14	10	22	14	2.20	2.00	1.86	1.25
Barneget Bay	42	31	60	41	1.94	1.88	1.91	1.78
Sedge Islands WMA	24	21	44	36	2.10	2.38	1.29	1.57
Great Bay to Atlantic City	43	41	69	49	1.68	2.12	2.05	1.53
Great Egg Harbor/Ocean City	60	56	74	54	1.32	2.43	2.38	1.71
Sea Isle City	20	18	32	14	1.78	1.91	2.07	1.06
Avalon/Stone Harbor Bays	59	52	91	62	1.75	2.02	1.88	1.45
Wildwood Bays & Cape May	20	16	34	32	2.13	1.50	1.50	1.39
Maurice River & Estuary Marshes	60	53	111	104	2.09	2.06	2.10	1.78
Salem Co./ Artificial Island / Delaware	16	13	21	10	1.62	2.38	2.50	1.81
<b>TOTAL of Study Areas</b>	<b>392</b>	<b>331</b>	<b>599</b>	<b>431</b>	<b>1.81</b>	<b>2.07</b>	1.97	1.58
Atlantic Coast only	316	265	467	317	1.76	2.07	1.92	1.53
Delaware Bay only	76	66	132	114	2.00	2.10	2.18	1.78
<b>Total Checked Statewide</b>	<b>392</b>	<b>331</b>	<b>599</b>	<b>431</b>	1.81	--		486

## **JOB 1E: Colonial Waterbirds Inactive**

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

## **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.

***Please note: Three tasks, described herein for completeness, were funded in 2012 by Section 6 NJ E-1-36.***

*Objective 1: Beach Closures (volunteer coordinator)*

*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 Closures (Delaware Bay, spring migration) – 2012 year marked the tenth year of beach closures during the shorebird migratory stopover on Delaware Bay (May 7 through 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 human recreation, ([www.njfishandwildlife.com/ensp/beachclozmap.htm](http://www.njfishandwildlife.com/ensp/beachclozmap.htm)). During the last ten years of low horseshoe crab egg densities, the beach closures helped birds optimize foraging time and significantly reduced or eliminated disturbance to foraging and roosting flocks. Closed beaches were staffed by Shorebird Steward Volunteers who educated the public about shorebirds, horseshoe crabs and the need for closures. NJ Division of Fish and Wildlife conservation officers patrolled beaches and assisted Shorebird Stewards as needed. ***This task was funded and fully reported in 2012 by Section 6, E-1-36.***
- Beach closures (Atlantic Coast, fall migration) – Since 2006, we have implemented partial closures to protect fall shorebird roosting areas on Brigantine Natural Area and Stone Harbor Point, NJ. Other important foraging and roosting sites on the NJ Atlantic remained unprotected (e.g., Avalon, North Wildwood).
- Adaptive Resource Management (ARM) Model and horseshoe crab harvest allocation method -- The ARM model is the new method by which the Atlantic States Marine Fisheries Commission (ASMFC) will set harvest quotas for Delaware Bay horseshoe crabs. The model relies on red knot information (weights, abundance, resightings of marked birds) and female horseshoe crab abundance to predict harvest quotas. The 2010 SWG report detailed findings and recommended actions provided to the ARM Technical Committee by the Peer Reviewers of the ARM Model. To date, two recommendations (Items 3 & 4) were addressed by the ARM Technical Committee. [Responses to Recommendation 3 & 4 are excerpted from meeting notes (A. Dey pers. comm.) from 12/13/11 and 9/10/12 ARM meetings, 9/5/12 ASMFC Delaware Bay Technical Committee meeting, and do not capture the full complexity of discussions.]
  - Recommendation 3. Explore uncertainties of model utility functions (knife-edge and slope functions [for valuing utility of female horseshoe crab harvest]). With perfect information, the knife-edge function is more restrictive of female crab harvest than the sloped function. Neither utility function apparently affects the red knot models; i.e., difference in red knot model curves are due to red knot models themselves.

- Recommendation 4. Perform additional simulations to evaluate model function.  
Model simulations of female horseshoe crab population growth showed 100 to 200 years before female crabs reach carrying capacity -- estimated at 14 million females. The most current population estimates, derived from the Virginia Tech Benthic Trawl, are 4.1 million females and 14.5 million males (ASMFC 2012a, available upon request). It is unknown which harvest package was used to conduct the simulation; however, it is likely that the scenario was based on ARM harvest package 3 (500,000 males, 0 females) or a harvest approximating current (Addendum VI) quotas.
- Additional recommendations to the ARM Committee by a participating member (L. Niles):
  - Mortality of adult female horseshoe crabs (from harvest and lysate production) should be incorporated as a covariate in the ARM model. Female mortality is not currently included in the model although it is likely to affect both predicted harvest packages and recovery time of female crabs;
  - Male crab abundance should be incorporated as a covariate in the ARM model. Male abundance is not currently included as a covariate in the ARM model despite the fact that harvest packages #2 - #5 (ASMFC 2012a) are male dominated, a negotiated threshold in the model will allow male harvest in excess of ARM harvest predictions, (i.e., when 3:1 male:female ratio is exceeded in the Virginia Tech Benthic Trawl), and Addendum VII, Option 3e., also allows additional male harvest through a 2:1 male:female offset (see next bullet).
- On February 9, 2012, the ARM model, and associated allocation model, were adopted by the Atlantic States Marine Fisheries Commission, Horseshoe Crab Management Board for use in setting harvest quotas starting in 2013 (Addendum VII; [www.asmfc.org](http://www.asmfc.org)). The Delaware Bay Technical Committee, and the Shorebird Advisory Committee, recommended that the Management Board adopt the following options under the ARM Model (ASMFC 2012b). The board adopted all technical committee recommendations with the exception of 3e. and voted to adopt 3e., the male-to-female offset.
  - Option 3a: Lambda (the proportion of Delaware Bay Origin crabs in harvests of NJ, DE, MD and VA) – the majority recommended Lambda should be set no lower than values derived from genetic information (NJ = 1; DE = 1; MD = 0.51; VA = 0.35 for harvest east of COLREGS). Note: COLREGS (the International Regulations for Preventing Collisions at Sea), referred herein specifically to VA, is represented by the straight line from the Cape Charles Light, VA, to the Cape Henry Light, VA; it is used to distinguish Chesapeake Bay waters from the Atlantic Ocean waters with regard to VA’s horseshoe crab harvest.
  - Option 3b – Weighting (the proportional allocation of ARM harvest among states) – the majority recommended that harvest should be allocated in proportion to Addendum VI quotas.
  - Option 3c – harvest cap for MD and VA – the majority recommended a harvest cap based on Addendum VI quotas to “protect non-Delaware Bay Origin crabs from overexploitation”.
  - Option 3d – Delaware Bay Stock Allowance (allows the harvest of 1-10% of the current female crab population) – the majority recommend against a Delaware Bay Stock Allowance because “. . . deviations from the harvest recommended by the ARM model would undermine the intent of the model framework and interfere with our utility in evaluation of the framework.”
  - Option 3e - the two-to-one male-to-female offset. The effect of the offset is to allow additional male harvest, above the allowed ARM harvest, by MD (85,000 males) and VA (20,000 males east of the COLREGS). This is counter to the consensus recommendation of the Delaware Bay Ecosystem Technical Committee and the Shorebird Advisory Panel who cautioned that additional harvest, outside of the ARM model predicted harvest, would undermine the ARM framework; “. . . allowing this two-to-one offset would further convolute the implementation of the ARM, moving farther away from the intent of the ARM Model.”
  - Option 3f – Contingency Plan (if crab or shorebird data become unavailable to populate the ARM model) – the consensus recommendation was that the board allow technical committees and advisory panels to review current data and make a recommendation to the board to either revert to Addendum VI quotas or use previous ARM quotas.
- As of September 5, 2012, the ARM model was updated with current information on female horseshoe crab abundance (to 2011) and red knot abundance and mass gains (to 2012) (ASMFC 2012a). The ARM Model

predicted harvest package #3 (500,000 males, 0 females). This package will be recommended to the ASMFC Horseshoe Crab Management Board at the November 2012 meeting. The Management Board is not bound to accept this harvest recommendation and may substitute its own.

- In August 2012, the ARM group produced a preliminary estimate of red knot stopover population size using resightings of marked and unmarked birds (44,000 individuals, J. Lyons pers. comm.); this roughly coincides with the east coast aerial count (38,929) (Dey pers. comm.).
- New Jersey Moratorium on Horseshoe Crab Harvest – The New Jersey moratorium continued in 2012. However, the continued harvest of horseshoe crabs by other Mid-Atlantic states may have slowed the recovery of Delaware Bay horseshoe crabs (see findings in Objective 3).
- Reinstatement of horseshoe crab harvest in New Jersey is tied to numeric recovery targets for the red knot stopover population on Delaware Bay identified in the *USFWS Red Knot Status Assessment*, pages 200-203 (Niles et al. 2007); additional recovery targets are identified in Niles et al. (2009), pages 160-162. Primary recovery targets can be monitored by existing surveys. Secondary recovery targets, which can identify potential problems outside Delaware Bay, should be monitored as funding becomes available.

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

### **Key Findings:**

- The winter count of Red knots in Tierra del Fuego increased to 14,200 after a one year decline in 2011 (Figure 1). The peak count of red knots on Delaware Bay also increased to 25,488, almost double the count of 2011, but consistent with counts done in the previous 10 years (Figure 2). ***In 2012, this survey was funded by Section 6 grant NJ E-1-36.***
- The number of red knots along the east coast of the US, surveyed within a two-day window in May, increased to nearly 40,000 birds (Table 1).
- The improvements in the number of red knots are most likely a consequence of improved production in 2009 and 2010 and a more effective coastwide survey. The availability of horseshoe crab eggs has improved over the last four years and has in turn improved the ability of red knots to gain weight (Figure 3). In 2012, 54% of red knots achieved weights equal or exceeding 180 grams, the threshold necessary to successfully migrate and breed (Figure 4). These improvements were largely due to unusually settled weather conditions that favored crab spawning and not an actual increase in crab numbers.
- Abundance of ruddy turnstones was lower in 2012 than any previous year. This species is likely in severe decline as documented in 2011 counts of its main wintering area in northern Brazil, (Figure 5). Winter aerial surveys conducted in January 2011 in northern South America (Suriname, French Guiana, Brazil), showed significant declines (55 – 90%) in red knots, ruddy turnstones and semipalmated sandpipers (Mizrahi and Morrison, unpublished data) from original Shorebird Atlas counts, 1982 to 1985, (Morrison and Ross 1989). Together with other published trends (Morrison et al. 2006, Gratto-Trevor et al. 2010) there is credible evidence of substantial population declines in shorebirds using Delaware Bay and not simply a shift to other stopovers due to the loss of crab eggs. In addition, turnstones, sanderlings and semipalmated sandpipers are less well studied in other periods of the year, and other threats may contribute to population decline. For example, shorebird hunting for sport in French Guiana, Guadeloupe, and Barbados, and possibly for subsistence in Suriname and Brazil, may have a great impact on shorebird populations but the extent of impacts and vulnerability of particular species is not yet understood.

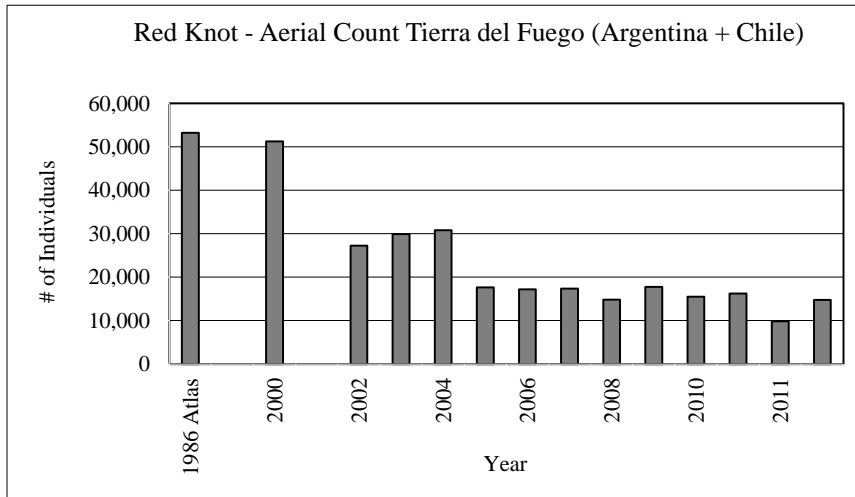


Figure 1. Aerial count of red knot in Tierra del Fuego. Source, R.I.G. Morrison, Canadian Wildlife Service.

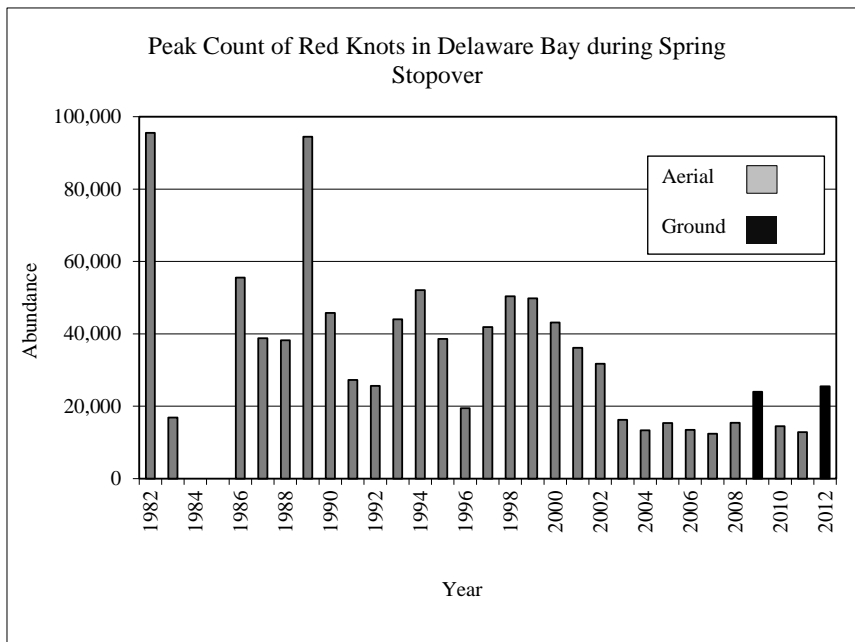


Figure 2. Peak count of red knots on Delaware Bay, 1982-2012. The number of knots counted in 2012 was higher than in 8 of the last 9 years. In 2012, as in 2009, we had a majority of the flyway's red knots staging in Delaware Bay on count day. In both of these years, the large, single-day count was followed by a large departure that night and a significant reduction in knot numbers the following day. For detailed discussion of Delaware Bay Count methodological changes, see NJ's 2011 SWG Report. Source: NJ and DE Divisions of Fish and Wildlife.



Table 1. East Coast red knot survey, 2006-2012. The improvement in red knot numbers may be due to improvement in the count method (i.e., single-day flight from VA to Delaware Bay) and a population increase from improved productivity in 2009 and 2012.

State	2006	2007	2008	2009*	2010	2011	2012
New Jersey	7,860	4,445	10,045		8,945	7,737	22,025
Delaware	820	2,950	5,350	16,229	5,530	5,067	3,433
Maryland	ns	ns	663	78	5	83	139
Virginia	5,783	5,939	7,802	3,261	8,214	6,236	8,482
North Carolina	235	304	1,137	1,466	1,113	1,868	2,832
South Carolina	ns	125	180	10	1,220	315	542
Georgia	796	2,155	1,487	ns	260	3,071	1,466
Florida	ns	ns	868	800	41	ns	10
<b>Total</b>	<b>15,494</b>	<b>15,918</b>	<b>27,532</b>	<b>21,844</b>	<b>25,328</b>	<b>24,377</b>	<b>38,929</b>
*2009 Delaware Bay (NJ + DE) count calibrated by ground counts							
ns = no survey							

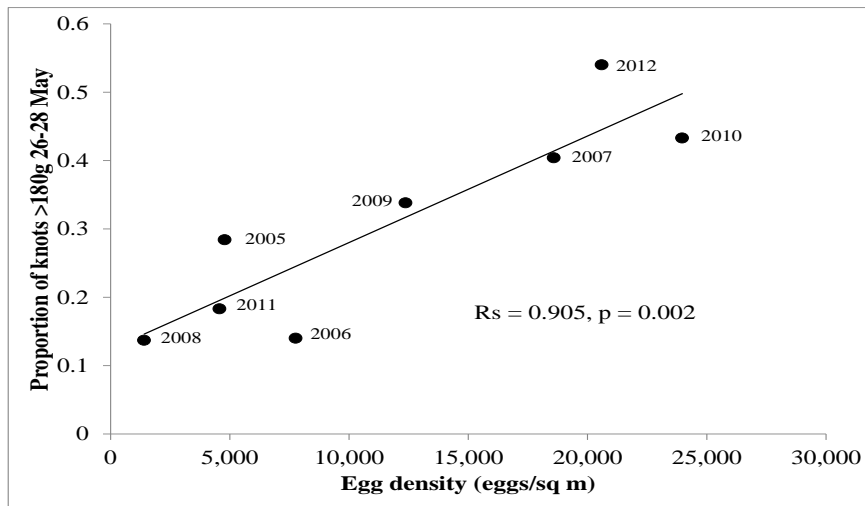


Figure 3. Proportion of Red Knots in the >180 g body-mass category in Delaware Bay during 26-28 May plotted against the median horseshoe crab egg density during 14-27 May 2005-2012 for Delaware and New Jersey ( $R_s = 0.905$ ,  $p = 0.002$ ). The significant positive correlation with the availability of horseshoe crab eggs during 14-27 May, is a credible measure of the bird's success in obtaining the resources they need at the time those resources are required. Source: NJ & DE Divisions of Fish and Wildlife.

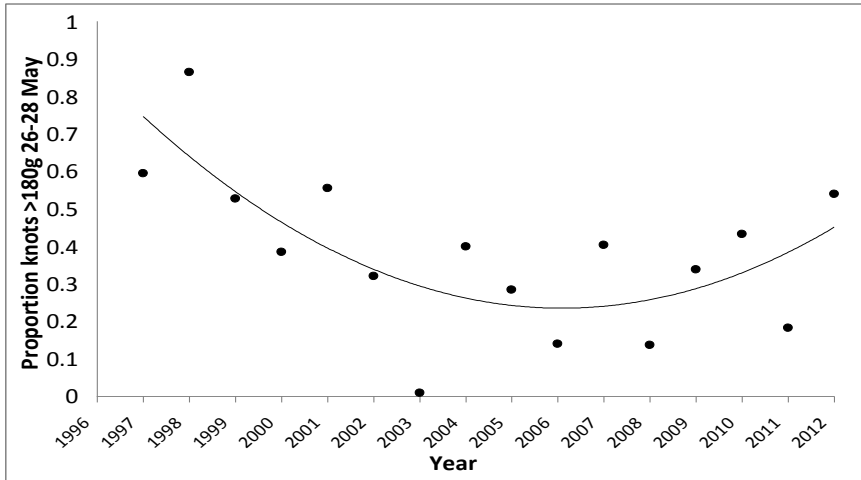


Figure 4. Proportion of Red Knots in the >180 g body-mass category in Delaware Bay near the usual departure time each year (26-28 May) over 1997–2012. The line shows a significant quadratic trend over 1997-2012 (the trend line  $\pm 95\%$  confidence intervals in respect of the line, not the variation in the data) was fitted using binary logistic regression of body mass >180g (1 = yes, 0 = no) on year (negative,  $p < 0.001$ ) and year<sup>2</sup> (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.

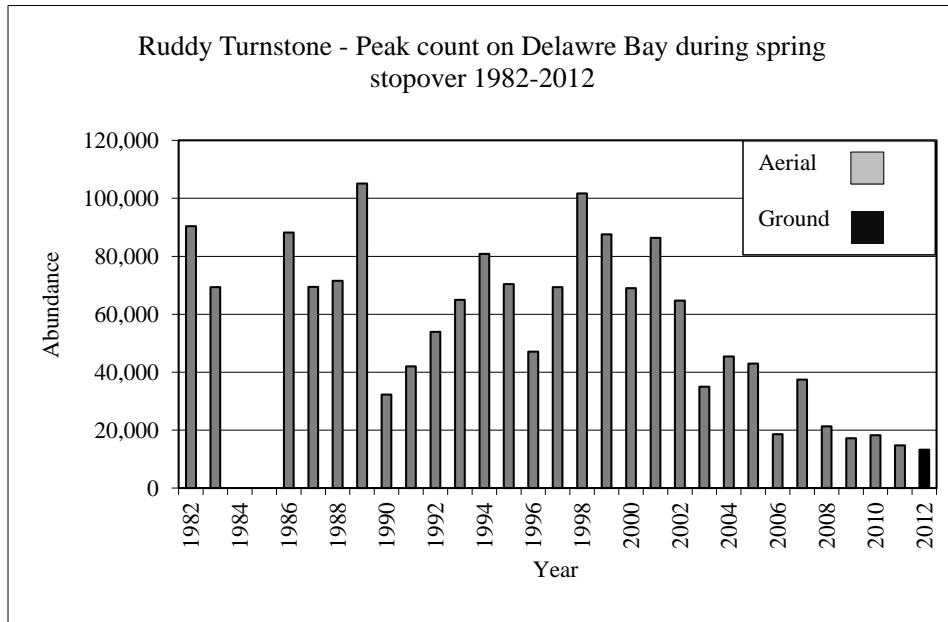


Figure 5. Peak count of ruddy turnstone on Delaware Bay during May, 1982-2012. (NJ Division of Fish and Wildlife)

**Objective 3: Assess recovery of the horseshoe crab egg resource**

**Key Findings:**

- Baywide horseshoe crab egg densities have not improved over eight years of the survey (Figure 6a). NJ egg densities remain low but may be improving while DE egg densities show a declining trend (Figure 6b);

Mispillion Harbor, DE, a site of very high egg densities, has remained stable (Figure 6c). ***In 2012, this survey was funded by Section 6 grant NJ E-1-36.***

- Over the last decade, horseshoe crab abundance, both within the bay and on the Atlantic coast wintering areas, has remained virtually unchanged according to both trawl (Figures 7) and spawning surveys (Figure 8).
- The number of crabs harvested from the Delaware Bay population has remained over 500,000 individuals for the last ten years; this figure includes harvests by New York (Figure 9).
- Beginning in 2013, harvest quotas will be set by the ARM model. While female harvest is not allowed in the ARM harvest predicted for implementation in 2013, male harvest will increase to over 600,000 individuals.

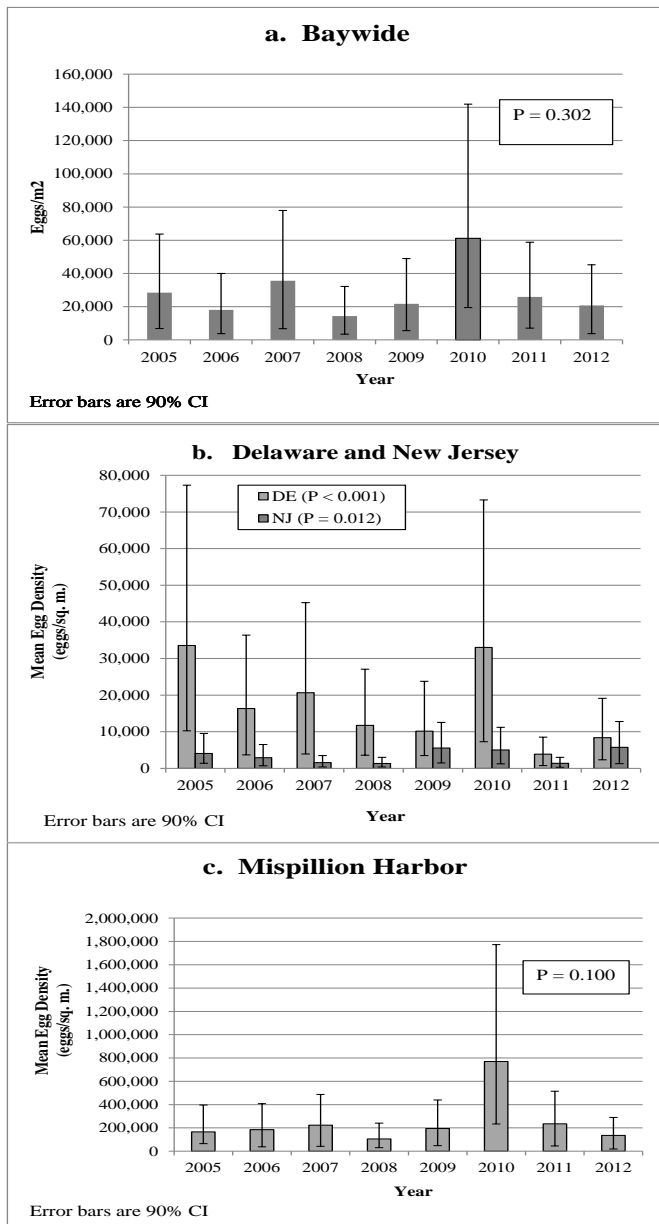


Figure 6 a, b, c. Mean horseshoe crab egg densities in the top 5 cm of sand (available to shorebirds): a.) Baywide (slope = 784.59, SE = 111,090.67, P=0.302), b.) NJ (slope = 228.15, SE = 9,297.71, P=0.012), DE (slope = -2,614.20, SE=52,043.68, P< 0.001, c.) Mispillion Harbor, DE (slope = 11,873.32, SE=303,281.51, P=0.100). Note difference in scales. Source: NJ and DE Divisions of Fish and Wildlife.

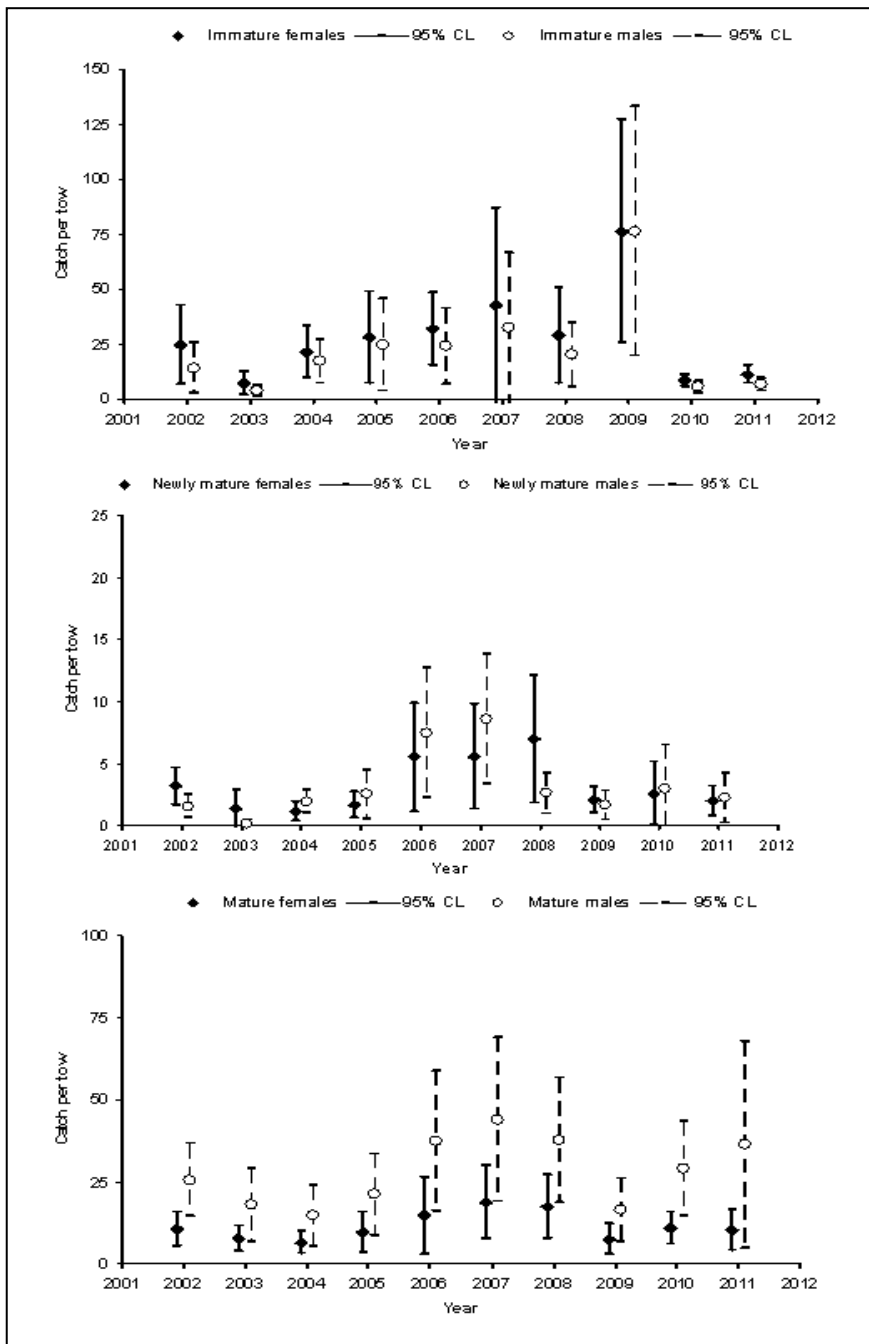


Figure 7. Plots of stratified (delta distribution) mean catch/tow of horseshoe crabs in the Virginia Tech Delaware Bay Offshore Trawl Survey by sex and demographic group: (a) immatures, (b) newly mature adults and (c) mature adults by demographic group ( $\pm$  95% confidence limits). Solid symbols and lines indicate Delta distribution; open symbols with dashed line indicate normal distribution. The survey area is within 12 nautical miles of the coast and from 37°40'N to 39°20'N, but excludes Delaware Bay itself. Note different y-axis scales. Source: Hata and Hallerman, 2012

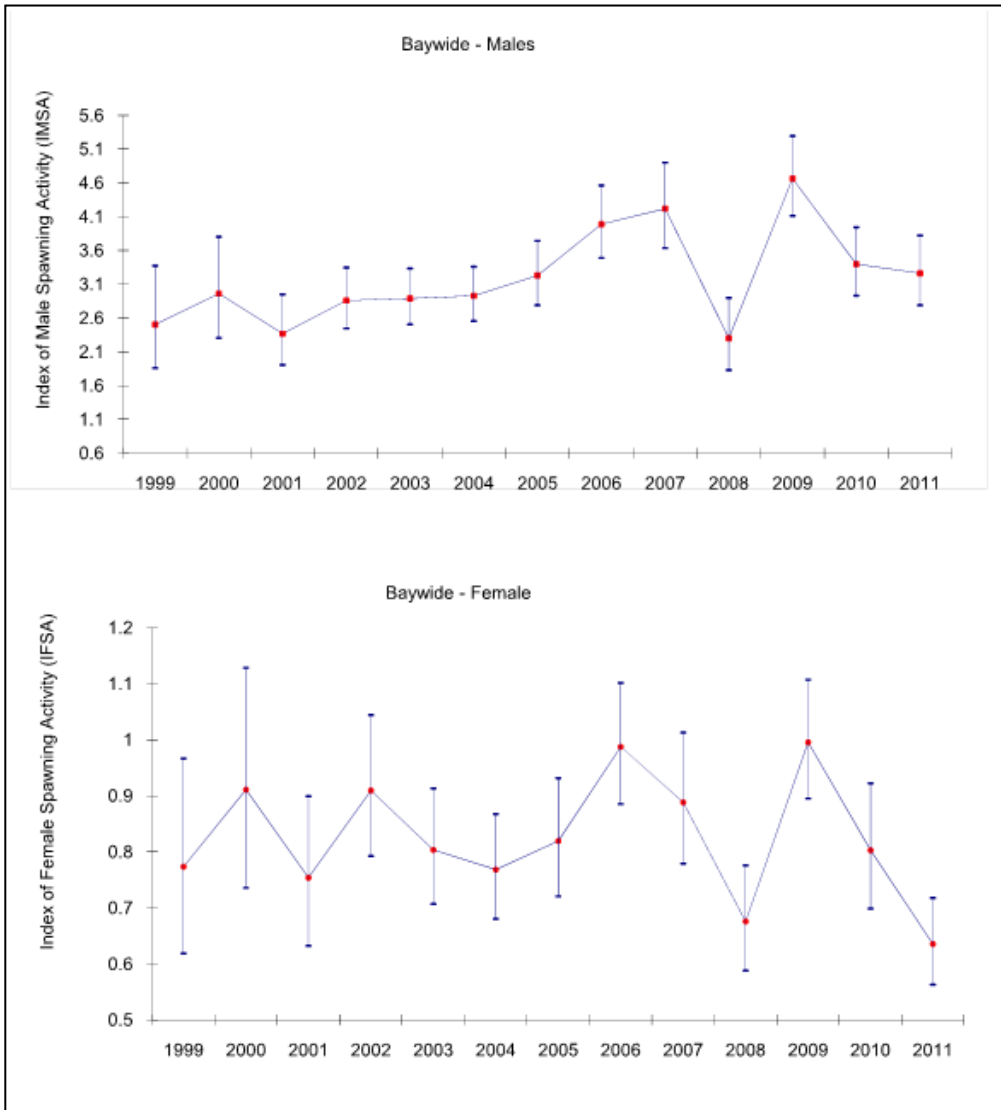


Figure 8. Index of crabs spawning (crab/m<sup>2</sup>) in Delaware Bay from 1999 to 2011. Error bars are 90% confidence interval. Source: Zimmerman et al. 2011.

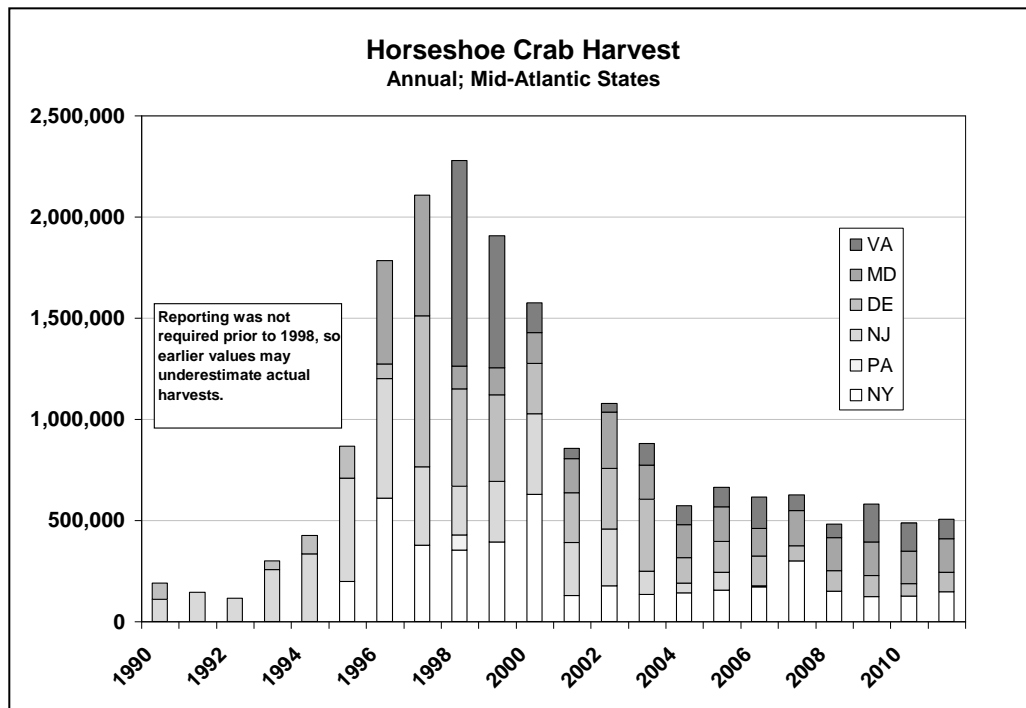


Figure. 9. Reported Atlantic coast horseshoe crab landings 1990-2011 for mid-Atlantic states; note that reporting was not compulsory until 1998 so earlier figures may underestimate the true harvest. Source: NMFS Commercial Fishery Landings Database 2009.

### Conclusions and recommendations

- The Delaware Bay underpins successful migration and productivity of red knots and other Arctic-nesting species. Efforts to recover horseshoe crab populations and their eggs will greatly improve conditions for the six species of shorebirds that rely on Delaware Bay (red knots, ruddy turnstones, sanderlings, semipalmated sandpiper, dunlin, short-billed dowitcher). Increased federal support is necessary to continue these efforts.
- 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 roosting, foraging and molting sites on the Atlantic Coast in fall and winter. Cooperative efforts to manage recreation and reduce disturbance must continue; public involvement and public outreach via volunteer shorebird stewards is critical to the success of existing and new management efforts. Additional funding will help with development of management techniques and recruiting/coordination of volunteers.
- Beach restoration efforts on Delaware Bay are important to restore horseshoe crab spawning capacity and support recovered crab and shorebird populations. Restoration efforts aimed at crabs and migratory shorebirds on the Bay (and select areas of the Atlantic coast) would benefit from federal priority and attention (multi-agency collaboration and funding).
- State and federal technical collaboration with the Atlantic States Marine Fisheries Commission has produced positive results for red knots and horseshoe crabs vis-à-vis the Adaptive Resource Management Model. The model will be used to set crab harvest quota beginning in 2013. However, the model relies wholly on red knot and horseshoe crab data collected by NJ and DE Divisions of Fish and Wildlife and the Virginia Polytechnic Institute, respectively. Reductions of SWG funds, and exhaustion of state funds in 2014, will end New Jersey's Shorebird Project; \$200,000/year is necessary to fully fund this work. The Virginia Tech Atlantic Coast Benthic Trawl, now in its 10<sup>th</sup> year, is in danger of termination unless stable funding is found; \$200,000/year is necessary to fully fund this work.

- Many of the above priorities are captured in the new Shorebird Conservation Plan spearheaded in 2012 by the USFWS, Region 5 (Scott Johnston, Caleb Spiegel). Full implementation of the plan by the USFWS will help stabilize projects necessary to monitor trend and recovery of red knots, other migratory shorebirds and horseshoe crabs.
- State participation in a flyway monitoring program, designed to develop population estimates for migratory shorebirds (Bart et al. 2011), should be supported and funded. Currently, there is no comprehensive effort in place to assess status and trend of migrant shorebird populations or evaluate the success of recovery efforts.
- Threats to shorebirds outside of the US (sport and subsistence hunting) must be assessed and pressure exerted on governments known to allow sport hunting of shorebirds (French Guiana, Guadeloupe, Barbados, others).

### **Additional Recommendations**

- A ten-year coastwide moratorium would jump-start recovery of horseshoe crabs and help increase red knot numbers. Thereafter, a sustainable “local” harvest could be implemented that would allow continued recovery of crabs and birds.
- In absence of a full moratorium, tighter requirements on harvest reporting and chain-of-custody reporting on bait and lysate harvests should be implemented. Bycatch of crabs in other fisheries should also be reported. These data would help fisheries managers identify sources of loss currently undocumented. Reporting should include GPS location and time of year harvests occur (especially for states adjacent to Delaware Bay: NY, VA, MD); chain-of-custody reporting should be required when horseshoe crabs are sold for bait or lysate bleeding (e.g., MA, MD, VA, NJ, SC where bleeding labs operate). All reporting should include location and date of harvest, harvester name and address, buyer name and address, dollar amount and date of sale, location of freezer where bait crabs are kept, information deemed appropriate by fisheries law enforcement.
- Requirements, as above, should apply to harvest in both state and federal waters; ASMFC harvest restrictions and the ARM Model only apply in state waters, 0-3 miles. Harvests in federal waters may be a large source of undocumented losses of Delaware Bay crabs; for example, if Delaware Bay crabs are landed in states assumed outside of known breeding range (NY and VA) or if crabs are used directly in the conch fishery and not landed.
- Require open and transparent sharing of information, both on harvests as above, and on the number of male and female crabs that are bled for lysate production. Currently, these data are treated as confidential and are not open for public or technical review.
- Lysate is a sustainable use for horseshoe crabs, but mortality could and should be significantly reduced and interstate sale of crabs for bleeding more closely monitored. It should be noted that >90% of the current global supply of lysate comes from the US, predominantly from Delaware Bay crabs, and demand is increasing by an average of 20%/year. Currently, >500,000 crabs are bled annually with a standard industry estimate of 15% mortality. However, credible studies of mortality, using normal industry handling and holding practices, have shown average mortality of 29% or greater (Leschen and Corriea 2010, Hurton et al. 2009).
- Require best management practices, open to external peer review, for lysate production that are demonstrated to reduce mortality from 15-30% to < 5%.

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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:

- In 2012 the New Jersey peregrine falcon population remained nearly steady at 25 known pairs (Figure 1), including one territorial pair with a one-year-old female. In addition, we suspected successful nesting at two other sites based on finding recent fledglings (one in Atlantic City's north end, one at the water tower site in Maurice River Township). Further, there are some urban sites (especially bridges) that could not be monitored but could be supporting nesting pairs. There were three known-occupied territories in cliff habitats, two of which were successful in fledging young.
- Twenty-four occupied sites were known or suspected to be active (laid eggs) (Table 1).



- ✓ Fourteen pairs on towers and buildings continued to be the core of the nesting population, producing 34 young, for a productivity rate of 2.43 young per active nest, which is about 40% higher than the long term average for New Jersey when the population stabilized in 1986. Weather conditions during incubation and chick-rearing were very fair, so there was little negative influence of weather. We treated <2 week old hatchlings with bird lice spray at two building sites and four tower sites to reduce infestations of parasitic flies (*Carnus hemapterus*); which have caused mortality of young hatchlings in recent years. The fly infestation was severe at three tower sites (Swan Bay, Forsythe-Brigantine, Dividing Creek), and likely caused early mortality of all but one chick at Swan Bay. The relatively mild winter in 2011-2012 may have resulted in better conditions for those parasites.
  - ✓ Three pairs were known to occupy territories in natural cliff habitat in northeastern NJ, down two from 2010. Two of the four pairs were successful in fledging young (4 and 1, respectively), while a third pair showed no sign of hatching or fledging young. We did not see ravens nesting in that territory, as we did last year.
  - ✓ Of six pairs on bridges, five were known to have produced 12 young, for a rate of 2.00 young/active nest, although we could not confirm successful fledging at one bridge where nesting was discovered this year. Some previously occupied bridges (e.g., Trenton, Hackensack and Newark Bay) were not tracked due to insufficient staff or volunteers. New Jersey monitored four pairs on bridges spanning the NJ-PA border. Pairs on the Betsy Ross and Walt Whitman bridges raised zero and one young, respectively. Pairs at Burlington-Bristol and Tacony-Palmyra bridges produced four and three young, respectively. Successful nesting was found this year on the Route 1 Bridge in New Brunswick and the Parkway-Egg Harbor Bridge. 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 all but six of the 51 young produced at 20 nests, using both a federal band and a bicolor band with an alpha-numeric code following Bird Banding Lab protocol.
  - Staff collected five addled eggs from three sites for future analysis. The study of contaminants in mid-Atlantic eggs was published in the journal *Environmental Contamination and Toxicology* (Clark et al. 2009). Coastal-NJ eggs were of special concern with regard to elevated levels of PCBs and DDT compounds, and warrant continued study.
  - In 2012 we continued to use remote, motion-activated cameras to photograph peregrines at nests. This enabled us to read the leg bands on 16 breeding adults at nine nest sites. An additional seven adults were identified using optics. The oldest birds identified were a 14 year old female (Atlantic City) and a 13 year old male (Swan Bay). Last year's oldest bird, a 15 year old female at Ocean Gate, was missing this year, replaced by a one-year old female that did not lay eggs. The average age of 14 males was 7.7, and of 14 females was 6.9 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 nest sites, three peregrines were resighted at nest sites in VA and WV: An 8 year old female was found nesting in coastal marsh in 2011, another 4 year old female also in a marsh situation in 2011, and a 3 year old female nesting in a quarry near Harper's Ferry, WV, in 2010.
  - All nest sites were maintained during the non-nesting season. Another tower was fitted with new sleeve predator guards and repairs were made to guards on others. Gravel was cleaned at all coastal nests to reduce the over-winter survival of parasitic fly eggs (*Carnus hemapterus*), which may have helped but did not eliminate the problem.
  - The Division, 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.
  - Unrelated to this job, the Division of Fish and Wildlife adopted changes to our endangered and nongame wildlife lists that changed the non-breeding season status of NJ peregrines from endangered to special

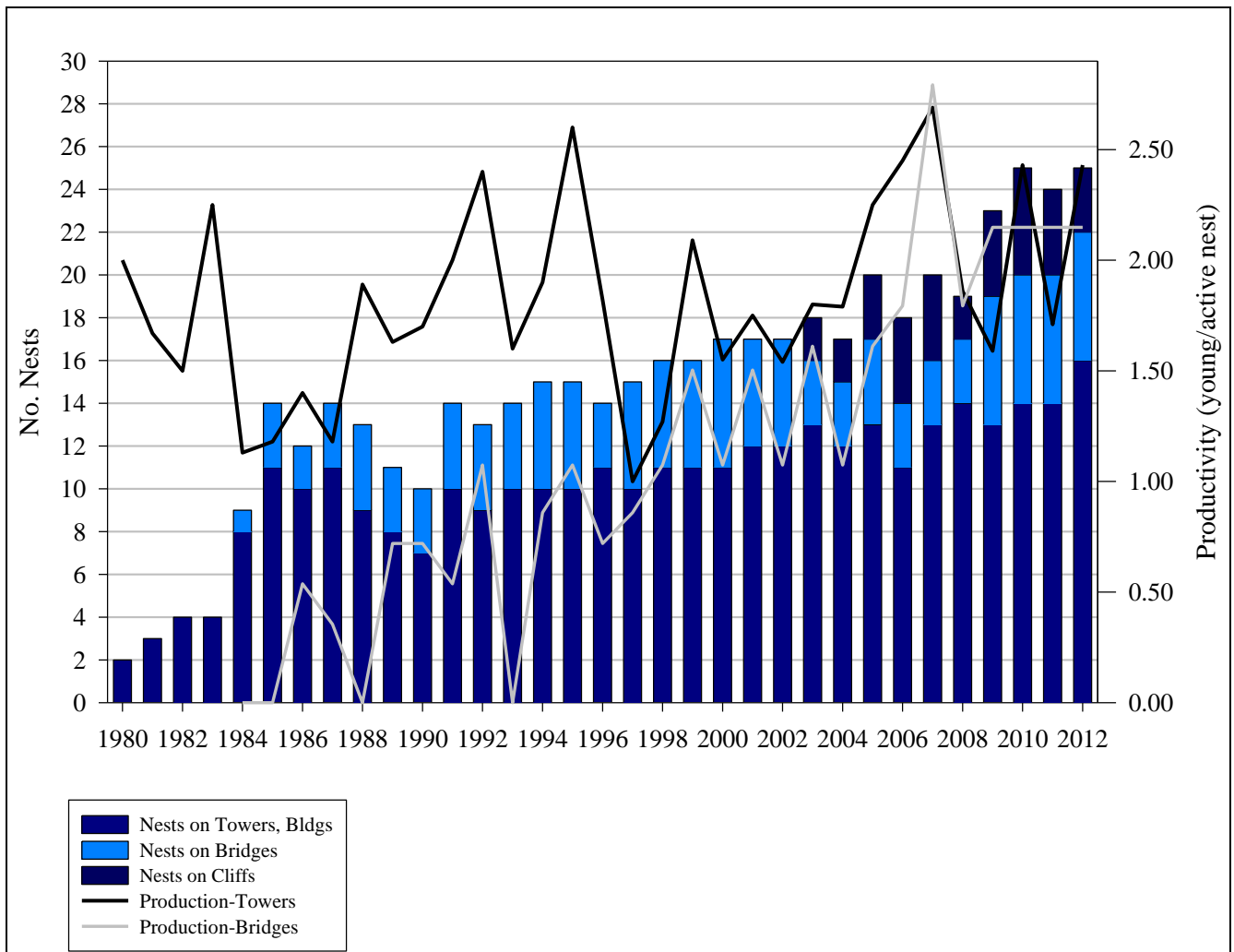
concern. That change, along with NJ Game Code changes, allowed NJ to participate in the Flyway's take of passage peregrines in September, 2012.

#### Conclusions:

- The peregrine population remained steady and nest success and productivity rose in 2012 (Figure 1). Across all sites – towers, building, bridges and cliffs – nest success was 80% and produced 2.04 young/active site. 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 situations for the birds, continues to be the predominant factor in a stable and productive population.
- 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. New research suggests the high levels of brominated fire-retardant chemicals (polybrominated diphenyl ethers) found in peregrines may affect adult peregrine nesting behavior and nest success, which certainly bears watching in NJ.
- Continue 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, 2012.

Name	Occupied	Active	Eggs	Yng Hatched	Yng@ BandAge	Yng Fledged	Comments
Sedge Island WMA Tower	Y	Y	4	Unk	1	1	
Forsythe NWR/Brigantine Tower	Y	Y	3	3	3	3	Treated early for flies
Forsythe NWR/Barnegat Tower	Y	Y	4	4	4	4	
Marmora WMA / Sea Isle Tower	Y	Y	4	2	2	2	Lost 1 <sup>st</sup> clutch?
Great Bay WMA/ water tower	N	N					
Heislerville WMA Tower	Y	Unk					Obs. 1 fledgling 8/17/12
Egg Island WMA Tower	Y	Y	4	4	4	4	
Swan Bay WMA Tower	Y	Y	4	1	1	1	Coll. 1 egg
Tuckahoe WMA Tower	Y	Y	3	2	2	2	Col. 1 broken egg
Ocean Gate (AT&T) Tower	Y	N	0				Female is 1 year old
Stone Harbor marsh	Y	Y	4	3	3	3	
Margate marsh	Y	Y	4	Unk	2	2	Unk if survived 6/30 storm
Hilton/The Grand Casino	Y	Y	4	4	4	4	Butler's end
101 Hudson, Jersey City	Y	Y	5	3	3	3	Coll. 2 eggs
Newark – <i>Unknown location</i>	U	U				U	
Elizabeth-Union Co. Court House	Y	Y	4	4	4	4	
Sewaren building	Y	Y	Unk			≥1	Fledgling obs. 6/1
Refinery (Greenwich-Paulsboro)	Y	Y	3	0	0	0	Eggs broke in nest
<b><i>SUBTOTAL TOWERS &amp; BUILDINGS</i></b>	<b>16</b>	<b>14</b>		<b>30</b>	<b>33</b>	<b>34</b>	
Natural Site C-1 (Alpine)	Y	Y	Unk	U	1	1	Not banded. New ledge.
Natural Site C-2 (South)	Y	Y	5	5	5	4	
Natural Site C-3 (South)	N	N					
Natural Site C-4 (North)	Y	Y	Unk	0	0	0	
Natural Site C-5 (Tenafly)	U	U	U	U	U	U	
<b><i>SUBTOTAL NATURAL SITES</i></b>	<b>3</b>	<b>3</b>		<b>≥6</b>	<b>6</b>	<b>5</b>	
G. Washington Br. (Hudson River)	Y	Y					NY side/NY monitored
Betsy Ross Br. (Delaware River)	Y	Y	3	0	0	0	
Walt Whitman Br. (Delaware R.)	Y	Y	U	U	1	1	NJ tower
Ben Franklin Br. (Delaware River)	Y	Y	U	U	4	4	PA side/PA monitored
NJ-PA Turnpike (Delaware River)	Y	Y	U	4	4	4	PA side/PA monitored
Tacony-Palmyra (Delaware River)	Y	Y	U	U	3	3	
Burlington-Bristol (Delaware R.)	Y	Y	4	4	4	4	
Rt 78-Scudders Falls Bridge	Y	Y	U	U		0	PA side/PA monitored
Brigantine Bridge (A.C.)	U	U				U	1 fledgling found 6/20 north end of A.C.
Vince Lombardi - NJTP Bridge	U	U					
Secaucus-Kearny NJTP Bridge	U	U					
Newark Bay Br. (NJTP or Conrail)	U	U	?	?	?	?	
Trenton RR Bridge	U	U					
Route 3 Br./Hackensack (NJDOT)	U	U	?	?	?	?	
Route 35/Belmar Bridge	U	U	?	?			
GEH-Parkway Bridge	Y	Y			3	3	Unk survival post-fledging. Not banded.
Route 1 Raritan Bridge	Y	Y			2	2	Not banded
<b><i>SUBTOTAL BRIDGES</i></b>	<b>6 (NJ)</b>	<b>6</b>		<b>6</b>	<b>13</b>	<b>≥13</b>	
<b>TOTALS (NJ only)</b>	<b>25</b>	<b>23</b>		<b>42</b>	<b>≥52</b>	<b>≥52</b>	<b>52 yng/23 KON=2.26</b>

## **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 (*Poocetes 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) was contracted to conduct the 2012 grassland bird survey. NJA fielded over 80 trained Citizen Scientist volunteers to conduct bird surveys on approximately 60 project and control sites totaling >4,000 acres of managed grassland habitats across New Jersey as part of ENSP's effort to evaluate management techniques on grassland bird populations.
- ENSP biologists, NJA staff and volunteers performed two point count surveys per location to record the number of breeding target grassland birds. Volunteers were trained to assure adherence to methodology and were instructed to record and map the location of individual target species. The survey periods were 1) May 15 to May 31, and 2) June 1 to June 15. During each of the two surveys, staff and volunteers also conducted a general habitat assessment at each point location that included overall habitat category (upland or wetland), habitat class (e.g., fallow field, row crop, meadow, sod) and average vegetation height.
- A total of 381 grassland survey points were assigned in the 2012 breeding season, including unmanaged roadside control points (n=218), managed Landowner Incentive Program (LIP) (n=117), Wildlife Habitat Incentive Program (WHIP) (n=12), Wildlife Management Areas (WMA) (n=20), and landfill (n=14).
- The 2012 bird survey data represent the final year of the broad LIP evaluation effort. We continue to evaluate the effectiveness of management techniques, and to standardize and correct the datasets. Running the data through basic statistics produced some interesting results:
  - Species response to warm-season grass (WSG) fields varied, with bobolinks being the only species with a positive response (Fig. 1). The number of converted WSG fields varied each year as fields were added to the program; conversion of crop/cool-season grass (CSG) to WSG declined in 2009 and 2010. As habitat structure of WSG fields change over time, species composition may be affected as different species require different habitat characteristics.
  - Species response to cool-season grass (CSG) fields also varied (Fig. 2). Grasshopper sparrow (GRSP) and Eastern meadowlark (EAME) show a slight overall increase in abundance at CSG sites, while horned lark (HOLA) shows a more even slope; bobolink (BOBO) trended a slight

decline. Yellow-breasted chat (YBCH), a scrub-shrub species, was not recorded in CSG fields from 2006-2011 and may indicate a lack in management for this species.

- All Roadside points were chosen for proximity to suitable grassland bird habitat, although specific habitat type varied at each point. Species response to roadside fields varied (Fig.3). BOBO are the only species to steadily increase, EAME trended downward in abundance, and GRSP remained steady. The spike in HOLA in 2010 resulted from one roadside point recording a flock of 25 individuals.
- All 2011 grassland bird data were QA/QCd and entered into Biotics. Approximately 60% of the 2012 grassland bird data have been submitted to ENSP and were mapped and submitted to Biotics for entry. We expect all the data by year's end, which will subsequently be entered in the Biotics database.

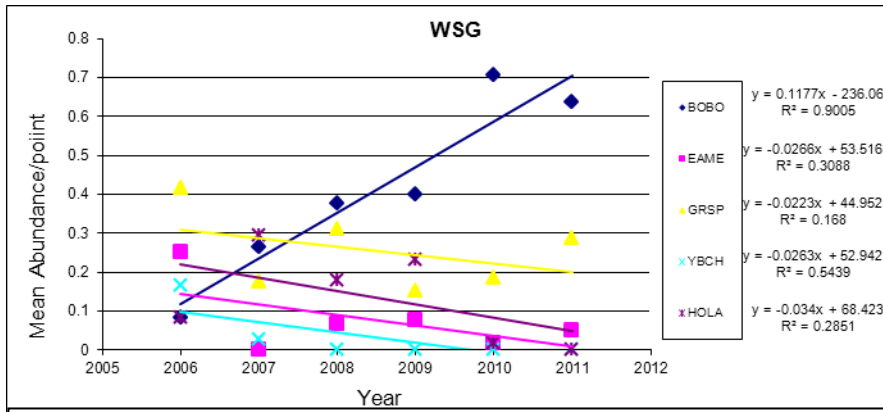


Fig. 1: Species response to warm-season grass (WSG) fields varied (Fig. 1). The number of converted WSG fields varied each year as fields were added to the program; conversion of crop/cool-season grass (CSG) to WSG declined in 2009 and 2010. As habitat structure of WSG fields change over time, species composition may be affected as different species require different habitat characteristics.

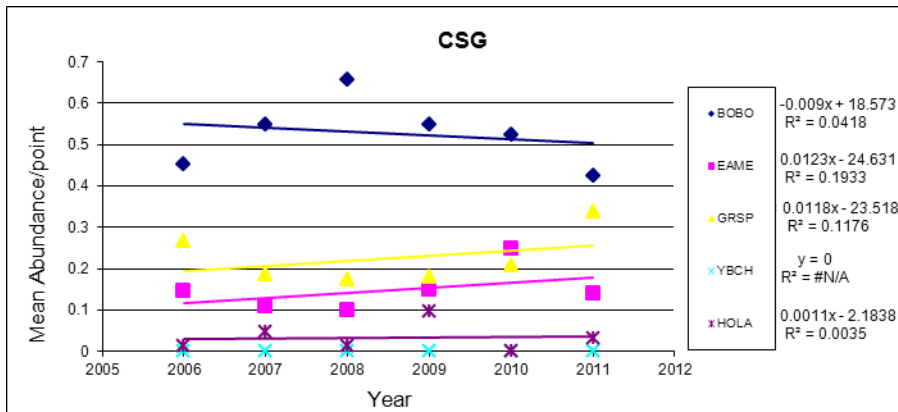


Fig 2: Grassland bird use of CSG LIP sites, 2006-2011. GRSP and EAME showed an overall increase in abundance at CSG sites, while HOLA showed little change and BOBO showed a slight decline. YBCH, a scrubshrub species, was not recorded in CSG and may indicate a lack of management for this species.

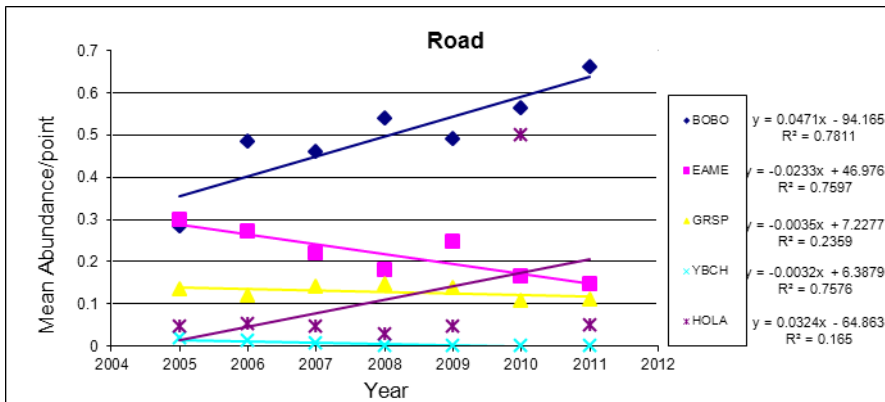


Fig 3: Grassland bird use of control Roadside points, 2005-2011. Roadside points were chosen for proximity to suitable grassland bird habitat, although specific habitat types vary at each point. BOBO were the only species to steadily increase; EAME trended downward; GRSP remained steady. The spike in HOLA in 2010 resulted from one roadside point recording a flock of 25.

- In an effort to continue evaluation of potential temporal and spatial differences in grass growth rates, in 2012 staff conducted a micro-habitat focused sampling effort by surveying the most southern sites first and moving northward between June 10<sup>th</sup> and June 20<sup>th</sup>. We repeated our 2011 micro-habitat survey sites, sampling 69 points including the 43 points that had increased bird survey effort.
- The predictive habitat model was not completed due to limited staff resources. All habitat data have been entered and will be included with the landscape variable and other covariates for the model.
- Although the model was not completed, staff reviewed the grassland bird data for all the LIP sites and selected sites where it appeared that a species was diminishing over time on that particular site. We then developed species specific management plans for that site. However, due to landowner reluctance to implement specific practices, the plans were not implemented.
- The best management practices (BMPs) for target grassland species were not completed.
- Although there were no regional grassland bird meetings during this reporting period, staff continued to coordinate with NJA for final evaluation of Landowner Incentive Programs region-wide.
- ENSP selected the grasshopper sparrow as the first grassland bird species we would develop a status assessment and recovery plan for. However, due to limited staff time and resources, we did not begin to gather or analyze existing information to produce a species status assessment (including assessment of threats, habitat condition, and population and productivity), and recovery plan for the NJ population of grasshopper sparrows.
- Determining the effectiveness of the 2011 increased bird survey effort at the larger LIP sites was not completed this reporting period. ENSP will work with a statistician to determine number of sites (including control) necessary to compare treatments or to assist in the selection of the statistical analysis that can be conducted with the existing data we have.

### Conclusions:

- The use of Citizen Scientists for grassland bird surveys continues to be a necessary and efficient method to collect data. Of the 65 primary volunteers that were assigned sites for the 2012 grassland survey, 57 (87.7%) of them have entered data online and returned their datasheets to NJA; 4 (6.2%) have entered data, but have not yet returned their datasheets; 3 (4.6%) have not returned data yet, and 1 (1.5%) did not complete his assigned surveys in 2012. Six total staff members participated in the surveys (including staff from NJA, DFW and Conserve Wildlife Foundation) and were excluded from the above numbers.

- Of the 85 primary and secondary volunteers that committed to the 2012 survey, 60 (71%) had participated in the survey for at least one previous year (2005-2011). The remaining 25 volunteers were new to the project in 2012. Furthermore, 43 of the 85 volunteers (51%) had participated in at least 2 previous surveys, 33 (39%) had participated in at least 3 previous surveys, 25 (29%) had participated in at least 4 previous surveys, 19 (22%) had participated in at least five previous surveys, 12 (14%) had participated in at least six previous surveys, and 7 (8%) had participated in all seven previous surveys.
- Since 2005, ENSP staff QA/QC'd bird data collected by staff and volunteers. While the error rates fluctuated from year to year, we estimate a low average error rate (<5%) with the majority of errors result from volunteers filling out the datasheet incorrectly and not following all of the instructions. Failure to map individual species locations is the most common error made by volunteers.
- Collecting microhabitat data on a spatial and temporal sample of sites is possible based on our 2012 work. However, the sample of sites must also consider adequately representing management practices.
- Analysis of 2010 - 2012 microhabitat data will allow us to better determine if there is a spatial and temporal difference between growth rates in northern and southern New Jersey.
- Standardization and conformation of all data collected must be completed including: habitat and management data on all Landowner Incentive Program (LIP) sites, management treatments and bird occurrences.
- Initial efforts to evaluate management practices on bird use identified questions/issues with how we identify each point to a management practice due to the nature of both bird movement and the agricultural landscape. As we complete our broad survey efforts and begin to focus on analysis and species specific adaptive management plans, these issues will need to be resolved.
- Finalizing the standardization of all our data will allow us to move forward in the development of predictive modeling and evaluation analysis as well as to assess the threat of habitat loss/conversion, agricultural practices, and fragmentation (area sensitivity) using habitat information gathered and changes in Land Use/Land Cover over time.
- Based on the reluctance of private landowners to voluntarily implement management strategies on their land, ENSP will now focus our efforts at developing species specific management plans for grassland habitat on public lands where we have the ability to engage the land steward in adaptive management practices. This refinement of our efforts will also allow us to better evaluate bird response by limiting survey efforts.

### **Recommendations**

- Continue to use Citizen Scientist volunteers to conduct two replicates of point count surveys for target grassland bird species at each site where management techniques are to be evaluated and controls.
- Determine effectiveness of the 2011 increased bird survey effort at the larger LIP sites. Work with a statistician to determine number of sites (including control) necessary to compare treatments or to assist in the selection of the statistical analysis that can be conducted with the existing data we have.
- Continue to survey a sample of sites using simplified microhabitat methodology; ensure sample represents all management practices are adequately represented. Complete baseline data collected every 3 years.
- Evaluate potential temporal and spatial differences in herbaceous growth rates using 2010 - 2012 data.
- Continue working on BMPs based on survey and habitat data (see above) for endangered, threatened and special concern grassland bird species where enough data has been collected.
- Complete 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.



- Create and validate a predictive habitat model using landscape variables (# total acres, core area, proximity to other open habitat, etc.) for one endangered or threatened grassland bird species and establish a protocol for developing habitat models for the remaining endangered, threatened and special concern grassland bird species.
- Continue participating in NE CBM Grassland Working Group meetings and to coordinate efforts with interested parties and explore ways to potentially share data.
- Identify at least one site on public lands to implement adaptive management strategies for selected species. Work with land manager to implement those practices in 2013 and develop bird survey protocol to evaluate bird response to those practices.
- Write final report of broad LIP surveys and develop method to re-survey sample of sites to enable us to track grassland bird trends.

### **JOB 1J: Raptors**

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

OBJECTIVE 1: To inventory and monitor state-listed woodland raptor populations and their habitat, and determine population trends in relation to available habitat. To develop forest management practice guidelines and informational vehicles that help reverse the declines of the state-endangered northern goshawk (*Accipiter gentiles*) and red-shouldered hawk (*Buteo lineatus*), and the state-threatened Cooper's hawk (*Accipiter cooperii*) and barred owl (*Strix varia*).

OBJECTIVE 2: To determine the distribution of owls throughout NJ including the listed short-eared owl (*Asio flammeus*), long-eared owl (*Asio otus*), and barred owl (*Strix varia*), special concern status common barn owl (*Tyto alba*), and other inhabitants including the great horned owl (*Bubo virginianus*), eastern screech owl (*Megascops asio*), and the northern saw-whet owl (*Aegolius acadicus*); and develop baseline data for long-term monitoring of owl populations, distribution, and habitat selection. **This portion of the job was not proposed for the 2009-2010 funding cycle.**

OBJECTIVE 3: To determine home range and broader habitat usage by barred owls within NJ, specifically targeting the differences between northern and southern residents.

#### **Job 1J, Part 1: Woodland Raptors:**

##### Key Findings:

- ENSP contracted Rutgers University statistician, Dr. Edwin Green, to analyze transect survey data (from the late 1980's, 2001-2002 and 2006) of woodland raptors (barred owl, red-shouldered hawk, northern goshawk and Cooper's hawk) and the relationship to land use/land cover.
  - It was not possible to conduct a temporal analysis of raptors detected in transects by landscape because survey routes have been altered over the years. Thus, the analysis focused on the relationships between raptor detections and the habitat variables of forest acreage (area) and the ratio of forest perimeter to forest area (a measure of patch size and shape).
  - The analyses employed a Bayesian model that incorporated a zero-inflated Poisson (ZIP) model and resulted in regression coefficients for each species in northern and southern NJ.
  - The results of the statistical analyses were inconclusive. However, select relationships were significant: barred owl presence was positively correlated with forest acreage in northern New Jersey, and negatively correlated with forest perimeter-to-area ratio in southern New Jersey.
  - The detections of red-shouldered hawk were positively correlated with forest perimeter to area ratio for both northern and southern NJ.
  - No significant relationships were found for Cooper's hawks. The number of detections of Northern goshawk was too few for this analysis.

Conclusions:

- This evaluation of the transect-route dataset for woodland raptors led us to conclude that the method is not suitable for its original purpose, detecting temporal trends in these populations. The standardized routes were changed over the years to adapt to keep survey points within suitable habitat. We recognized this earlier and, in 2006, surveyed original points in northern NJ to document “negative” data in habitat that had become unsuitable; this effort too was insufficient. As a result of route and point changes over the years, there was insufficient standardization of the routes and points for the trend analysis. Thus, we recommend discontinuing these survey transects. However, we will be able to use the long-term data collected at standard, unchanged, locations for trend analyses.
- The statistical analysis did reveal some relationships: the positive relationship of barred owls with forest area (in northern NJ), and the negative correlation of barred owls with forest perimeter to area ratio in southern NJ. These highlight the barred owl’s relationship to larger and less-fragmented forest parcels. However, we cannot state that relationship holds across all habitats until these data are augmented with a dataset that is randomly-generated. The transects were originally set up in mostly forested regions, not via random selection. Additional data have since been collected in other woodland raptor surveys using a stratification of forest parcel size, and those data are available to augment and further test the transect data.

Recommendations:

- ENSP should discontinue the current standardized survey routes and refocus survey efforts using stratified habitat parcels and random sampling.
- Due to limited funding, ENSP will work internally to conduct preliminary analyses of woodland raptor data from other survey efforts using the same variables (forest acreage, forest perimeter-to-area ratio) to determine if these findings can be verified or expanded.
- As resources are made available, ENSP will work with Edwin Green, Rutgers University, to conduct more complex data analyses using raptor data from other survey efforts.

**Job 1J, Part 3: Barred Owl, Home Range Study**

*Inactive* here due to separate funding under Pittman-Robertson grant W-70-R-1.

**Job 1J, Part 4: Defining Core Habitats for Barred Owl**

Key Findings:

NORTHERN REGION

- ENSP planned to conduct barred owl surveys in northern New Jersey in spring 2012 as part of a regional effort to evaluate our method for valuing Barred Owl habitat in the State’s Landscape Project Map.
- Forest parcels were categorized by size with a minimum size of 100 ac, and 343 parcels were identified. Due to limited resources, we focused the survey effort on the larger parcels and divided them into two groups; group “A” including parcels 600-999 ac, “B” including parcels 1000-approximately 2400 ac.:

# of parcels	Acreage range	% parcels $\geq 100$ ac.	Survey group GIS)
241	100-299	70.3%	n/a
57	300-599	16.6%	n/a
26	600-999	7.6%	A
19	1,000- approx 2,400	5.5%	B

- The forest parcels were further divided into (and targeted) two categories including those  $\leq 1$  mile and those  $>1$  mile from a forest currently valued for Barred Owl in Landscape Project Map. Survey locations were selected in approximately equal number of forests  $\leq 1$  mi and  $>1$  mi from valued habitat.

Table J-1. Northern NJ forest parcels selected for surveys to test habitat suitability parameters.

Parcel ID	County	Acreage	Survey group	$\leq 1$ mi from Valued Forest?	# Survey Pts Proposed
4172	Morris	914	A	Yes	7
4567	Morris	615	A	Yes	4
4379	Morris	620	A	Yes	5
4052	Morris	610	A	Yes	-
4984	Warren	653	A	No	4
3691	Morris	715	A	Yes	-
4160	Warren	847	A	Yes	6
4365	Warren	940	A	Yes	5
4999	Morris	648	A	No	5
5384	Morris	847	A	No	6
5000	Morris	799	A	No	6
2790	Warren	856	A	No	6-extra
3554	Warren	844	A	No	7-extra
4702	Morris	1125	B	Yes	7
6371	Morris	1312	B	Yes	9
4151	Morris	2396	B	Yes	-
4164	Warren	1526	B	Yes	10
3758	Warren	1953	B	Yes	13
4663	Morris	1353	B	No	5
4492	Warren	1330	B	No	6
2642	Hunterdon	1488	B	No	-
2315	Hunterdon	1100	B	No	-
2087	Hunterdon	1860	B	No	-

- Equipment, maps and contracts were completed and distributed by early March; later than planned as surveys may begin March 1.
- Two contractors, one volunteer and one ENSP biologist were scheduled to conduct the surveys. Due to personal constraints, one contractor opted out of the survey by mid-March. The second contractor opted out of the survey by late March due to unexpected illness. The volunteer could not survey due to equipment problems (initially) and then for personal reasons. The ENSP biologist who had planned to survey could not because of time constraints and unexpected illness. Therefore, no data were collected nor analyzed for the northern region.

#### SOUTHERN REGION

- ENSP conducted barred owl surveys in southern New Jersey in spring 2012 as part of the regional effort to evaluate our method for valuing barred owl habitat in the State’s Landscape Project Map.
- Forest parcels were categorized by size with a minimum size of 100 ac; 428 parcels were identified. Due to limited resources, we focused the survey effort on the larger parcels and divided them into two groups, “A” including parcels 600-999 acres, “B” including parcels  $\geq 1000$  ac.:

# of parcels	Acreage range	% of total parcels $\geq$ 100ac.	Survey group (GIS)
226	100-299	52.8%	n/a
72	300-599	16.8%	n/a
47	600-999	11.0%	A
83	1,000-approx 65,000	19.4%	B

- The forest parcels were further categorized as to proximity from a parcel already valued for barred owl in Landscape. However, Pinelands-region forest parcels are much less fragmented by roads than any other area of NJ, resulting in very large forest patches as defined by the Landscape Map. Therefore, all the parcels chosen for surveys occurred  $\leq$ 1 mi from a valued forest parcel.

Table J-2. Southern NJ forest parcels selected for surveys to test habitat suitability parameters.

Parcel ID	County	Acreage	Survey group	$\leq$ 1mi from Valued Forest?	# Survey Pts Proposed	BDOW detections
1479	Camden	668	A	Yes	2	0
2754	Burlington	686	A	Yes	2	0
3066	Burlington	712	A	Yes	2	0
1744	Ocean	771	A	Yes	2	1
1617	Ocean	796	A	Yes	2*	1
3214	Ocean	883	A	Yes	2*	1
1549	Ocean	1,028	B	Yes	1	1
1222	Burlington	1,032	B	Yes	2	0
1267	Atlantic	1,263	B	Yes	2	0
2800	Burlington	1,331	B	Yes	2	0
1526	Burlington	1,356	B	Yes	1	0
3264	Burlington	1,895	B	Yes	2	2
1354	Atlantic	2,000	B	Yes	4	0
1281	Burlington	2,010	B	Yes	2	0
1303	Burlington-Ocean	2,742	B	Yes	3	0
3178	Ocean	3,978	B	Yes	shared*	0
2723	Burlington	4,055	B	Yes	3	0
3529	Ocean	4,437	B	Yes	4	1
3159	Burlington	4,503	B	Yes	5	1
2285	Camden-Burlington	16,134	B	Yes	7	2
2495	Burlington	28,874	B	Yes	3*	0
2021	Burlington-Ocean	29,602	B	Yes	13	2
3211	Ocean	30,366	B	Yes	2	0
3344	Burlington-Ocean	35,448	B	Yes	3	0
2566	Burlington	65,152	B	Yes	4	0

\*Parcel shares survey points with neighboring parcel(s); individual survey points were only included once within table

Parcel 1617 (cat. A) shares 1 point with parcel 1549 (category B)

Parcel 3214 (cat. A) shares 2 points with parcel 3178 (category B)

Parcel 2495 (cat. B) shares 2 points with parcel 3344 (category B) & 1 point with parcel 2723 (cat. B)

- One contractor (Thomas Clifford) was hired to survey 75 points located primarily in the Pine Barrens region. Barred owls were detected at 12 points, as noted in Table J-2.
- We have not yet applied a landscape-level analysis of the positive versus negative survey results in southern NJ. This work will be conducted in the coming months.

#### Conclusions:

- Contracted surveyors (versus the use of volunteers) do not necessarily ensure survey completion.
- We will see what the analysis of the southern region surveys tell us about the stratification of survey locations and effectiveness for pursuing the same kind of surveys in the north. However, Pine Barrens habitats and forest parcel sizes are considerably different from north Jersey and may limit the comparisons.

#### Recommendations:

- Surveys in the northern region were scant in 2011 and not conducted in 2012. Surveys should be contracted in 2013, funds permitting, to attempt to ensure more sites are surveyed to maximize consistency in those surveys.
- Data analysis must be continued to examine the forest core-area size relative to documented barred owl distribution in northern and southern NJ regions separately. That analysis should also identify where additional survey data may be needed to answer the questions regarding core forest size.

### **JOB 1L: American Kestrel**

Project co-leaders: Peter Winkler, GIS Specialist and Kim Korth, Principal Zoologist

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 showw 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).
- Suitable sites for American kestrels were identified using the GIS predictive model based on the NJ DPE'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 5-year study (Table 1).

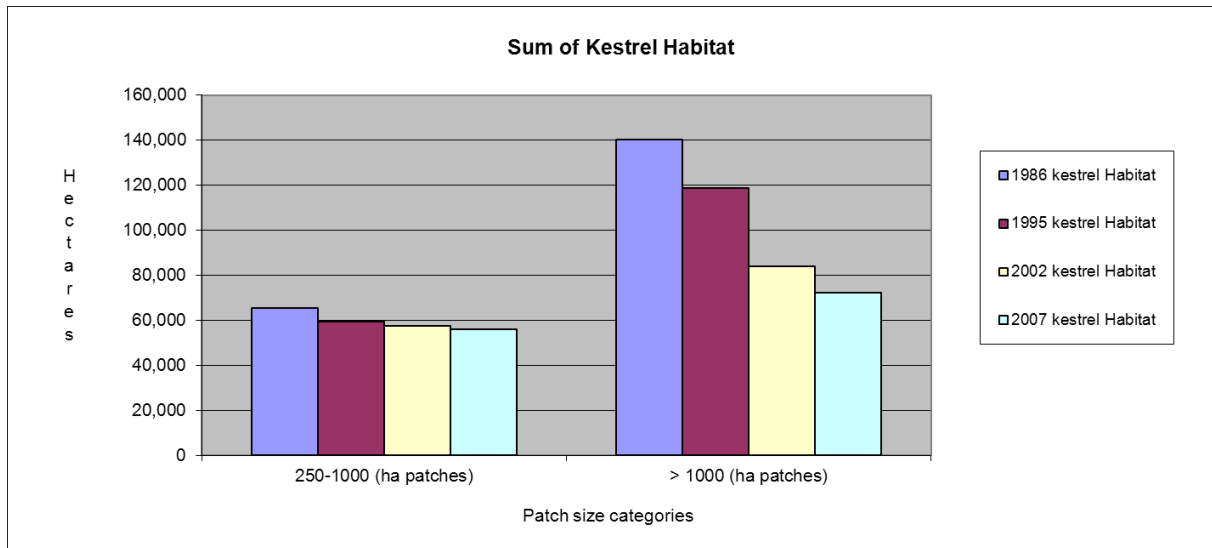


Figure 1. Total habitat for the top 2 categories, 250-1000 ha and > 1000 ha

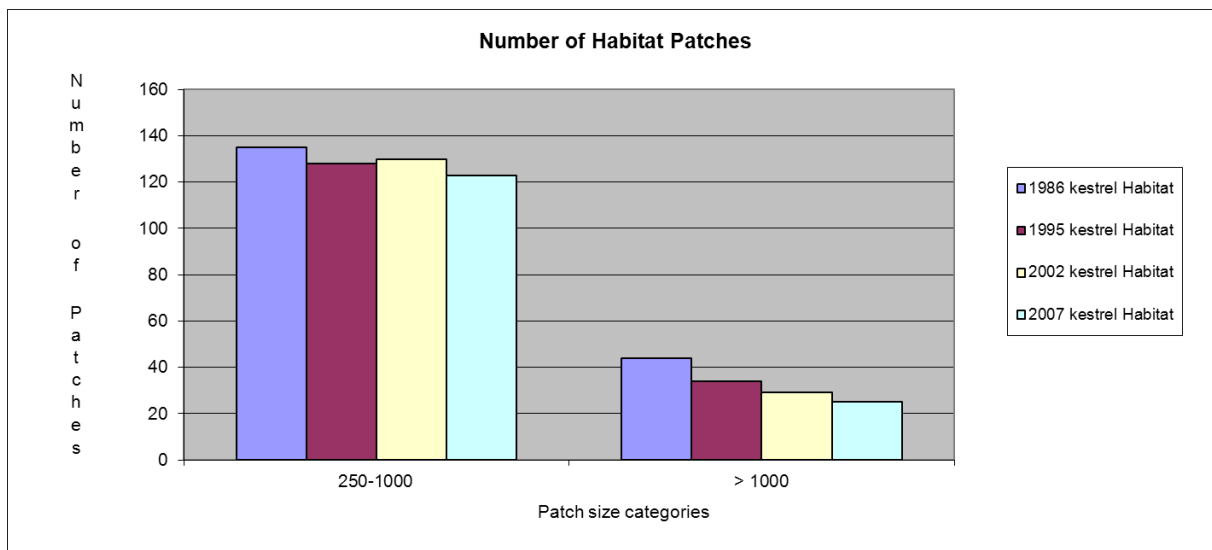


Figure 2. Number of habitat patches for the top 2 categories, 250-1000 ha and > 1000 ha

**Table 1.** Percentage of active nest boxes in patches >250 ha for all study years (2006-2011).

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%

- For the 2012 season, ENSP targeted 117 nest boxes for monitoring. The majority of the nest boxes monitored was from a subset (99) of the existing 275 boxes, the remainder (18) of the nest boxes was from a 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 117 nest boxes were monitored every 12-15 days from April through August 2012. Of those 117 nest boxes, 52 (44%) were occupied by American kestrels. Of the occupied boxes 40 (77%) were successful, defined by the nest attempt resulting in nestlings that reached bandable age of 14-22 days. Twelve nesting attempts (23%) resulted in failures.

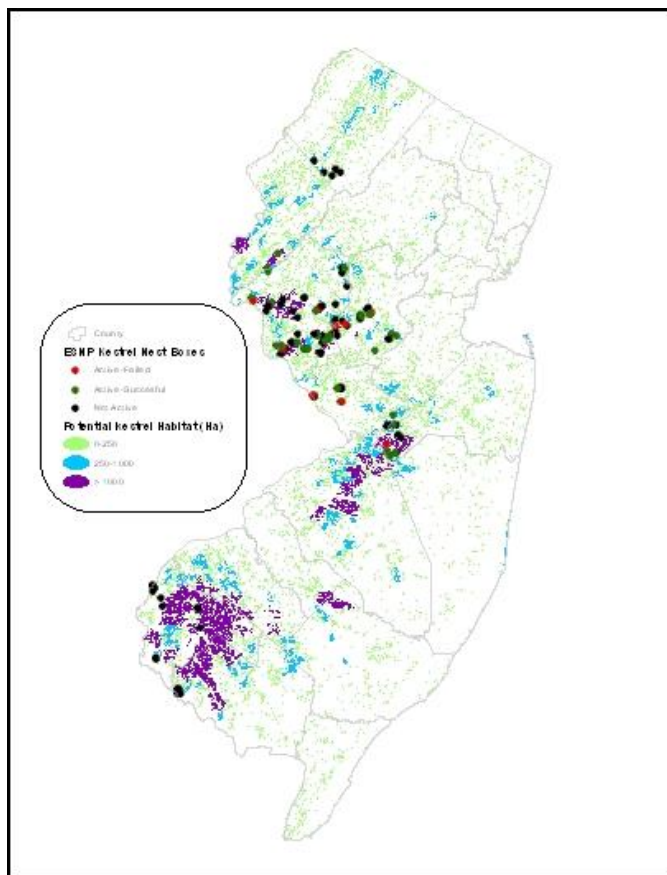


Figure 3. 2012 ENSP American kestrel nest boxes.

- Two new nest box volunteer monitors were recruited and trained. ENSP also partnered with DuPont and their Habitat Team (6 members). Through a collaborative effort, 5 nest boxes were placed on DuPont's Deep-water site.
- The 2012 nest box field season resulted in the following:
  - 183 kestrels were banded: 158 young (62 female, 81 male, 15 unknown) and 25 adults (22 female, 3 male) at 44 nest boxes.
  - Eight previously banded adults were recaptured (7 female, 1 male). Two females were banded at ENSP nest boxes as adults in 2010 and 2011. Those two females successfully raised 4 chicks each this season.

- All Recapture encounters have been mapped and compiled in the attached PDF. (Kestrel\_Recapture\_data.PDF).
- Fifteen volunteers monitored 81 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.
- Work has begun on a comprehensive report for 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](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>)
  - Figures 4-6 summarize the work done on the kestrel project over the past 7 seasons.

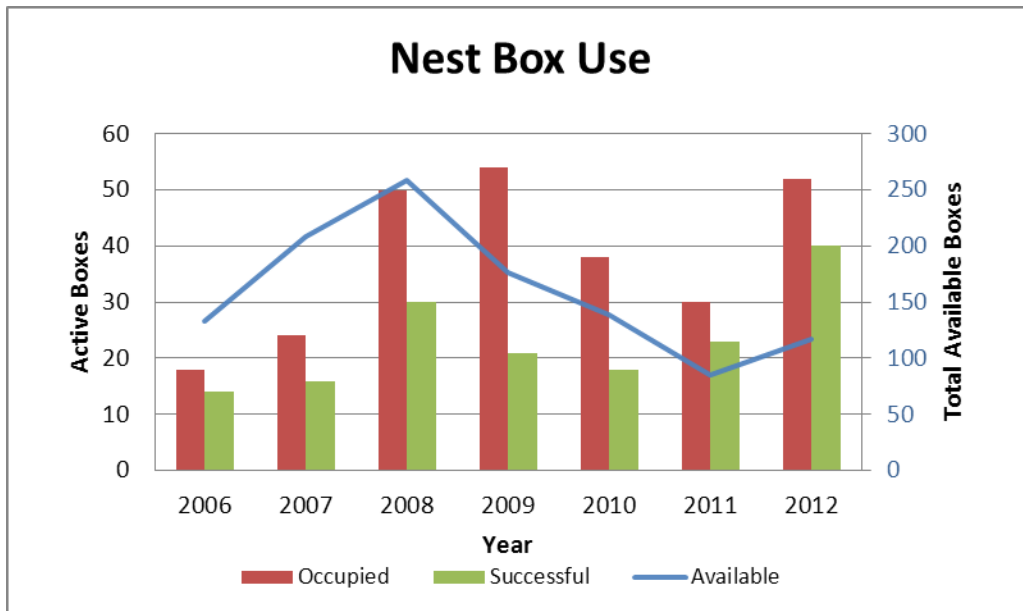


Figure 4. American kestrel nest box use, 2006-2012.



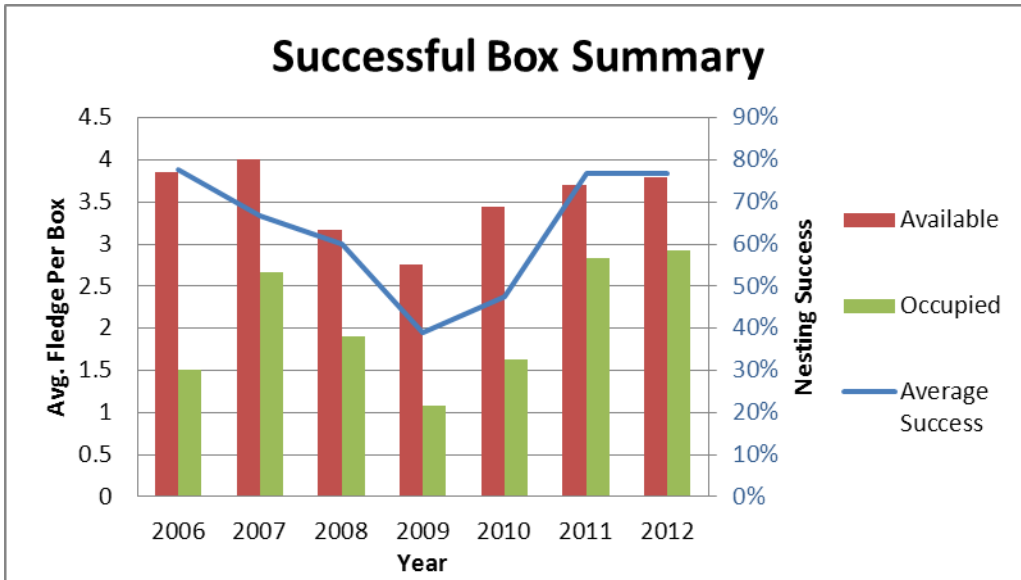


Figure 5. Average number of fledglings per available vs. occupied nest box and overall success of occupied boxes.

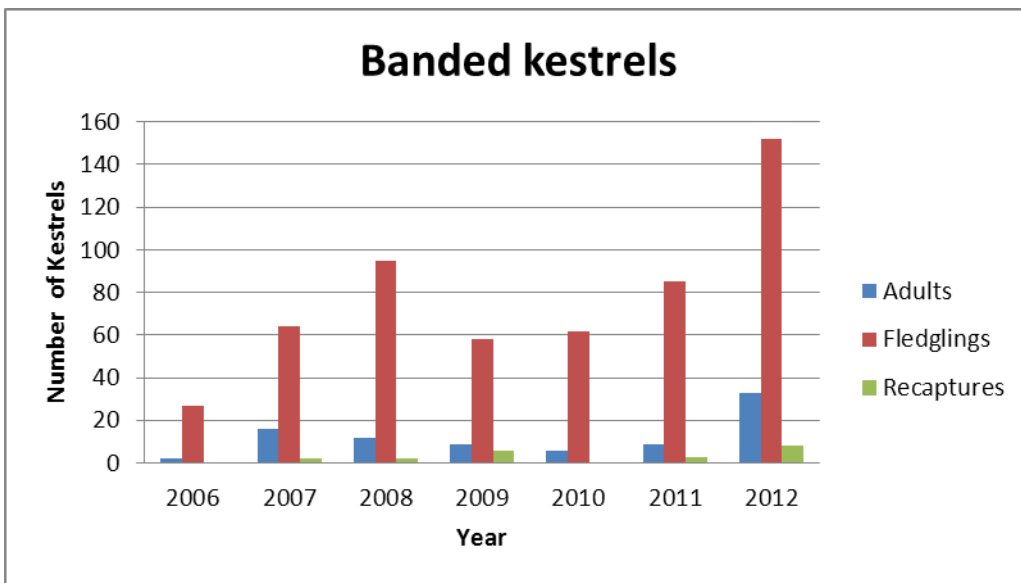


Figure 6. American kestrels banded 2006-2012.

- GIS data has been compiled and a pilot project is being developed to investigate use of and potential loss of kestrel migration habitat in New Jersey and nationwide. Funding for this component of the project has been researched with no promising leads.
- 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.
- Develop framework and funding to investigate use of and potential loss of kestrel migration 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 and Robert Somes, Assistant Zoologist

OBJECTIVE 1: Develop, evaluate, and implement a monitoring program for secretive marsh birds (rails and bitterns) and breeding marsh birds (saltmarsh and seaside sparrows) within the Coastal and Delaware Bay Regions of New Jersey to determine distribution.

OBJECTIVE 2: To monitor migratory landbirds within the Coastal and Delaware Bay regions of New Jersey.

**Key Findings:**

- Secretive marsh birds (SMB) in the southern part of the state were surveyed for the second year in 2012 as part of a 2-year study (2011 was year 1).
- ENSP partnered with the University of Delaware, a project leader of a regional, multi-cooperator SWG-funded project (Saltmarsh Habitat & Avian Research Program – SHARP). ENSP staff used datasheets and protocols provided by SHARP to ensure that data collected was consistent with other efforts and could be used both within New Jersey and throughout the region.

- SMB are notoriously hard to survey, due to their secretive nature and the difficulties associated with accessing their habitat. Contractors hired to do surveys had to possess at minimum intermediate birding skills as most birds would be heard and not seen. Southern New Jersey is a Mecca for birders, however, so finding surveyors proved to be fairly easy. Six people were contracted to complete surveys (3 staff members also participated), which consisted of visiting assigned points three times over the course of 10 weeks. Each contractor was assigned a different number of points (range 8-23). All of the contractors completed all of their surveys, with the exception of two May surveys that were not accomplished due to weather (the contractors made multiple attempts but the tides and weather never cooperated).
- The SHARP survey was organized such that marshes from Maine to Virginia were covered in hexagons. Within each hexagon, 10 randomly located points were plotted. ENSP took responsibility for nine hexagons, or 90 points. Upon review of the points, it was clear that many would be difficult to reach by foot or boat and would make surveying them unrealistic. With the approval of the SHARP coordinators, many points were moved to make them more accessible by foot or boat. There were 22 points that could not be moved to locations that were accessible (some were on federal properties, some were too far from any navigable waterways or roads) so ENSP contractors did not complete these (also with the approval of SHARP coordinators).
- Each point was surveyed once during 1-31 May, 1-30 June, and 1-15 July (3 time total). Surveys took place between the hours of sunrise and 10 am (11 am at the latest) in conditions where winds were <12 mph. For those accessing points by boats, surveying at high tide was often required to ensure enough water was present to reach points. At each point, surveyors listened passively for 5 minutes; for the next 8 minutes, a secretive marsh bird call (black rail, least bittern, sora, Virginia rail, king rail, clapper rail, American bittern, common moorhen) was played for 30 seconds, followed by 30 seconds of silence. All species seen and heard were logged on the datasheet, with more detailed information being collected on SMBs compared to other species encountered.
- During the middle survey (1–30 June), a vegetation survey was also conducted at each point. SHARP provided protocols and datasheets for this component as well. Surveyors were asked to determine the percent cover and type of vegetation cover in a 50m radius from the point (100m diameter circle). They were also asked to use a clinometer to measure the height of the vegetation at the horizon (in each cardinal direction) for each point.
- Hexagons were located on the Atlantic coast and along Delaware Bay. Sites included the marshes around Great Bay Boulevard (Ocean County), North Brigantine Natural Area (Atlantic County), Somers Point (Atlantic County), Tuckahoe River (Atlantic/Cape May County), and Port Norris/Fortescue/Dividing Creek (Cumberland County).
- As dictated by the protocol, all species encountered were logged on the datasheet, with special attention being paid to the secretive marsh birds. One hundred five (105) species were heard or seen on the surveys, compared with 91 in 2011. Of those, three were target secretive marsh birds species – least bittern, Virginia rail, and clapper rail. Two were target breeding marsh birds – seaside sparrow and saltmarsh sparrow. The breakdown of the other species was as follows: 57 passerines (45 in 2011), 12 shorebirds (11 in 2011), 9 waders (8 in 2011), 8 terns/gulls (8 in 2011), 7 waterfowl (6 in 2011), and 8 raptors (7 in 2011).
- Of the three secretive marsh bird species were detected, only clapper rail was heard with any regularity. They were detected in all hexagons and on almost all survey periods; the only exceptions were the two hexagons, North Brigantine Natural Area and Heislerville, that were not surveyed in May due to weather conditions. Had they been surveyed, it is highly likely clapper rails would have been detected as they were quite prolific on the June and July surveys.
- Virginia rail was detected ten times (likely 4 individuals): nine times in the Turkey Point hexagon (three each in May, June and July but at the same point so likely the same individuals), and once in that same hexagon but at a different point.

- Least bittern was detected ten times: twice in June and twice in July (at two different points) near the Tuckahoe River, five times near Turkey Point (once in June and three times in July at the same point and once in July at a different point) and once in July in the Heislerville hexagon.
- Black rail, sora, king rail and American bittern were never detected on any survey.
- Since the two breeding marsh birds, seaside sparrow and saltmarsh sparrow, were not considered focal species in the SHARP protocol, the data that was collected on them is more difficult to tease out and specific quantitative data has not yet been completed as of this grant report. However, as with 2011, some generalizations can be made. First, seaside sparrows were far more common than saltmarsh sparrows, by a ratio of 8:1. They were observed in every hexagon many times for almost every time period; the only exceptions were the two hexagons (North Brigantine Natural Area and Heislerville) that were not surveyed in May due to weather conditions. Saltmarsh sparrows occurred far less frequently. They were observed in six of the nine hexagons (all but Heislerville, Great Bay Boulevard #2 and Somers Point), but the numbers in which they encountered were far less than seaside (88 detections versus 714). In locations where it was detected, it was recorded in all three survey periods, except the two hexagons, North Brigantine Natural Area and Heislerville that were not surveyed in May due to weather conditions and the July survey of the Fortescue hexagon.
- There were nine species of threatened or endangered species detected on the survey. These were sedge wren, peregrine falcon, black skimmer, least tern, bald eagle, black-crowned night-heron, northern harrier, osprey and yellow-crowned night-heron. There were 12 special concern species detected, among them American oystercatcher, common tern, little blue heron, least bittern and Virginia rail.
- Clapper rail was detected so often that comparisons of abundance among areas were possible. Each individual rail was tallied for each point and since the points were located approximately 0.25 miles from one another there is a low probability of double counting individuals (assuming they did not fly and were counted twice at different locations). In total, 265 rails were detected in May (156 in 2011), 232 rails in June (144 in 2011), and 222 in July (113 rails in 2011). The increase from 2011 to 2012 is at least in part due to the inclusion of Turkey Point and Fortescue points this year, as there were no data issues at these sites in 2012 (there had been in 2011 and the data was unusable). Of the data available, the area with the greatest density of clapper rails was in the Turkey Point and Fortescue area and the lowest densities were in the hexagon north of the Tuckahoe River and at North Brigantine Natural Area.
- The use of an iPhone, or other smart phone device, in conjunction with Google Earth images was again found to be far superior to the lower-tech GPS handheld units often employed by ENSP. Having the routes plotted on aerial images that moved in real time made locating points in the field very easy, which was especially useful in an environment where having a birds-eye view can save time (critical when the survey must be completed in a designated time frame). For instance, when surveying in a boat, time can be lost by trying to reach points through creeks that dead end or otherwise deter from the most direct line to the point. An aerial image allowed surveyors to find their points and map as direct route as possible between each one as efficiently as possible.
- Ending the survey by 11:00 AM still seemed too late for this species group, who are more likely calling earlier in the morning (or during the night).

### **Conclusions:**

- Collaborating with the SHARP researchers was again a positive experience. By working with them, ENSP collected data that will be comparable to the rest of the northeast and Mid-Atlantic States but that can also stand alone as a state dataset. The negatives about working as part of this group was that the datasheet was far more complicated than ENSP would have preferred. In 2011, this led to complications with data being recorded correctly (ultimately leading to it not being able to be used). In 2012, this was corrected by SHARP offering an in-person training session to ensure contractors understood the datasheet and protocol. After the first round of surveys, ENSP also required contractors to submit sample datasheets for review and correction and this resulted in all data collected in 2012 being useable.
- As in 2011, the number of species recorded across all sites remained relatively high, but the number of secretive marsh birds detected was again quite low. Of special concern continued to be the absence of black rails, which is a species known to be declining rapidly in the region. The caliber of observer skill

was again quite high, so it is unlikely one would be missed if it were calling. The lack of rails and bitterns (notwithstanding clapper rails) in the coastal region is cause for alarm.

- Observers opined that points relocated to be near quiet roads (and therefore easier to access than their original location deep in the marsh) were no less likely to have birds respond than those located away from quiet roads. Conducting the survey by foot, by car or by boat all appeared to be equally good options for surveying these sites.
- Observers expressed concern that the rate of 30 seconds calling/30 seconds silence was not enough time to ensure callbacks from focal species. There was also concern that the protocol was not designed for detecting nocturnally calling birds, such as black rails. The datasheet was not changed in 2012 since it would not make results comparable to 2011.
- In 2011, observers recommended that the protocol of each point to be visited in the same order on each of the three visits be reconsidered. They felt a more accurate assessment of species composition at a given point may be achieved by changing the order, so that certain points are not always surveyed late in the time frame (i.e., it is likely fewer birds will be vocalizing at 10:00 AM compared to 6:00 AM). The project leaders were amenable to this change and it was instituted in 2012.
- The SHARP project leaders are responsible for collating and analyzing the data and that information will not be available for at least a year. During their preliminary analysis of 2011 data, however, they did indicate that New Jersey has the highest density of clapper rails and willets in the study area. While clapper rail population in New Jersey appear to be secure, they may be playing a key role in regional populations and species managers should stay mindful of this when moving forward with conservation actions.

### **Recommendations:**

- Future efforts should consider surveys that are timed better for detecting black rails species. Although the decline of black rails seems to be undisputed, the lack of *any* black rails detected may be in part due to timing. The survey was conducted around sunrise, but black rails are more likely to call in the hours nocturnally.
- If ENSP decides to continue this survey in the future independent of SHARP:
  - Create a more streamline datasheet by narrowing the focus of the survey. Although this was intended to be a call playback for secretive marsh birds, observers were asked to log almost all species encountered which was a near impossible request. Narrowing the focus to just secretive marsh birds would make for a less frustrating experience for observers and more SMB focused data collected.
  - Consider protocol changes including increasing the timing of the species vocalizations from 30 sec on/30 sec off to 2 min on/2 min off, ending the survey at 9:00 AM instead of 10:00-11:00 AM, and creating a list of all calls from all species for observers to reference when logging the call type of a particular individual.
  - Determine how important data relating to the breeding marsh bird species are to the goals of a survey. If they are as important as SMB data, then the datasheet should reflect their status and collect more detailed information on them.
  - Survey additional sites.
- Compare the results of this effort to the data that was simultaneously collected by acoustic devices at ten sites throughout the New Jersey project area (funded and reported in WSFR W-70-R-1). Determine if call playback surveys are the best way to gather data or if remote sensing technologies provide advantages that make them more suitable to surveying this suite of species.
- Encourage all observers to take advantage of a smart phone while in the field to carry out an efficient survey as possible.
- Submit all relevant data for inclusion into Biotics database and Landscape Project.

## **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.

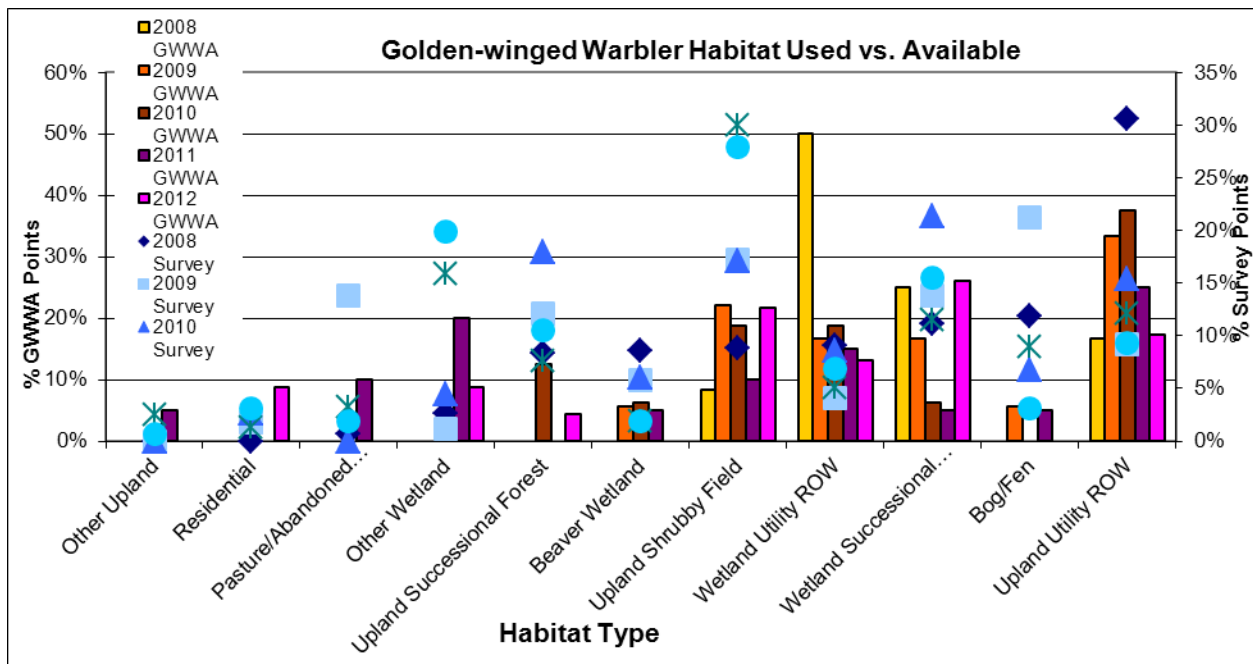
#### **Key Findings:**

- Data on golden-winged warbler occupancy and habitat were collected in 2012 contributing to the 2012 Golden-winged Warbler Atlas run by Cornell Lab of Ornithology. Biologists surveyed 161 points for golden-winged warblers in potential habitats (utility ROW, shrub swamp, successional forest, old field) in northwestern NJ to aid in the identification of priority areas for golden-winged warbler management. One hundred four of the 161 points surveyed were new (not surveyed in 2008, 2009, 2010, or 2011) and 57 were repeated from 2008, 2009, 2010 and/or 2011.
  - Habitat data were collected at all survey points in 2012. Approximately 47% of the survey points were in predominately wetland habitat, and 53% of the points were in predominately upland habitat.
    - The majority of the survey points were in upland shrubby fields (28%), other wetlands (20%), wetland successional forests (15%), and upland successional forests (11%). The remainder of the survey points were in upland utility ROWs (9%), wetland utility ROWs (7%), bogs or fens (3%), residential (3%), pasture or abandoned farmland (2%), beaver wetlands (2%), and other upland (1%) (Fig. 2B-1).
    - Most (90%) of the survey points contained <50% tree cover, with the majority (54%) containing 25-50% tree cover (Fig. 2B-2).
    - Most (80%) of the survey points had between 25 and 75% herbaceous cover with the majority (56%) containing 25-50% herbaceous cover (Fig. 2B-2).
    - Most (94%) of the survey points contained <50% shrub cover with the majority (79%) containing 25-50% shrub cover (Fig. 2B-2).
    - All of the survey points contained <50% 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 (61%) points and 39% of the points had vegetation >2m tall (Fig. 2B-3).
    - The majority of points (61%) had swamp or wet ground present; 34% had no water visible (Fig. 2B-4).
  - Twenty-four golden-winged warblers, five hybrids, and 121 blue-winged warblers were observed during the 2012 survey (Fig. 2B-5). Twenty-three golden-winged observations were males while

one was a female mated to a blue-winged warbler male. All 5 hybrids observed were Brewster's males.

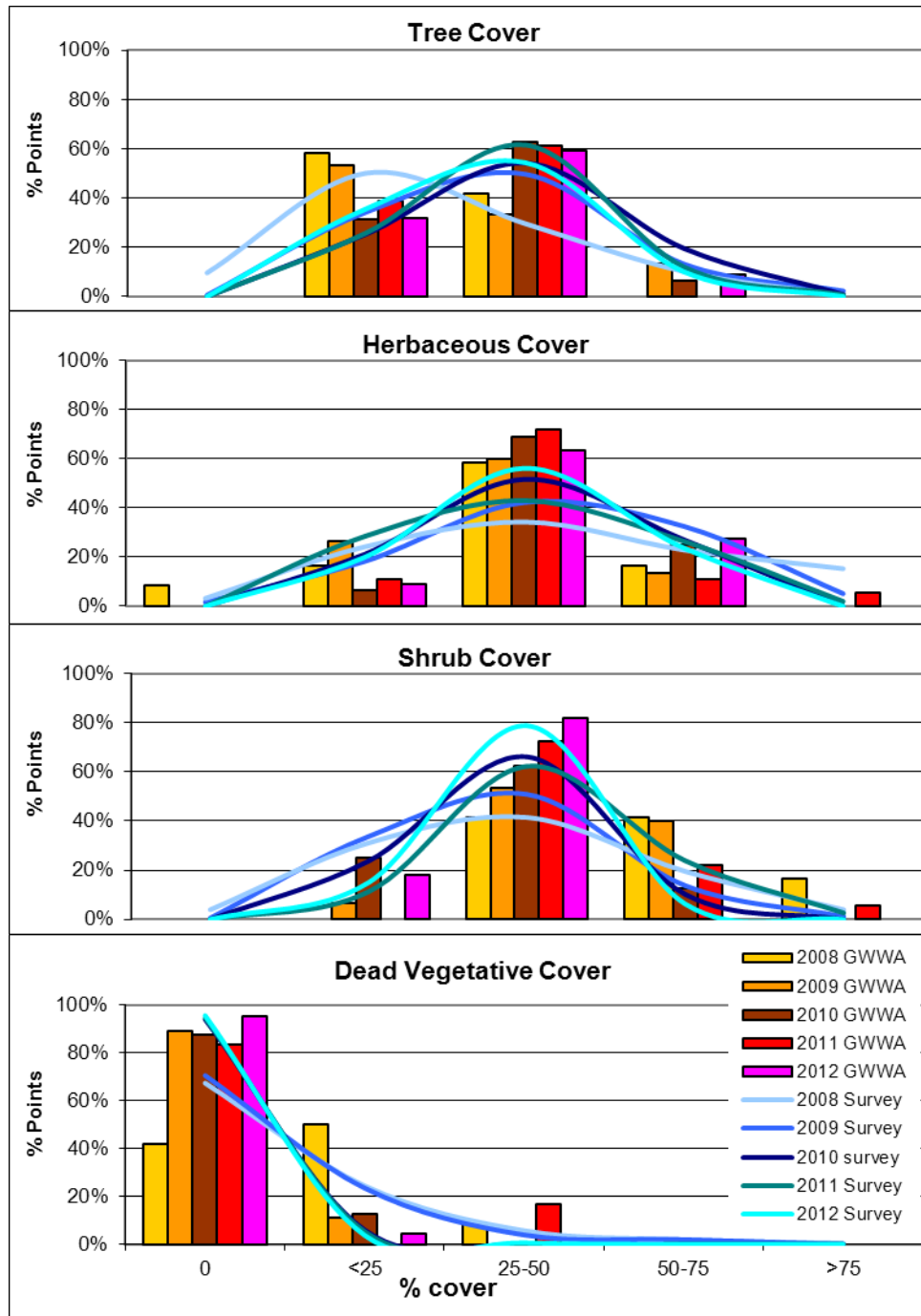
- Thirteen male and two female golden-winged warblers were mist-netted and color-banded and two male Brewster's warblers were incidentally captured and banded with just a USFWS band. All bands were submitted to the Bird Banding Lab.
- Of the 24 golden-winged warblers observed, six (26%) were in wetland successional forest, five (22%) were in upland shrubby fields, four (17%) in upland utility ROWs, three (13%) in shrubby wetlands, two (9%) in other wetlands, two (9%) in old residences, and one (4%) in upland successional forest (Fig. 2B-1).
- Most (59-64%) 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. About half of the GWWAs (54%) occurred in areas where the average vegetation height was 0-2 m. Most (73%) of the GWWAs occurred in areas where a swamp or wet ground was observed (Fig. 2B-2).
- Less than ten percent (8/104) of new (non-repeated) 2012 survey locations were occupied by golden-winged warblers, 78% by blue-winged warblers, 3% by a hybrid (Fig. 2B-6).
- About 30% (5) of the seventeen 2011 survey locations occupied by golden-winged warblers were not occupied in 2012 (Fig. 2B-7).
- Management of selected ROW spans for golden-winged warblers is still held up due to permitting issues.
- Guidance for managing lands for golden-winged warblers were provided and surveys conducted for a variety of land managers:
  - o Public Lands
    - Management for golden-winged warblers on Sparta Mountain Wildlife Management Area has been completed. Post-management surveys were conducted on May 17, 2012 (Table 2B-1)
    - Plans are being made for a second set of cuts on Sparta Mountain
    - CBT funding has been acquired to create golden-winged warbler habitat on Weldon Brook Wildlife Management Area. A forest stewardship plan has been created and is being reviewed for final acceptance.
  - o NGO Lands
    - Reclamation of an old gravel mine it to young forest/scrub-shrub conditions at TNC's Minisink Preserve is continuing and post-management surveys were conducted. The reclamation is still in the early stages with little herbaceous cover so few species were observed during the surveys.
  - o Working Lands for Wildlife (WLFW)
    - Eight landowners applied for WLFW in 2012 and six went to contract, resulting in about 85 acres of land approved to be managed for golden-winged warblers for the next 10 years.
    - Sites of all the applicants were visited and surveyed for golden-winged warblers if suitable habitat was already present on site. None of them had golden-winged warblers but two sites had blue-winged warblers.
    - Guidance was provided to NRCS biologists and landowners, on a site-by-site basis, for the locations and management in order to have the greatest probability of achieving golden-winged warbler habitat.
    - All approved WLFW sites were rated using the Wildlife Habitat Evaluation Guide for Golden-winged Warblers.
- Staff attended the Appalachian Mountain Joint Venture Technical Meeting in Morgantown, WV from August 6-8, 2012.

- The Golden-winged Warbler working Group did not meet this year. However, staff submitted information on golden-winged warblers in NJ for the 90-day finding for the petition for federal listing.
- A draft of the manuscript based on the analyses of 2003-2007 data has been completed and is being reformatted before final review for submission to a peer-reviewed journal.
- Landscape V3 was released in February 2012 using a species-based patch approach, which is the closest we have to a predictive model for golden-winged warblers based on known occurrences. More in-depth analyses of habitat for golden-winged warblers may be done this winter for the state status assessment of golden-winged warblers.
- The data will be submitted for entry into the NJ DEP's Biotics database by mid-November.

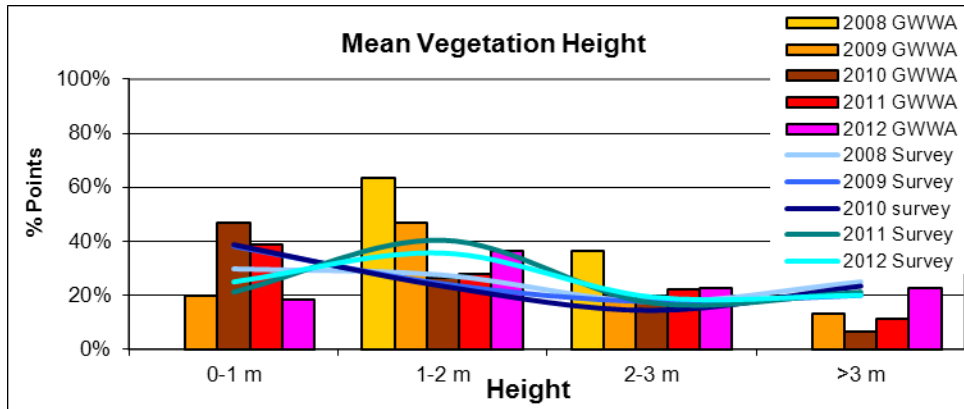


**Figure 2B-1.** Habitats used by golden-winged warblers (GWWA) vs. available habitat surveyed (Survey) during the 2008, 2009, 2010, 2011, and 2012 surveys.

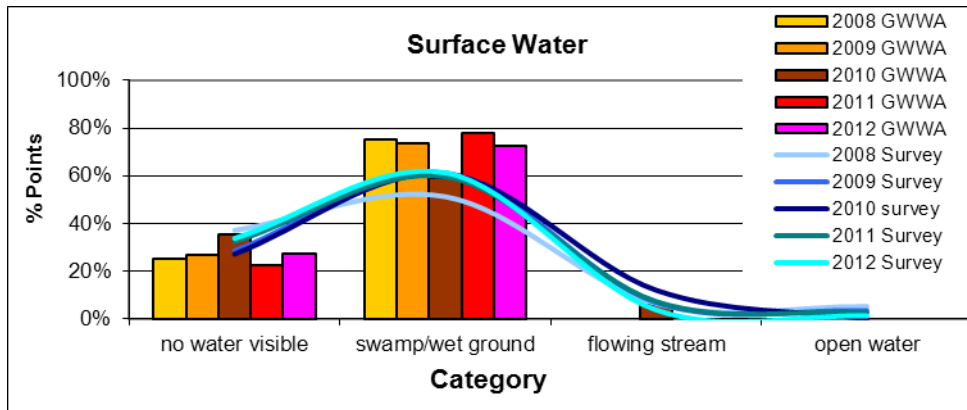




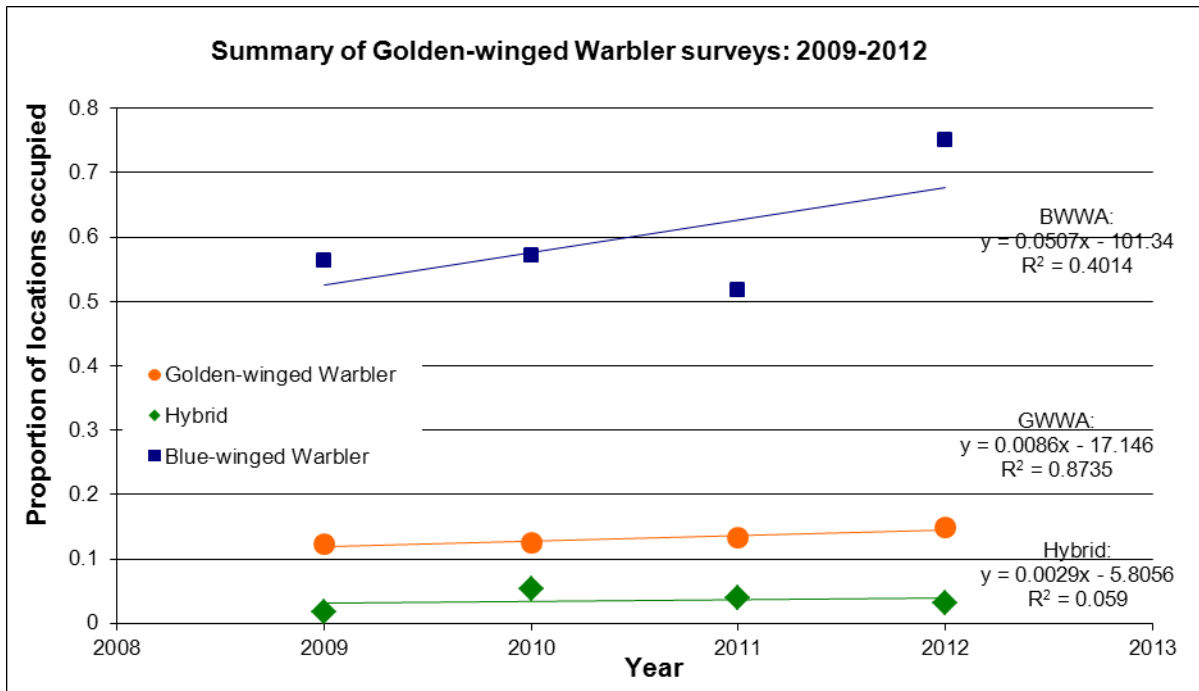
**Figure 2B-2.** Percent cover type used by golden-winged warblers (GWWA) vs. available (Survey) during the 2008, 2009, 2010, 2011, and 2012 surveys.



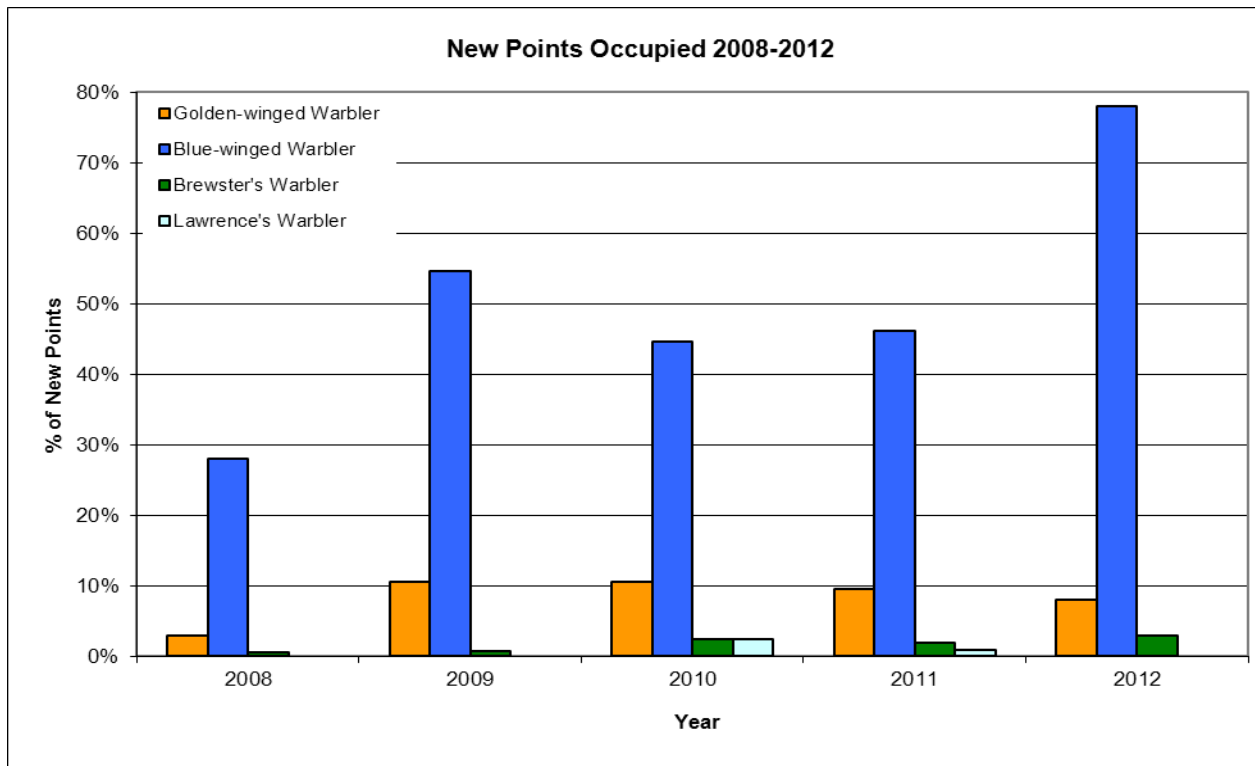
**Figure 2B-3.** Mean vegetation height in the area used by golden-winged warblers (GWWA) vs. available (Survey) during the 2008, 2009, 2010, 2011, and 2012 surveys.



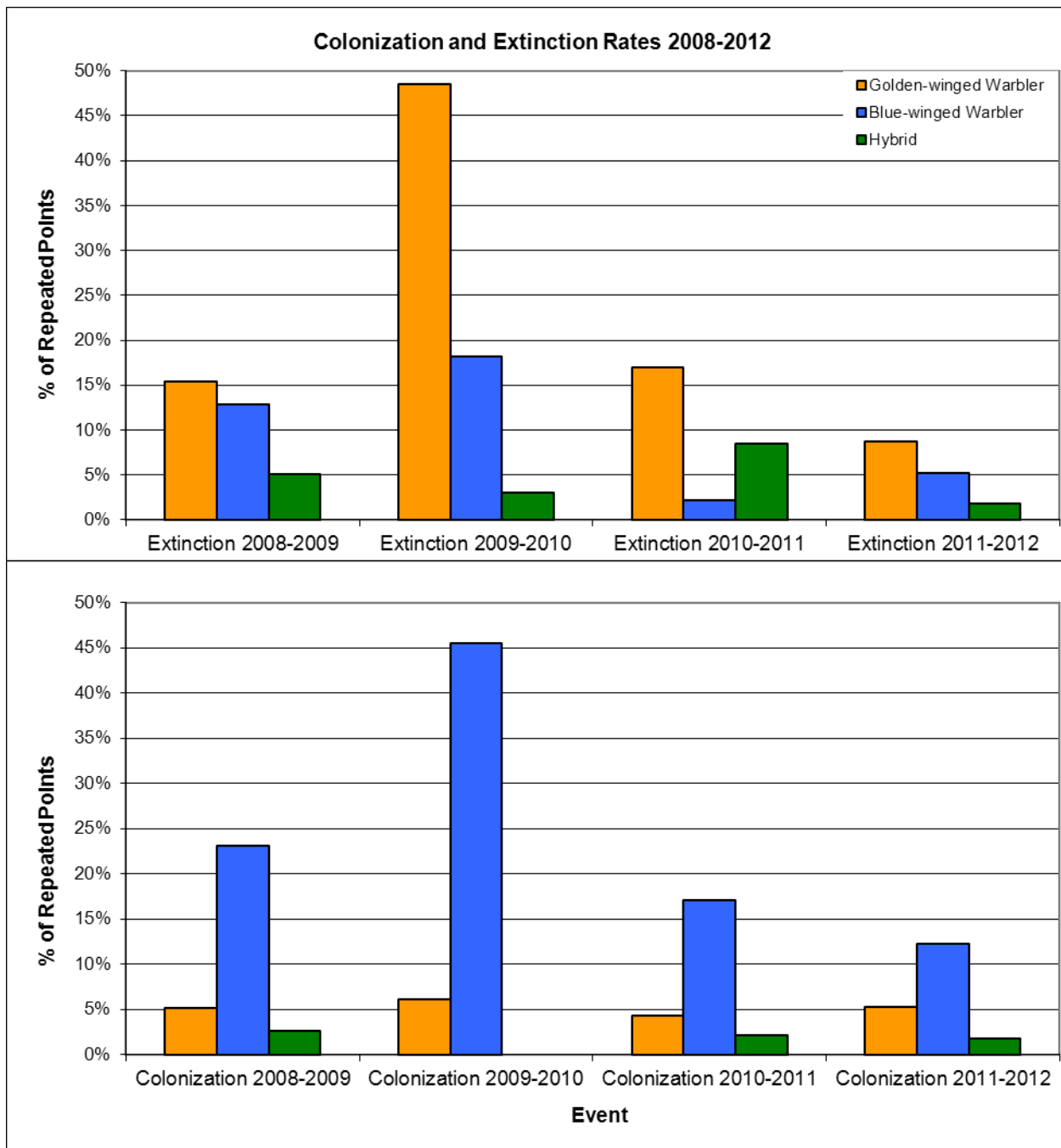
**Figure 2B-4.** Surface water observed in the area used by golden-winged warblers (GWWA) vs. available (Survey) during the 2008, 2009, 2010, 2011, and 2012 surveys.



**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), and 2012 (n=161) 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, blue-winged warblers, or hybrids during 2008 (n=405), 2009 (n=141), 2010 (n=85), 2011 (n=104), and 2012 (n=104) surveys.



**Figure 2B-7.** Percentage of golden-winged warblers, blue-winged warblers, and hybrids undergoing colonization or extinction events at each repeated survey location during 2008-2009 (n=39), 2009-2010 (n=33), 2010-2011 (n=47), and 2011-2012 (n=57) surveys.

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

<b>Species</b>	<b># Points Detected</b>	<b>Total # Species</b>
American redstart	2	3
American robin	1	1
Baltimore oriole	2	2
blackpoll warbler	2	2
brown-headed cowbird	3	3
cedar waxwing	1	1
chipping sparrow	1	1
common yellowthroat	1	1
eastern bluebird	3	3
eastern towhee	2	2
eastern wood pewee	2	2
field sparrow	1	1
great-crested flycatcher	2	2
indigo bunting	1	2
ovenbird	1	1
prairie warbler	3	4
red-eyed vireo	1	1
rose-breasted grosbeak	1	1
scarlet tanager	1	2
swamp sparrow	1	1
veery	1	1
white-breasted nuthatch	1	1
yellow warbler	1	1
yellow-rumped warbler	1	1
yellow-shafted flicker	1	1

Conclusions:

- While colonization of sites by golden-winged warblers has remained stable throughout the duration of these surveys, the number of extinctions of existing golden-winged warbler sites has been decreasing since 2009. This would explain a slight increase in number of male golden-winged warblers observed in 2012.
- Although habitat exists in NJ for golden-winged warblers and it appears the population has not significantly changed since 2008, the extinction rate of a point occupied in the previous year is still greater than the colonization rate of a point not occupied in the same previous year, where the inverse is true for blue-winged warblers.
- The number of hybrids is stable across years although no Lawrence’s warblers were observed in 2012.
- Utility ROWs still appear to be the preferred habitat for golden-winged warblers with a probability of occurrence ( $P_{occ}$ ) of 1.88 followed closely by wetland forests ( $P_{occ}=1.68$ ). Although more golden-winged warblers were observed in upland shrubby fields than any other habitat, the probability of occurrence is only 0.79, and shrub swamps were the least preferred ( $P_{occ}=0.35$ ).

Recommendations:

- Complete management recommendations for source golden-winged warbler habitat based on the analyses of 2003-2007 data and in coordination with the Golden-winged Warbler Working Group.
- 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.
- Continue to work with land managers to use the best methods for maintaining optimal golden-winged warbler habitat in areas where individuals have already nested without displacing those individuals by severely altering the habitat.
- Create a status assessment and draft species recovery plan for golden-winged warblers in NJ

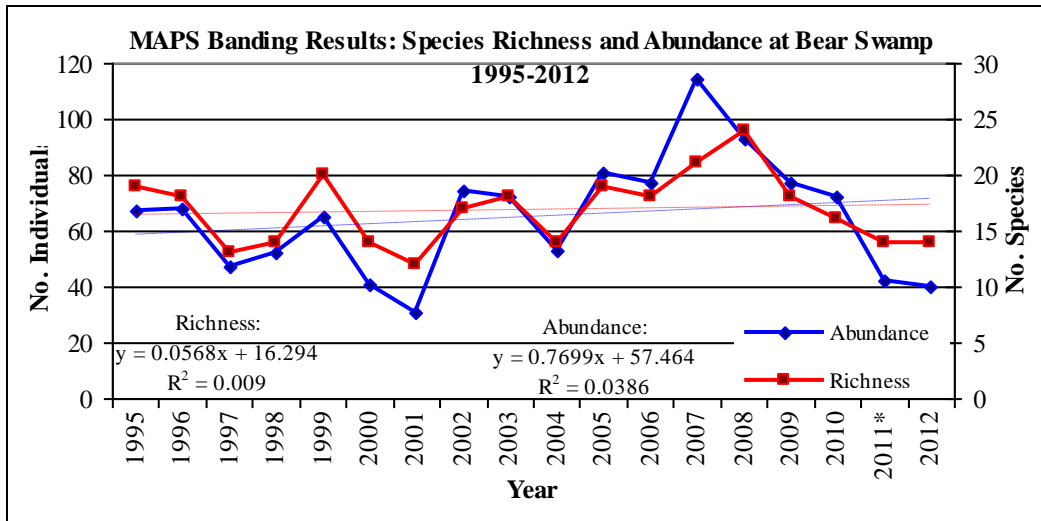
## **JOB 2C: Monitoring Avian Productivity and Survivorship (MAPS)**

Project leader: Sharon Petzinger, Senior Zoologist

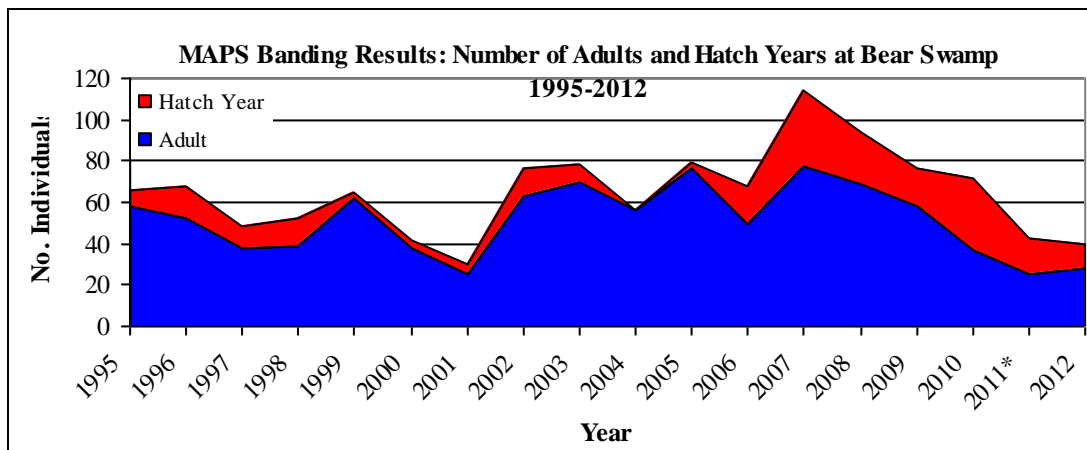
OBJECTIVE: To provide data to the Institute for Bird Populations that will help describe temporal and spatial patterns in the vital rates of target species. Identify causes of population declines, formulate strategies to reverse declines and maintain healthy populations, and evaluate effectiveness of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

### Key Findings:

- In 2012 two trained volunteers mist-netted in Bear Swamp, Cumberland County for approximately 450 net hours on eight different days from May through August. This is the 19<sup>th</sup> consecutive year of operation at this station.
  - Forty-seven individual birds of 14 different species were mist-netted, 32 of these were new captures (30 banded) and 15 were recaptures from previous years.
  - The majority of the birds netted were ovenbirds followed by tufted titmice, worm-eating warblers, and red-eyed vireos.
  - The mean species abundance in Bear Swamp from 1995–2012 was 69.26 ( $\pm$  6.84); mean species richness was 17.47 ( $\pm$  1.01) (Figure 2C-1).
  - Productivity in 2012 is the lowest since 2005 with 22% (12) of banded individuals hatch year birds (Figure 2C-2).
- According to the breeding bird survey trends in the Mid-Atlantic Coast, 2000-2010, populations of ovenbirds have been stable, tufted titmice, worm-eating warblers, and red-eyed vireos have been increasing, and wood thrush, Kentucky warblers and Carolina chickadees have been decreasing.
- Data have been submitted to the Institute of Bird Populations and the Bird Banding Lab and will be submitted for entry into NJ DEP's Biotics database by mid-November.



**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

**Conclusions:**

- Both species abundance and richness at Bear Swamp are on a downward trend and productivity is below the mean of the last 19 years. 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.
- Trends from the Breeding Bird Survey can partly explain the lower numbers of banded wood thrush and Kentucky warblers the last few years.

**Recommendations:**

- Due to budget constraints and a loss of trained volunteers, we do not recommend continuing this project in 2013 but will examine re-instating this project for 2014.

### **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

OBJECTIVE 1: Determine breeding population and reproductive success of American oystercatchers (*Haematopus palliatus*) that utilize beach strand habitat (i.e., Atlantic coastal beaches, inlet beaches, inlet sand islands).

#### Key Findings:

- American oystercatcher breeding surveys were conducted in 2012 at all Atlantic coast barrier island beach strand sites. Intensive surveys were completed in conjunction with piping plover and other beach nesting bird surveys. The Conserve Wildlife Foundation of New Jersey was the lead organization in monitoring and coordinating oystercatcher conservation statewide, but NJDFW-ENSP provided assistance in monitoring through its own seasonal technicians.
  - 86 nesting pairs were identified at 28 beach nesting sites.
    - A little under a half (43%) of the beach nesting pairs hatched young.
    - Productivity was 0.52 chicks fledged per beach nesting pair.
    - Flooding was the leading cause of nest failure.
- All nests were documented using GIS for incorporation into NJ DEP's Biotics database and ENSP's Landscape Project.

#### Conclusions:

- The number of breeding pairs of American oystercatcher (86) on barrier/beach strand (the beach nesting portion of the population) increased in 2012, compared to 2011 (79 pairs). This continued a recent upwards trend, although some of the rise in pairs can be attributed to an increase in survey intensity.
- Pair hatch success (43% of the pairs hatched young) for beach nesting American oystercatchers increased in 2012, compared to 2011 (32%), and was also well above the average for the period since 2003 when comprehensive monitoring began.
- Productivity for beach nesting American oystercatchers increased in 2012 (0.52 chicks fledged per pair), compared to 2011 (0.35 chicks fledged per pair). It was one of the highest levels for the period since 2003 when comprehensive monitoring began.

#### Recommendations:

- Continue to help monitor breeding population and productivity of beach nesting American oystercatchers on an annual basis.



- Continue implementing American oystercatchers management strategies (i.e. fencing and signage) at sites where other beach nesting birds (i.e., piping plover, least tern, black skimmers) are present.
- Continue to incorporate breeding data into Biotics and Landscape Project databases.

### **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 Morgantown, WV from August 6-8, 2012.
  - One biologist participated in discussions about Working Lands for Wildlife and impacts on golden-winged warbler management in this region
- Twenty-five out of twenty-eight routes were assigned in 2012 with 22 volunteers and 1 staff and 23 of those routes were surveyed. Three volunteers did not turn in data for 2012.
- Statisticians from Patuxent Wildlife Research Center were consulted on the feasibility of using observations of colonial waterbirds during the waterfowl breeding population to replace the colonial waterbird aerial surveys.
  - Staff from ENSP and BWM discussed the usefulness of the data received and the recommendations from statisticians about previous years' data and decided to phase out ENSP's participation with this survey
- Biologists from NJ DFW collaborated for the eighth year to conduct a joint waterfowl breeding population index (BPI) and endangered and threatened waterbird survey but reduced ENSP staff involvement by 1 biologist.
  - Four ENSP biologists spent about 17 days conducting surveys
  - Data from this survey were not summarized or analyzed because of the decision to phase out ENSP's participation in the survey

### **JOB 4: New Jersey Important Bird and Birding Areas (IBBA)**

Inactive

## EXECUTIVE SUMMARY

<b>Project:</b>	<b>Mammal Conservation</b>
Federal Aid Project:	T-1-6 (State Wildlife Grants)
Segment dates:	September 1, 2009 to August 31, 2010
Total Project Expenditures:	\$169,000 (\$109,850 Federal, \$59,150 State) ('11-'12 year only)

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### **JOB 1: Federal and State Listed Mammals**

**OBJECTIVE:** To conserve populations of federal and state-listed species through a coordinated approach of population and habitat monitoring, threat assessment, habitat protection and acquisition, management, research, education and environmental review.

#### **JOB 1A: Bobcat Conservation**

Project leader: Mick Valent, Principal Zoologist

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

#### Key Findings:

- A total of 30 trap/days resulted in the capture of one adult male bobcat using box traps baited with beaver carcasses. The adult male bobcat weighed 31 lbs. and was trapped on private property in Allamuchy Township, Warren County, NJ, on 3/7/12. The animal was chemically immobilized using a 10 mg/kg : 2 mg/kg dosage of Ketamine:Xylazine, and then fitted with a GPS/VHF collar (Advanced Telemetry Systems) for tracking. Field examination found the animal to be in excellent condition. The animal was held overnight for observation and released at the point of capture on 3/8/12. Biologists and volunteers continue to track this animal on a two week schedule. The collar is scheduled to drop off on 2/20/13.
- The adult female bobcat that was trapped on 2/13/11 in Allamuchy Township was captured in a trapper's snare and died on 1/19/12. The animal was recovered from the trapper and biologists collected the GPS collar, reproductive tract, a DNA sample (ear punch) and extracted a canine tooth for ageing. This was the first time a collared bobcat was captured by a licensed trapper.
- On 2/27/12 biologists used strut-mounted antennas attached to a Bell 206B JetRanger owned by the State of NJ Forest Fire Service in an attempt to locate the adult male bobcat that was trapped and collared on 2/18/11 at Picatinny Arsenal in Morris County. After several hours of flying transects around the capture location, biologists failed to find the signal from the collared cat. We suspect the collar failed during the previous months as several attempts to locate the animal using coordinated ground searches by several volunteers were unsuccessful. This represents the second (of 6) ATS G2110B collars that failed during a field application. Both collars apparently failed in the same manner as the VHF signal failed several months after field deployment.
- Biologists received four calls from licensed trappers who caught bobcats in legally set snares during the 2011/12 trapping season. Two of the snared bobcats died before they could be released. A female bobcat from Wantage Twp., Sussex Co. was snared around the waist and drowned. An adult male bobcat from Frelinghuysen Twp., Warren Co. was snared around the neck but died immediately after the snare was removed from the animal. Another adult male was snared around the neck at Picatinny Arsenal in Rockaway Twp., Morris Co. on 12/17/11. The animal was tranquilized and released from the snare. The animal was taken to a veterinarian for examination and was cleared for release on 1/8/12. An adult female from Frelinghuysen Twp., Warren Co., was snared around the neck and was

sedated and successfully released from the snare. The animal was taken to a veterinarian for examination and cleared for release on 12/22/11.

- A preliminary analysis of within home range habitat use continued. Staff consulted with a statistician at Rutgers University on data analysis. Once we have the data from a collar that is due to fall off on 2/21/13 and have generated the habitat variables, the statistician will assist with the analyses. Currently, satellite and GPS collar data (used locations) from 8 bobcats (4 males, 4 females) ranging across 2002 – 2011 are available (Fig. 1). All collar data will be compared to randomly generated points (unused locations) within each bobcat's home range (95% minimum convex polygon). Six hundred random points will be generated at least 60m away from any existing bobcat location within each home range. Location data from 2002-2004 and from 2005–2011 are being related to 2002 and 2007 land use land cover data, respectively. GIS layers will be generated (using ArcGIS 10 and Fragstats 4.0) for 16 habitat variables and will be statistically compared between used and unused locations (Table 1). Data layers and detailed documentation of methods are being prepared so that there will be a quick turn-around when the last collar data becomes available and when the dataset will be ready for analysis. The within home range analysis will inform a landscape level analysis aimed at updating the existing bobcat predictive habitat model developed in 2006.
- Preliminary review of the data indicate the following trends: there is a higher percentage of used locations closer to streams, wetlands, forests and farther from urban areas compared to unused locations. The distribution of collar locations suggests that high volume roads (>10,000 vehicles/day) may function as barriers to bobcat movements (Fig. 1).
- Habitat change analyses will not be completed until an updated landscape level predictive habitat model is produced.
- A draft bobcat habitat corridor model was produced to test GIS corridor modeling tools (Corridor Designer and Circuitscape) that have been developed in other states that have produced statewide connectivity maps. The bobcat corridors were developed using the bobcat predictive model built in 2006. Staff have developed a detailed work plan, but are still in the process of forming the connectivity mapping working group (T-11-9-2, Job 3F) that will be developing the statewide connectivity map.
- Staff monitored 3 structures under Route 23, a high volume road in northern NJ, using remotely triggered cameras. The road is slated for improvements by NJDOT and also intersects areas with high probability of bobcat use based on the 2006 predictive habitat model. Two structures are open-span bridges and the third is a round concrete culvert, approximately 3 ft in diameter (Fig. 2). The concrete culvert was used much more frequently and by many more species than either of the open span bridges (Table 2, Fig. 3). A bobcat was documented using one of the open-span bridges.
- The dog-handler team, cameras, and collar data were not used to help validate the bobcat corridor mapping. These tools will be used once an updated predictive habitat model has been incorporated into the corridor modeling effort.
- Bobcat observation data from the public as well as from scat data collected by the dog-handler team in 2011 (n=72) have been entered into the Biotics database in time to be incorporated into Species Occurrence Areas, Version 8 (SOA\_8). Species Occurrence Areas are species-specific polygons associated with a known species location (point). SOAs are applied to all species locations used in developing the Landscape Project Maps. SOAs depict the amount of area that a particular species is presumed to occupy on the landscape and is based on home range or territory size taken from the literature or from ENSP research.
- A status assessment and recovery plan have not been completed for bobcats because vital baseline data are still being gathered and analyzed that will inform both the assessment and recovery plan. The baseline data include the results of the regional genetic variability study and both the updated landscape level predictive model and bobcat corridor model that will assess distribution of habitat and habitat change over time as well as the distribution of remaining protected, suitable areas for bobcats in northern New Jersey. In addition, the sex ratio, population size, and survival rate estimates from

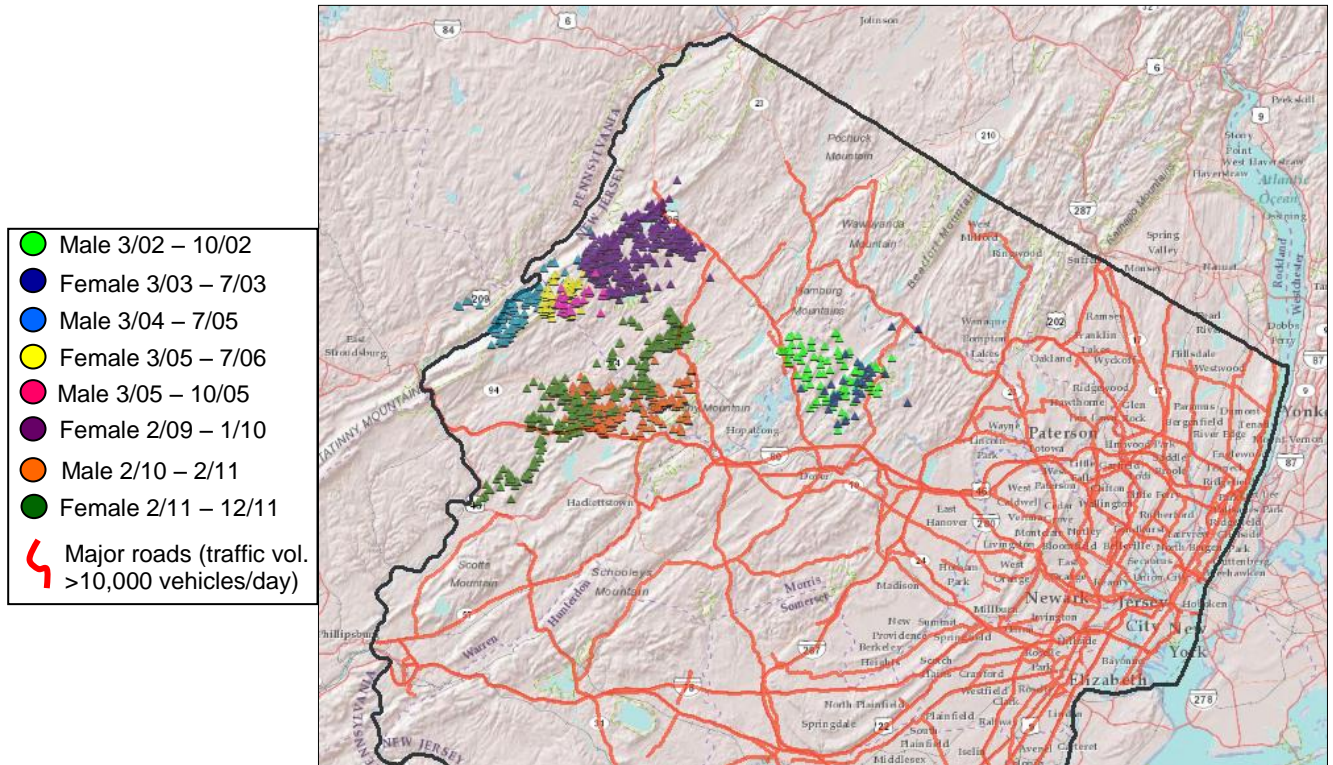
the capture-recapture model as well as the age structure, and fecundity, and pregnancy rate estimates from the tooth and reproductive tract analyses, respectively, will be crucial information to incorporate into the status assessment and recovery plan.

#### Conclusions:

- The within home range habitat analysis will be conducted once the final GPS collar data is available in early 2013. At that time, the final habitat variables related to the collar data will be generated and added to the existing dataset. ENSP biologists will work with the statistician at Rutgers U. to complete the analysis, taking into account factors such as sex, seasonality, and varying buffer sizes. The trends observed in the dataset to date agree with what has been reported in the literature and support field observations by staff biologists.
- The corridor modeling tools were successfully used for bobcats during a test run.
- Monitoring of 3 structures under a high volume road in northern NJ with remotely triggered cameras resulted in the first documented evidence of a bobcat using an existing structure under a high volume road in New Jersey. This will help biologists make recommendations to NJDOT regarding wildlife/road mitigation measures as they plan road improvements along this section of roadway. The data thus far suggest that the most frequent and species diverse use of a manmade structure occurred at a relatively small, round concrete culvert as opposed to the open span bridges that were also monitored. The results emphasize the need to strongly consider location, surrounding landscape context and future development patterns when evaluating the suitability of structures for wildlife passage.
- Much more extensive culvert monitoring will be conducted when the habitat connectivity mapping is complete and the culvert inventory protocol is finalized.

#### Recommendations:

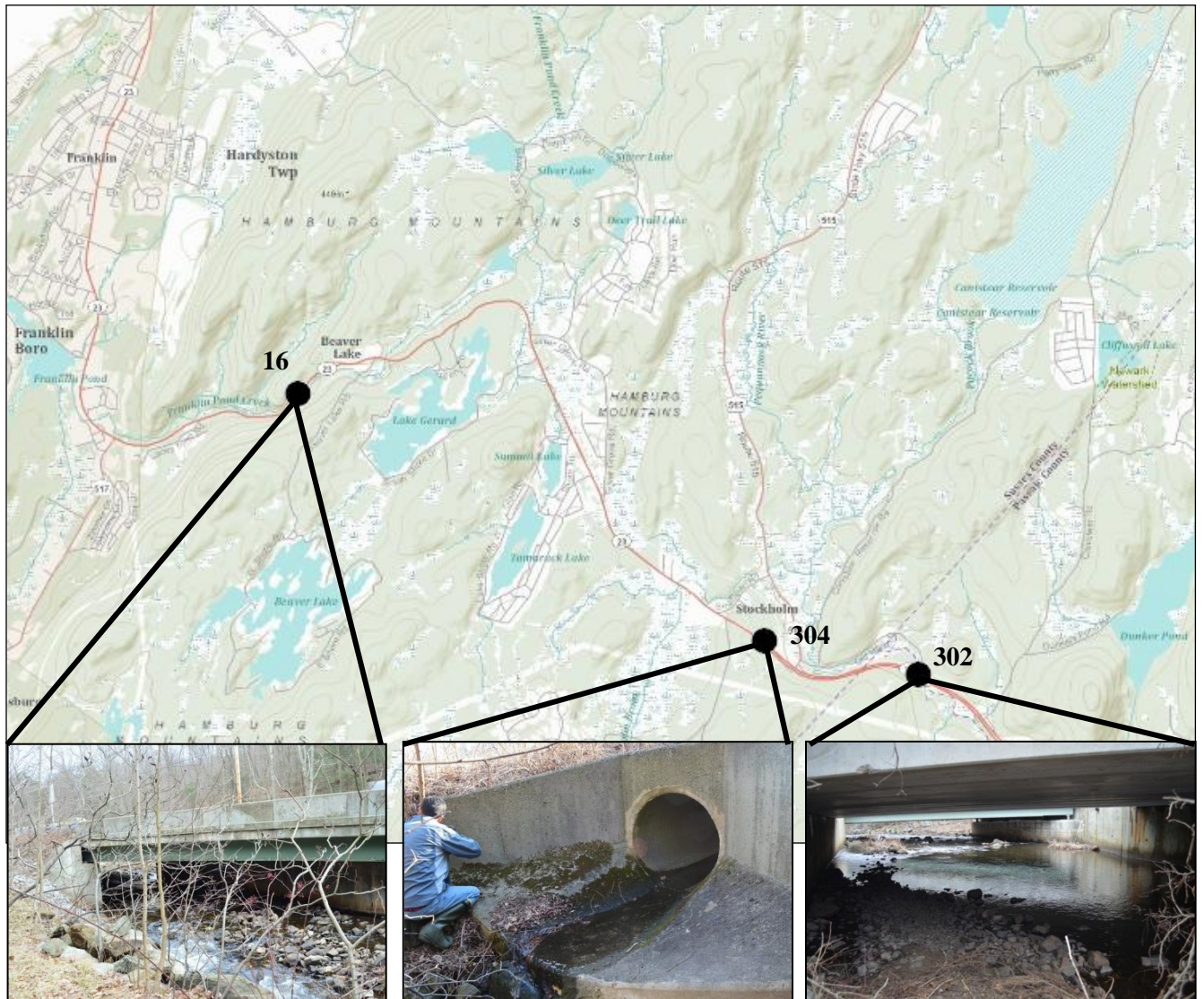
- Complete the within home range habitat analysis and produce predictive habitat model at the within home range scale if the classification accuracy is adequate.
- Compare habitat use by each bobcat, by sex, and season.
- Use the results to inform landscape level analysis to build an updated predictive habitat model using scat data collected in 2007, 2008 and 2011.
- Use the updated landscape level predictive habitat map to feed into the bobcat corridor modeling effort either as part of the statewide connectivity mapping project if bobcat is chosen as a focal species or independently if it is not a chosen focal species.
- Continue monitoring the structures under Route 23 to assess existing suitability of crossing structures for bobcats and other species. When finalized, assess the three structures currently being monitored using the culvert inventory protocol being developed by the Roads and Wildlife Working Group (t-11-9-2, Job 3A). Begin monitoring other existing structures using the culvert inventory protocol in areas where the updated bobcat corridor model intersects roads. Document culvert/structure use and suitability in those areas and make recommendations designed to increase road permeability for bobcats.
- Use the dog-handler team, cameras, and collar data to help validate bobcat corridor mapping when it is complete.
- Continue to update the Biotics database with data collected by the public and staff survey efforts.
- Develop a status assessment and recovery plan for bobcats in New Jersey, once the habitat, genetic, and demographic information have all been gathered and analyzed.



**Figure 1.** Distribution of bobcat satellite and gps data from 8 collared bobcats in northwestern New Jersey between 2002 and 2011.

**Table 1.** Habitat variables being developed and that will be compared between used and used locations of bobcats within 9 home ranges in northwestern New Jersey. Density and diversity index values are being calculated based on 50m, 100m and 250m radii from the location point.

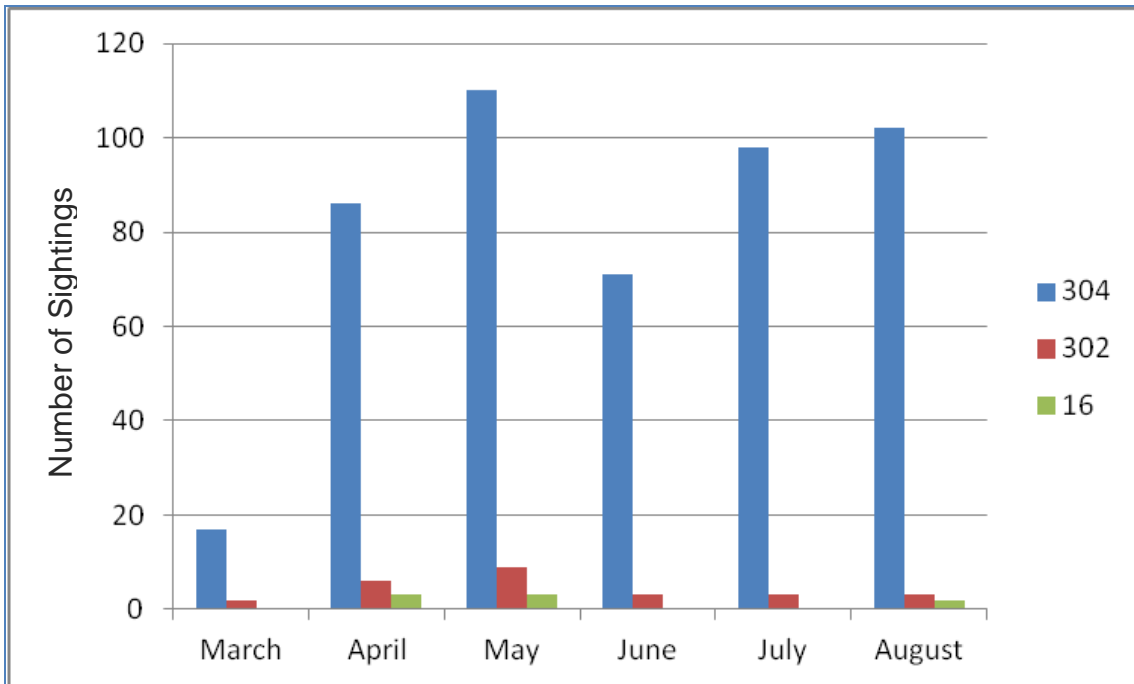
Variables
Distance to all roads
Distance to high volume roads
Road (all) density
Distance to streams
Stream density
Topographic position diversity index
Distance to stony soils
Stony soils density
Forest/Agriculture/Wetlands diversity index
Forest/Wetlands diversity index
Urban density
Distance to urban
Forest density
Distance to forest
Distance to wetlands
Agriculture edge density



**Figure 2.** Locations of three structures monitored with remotely triggered cameras between March 9 and August 31, 2012, under Route 23 in northwestern New Jersey.

**Table 2.** Species captured by remotely triggered cameras at three structures under Route 23 in northwestern New Jersey between March 9 and August 31, 2012.

Species	304	302	16
Black bear	x	x	
Bobcat		x	
Domestic cat	x		
Great blue heron		x	x
Groundhog	x		
Long tailed weasel	x		
Opossum	x		
Porcupine	x		
Rabbit	x		
Raccoon	x	x	
Red fox	x		
Squirrel	x		
White-tailed deer			x



**Figure 3.** Number of sightings of wildlife at each of three structures monitored with remotely triggered cameras between March 9 and August 31, 2012 under Route 23 in northwestern New Jersey.

## **JOB 1B: Allegheny Woodrat Conservation**

Project Leader: Mick Valent, Principal Zoologist

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

### Key Findings:

- Standard trapping protocol was conducted at six separate talus slope sites at the base of the Palisades Interstate Park on September 26 and 27, 2011. Tomahawk TM Model 201 (5"x5"x16") Collapsible and Standard Single-door Live Traps were used for sampling. The traps were baited with apple slices and peanut butter.
- Forty traps were set for two consecutive days for a total of 80 trap-nights of sampling effort.
- Trapping success in 2011 remained the same as in 2010 with the capture of 16 unique individuals. Woodrat numbers (based on capture index) had been declining at the Palisades site from 2006 to 2009 but then began a gradual increase in 2010. The capture index (# of individuals captured/10 trap nights) in 2011 remained at 2.0 for the second consecutive year.
  - Captured animals consisted of five adult males, four adult females, one sub-adult male, four sub-adult females, one juvenile male and one juvenile female.
  - Three males were recaptures from 2010.
  - One female was recaptured from 2009.
    - No movement information could be obtained because ear tags were not used in 2010 as an ear punch from each ear was collected for genetic analyses. Therefore, individual animals could not be identified.
- All captured animals were held for several minutes prior to their release to determine if they exhibited any symptoms of infection by *B. procyonis*. None of the captured animals exhibited any signs of infection by *B. procyonis*. All animals were sexed and weighed at the point of capture. In addition, a 2 mm tissue punch was used to collect two tissue samples (one from each ear) from each animal for genetic testing. All animals were released at the site of capture.
- Due to the downward trend in the population over the past few years, piperazine-treated fishmeal/polymer baits were again distributed in the areas surrounding the active woodrat sites in an effort to interrupt egg shedding by infected raccoons. To reduce access to the baits by non-target animals, the baits were dispensed via PVC bait dispensers that were developed by researchers to dispense rabies vaccine to raccoons in suburban areas (Boullanger et al. 2006). Treated baits were placed into each of 6 PVC bait dispensers (approx. 40 baits per dispenser) during the spring (4/12/11). Motion sensitive cameras were used to monitor PVC bait dispensers to determine what species were taking the baits. Raccoon was the only species documented consuming the baits at all stations while the cameras were employed. As many as four individuals were documented at a bait station at one time. The bait dispensers present a far less labor intensive approach to distributing baits and they are inexpensive, portable, weather-resistant and effective at reducing bait consumption by non-target animals.
- Supplemental feeding was conducted at several locations within the Palisades woodrat site for the third consecutive year. Flags marking successful trap locations were left in place at the site and mast was distributed at the flagged locations. Approximately 40 gallons of hard mast was distributed throughout the sites. Very little information exists in the literature regarding the effectiveness of supplemental feeding on Allegheny woodrat populations. However, mast was placed on wooden trays in the talus where woodrats were captured and monitored with motion-sensitive cameras to determine which species were consuming the mast. Woodrats were documented feeding at all of the monitored trays. Only one squirrel was documented feeding at one of the monitored trays.



- No raccoon scat searches were conducted at the Palisades during the project year. Past scat collection and testing has confirmed the presence of *B. procyonis* at the site. The use of anthelmintic-treated baits is being used to control the *B. procyonis* egg loads in raccoon scat.

#### Conclusions:

- Allegheny woodrat numbers remained the same for two consecutive years after four years of decline (based on our capture index).
- We are currently waiting for the results of the second year of genetic sampling but fully expect it to support the preliminary results (Smyser 2009) that the Palisades woodrat population is suffering from inbreeding depression. The Palisades population is totally isolated from any other extant population of Allegheny woodrats.
- Four individuals were recaptured from previous years, suggesting that at least some adult animals within the population are surviving and not succumbing to *B. procyonis* infection. Additionally, none of the captured animals exhibited any symptoms of infection by *B. procyonis*.

#### Recommendations:

- Research (McGowan 1993, LoGuidice 2000) suggests that *B. procyonis* infection in Allegheny woodrat populations is a serious mortality factor and can result in rapid population declines for the intermediate host. Therefore, woodrat/raccoon population monitoring at the Palisades Interstate Park site should continue. Periodic searches for raccoon evidence should continue and should include scat analysis for *B. procyonis* egg prevalence.
- The number of raccoons documented at feeding stations by motion-sensitive cameras again suggests that a healthy raccoon population exists at the Palisades. In 2008 we documented a decline in the percentage of raccoon scats that tested positive for *B. procyonis* eggs after putting out treated baits. This suggested that treatment of the population with medicated baits can successfully reduce *B. procyonis* egg loads in the environment. Therefore, it is recommended that fishmeal/polymer baits, treated with the anthelmintic drug piperazine, be distributed at regularly scheduled time intervals throughout the year in an effort to interrupt the egg-shedding cycle. The use of polyvinyl chloride bait stations will replace broadcast baiting as they have been documented to be more effective at targeting the raccoon population. Piperazine was chosen as the treatment drug due to its high efficacy in clearing roundworms and its low toxicity (LoGuidice 2000). However, we plan to alternate the use of piperazine and pyrantel pamoate so that we don't develop anthelmintic-resistant *B. procyonis*.
- Preliminary genetic testing has indicated that inbreeding depression is a serious threat to the population; therefore, we will continue to conduct non-invasive genetic sampling to gain a better understanding of the genetic health of the Palisades woodrat population and to support possible management actions to remedy the problem.
- We will continue to consult with other experts in the field to determine the appropriate next steps to take to improve the health of the woodrat population at the Palisades.

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### **JOB 1C: Small Mammal Survey**

Project leader: Mick Valent, Principal Zoologist

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

#### Key Findings:

- Five different habitat types were selected for sampling small mammals in northwestern New Jersey: open field; shrub-land; upland forest; wet lowland forest; and a riparian habitat with an emergent wetland. All sampling sites were within the boundaries of Stokes State Forest in Sussex County within the Upper Delaware River Valley and Kittatinny Ridge Conservation zones as defined in the NJ Wildlife Action Plan.
- Vegetation sampling was conducted along a 100-meter transect running through the center of each site. Starting at the center of the site, a random table of compass bearings was used to orient the transect. The transect was laid down 50 meters in each direction from the center point along this bearing. At 10-meter intervals along this transect, all trees and shrubs were identified that were within a 5 meter radius of each sampling point. In addition, a 2.5-meter long rope was used to create a circle 5 meters in diameter, within which all vegetation in the herb layer was identified. Within each of these circular sampling plots along the transect, species were identified and assigned to a vegetative layer (canopy, sub-canopy or herb), and their abundance recorded. For trees (canopy) and shrubs (sub-canopy), the number of each species at all sampling points was pooled and reported as a percentage of the total number of species recorded in each of those layers, except for site 1. On site 1 (shrub land habitat), all the shrubs present on the 5 acre site were recorded and reported here as a percentage of all shrubs. Since individuals within each species were difficult to count in the herb layer (especially on sites 1, 2 and 5), the abundance of species in this layer was recorded as a percent of the total area they covered on each 5-meter circular sampling plot. The numbers were then pooled across all sampling plots within each site and reported as a percent.
- All study sites were sampled using both a pitfall array and a live trapping grid. The pitfall array consisted of 16 pitfalls 3 meters apart connected in a “Y” pattern by drift fencing. Individual pitfalls were 8 inches deep, 8.25 inches in diameter, made of plastic and fitted with a lid. The plastic containers were placed in holes that were dug deep enough so that the rim of the container was at ground level. Plastic fabric drift fencing was then used to connect the pitfalls by staking the fencing so that it bisected each pitfall. The live-trapping grid consisted of 25 Sherman mouse-size live traps (SNA or SNG folding 2x2.5x6.5” or 3x3.5x9”) arranged in a 5x5 grid with traps placed at ten-meter intervals. Sampling at each of the five sites was conducted for ten consecutive days from May 7 to May 16, 2012, for a total of 410 trap-nights on each site or 2,050 trap-night on all sites. On the morning of day one, pitfall covers were removed and live traps were armed and baited with apple. All traps at each site were checked each day and the mammalian species collected were identified, weighed, aged (pelage characteristics), sexed (where possible) and the data entered directly into an Excel spreadsheet using a laptop computer. In addition, obvious reproductive attributes were noted (e.g., lactation, pregnancy, and testicular position). Mammals that were found alive in the traps (n=44) were marked (toe clipped) and released at the location of capture after processing. All others (those found dead in the traps, n=169) were individually cataloged and frozen.
- Two-hundred thirteen (213) animals representing 9 species were captured over the 10-day trapping period across all sites. The species captured (in descending order of abundance) included: *Microtus pinetorum*, *Sorex cinereus*, *Peromyscus leucopus*, *Clethrionomys gapperi*, *Blarina brevicauda*, *Microtus pennsylvanicus*, *Condylura cristata*, *Tamias striatus* and *Zapus hudsonius*. None of the species captured are considered rare in the state.
- Pitfalls captured 8 of the 9 species captured during the study (89%), whereas live traps captured 7 of the 9 species (78%). Only *Tamias striatus* was missing from the pitfall trapping effort, probably due to its ability to leap out of the trap. Live traps missed both *Condylura cristata* and *Zapus hudsonius*. Pitfalls captured nearly

three times the number of animals that live traps caught, even though the number of trap nights for pitfalls (800) was significantly less than the number for live traps (1250).

- The lowland wet forest had the most captures with 60. The wetland/riparian site was the most productive with 8 of the 9 species being captured in that habitat type. *Sorex cinereus* was the most abundant species captured in each of the sampled habitat types.
- Eight of the 9 total species captured during the study were represented in the sample taken on the very first day. Only *Tamias striatus* eluded the traps until day 4.

#### Conclusions:

- Eight of the 9 species captured during the study were represented in the sample taken on the very first day. However, some of the less common species that have been trapped in the past (by the author and others) did not show up in this study. Most notably, *Sorex hoyi*, *Sorex dispar* and *Napaeozapus insignis* were absent from the sample.
- Pitfall trapping appears to be superior to live trapping in sampling small mammals, both in number of individuals captured and species diversity. Pitfalls captured more species and many more individuals, despite representing less than 40% of the total trap nights. The effectiveness of pitfall trapping in taking low weight individuals is a prime reason - live traps are notorious for excluding low body-weight animal, presumably due to the limitations of the triggering mechanism of the trap. The drift fencing that ties together all of the pitfalls in an array is apparently very effective in funneling animals into the traps. In addition, it's not surprising that pitfall arrays would be more effective in capturing shrews and voles based on the feeding strategies and ranging patterns of these animals.
- Despite the relatively low productivity of live trapping, live traps are still useful in sampling studies. One obvious advantage of live trapping is the ability to locate traps in specific microhabitats that are likely to yield captures of target species (e.g., in runways, at tunnel entrances, etc.). Another advantage is that live traps can be placed in areas not conducive to pitfall trapping (e.g., in boulder fields).
- The combination of pitfall arrays and live trapping grids appears to be an effective method for sampling small mammals in New Jersey.

#### Recommendations:

- Since 8 of the 9 species represented in this study were captured on the first day of trapping, perhaps a shorter sampling period could be justified. However, 10 days of sampling helped to establish relative abundances on each site. If this information is not needed a shorter sampling period may be adequate to determine presence/absence.
- Given the large number of species (11 of 39) that received an "Undetermined" status in the recently completed status review of the terrestrial nongame mammals, further sampling is needed across the state to gain a better understanding of the range and abundance of these species. Once adequate data for these species is available we can assign an appropriate status for each.
- Continue to conduct small mammal sampling across the state in representative habitats to gather data on species occurrence and relative abundance, especially for those species that were assigned an "Undetermined" status in the recent Delphi Status Review of terrestrial nongame mammals.
- Continue to gather data that will enable us to develop models that predict the distribution and abundance of small mammal species, or suites of species, over the broader region. These models would be useful in targeting areas for small mammal surveys.

### **JOB 2A: Bat Conservation and Management – Inactive due to other funding**

### **JOB 3. Pinniped Research and Conservation - Inactive**

## EXECUTIVE SUMMARY

<b>Project:</b>	<b>Reptile and Amphibian Conservation</b>
Federal Aid Project:	T-1-6 (State Wildlife Grants)
Segment dates:	September 1, 2009 to August 31, 2010
Total Project Expenditures:	\$319,000 (\$207,350 Federal, \$111,650 State) ('11-12 year only)

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### **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:

- During the 2011-2012 season, ENSP volunteers were assigned 46 sites for turtle surveys, which included 7 wetlands of suitable habitat only. The majority of the field work this past field season was performed by volunteers and volunteers detected turtles from at least 12 of the sites, all where turtles had previously been documented. As of the drafting of this report, many volunteers have yet to submit their raw data and therefore we can only report on findings received to date.
  - During this effort at least 30 bog turtles were captured at 12 sites by volunteers.
    - At one site in Salem County, the only 2 turtles found were both dead. There was not enough flesh on the animals to send in for necropsy. It has been 3 years since a live turtle was found at this location.
    - As part of this volunteer effort, no new sites were discovered.
- ENSP staff time on this project was primarily spent coordinating site access to private lands for the volunteers, reviewing Scientific Collecting Permits, and assigning notch sequences. In addition, time was spent field training additional ENSP and CWF staff.
- ENSP coordinated with NJDEP Land Management staff on managing two bog turtle properties on state land. Land Management staff arranged for hydroaxing the uplands of one site in preparation for a new fence. This preparatory work was completed in December of 2011 and the new fence was installed later that winter. At the second site, we developed a study and management plan along with researchers from Hofstra University. During the 2013 field season, up to 5 bog turtles will be radio-tracked by Hofstra students, and then Lands Management will develop a contract for habitat restoration of encroaching *Alnus* sp. Hofstra researchers will then radio-track the same turtles in the 2014 field season to record responses to the woody vegetation work.
- No sites were monitored exclusively for determining use of habitat post-restoration.
- No surveys were done this reporting period with the dog-handler team.
- Only one nest was protected using fencing. At one site, a nest with 3 eggs was found on 6/19 and we put up a predator exclusion fence around it on 7/2. The eggs were observed at this nest as recently as 8/7. A second nest at the same location was found on 7/30, where one egg had fallen out of the cavity and at least one other was still in the cavity. Staff went to erect fencing around the second nest on 8/9 and all eggs were missing from both nests. It was surmised that small mammals scent-detected the eggs from nearly 1m away and removed the eggs by climbing over 6-8 inches of small-gauge mesh and then carried each individual egg out via the same or similar route. There

was no indication of tunneling beneath the nest cavity and there were no discernible mammalian footprints within the enclosure. It's also possible that eggs were removed under the fencing, but fencing was countersunk up to 6in around and no tunnels or gaps were identified. There was no cover atop the enclosure so the possibility also exists that a bird took the eggs or perhaps a snake crawled through the fencing.

- A memo and site description package was created for state and federal law enforcement cataloging anecdotal and known occurrences of illegal collection or trespass in bog turtle wetlands and shared in the fall, 2011. No additional follow-up was made with law enforcement.
- In the fall of 2011, ENSP staff attended a bog turtle workshop to discuss next steps related to bog turtle recovery planning. In July 2012 ENSP staff attended the NEPARC conference, and in August 2012 ENSP staff presented on northern population bog turtle recovery at the Turtle Survival Alliance conference.

#### CONCLUSIONS:

- A number of wetlands feature habitat suitable for bog turtle, but survey efforts (often minimal) have not revealed turtle presence this past season using volunteers. Presence, particularly at low/unknown density sites, is often not achieved in a single visit. As more of the top-tier bog turtle sites are secured and maintained through restoration, habitats exhibiting “suitable habitat with some improvement” or “highly suitable” will be targeted for survey and/or trapping.
- The volunteer surveyors assigned to the higher density bog turtle sites have continued to produce reliable data that will be used to estimate population by site. ENSP gains from the relationship by receiving data on several of the top tier sites in the state while the volunteer surveyors gain experience with the species allowing them to apply for or remain on the New Jersey Recognized, Qualified Bog Turtle Surveyors list.
- Fencing to protect bog turtle nests must consider the kinds of predators that may take eggs and be designed to address those threats. Given my work with a scent-detection dog and bog turtles, I remain skeptical that a small mammal was responsible for the missing eggs at one site, but perhaps I do not give enough credit to the small mammal.

#### RECOMMENDATIONS:

- Assess volunteer surveyor dataset for use in preliminary population estimate. This was planned for the winter of 2011/2012, but was not completed.
- Prepare better fencing for protecting bog turtle nests. Use small mesh sized materials with a top and countersink well into muck surrounding the nest. Preferably maintain a buffer from nest center to fence edge of 1-meter or greater to minimize scent detection by potential predators.

#### **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:

2011 Fall Surveys

- ENSP staff conducted visual surveys along 14 stream segments in Sussex, Warren, Morris, Hunterdon, Somerset, and Mercer counties.

- Ten of the segments were selected because they were proximate to occurrences over that were at least 15 years old. Survey goals were to assess habitat suitability and add occurrence data to these areas with limited observations and “historic” data.
- Four of the segments were known reference sites and surveys were conducted here to determine current activity ranges of local populations before visiting low density sites.
- Four of the segments (one reference) were also surveyed using a scent detection dog to start training him on detecting wood turtles. The dog was taught to alert to each turtle found by other surveyors.
- Only two turtles were captured at two different segments in Sussex County. Both captures were of previously unmarked/notched adult turtles. One of the new captures was at a reference site where the scent detection dog was being trained.

#### 2012 Spring Surveys

- Due to staff limitations no spring surveys were conducted. In lieu of spring surveys, coordination began with Mike Jones from the University of Massachusetts, Amherst, on implementing the RCN project for wood turtle population assessment. ENSP staff began reaching out to prospective project volunteers and developing a GIS methodology for randomized stream segment selection. This work will set the stage for fall 2012 project implementation.

#### Additional Actions

- No work began on a species status assessment or recovery plan. Development of these products will begin after the analysis of the completed RCN wood turtle project is complete.
- The project related to artificial nest mounds was completed during the last segment and there are currently no plans to continue this work. ENSP continues to coordinate with the Great Swamp NWR staff on their artificial nest mound project. A semi-permanent predator excluder was not installed around a nest mound as proposed in the last report. Volunteers at the property were given new priorities. It is unknown at this time if that project will continue.
- Population structure and trend work will be aligned with RCN wood turtle surveys at reference populations. The RCN surveys will begin in fall 2012.

#### Conclusions:

- Wood turtles continue to be documented in locations where records were  $\geq 15$  years old, but limited data exists on the viability of both the local- and meta-populations throughout their strongholds. It has been encouraging to see younger age classes and gravid females at several of the surveyed transects, but additional studies will be needed to assess the survivorship of the juveniles or nests.
- As with many secretive and cryptic species, multiple surveys per site may be necessary to confirm presence.

#### Recommendations:

- Continue to implement the regional wood turtle RCN project. Results from this study will help inform the development of a New Jersey specific status assessment. Results will also inform whether the proposed survey methodology can be used to detect trends in population structure and/or size.
- Identify local populations where augmentation through nest creation and/or protection may benefit wood turtle recovery or long-term stability. Areas where adult and juvenile mortality are above average are not strong candidates for augmentation at the nesting stage.

## **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:

#### STATEWIDE

- During this reporting period 154 rattlesnake sightings were entered into NJ DEP's Biotics database (Biotics), 54 of which were reported by State-approved venomous snake monitors working on a large project site in Northern New Jersey. An additional 16 rattlesnake sightings were entered into ENSP's tracking database (preliminary database used prior to entry into the Biotics database) and will be reviewed by ENSP staff over the next year for entry into the Biotics database.
- The Biotics database continues to be updated with sighting records for timber rattlesnakes and this information will ultimately make its way into the Landscape Project mapping.
- No radio transmitters were implanted in or attached to timber rattlesnakes in 2012. All observations could be connected to currently documented dens or were random observations reported by citizens.
- No further work has been conducted on the rattlesnakes' status assessment (which would contribute to the development of a recovery plan) due to staff time constraints and priorities including an unexpected and inordinate amount of time reviewing and providing technical assistance on 2 projects related to utilities and rights-of-way proposed through the State permit process. This activity is reported on in more detail under the "Technical Assistance" SWG Job, but the unexpected workload detracted from this project.

#### PINELANDS REGION

- ENSP partnered with NJ Conservation Foundation (NJCF) to identify timber rattlesnake critical habitats in the Pinelands during this year.
- Venomous Snake Response Team:
  - Staff made an extensive effort (i.e., outreach) to identify and recruit new members for the Venomous Snake Response Team; many of whom are local animal control officers and park staff. Trainings will be held in September 2012.
  - Of the 7 active members of the Venomous Snake Response Team (excluding federal personnel) in the southern region, only 1 submitted an official timesheet reporting their 2012 response activity in time for this report. No volunteers reported responding to timber rattlesnake complaints on private lands although one ENSP biologist responded to two confirmed rattlesnake complaints.

#### HIGHLANDS REGION & KITTATINNY RIDGE

- Habitat Restoration component: Unexpected financial support from mitigation funds covered ENSP staff time to create/restore and assess potential timber rattlesnake basking habitats. However, materials (cameras, reusable batteries, chargers, memory cards, memory card reader) were purchased with SWG funds. After beginning to identify potential sites for management in 2011, ENSP biologist saw the need to better understand the equipment capabilities used to monitor project success prior to conducting habitat management. As such, 2012 efforts focused on testing the equipment.
  - Three Bushnell Trophy cameras and 1 Reconyx PC800 camera were tested during the spring of 2012 to determine functionality of each camera, identify possible malfunctions or shortcomings

- and test which model meets the needs of the study. In addition, different batteries were tested including nickel metal hydride, Energizer alkaline and Energizer lithium.
- Regardless of the batteries, the Bushnell Trophy cameras repeatedly failed in some way (either flash failure or failed to take pictures) while the Reconyx PC800 was successful.
  - Communication with the distributor resulted in receiving one newer Bushnell model for testing. Upon the results, ENSP will either exchange all Bushnell Trophy cameras for the financial equivalent of Reconyx PC800 or the newer Bushnell model.
  - The average number of photos reviewed (for Bushnell) was 5,900-7,000 photos and required approximately 1.5-2.5 hours to review. For Reconyx, the average photos reviewed was 13,894 and took approximately 2.3 hours to review.
  - Approximately 258.6 hours were required to complete 12 weeks of survey effort with four active cameras at three sites (~ 21 hours/week). This time includes weekly manual surveys (5%), reviewing memory cards (27%), exchange of memory cards and batteries, discharging and recharging batteries, and downloading data. The remaining 68% of time was incurred traveling to/from sites and miscellaneous related activities that were not recorded.
  - No additional prospective sites were identified due to staff constraints (ENSP seasonal employee left in June, ENSP biologist was unable to conduct field work for medical reasons).
- Radio-telemetry:
    - Picatinny Arsenal (CH1107; post-partum female): ENSP biologist tracked a post-partum female twice in September 2011; she was moving in a northeasterly trajectory along the same slope as the birthing site. By 06 September 2011, she had moved approximately 115 m northeast. By 09 September, her signal was coming from a dense greenbrier patch approximately 45 m downslope of the previous observation. On 13 September, since the signal was still coming from the greenbrier patch, ENSP biologist carefully searched the area and located the external transmitter in the dense greenbrier. Given the density of the greenbrier patch, it appears the female entered the area and briars rubbing the transmitter (and surgical tape) pulled the transmitter off. No den was found. It was relatively early when her transmitter came off so it's unlikely she had reached her den; but the presence of the birthing site indicates the den is in close proximity.
    - Despite numerous attempts and trackers, the transmitter-implanted male timber rattlesnake from 2011 was not located.
    - Only one (failed) attempt was made to locate the male with the externally-attached transmitter in the fall, 2011.
  - Eight known rattlesnake dens were visited during spring emergence. While at least one rattlesnake was observed at each, only two dens confirmed continued recruitment.
    - Four rattlesnakes at three dens were collected during 2012 emergence exhibiting similar symptoms to those found in timber rattlesnakes of New Hampshire and Massachusetts and massasauga rattlesnakes of Illinois which led to the death of some of those snakes. *Chrysosporium anamorph of Nannizziopsis vriesii* (CANV), also being referred to as *Chrysosporium ophiidiocola*, which according to Jean Pare of the Wildlife Conservation Society, is a renamed clade of CANV, is the fungus being incriminated for these problems. All snakes were released to the State-approved venomous snake rehabilitator where they received supportive care and medicine as appropriate, but due to limited resources, only one (a black rat snake) was submitted for testing. Note, dens 1 and 2 are within the potential home range of the rattlesnakes inhabiting those dens and therefore, those snakes may interact; den 3 is in a separate mountain range.
      - Snake 1, Den 1 (photos 1a – 1d): Adult male was captured in March 2012 with necrotic facial tissue. He received supportive care and was tube fed approximately once per month. He received antibiotics (below) and one oral dose of fluconazole (medicine available to the rehabilitator although interestingly, if the snake is/was infected with CANV, CANV it is resistant to fluconazole). He went pre-shed several times but didn't shed completely. Nothing shed from his head so the rehabilitator “peeled” him on 6/23/12; requiring a lot of force to



- pull the crusted layers off. He did retain one, dented, eye cap during the last shed prior to this report, visible in photograph. Part of the upper lip eroded away from the infection. After his last shed, the rehabilitator coated him with miconazole cream and will continue to do so; the exposed area formed scar tissue. The rehabilitator reported that his facial tissue looks granulated with scales forming. Because the snakes appear to get opportunistic bacterial infections, the rehabilitator also treated him with about 4 doses of ceftazidime (20mg/kg) and enrofloxacin (5mg/kg) at the same time. No tests were conducted on this snake prior to this report. He remains in captivity for additional care and may undergo testing through the Wildlife Conservation Society.
- Snake 2, Den 2 (photos 2a – 2c): Adult female was captured 19 April (released to rehabilitator 23 April) with necrotic facial tissue. She also received supportive care and was permitted to shed on her own, again removing scales and skin, exposing facial muscle. After using miconazole cream to soften the scabs, she shed (unassisted) on 09 May, after which the exposed area began to form scar tissue. No tests were conducted on this snake; she was PIT-tagged and released in early June.
  - Snake 3, Den 3 (photo 3): Adult female was captured 01 May with questionable facial scarring. This may be attributed to “normal” hibernation sores, however, the inside of her mouth along her upper jaw line was black. After the rehabilitator assessed her, she was PIT-tagged and released in June (preshed). No tests were conducted on this snake.
  - Snake 4, Den 3 (no photos): Adult, gravid female was captured 26 April (transferred to rehabilitator 27 April) with what appeared to be some necrotic facial tissue (crusty appearance) and difficulty breathing. The rehabilitator determined she was suffering from stomatitis, provided supportive care and sporadic antibiotic treatment for approximately one month (as the rehabilitator reported it was difficult to give her shots since she was gravid and therefore, needed to be handled more gingerly). She received both ceftazadime (20mg/kg) and enrofloxacin (5mg/kg) for a total of 4 doses, the last two being 6-4-12 and 6-9-12. No tests were conducted on this snake; she was PIT-tagged and released 11 June.
- A fifth rattlesnake (Snake 5, Den 1, photo 4) was observed with similar facial lesions and shed its skin from the head while the volunteer was observing it. The snake was not captured as the rehabilitator was unable to accept additional animals. During the shed, this snake exhibited the same result as other snakes in the rehabilitator’s care (Snakes 1 and 2); the scales and skin came off exposing the facial muscle in addition to revealing open wounds on the side of the face and jowl.
  - One black rat snake and one black racer were also collected for testing and observation, respectively. The black rat snake was euthanized due to the extensive damage to its eyes and face and submitted to the USGS National Wildlife Health Center for testing. Fungal testing conducted at the time of this report found five different fungi, all of which would be considered contaminants (i.e., environmental source versus an infection). A black racer was collected in the spring by the rehabilitator, given supportive care and treatment and released in July. Additional reports were received from ENSP volunteers that found black rats, racers and garter snakes with what appeared to be necrotic facial skin.
  - Due to the potential distribution of this “disease”, ENSP met with Jean Pare of the Wildlife Conservation Society and additional staff to discuss and develop a 2-year pilot study (2013-2014) of snakes exhibiting such symptoms.
  - Due to the frequency with which ENSP staff was observing affected snakes, den surveys focused on locating additional affected individuals from various non-interacting dens rather than gathering data on numbers observed and age classes.
  - As reported during the previous funding cycle (see *NJ T-1-6*, September 1, 2010-August 31, 2011), the plan to ascertain potential numbers of individuals (observed, not estimated) and potential age class variation by revisiting known dens was abandoned.

- Den searches: Due to the apparent presence of potentially infected snakes, emergence surveys focused on returning to documented dens to locate potentially infected individuals in need of medical assistance. No surveys were conducted to search for currently undocumented dens or reported by unconfirmed dens.
- Venomous Snake Response Team:
  - Staff made no extensive outreach effort to recruit and encourage citizens to report rattlesnake observations to help populate the Biotics database other than their interactions with volunteer responders and staff. The members of the Venomous Snake Response Team, many of whom are local animal control officers and park staff, are required and continue to educate citizens and encourage citizen involvement in rattlesnake conservation by reporting observations and sharing their knowledge of snake behavior, needs and protection with friends and neighbors.
  - Nine Venomous Snake Response Team members reported responding to 47 complaints on private lands during the 2012 field season, 16 were confirmed to be timber rattlesnakes (4 northern copperheads, the remaining were non-venomous snakes).
  - Of the 57 active members of the Venomous Snake Response Team (excluding federal personnel) in the northern region, only 36 submitted official timesheets reporting their 2012 response activity in time for this report.
- An unexpected injury and illness to the ENSP's rattlesnake biologist caused a truncated field season; no gestation/birthing site surveys were conducted.
- Due to staff time constraints, no additional landscape-scale features were tested in GIS to refine the 2009 den model.
- Due to staff time constraints, no additional information was gathered that would assist in conducting a species status assessment.

#### Conclusions:

##### STATEWIDE

- Obtaining completed timesheets from volunteers of the Venomous Snake Response Team continues to be challenging. However, volunteers 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.

##### PINELANDS REGION

- Due to limited resources, ENSP relies on conservation and research partners to [help] protect and improve rattlesnake habitat.

##### HIGHLANDS REGION & KITTATINNY RIDGE

- Our work strongly suggests that NJ's northern region timber rattlesnakes may be suffering infections of the same pathogens/fungi as those in MA and NH and the massasauga rattlesnakes of IL.
- Although the wounds of the two timber rattlesnakes that received medical assistance appear to have developed scar tissue, it is undetermined if the wounds will reopen each time the snakes shed, making them more susceptible to parasitic insects, injuries and infection.
- Testing the photography equipment was an invaluable task as the results demonstrated that the cameras intended for use on the habitat restoration project would not have successfully monitored the sites. In addition, the use of the cameras is extremely time intensive and may make it difficult if not impossible to monitor sites with the originally proposed intensity (i.e., multiple cameras at multiple sites reviewed weekly).
  - It was time intensive not only to review the pictures collected through time lapse photography but conducting weekly visits to exchange the memory cards and batteries.

- The difference in image clarity between the two cameras contributed to the difference in the amount of time needed to review the data.
- Although obtaining timesheets from volunteers continue to be difficult, the ENSP's northern region's Venomous Snake Response Team continued to be effective at rapidly responding to residents requests for assistance regarding rattlesnake presence on their properties and providing additional distribution locations for the Biotics database.
- Increasing development and roads continue to impede and/or threaten travel between habitats, isolate populations, and limit habitat use.

Recommendations:

STATEWIDE

- Continue to maintain the current and expand the Venomous Snake Response Team.
- Focus spring emergence and gestation/birthing site surveys on currently 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.

PINELANDS REGION

- If appropriate personnel are available, ENSP could review GIS data and determine if there are any correlations among the streams housing rattlesnake dens that might contribute to the development of a model to locate potential undocumented den areas.

HIGHLANDS REGION & KITTATINNY RIDGE

- Review and test, when appropriate, 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 can not be linked to documented dens; an indication that they may reveal a currently undocumented den.
- Although the use of external transmitters has not always proven successful, given they pose no potential harm to the snakes and *may* provide valuable data, ENSP should continue to use them when appropriate.
- Continue to assess sites for the creation and management of potential basking areas on public lands and reconsider how (and if so, how many of) the sites will be monitored long-term to evaluate success.

## Snake 1



Photo 1a: Snake upon captivity. Necrotic facial tissue; crusty appearance.



Photo 1b: Pre-shed.



Photo 1c: Immediately post-shed; facial scales and skin removed.



Photo 1d: Approximately 2 months after shedding and after receiving medical treatment/care, scar tissue developed.

## Snake 2



Photo 2a: Snake upon captivity. Necrotic facial tissue; crusty appearance.



Photo 2b: Immediately post-shed; facial scales and skin removed.



Photo 2c: After shedding and receiving medical treatment/care, scar tissue developed.

## Snake 3



Photo 3: Snake upon captivity had some facial sores that may be attributed to "normal" hibernation sores. However, her upper jaw line (inside her mouth) was black which is abnormal.

## Snake 4



Photo 4: Snake was observed in the field with what appeared to be open lesions and necrotic facial tissue. While observing the snake, it shed the skin from its head, removing scales and skin and exposing muscle on his lower jaw, open wound/lesion on the side of its face and jowl.

## JOB 1D: Northern Pine Snake

Project leader: Kim Korth, Principal Zoologist

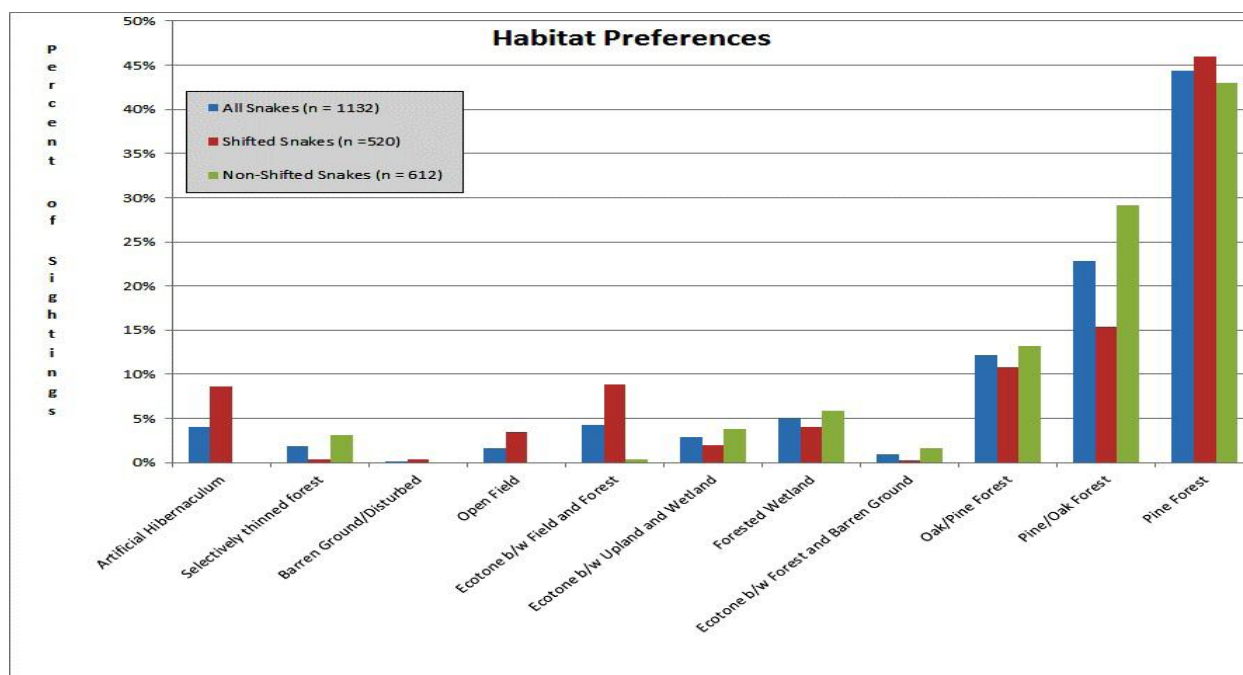
**OBJECTIVE:** To develop a recovery plan, identify life-history requirements, and conserve habitat for the state-threatened northern pine snakes (*Pituophis melanoleucus melanoleucus*). Identifying critical habitats, monitoring trends in populations and habitat, and evaluating meta-population issues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

### Key Findings

1. In 2011-2012 the Endangered and Nongame Species Program worked with its research partner, Herpetological Associates, to complete the sixth 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. During the field season 12 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 8 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 2011 field season. Details of these activities are summarized below.

*Data Collection During the 2012 Field Season:* As in previous years (beginning in 2007), we determined the location of each study snake roughly every other day throughout the 2012 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 2012, data collection for this field season was still ongoing and, therefore, data analysis has not yet been carried out on the 2012 field data.

*2011 Data Analysis Conducted During 2012:* During this reporting period data were analyzed on telemetry data collected in the 2011 field season. A total of 1,132 telemetry relocations were made on 14 pine snakes during 2011. As in previous years, most relocations were made in pine or pine oak forests (Figure 1).



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

2. ENSP also worked with research partner Dr. Walt Bien, Drexel University (Laboratory of Pinelands Research), who radio-tracked 13 adult female northern pine snakes at Warren Grove Gunnery Range (WGR) from April through October 2012.
  - During April-October, 2012, thirteen females were tracked for the duration of the field season in order to determine possible nesting locations.
  - All telemetered individuals were relocated approximately every 48 hr throughout the season. Habitat type, meteorological data, and behavior data were recorded for each relocation.
  - Approximately 700 relocations have been made for the 2012 field season but data analysis was not complete as of this writing in November, 2012.
  
  - In April 2012, known pine snake hibernacula at WGR (n=14) and Franklin Parker Preserve (n=3) were corralled with silt fencing and checked every 24 hr to identify individuals as they emerged from hibernation. Forty-two pine snakes egressed from these corralled hibernacula at WGR, and 11 from Franklin Parker Preserve.
  - Two post-copulatory females were collected and implanted with radio transmitters and tracked to their active nesting sites at Franklin Parker Preserve.
  - Seven potential nests across three research sites were located and corralled. Hatching and egress will be documented and reported in the 2013 reporting period.
  
  - Fifty-six samples (blood and/or tissue) were collected for genetic analysis during 2012, from Ed's Place den (n=30), Franklin Parker Preserve (n=11), WGR (n=11), and from carcasses found dead-on-road (n=4).
  
  - Drexel researchers also launched a pilot study to evaluate how pine snakes move across road surfaces began in 2011. During spring egress from known hibernacula (Spring 2012) Drexel captured 13 adult pine snakes and evaluated their behavior (time remaining stationary), movement direction, and rate of movement across three substrates: asphalt, concrete, sand. Those data will be analyzed after fall 2012 ingress.

### **Conclusions**

- The 2011 report on research at Stafford Forge by Herpetological Associates was submitted to ENSP and Pinelands Commission. The 2012 report is being finalized by the consultants.
- We continued our long term research project to examine the typical home range size and habitat use of the northern pine snake at Stafford Forge and have coupled this with similar work by partnering more closely researchers at Drexel University.
- Radio-tracking pine snakes is an effective way to locate undocumented hibernacula and nesting sites.
- 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 2011 project partner sightings were submitted to ENSP but relevant observation data have not yet been entered into Biotics. In our effort to carry out meta-analysis of northern pine snake data for population estimates, habitat preference and model development, Biotics staff identified data inconsistencies, particularly with telemetry relocation points. Biotics and ENSP staff are working to resolve these issues to ensure they are included in the Biotics database and can be used for analysis. Staff worked with consultants approved to collect northern pine snake data to submit data in a format that is more easily accepted and entered into Biotics. We expect to receive all the 2012 project partner data in the near future and 2012 data from consultants will be provided prior to approving collection permits for the 2013 field season. Those data will be entered in the Biotics database.
- In an effort to modify and make consistent our scientific collecting permits requirements for snakes, it became clear that permittees were not submitting reports and data in a timely fashion. In addition, some of the data submitted were in an unusable format; we are working to obtain past reports and data. Staff revised permit conditions to ensure consistency and that data are submitted in a format we can use prior to the next permit cycle.

- Due to the need to obtain past reports and confirm data, we were unable to use these data for the creation of a pine snake habitat model using the underlying principles of HEP modeling.
- Understanding how road substrate affects pine snake movement will enable us to develop better BMPs for road construction and re-surfacing.
- Estimates of mean number of pine snake using hibernacula have been calculated at the WGR and at the Stafford Forge study sites. These data were used to develop an extrapolation model to estimate pine snake population size for Warren Grove. We concluded that the model was not meaningful due to the model assumptions including homogenous landscapes that may influence differences in abundance and distribution. It is necessary to increase the sample size to better calibrate the model as well as test in other Pinelands areas to validate the model.

### **Recommendations**

- Continue to collect and analyze population data and refine and validate the model to estimate the northern pine snake population size in New Jersey.
- Continue to collect new data as needed at WGR and Stafford Forge and analyze movement data.
- Continue to identify the location of new hibernacula at WGR and Stafford Forge to compare differences in hibernacula density between sites. Existing data may be enough to complete this analysis.
- Continue road surface study through the 2012 field season and identify seasonal differences in movement rates across different simulated road surface substrates; develop recommendations based on the results.
- Continue to collect blood and tissue samples to elucidate differences in population genetic structure. These data will be important for detecting genetic bottlenecks and identifying where barriers (e.g., roads) maybe reducing gene flow.
- Develop a recovery plan for the northern pine snake.
- Continue to obtain outstanding reports and ensure the data are submitted and included in Biotics; revise scientific collecting permit conditions as necessary to ensure timely submission of reports and data.
- Continue to work on conforming data; carry out meta-analysis on annual reports received from environmental consultants to generate estimates of average activity range and habitat preference for this species. Once the data issues have been resolved, work with experts to create a pine snake habitat model using the underlying principles of HEP modeling.

## **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 27 northern copperhead sightings were entered into NJ DEP's Biotics database (Biotics). One 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 over the next year for entry into the Biotics database.
- One dead northern copperhead, collected during the winter 2010-2011 had been submitted for testing as it exhibited similar symptoms to those seen in timber rattlesnakes of New Hampshire and Massachusetts and massasauga rattlesnakes of Illinois which led to the death of some of those snakes. In 2012, a PCR was conducted but resulted in identifying two amplicons which were sequenced, one of which represented *Cladosporium cladosporioides* (greater than 99% sequence identity with



GenBank), and the tree mushroom *Trametes versicolor*; both of which appear to be “contaminants” from the snake’s environment rather than linked to the problems the snakes are encountering.

- As reported last year (*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.
- Venomous Snake Response Team: (*See Timber Rattlesnakes section for additional details*)
  - Venomous Snake Response Team members removed 4 northern copperheads from private land.
- No radio transmitters were implanted in or attached to northern copperheads in 2012. All observations could be connected to currently documented dens or were random observations reported by citizens.
- Due to staff constraints, no effort was made to recruit assistance from conservation organizations or the Division of Parks and Forestry to obtain northern copperhead location data, only the Venomous Snake Response Team.
- PCR test conducted on specimen found during the winter 2010-2011 revealed no useful information. Only contaminants were identified [*Cladosporium cladosporioides* (greater than 99% sequence identity with GenBank), and the tree mushroom, *Trametes versicolor*].

#### 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 continue to limit our ability to locate and reach out to additional potentially knowledgeable parties.

#### Recommendations:

- Continue to maintain the current and expand the Venomous Snake Response Team.
- Focus spring emergence and gestation/birthing site surveys on currently 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.
  - Recruit assistance from conservation organizations.
  - Recruit assistance from the Division of Parks and Forestry staff through notifications and identification education.
  - Continue to work with the Venomous Snake Response Team.
- Conduct radio-telemetry on copperheads observed in areas that cannot be linked to a known den in an effort to identify the 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

#### 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. 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. CWF 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 2012.

- We continued analysis of sea turtle impingements recorded at the OCNGS along with weather and meteorological factors as an initial step in developing a predictive model for predicting when captures are most likely to occur at the power plant. Data from 1992–2011 were used in the analysis, including several captures that had not been previously entered from 2003. Data from 2012 were not considered in the analysis, since sea turtles will most likely be reported within the year but after the end of the project period (August 31, 2012).
- The following factors were used during the analysis 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) and 7) direct human interaction (i.e., boating effects).
- Capture data from 1992-2011 were analyzed using Microsoft Excel graphing and regression software to identify trends. Data for all years and months were combined. We also stratified data into combined monthly datasets and individual monthly datasets for each year.
- We identified factors associated with each sea turtle capture. In addition, we identified captures that showed no apparent association with selected factors. Each sea turtle capture was compared to weather parameters as recorded by [www.wunderground.com](http://www.wunderground.com) at the Atlantic City Airport. Air temperature was used in the analysis because sea surface temperature was not available. It is presumed that air temperature is indicative either 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

- When we combined all capture data, there were no apparent trends due to variability caused by seasonal changes and annual differences. When data were stratified into months (and means derived for all months combined), there was too much variation between years (and no high correlation coefficients).
- Data that were separated into individual months, with analysis conducted on each day’s specifics, with or without captures, yielded the following results:
- For June, factors associated with sea turtle captures were 1) high wind gusts from the East and South 2) nor’easter storm and 3) heat shock (air temps reached 102F).
- Sea turtle captures remained low and late in June until 2010. Captures in 2010-2011 happened earlier and more often.
- For July, factors associated with sea turtle captures were 1) July 4<sup>th</sup> weekend boat traffic and 2) high wind gusts from the East, South and West.
- For August, factors associated with sea turtle captures were 1) heat shock (air temps reached 102F) 2) hurricane and 3) wind gusts from East, South and West.
- For September, factors associated with sea turtle captures were 1) nor’easter storm and 2) wind gusts from the East and South (primarily).
- For October, factors associated with sea turtle captures were 1) nor’easter storm 2) cold shock (air temps fell to 28F) and 3) wind gusts from West and East.
- Increasing and earlier captures of sea turtles at the OCNGS in June may provide insight as to coastal sea turtle abundance. 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. There is anecdotal information from fishermen that sea turtles are arriving earlier and staying off the coast of DE longer (E. Stetznar, 2012, DE Division of Fish and Wildlife, pers. comm.). In addition, there are recent reports of attempted nesting by sea turtles along mid-Atlantic beaches, including in NJ.

- Sea turtle catch at the OCNGS is primarily affected by local abundance and distribution. Gusty east winds 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. Another possibility is that it may be impossible 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). According to Morreale and Standora (1998), juvenile sea turtles entered inshore waters of NY and took up residence in specific and relatively confined areas for many weeks. Perhaps some sea turtles that have entered Barnegat Bay exhibit similar behavior and are able to remain in confined (and somewhat sheltered) locations despite gusty winds and other factors. A bay-wide analysis of available sea turtle habitat may offer insight into local distribution.

#### Recommendations:

- Continue compiling data for OCNGS sea turtle impingements and enter in the Biotics database to maintain records of sea turtle occurrences.
- Continue analysis of sea turtle impingements vs. variables such as proximity to Gulf Stream, species movements coastally, prey abundance and distribution, moon phase, and other factors not yet determined. Determine whether results of gut contents analyses performed on dead sea turtles collected at OCNGS from 1992 to the present are available in order to identify primary prey items.
- Build files to show surface oceanic temperatures along sea turtle migration routes over time through 1992-present to begin model development.
- Continue to gather information from the NMFS to determine coast-wide population trends.
- Research methods of identifying sea turtle habitat (foraging, resting, etc.) in Barnegat Bay and determine whether proceeding with such an effort is feasible given current resources. Begin dialogue with DE Division of Fish and Wildlife to perhaps partner on a similar effort in Delaware Bay.
- Work with OCNGS and NMFS staff to establish voluntary protocols to be implemented during predicted times of likely 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.
- Investigate feasibility of assessing threats associated with commercial and recreational fishing gear interactions to sea turtles in NJ. Work with Bureau of Marine Fisheries (BMF) staff to explore whether undertaking research to determine the role of bycatch on listed marine turtles is warranted and achievable. Investigate the potential to map fished areas by gear type and overlay with listed species occurrences to identify threats. Work with the NMFS and BMF to obtain observer data and enter into Biotics.

#### Literature Cited

Morreale, S.J. and E.A. Standora. 1998. Early life stage ecology of sea turtles in northeastern U.S. waters. NOAA Technical Memorandum NMFS-SEFSC-413, 49 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.

### Key Findings:

#### Common Snapping Turtle

- No reports on harvest have been received from the Bureau of Freshwater Fisheries with regard to snapping turtle commercial harvest during this fiscal cycle.
- Additional reporting fields were added to the commercial harvest data form in order to determine the intended use of the catch, i.e., to whom turtle meat was sold. No changes have otherwise been made based on information from the previous reporting period.
- ENSP continued to coordinate with a Montclair State University PhD student on examining toxicity of snapping turtle meat and population estimate studies.
- The project leader gave a presentation on snapping turtle harvest to the NJ Chapter of the Wildlife Society.

#### Northern Diamondback Terrapin

- No investigations were made into the harvest of northern diamondback terrapins.

### Conclusions:

- The season for harvesting snapping turtles is the most open compared to many other harvested species, including white-tailed deer, turkey, gray squirrel, and rabbit, which are all more fecund than the turtle.
- New Jersey has no restrictions on harvest based on age, size, or daily/annual bag limit.
- The number of commercial applications for snapping turtle harvest has increased since 2008, but we do not yet know the numbers for the 2012 season.
- Snapping turtle harvest may be unsustainable in certain waterbodies based on recommendations in the literature.

### Recommendations:

- Request data from Bureau of Freshwater Fisheries on past year's snapping turtle harvest.
- Continue to coordinate with Montclair graduate student on snapping turtle research.
- Consider these potential changes to the state's snapping turtle management:
  - Close all harvest of snapping turtles until we can determine if current harvest is sustainable.
  - Extend the closed season (currently 5/1-6/15) for snapping turtle harvest to limit take during communal or overwintering periods.
  - Implement a daily or annual bag limit by waterbody based on waterbody size.
  - Limit repeat harvest of individual waterbodies from year to year.
- Continue to improve reporting process for commercial permits.
- Elevate level of concern over harvest to higher levels within the NJDEP.

## 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

#### Habitat Enhancement

- *USFWS Refuge:* Construction of vernal pools at this site was delayed as negotiations continued with partner organizations. Pool excavation is now anticipated in early 2013.
- *Lizard Tail Swamp Wildlife Management Area:* Excavation of 10 vernal pools was completed in November 2011. Leaf litter and debris were added to pools and the surrounding area was seeded with warm season grass in December 2011. In mid-December tiger salamander egg masses were identified in these new ponds, evidence that local population(s) of eastern tiger salamanders found the newly created ponds and were breeding there.



Excavated pools at Lizard Tail Swamp. ©D. Golden

- *Egg Enclosures:* We constructed enclosure cages in the new ponds to increase survivorship of egg and early larval stage tiger salamanders by excluding predators while maintaining the optimal depth in the water column for development. Ten egg masses collected by staff from marginal

sites were placed inside enclosure cages in the new ponds. Preliminary results indicated high hatching success but more data is needed. Genetic samples were collected from each egg mass for long-term monitoring of our management of salamanders at this site.

- *Headstarting:* We worked with Cape May County Zoo to develop a headstarting project to improve hatching success of wild salamander eggs. We limited collection to sites with more egg masses than the individual pond could support and targeted egg masses deposited too high in the water column to survive water and temperature fluctuations during development. Staff collected 8 egg masses, which were headstarted at Cape May County Zoo in early 2012. Hatching was successful but larvae grew slowly. In late March 2012, the CMC Zoo veterinarian took genetic samples from larvae (a tail clipping), causing approximately 80% mortality. Remaining larvae were released into pool in April 2012 with unknown results. Larvae appeared much smaller and swam more weakly than those in the ponds.



Kim Korth and Dave Golden (NJ Division of Fish & Wildlife) join Kevin Wilson (CMC Zoo) releasing headstarted larvae  
© K. DiLeo

- *Long-term genetic monitoring:* Samples from headstarted salamanders and individual eggs from enclosures have been sent to Montclair University for processing. Genetic samples will continue to be collected (two eggs per egg mass) as headstarting and enclosures are repeated in 2013. Tail-clips from adults using ponds will be collected opportunistically from November 2012 through June 2013; this is a non-lethal method for adult tiger salamanders used in disease screening and genetic testing (Rojas *et al* 2005, Forson and Storfer 2006, Greer and Collins 2007). By collecting maternal DNA of each egg mass, both headstarted and field-enclosed, we will be able to compare success rate of these treatments with individuals using the pool by natural migration.
- **Rio Grande:** Predatory fish were identified as a limiting factor at an eastern tiger salamander pond in Rio Grande, Cape May County. In 2011, removal of fish was successfully completed when the pond was drained and the fish were seined and moved into a different (permanent) pond.
- **Bayshore Mall population analysis:** ENSP was not able to obtain the 1986, 1988, and 1991 “Bayshore Mall data” from Herpetological Associates in order to compare it to the data collected in 2009 and 2010 at this site. ENSP did discuss this data exchange with Herpetological Associates; however, due to limitations in staff time, no follow-up conversations on this data exchange or analysis have taken place.
- **General Surveys:** Working with Conserve Wildlife Foundation of NJ, a new site tiger salamander site was discovered in Cumberland County in spring, 2012. Surveys were minimal during this reporting period due to limited staff time.
- **Staff worked with Atlantic City Electric to identify habitat enhancement opportunities along their rights-of-ways that would help create tiger salamander movement corridors between known populations. Vernal pool construction at Cape May National Wildlife Refuge, along the ROW, is anticipated to begin early 2013. We are working with partners to set-up an onsite meeting with**

Atlantic City Electric (ACE) to finalize maintenance plans.

- All records that were entered into Biotics have been included in the new release of the Landscape Project. Results from winter 2012/2013 surveys will be submitted into Biotics in early 2013.

#### Conclusions

- ENSP's management efforts for tiger salamanders are focused on sites that appear to hold the most value to maintain long term persistence of tiger salamanders in New Jersey. These sites are in the center of Cape May peninsula and thus at relatively lower risk of being impacted by sea-level rise.
- Management to enhance tiger salamander breeding habitat holds the most promise for increasing tiger salamander abundance at key sites. Vernal pool construction was successfully completed at Lizard Tail Swamp in December 2011. The new pools were occupied almost immediately after completion, thus adding organic material (leaf litter and stems) may be a valuable addition to newly created ponds.
- Field egg enclosures appear to be an effective way to increase survivorship in egg and early larval stage eastern tiger salamanders.
- Headstarting may be effective if we are able to grow more robust larvae prior to release into ponds. However, genetic samples should not be collected from individual larvae due to high mortality.

#### Recommendations

- Work with partners to create habitat linkages between known breeding ponds, especially with the creation of vernal pools along Atlantic City Electric (ACE) right-of-way on and near USFWS refuge property.
- Continue translocation of egg masses to new pools at Lizard Tail Swamp using egg enclosures.
- Continue with headstarting with Cape May Zoo but with modified protocol including:
  - Collecting two eggs per egg mass for genetic monitoring instead of tail clipping larvae.
  - Improve growth rates of larvae by feeding with zooplankton collected from vernal pools.
- Work with partners to continue monitoring at Lizard Tail Swamp in 2013. Continue planning tiger salamander breeding habitat enhancement projects that will contribute to linking sustainable tiger salamander populations, especially those at Lizard Tail Swamp WMA and the USFWS Cape May National Wildlife Refuge site.
- Work with partners to monitor water level and salinity at sites most susceptible to sea-level rise.
- Monitor for egg masses at Rio Grande in January 2013 during the breeding season to determine if restoration was successful.
- Using volunteers and/or partners, continue to survey for eastern tiger salamanders in appropriate habitats and incorporate findings into the Department's Biotic's database and Landscape Project.
- Continue to work with Herpetological Associates to obtain Bayshore Mall data. This will allow us to analyze population data pre- and post- construction of the Bayshore Mall and subsequent development in the late 1980s and early 1990s. These findings will inform future permit decisions that have adverse impacts on eastern tiger salamanders.

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

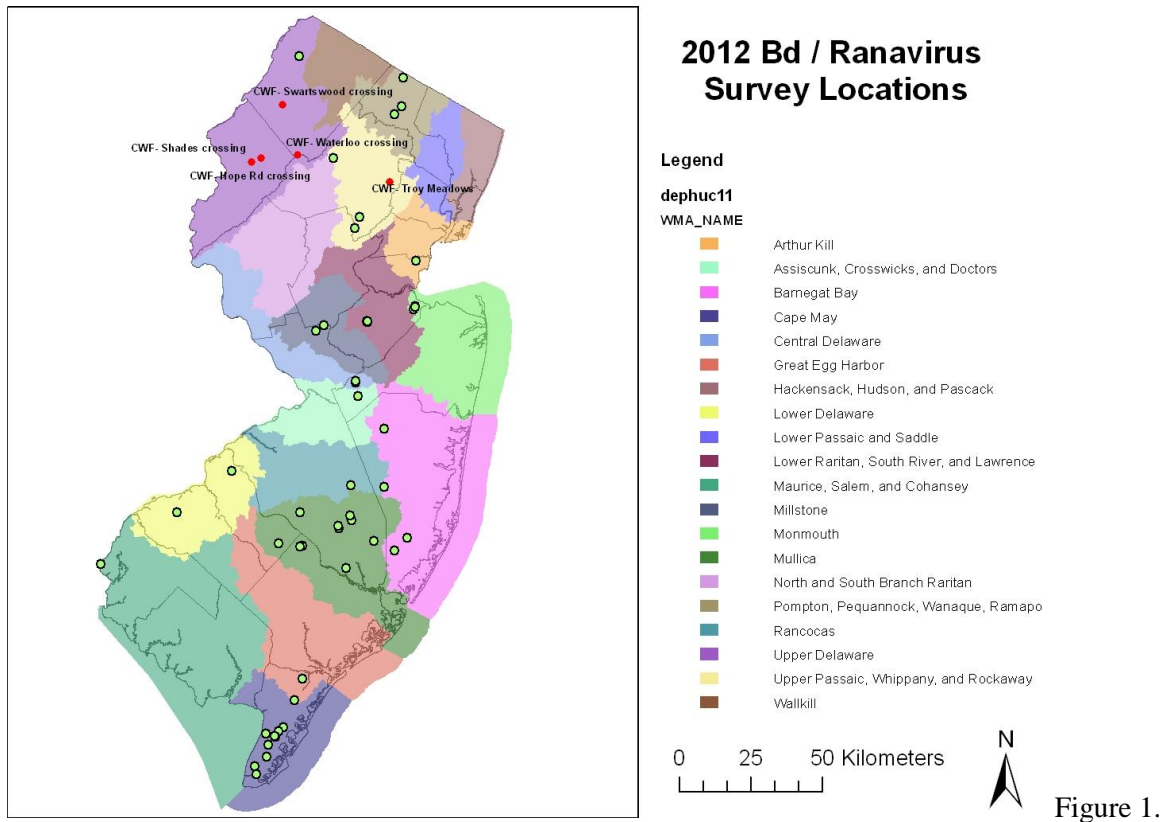
Project leader: Bill Pitts, Wildlife Technician

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

### Key Findings

- Background and Past Findings
  - For the past three years, ENSP has awarded Montclair University a small grant (from the NJ wildlife license plate fund) to initiate screening for this pathogen in New Jersey. Chytrid was detected in 2 out of the 27 samples that were screened during the pilot project in 2009 and 2010. These samples were taken from only two ponds, therefore a more extensive and widespread monitoring effort for this pathogen was needed in New Jersey.
  - In 2011, a total of 907 samples were delivered to Montclair University at the completion of sampling for analysis for *Bd* using Real Time PCR (RT-PCR) analysis. Additionally, 426 samples were delivered to Montclair at the end of sampling for traditional PCR analysis for Ranavirus. Due to a malfunction with the RT-PCR machine *Bd* samples were not analyzed until just recently, and we were awaiting results as of this writing in November 2012. Two sites, however, Stafford Business Park and Tuckahoe, had confirmed incidents of Ranavirus.
- New Findings
  - Sampling Methodology and Results
    - In order to better stratify our sampling effort and more effectively fill in gaps in sampled locations, previously sampled locations were plotted on DEP HUC11 watersheds. Of the 20 watersheds in New Jersey, 14 had already been sampled. The remaining six were targeted for sampling in 2012: Arthur Kill, Assiscunk, Hackensack, Lower Passaic, North & South Branch Raritan, and Wallkill. Sites that had previously tested positive for *Bd* or Ranavirus from 2009-2011 were sampled as well. Forty-three sites in 14 counties were sampled (green dots in Figure 1); 2012 datasheets are still being compiled.





Sampling locations in 2012 were stratified by HUC11 watershed.

- Amphibian samples were collected March through July. Montclair State University provided Eppendorf tubes, swabs, and datasheets for all *Bd* samples to be collected. Location and general habitat information were recorded at all sites as well as samples of water and sediment from the edge of each pond.
- Amphibians were captured by hand or a net and swabbed 10-15 times around their leg joints and vent. Additionally, toe-clips were taken from all frog species within the genus *Lithobates* and tissue samples were used for Ranavirus screening that Montclair was conducting.
- A total of 310 *Bd* samples were delivered to Montclair University at the completion of the sampling period for (RT-PCR) analysis.
- A total of 1,643 samples have been collected to date for *Bd* and Ranavirus testing.
- Increased Partnerships
  - In 2012, the Conserve Wildlife Foundation of New Jersey (CWF) was added as a sampling partner in Northern New Jersey, per ENSP's recommendation from last year. CWF monitors amphibian crossing sites throughout the northern portion of the state, and identified four sites in the Upper Delaware Watershed for potential sample sites (see map). One additional site in the Upper Passaic Watershed was targeted for potential sampling.
  - Montclair continued to monitor the sites that previously tested positive for *Bd* and Ranavirus, as well as collecting from new sites in northern NJ. ENSP focused on sampling at five watersheds in 2012: Arthur Kill, Assiscunk, Barnegat Bay, Lower Delaware, and North & South Branch Raritan. These include three of the six watersheds that had not previously been sampled.

#### Conclusions:

- By changing to a watershed-based sampling approach, we will be better able to identify data collection gaps and minimize duplicative survey efforts in areas that may already have been confirmed to harbor *Bd*. This should also prove to be a more relevant means of monitoring this water-borne pathogen.
- Adding CWF as a project partner allowed us to collect additional samples from important amphibian populations.
- *Bd* and Ranavirus have both been positively identified in New Jersey and we are awaiting additional results from Montclair that will help us prioritize sampling locations for the next field season.

#### Recommendations:

- Continue to monitor for *Bd* in New Jersey using a watershed-based approach. We have samples from at least 17 of the 20 watersheds in New Jersey to date, and we should target the remaining ones in 2013.
- 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 and/or municipalities that operate amphibian crossings to sample. Provide sampling supplies, datasheets and standardized protocols to these groups.

### **JOB 3: Herp Atlas Database**

Project leader: Bill Pitts, Wildlife Technician

#### 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

- At the end of 2011, staff changes dictated the need to alter this job. It was decided that the Herptile Atlas Monitoring Program would be put on hiatus, while the Calling Amphibian Monitoring Program (CAMP) would be maintained. CAMP data ultimately contributes to the Herp Atlas database.
- 33 CAMP volunteers were recruited throughout New Jersey. The newly discovered Green Treefrog (*Hyla cinerea*) was added to CAMP routes in the physiographic regions in which it is expected to occur, and Upland Chorus Frog (*Pseudacris feriarum*) was removed from the NJ species list due to findings in recent literature that refutes NJ being part of that species' range.
- Data for the New Jersey CAMP program was integrated into the North American Amphibian Monitoring Program (NAAMP), and data entry is now done online through a portal hosted by the USGS Patuxent Wildlife Research Center.
- Data was pulled from the NAAMP database, and ENSP is currently evaluating and formatting that data for incorporation into the Biotics database of rare and listed species.
- Another dataset was gathered from the North American Field Herping Association (NAFHA), evaluated and entered into Biotics.

#### Conclusions

- While a formal Herp Atlas program was put on hold, data on non-SGCN species was 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 that program be reinstated.

#### Recommendations

- Once data is compiled and entered and mapped, it should be used to inform the update of the Field Guide to Reptiles and Amphibians of New Jersey.
- Analysis and manipulation of NAAMP data needs to be completed so that it can be incorporated into the Biotics database and formatted in a way that will be useful for future Delphi reviews.

### **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 pools were recorded during this reporting period. Existing data is as follows.
  - Potential vernal pools mapped (total): 14,095
  - Vernal pools meeting physical and hydrologic criteria (total): 4,155
  - "Certified" vernal pools, which meet physical, hydrologic, and biological criteria (total): 1,340
- We exported vernal pool data for integration into the state Biotics database and Landscape Project Mapping.
- No volunteer vernal pool surveys were performed this reporting cycle.
- The vernal pool database update has not been completed. The next step is to catalog any flaws in the existing database structure, develop a new list of expected queries, and determine whether any new features will be needed.
- No volunteer outreach was made during this cycle. Conserve Wildlife Foundation staff have approached ENSP about the possibility of instituting volunteer trainings in 2013.

#### Conclusions:

- For the purposes of Biotics data entry and Landscape Project Mapping revisions, annual updates to the vernal pool database are acceptable.

#### Recommendations:

- Redesign vernal pool database to integrate with ArcGIS V. 10 and address existing flaws.

## **JOB 5: Italian Wall Lizard Survey**

Project leader: Bill Pitts, Wildlife Technician

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 is important to determine its “baseline” distribution and estimate its abundance in order to ascertain if, and at what rate, its population is spreading or growing
- New Findings
  - On September 8, 2011 a sighting, accompanied by a photo, was submitted from a neighborhood (Rancocas Woods) that is >6 km from the known population. ENSP conducted a survey within the week, but was unable to find any evidence that a new population had become established there.
  - In August 2012, ENSP was approached by a professor at Rowan University about the prospects of partnering on a more robust population study. ENSP worked on a methodology with Rowan to conduct a mark-recapture study using PIT (Passive Integrated Transponder) tags, which will provide the ability to be able to recapture individuals in subsequent years.
  - A Scientific Collecting Permit was issued to Rowan, and field visits were conducted to capture lizards and test the new marking method in the laboratory at Rowan. After being closely monitored in the laboratory, lizards will be released at the original capture locations using GPS data. A report will be provided to ENSP at the end of the year with the findings of these tests

Conclusions:

- It is likely that additional populations of this non-native lizard are present in the state.
- If Italian Wall Lizards are able to withstand subcutaneous injection with PIT tags, ENSP and Rowan will be able to track a variety of life history characteristics, long-term, which will provide valuable data on the ecological role this species plays and the potential for causing ecological harm in the future.

Recommendations

- A follow-up survey of Rancocas Woods should be conducted next spring when lizards become active to verify whether or not the population has dispersed.
- After receiving findings of Rowan’s pilot marking investigation, further develop a research plan for this study.

## EXECUTIVE SUMMARY

**Project:** **Invertebrate Conservation**  
Federal Aid Project: T-1-6 (State Wildlife Grants)  
Segment dates: September 1, 2011 to August 31, 2012

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### 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:

- We surveyed nine stream stretches and two lake sites in five counties for listed freshwater mussels during the survey period. Timed searches for mussels were conducted at historic locations and/or previously unsurveyed suitable habitats.
- We performed habitat assessments and/or preliminary searches at six additional sites to determine if larger surveys were warranted.
- Scores from EPA Habitat Assessment Field Data Sheets (high and low gradient combined) ranged from 115 (North Branch, Rancocas Creek, Burlington County) to 152 (South Branch Raritan River, Hunterdon County), out of a possible 200. Previous ENSP studies have shown that freshwater mussels occur within a habitat score range of 68-173. All sites surveyed scored within the preferred habitat range.
- We continued an analysis of freshwater mussel data collected between 2000 and 2011. 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 vegetative cover, total bank stability and riparian zone width scores 2) abundance is correlated with sediment deposition scores and 3) species richness is correlated with vegetative cover and total bank stability scores. We are currently incorporating 2012 information into the analysis.
- We continued testing a new type of sampling gear that we designed in 2010. It is essentially a rake with a cross sectional opening 12 inches wide and 2-¼ inches deep. A steel-meshed basket was welded to the rake opening with diamond-shaped mesh openings of ¼ inch by ¾ inch. Our new gear type is designed to facilitate sampling fine to coarse sediments that are used by particular species of mussels. It was designed specifically to not harm mussels during sampling, since the rake's tines are covered by a mesh basket (which serves as "scoop") and cannot cause damage by snagging or piercing soft tissue.
- A preliminary methodology for using the "rake" was applied as follows: prior to deployment, the area to be sampled is visually inspected for observable freshwater mussels. During testing, the rake is drawn 18 inches through the sediment in a sawing motion. The contents are gently shaken underwater and a visual inspection of the remainder is completed. The area is sampled two to three more times, with the rake digging deeper to 10 cm. A visual inspection is then made of the area after the sampling effort to look for missed specimens.

- Rake testing in the Pequest River this season yielded a single fresh shell of the Triangle floater (T). 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 in fine to coarse sediments. Subsequent visits to Pequest River sites tested in 2010 and 2011, along with the Salem Creek site tested in 2010, showed that there is no permanent disruption or removal of freshwater mussel habitat due to rake sampling. Further, it doesn't appear that rake sampling disrupts habitat any more than quadrat sampling.
- Water quality values were as follows: pH ranged from 5.8 to 8.2, water temperatures ranged 5.6 - 29° Celsius, dissolved oxygen ranged 6.9 - to 9.8 ppm.
- Catch per unit effort (CPUE) for all species combined during time searches was highest in Salem Creek, Salem County, with 0.7 live mussels/minute.
- Endangered and Nongame Species Program staff and volunteers found nine 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 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/new occurrences included live Tidewater muckets in Swede's Lake, Burlington County, live Tidewater muckets and Eastern pondmussels in Union Lake, Cumberland County, and Tidewater mucket shells in Salem Creek, Salem County.
- We contracted consultants to perform a quantitative survey for Dwarf wedgemussels in the Pequest River within a known occurrence area. Biologists from Normandeau Associates (NA), which are on the USFWS -NJ Field Office's list of approved Dwarf wedgemussel surveyors, were hired to gather information on age structure, population size and overall population health of Dwarf wedgemussels within a particular stretch of the river. In addition, biologists were to report on all other freshwater mussel species located during survey efforts. The survey was conducted along a 2.5 km reach of the Pequest River in Great Meadows, Warren County. Despite intensive searches throughout the area (qualitative and quantitative), only the common species, Eastern elliptio, was found live. Shells of the Triangle floater, along with an unidentified shell that has characteristics of both the Triangle floater and Dwarf wedgemussel, were also found. The unidentified shell has now been examined by a number of biologists and is being sent to additional experts for species consensus.
- 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.
- We continued searches for the Chinese pond mussel (*Sinanodonta woodiana*) in Wickecheoke Creek, Hunterdon County. In 2010, we documented the first North American occurrence of the highly invasive species from ponds owned by the NJ Conservation Foundation (NJCF). The five ponds, which flow into the creek during flooding events, was formerly 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.
- Efforts by NJCF and the Division's Bureau of Freshwater Fisheries (BFF) staff to eliminate big head carp and Chinese pond mussels included application of rotenone to all ponds on site, removal and destruction of all fish in the ponds, and lowering the ponds over the winter, 2010. Despite these actions, we found fresh Chinese pond mussel shells alongside one of the ponds (n=24) and downstream at the nearest road crossing (n=12). In addition, we found small shells (n=4) several miles downstream of the ponds at Lockwood Road. The stream regularly goes dry above this section; given the small size and freshness of the shells, it is doubtful that the NJCF ponds are the actual source of the species at this location.
- Volunteers continued to identify and survey freshwater mussels as part of the freshwater mussel atlas effort. The volunteers are covering Cape May, Salem, Cumberland and Atlantic counties, and using a draft version of the NJ Freshwater Mussel Field Guide for identification purposes.

- All new locations found to have federal and/or state listed mussels from these surveys and others (e.g. surveys by private consultants in the Paulins Kill, Delaware River, 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.
- Working with the DEP's Bureau of Water Monitoring and Standards, we are participating in an internal task force to determine how to revise the Department's methods for upgrading stream classifications, including methods for selecting Category 1 areas based on listed aquatic obligate species (including freshwater mussels).

#### Conclusions:

- Based on habitat suitability assessments and preliminary searches, two out of six sites visited 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 rare species.
- There appears to have been significant habitat change in the Great Meadows section of the Pequest River. Biologists from NA found that habitat conditions in and around Dwarf wedgemussel occurrence areas were more consistent with low gradient streams, i.e. fine grained substrate, slow flow, and few riffles. Hurricane Irene was determined to be the most likely cause for the change in habitat conditions and mussel diversity. The hurricane hit the east coast of NJ during late August 2011. The high, turbulent flows in the Pequest River during the hurricane are believed to have carried fine grained sediment into the 2012 survey area, significantly changing the habitat and transforming suitable Dwarf wedgemussel areas into unsuitable areas.
- 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; these 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.
- Discovery of Tidewater mucklets and Eastern pondmussels in previously undocumented locations underscores the need for more surveys in New Jersey. It is possible that other populations occur in the previously unsurveyed streams with suitable habitat and appropriate host fishes present.

#### Recommendations:

- Continue surveys for listed species in previously unsurveyed suitable habitats to document distribution; monitor populations in known locations.
- Continue analyzing habitat data to determine relationships with freshwater mussel abundance and diversity. Compare listed species abundance with individual habitat parameters. Develop more robust statistical testing of variables.
- Continue testing of the sampling rake to determine if further use in the field is appropriate. Develop and implement a more scientifically sound sampling design.
- Determine threats to listed freshwater mussels from the Chinese pond mussel introduction and enlist volunteers to assist with efforts to eradicate individuals and prevent the spread of this invasive species.
- Focus survey efforts in the Pequest River to determine Dwarf wedgemussel population boundaries and size. Assess impacts of Hurricane Irene and Tropical Storm Lee on other Dwarf wedgemussel

occurrences within the Pequest River. Assess impacts of hurricanes and extreme weather events on other listed species locations.

- 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. Complete maps for field guide, print and distribute to interested parties.

## **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, Hessel's Hairstreak, and Frosted elfin.

### **Job 2A: State Listed Lepidoptera**

Project leader: Robert Somes, Senior Zoologist

OBJECTIVE: Identify, survey, protect and manage for listed Lepidoptera populations and habitats in New Jersey. Coordinate research activities and habitat management with both private and public partners.

#### Key Findings:

- Sixteen locations were surveyed for Bronze Copper during the project period, with 14 individuals observed at four sites. One site represented an entirely new population.
- Ten locations were surveyed for Silver-bordered Fritillary, with seven individuals observed at two locations. One of the two locations with the Silver Bordered Fritillary was a new site for the species.
- Sixteen locations were surveyed for Leonard's Skipper, with 11 individuals observed at four different locations.
- A highlight of the year the discovery a large population of Checkered White in southern New Jersey. It was in the vicinity of a smaller colony discovered two years ago. What would best be described as a large metapopulation was distributed over an area roughly 10 miles long (north to south) by two miles wide (east to west). Within this area numerous colonies were found in areas of suitable habitat containing the food plant and ample nectar sources. A total of 20 distinct locations were surveyed. At the largest colony, 130 individuals were counted and several smaller colonies numbered between 20 and 30 individuals. Numerous dispersing individuals were observed at various locations with nectar between and outside of larger colonies.

#### Conclusions:

- Several known sites still had Bronze Copper present though at lower numbers than in previous years. One entirely new site was found with a single fresh individual observed.
- Very low numbers of Silver-bordered Fritillaries were observed this year. The species was noticeably absent from several historic sites in central New Jersey. However, the only new site was found in central New Jersey with one individual observed. The early spring and summer heat waves could have led to difficulties in timing the flight of this species perfectly.



- Leonard's Skipper was also noticeably absent from several southern New Jersey sites but present in many other locations. This often occurs in very small colonies and is easily missed.
- The Checkered White is a notoriously eruptive species though it is extremely surprising to find a colony of notable size after an absence of 15 years. Adults were observed emerging from chrysalis and numerous larvae were found during our survey efforts.

Recommendations:

- Continue surveys to monitor and determine the size and distribution of known populations; locate new populations of rare species.
- Survey newly discovered sites to determine population size and establish whether they are large self-sustaining colonies or just satellite colonies of a larger population.
- Survey the new Checkered White population extensively during the beginning of the flight season to determine whether it was an anomaly due to the previous year's unseasonably warm winter.
- Conduct surveys for Leonard's Skipper in southern New Jersey to determine distribution and work with public property land managers to improve early successional and grassland habitat at historic sites.

**Job 2B: Frosted Elfin**

Project leader: Robert Somes, Senior Zoologist

OBJECTIVE: Identify, survey, protect and manage Frosted Elfin populations and work to insure habitat protection and maintenance for the species. Work with land owners and managers that have Frosted Elfin populations on their properties to conserve the species through habitat protection and appropriate management practices.

Key Findings:

- Extensive surveys were conducted for Frosted Elfin with the majority of known sites surveyed, along with adjacent areas of suitable habitat. Extremely early, warm weather this year led to some of the earliest emergence dates for the species at several locations. This also led to the flight for this species being very spread out over time. Low numbers were observed at many locations.
- A large multi-species, habitat restoration project was conducted at the Lizard Tail Swamp Frosted Elfin site in conjunction with Division of Fish and Wildlife's Bureau of Lands Management (BLM) staff during the fall and winter of 2011. This involved the repair and restoration of a large area of gravel pits that had been heavily disturbed by All Terrain Vehicle use and spring flooding. Native grasses and wild flowers were planted and 1,600 *Baptisia tinctoria* plants were ordered in anticipation of fall planting. Areas of existing *Baptisia* plants were surveyed and protected during the restoration project and new plants were found in many previously flooded areas.
- The areas of the Beaver Swamp Frosted Elfin site that were treated with herbicide during Fall 2010 were found to have no Frosted Elfin present this year. However, owing to the size of the site and warm early spring, it is likely the emergence was small and spread out. This site has held very low numbers over the last several years as well. Surveys yielded far more extensive areas of *Baptisia* than the previous year. Work was coordinated with the power company that maintains the Right-of-Way on this site to have several areas of overgrown/nonsuitable habitat mowed during the late summer/early fall. Work was also coordinated to insure that areas of *Baptisia* were not mowed.
- One potential new site with extensive *Baptisia* present was found near the Atlantic City Airport population on a utility Right-of-Way.

Conclusions:

- Frosted Elfin continue to exist in low numbers at several locations. The loss of several populations is of concern but it is hoped these sites will be recolonized (as they have been in the past). Between our

habitat restoration efforts and the coordination of management activities, it is hoped that Frosted Elfin habitat can be improved and the population sizes increased.

- There are still areas of unsurveyed, potential habitat at many nearby locations that may support undocumented populations.
- Improved management practices should help to maintain populations at several locations on public property.

Recommendations:

- Continue surveys of known populations to determine status and distribution.
- Survey and monitor populations at sites where we conducted habitat management this season to determine the population's response and the effectiveness of the management efforts.
- Plant *Baptisia* plants at the Lizardtail restoration site during September 2012 and work with BLM to control invasive weeds at the site.
- Revisit historic sites that did not have Frosted Elfins this year to determine if they are recolonized.
- Work with land managers at Frosted Elfin sites to insure management activities are conducted in a manner that is not detrimental to the species; identify and manage sites where management activities could be beneficial to the species.
- Survey the potential new site near the Atlantic City Airport to determine if Frosted Elfin is present at this location.

## **Job 2C: Northern Metalmark**

Project leader: Rob Somes, Senior Zoologist

OBJECTIVE: Identify, survey, protect, and manage Northern populations and work to insure habitat protection and maintenance for the species. Work with appropriate land managers to maintain or enhance habitat for Northern Metalmark in northern New Jersey through invasive species removal and creation of cedar glade pockets in late successional red cedar stands.

Key Findings:

- All known (12 locations) Northern Metalmark populations and adjacent, suitable habitats were surveyed at least twice over the course of four days. Northern Metalmarks were present at three known locations with 67 individuals observed (41 at the Cabin Glades site and 26 at the Roadside site). Many known/historic locations no longer contain suitable habitat owing to succession and the invasion of exotic plant species. Larval surveys during September yielded one early instar larva in new/managed habitat. Greater numbers were observed at two populations where habitat enhancement was performed. These two populations were also distributed over a greater area of suitable habitat now that many areas have been improved and barriers to dispersal removed. Several sites that held small numbers of Metalmarks last summer did not have any observed this summer.
- Habitat management was conducted (with the assistance of The Nature Conservancy) at two locations in the White Lake population over the course of six days in winter and early spring to remove invasive plants and open up the tree canopy. One location was one acre in size and the other was approximately five acres. Large areas of invasive plants were removed and many areas that were becoming overgrown were made suitable again for this species. Native wildflower seeds were distributed in open gaps to augment the nectar plants found at the site.
- Work is also being coordinated within the Division of Fish and Wildlife to improve habitat adjacent to our known sites. Several fields that are leased by the Division for agricultural purposes had 30 meters along the edges of cultivated fields left fallow to encourage the growth of nectar source plants.

#### Conclusions:

- Many historic locations appear to have been extirpated and two core populations remain with secondary occurrences around them.
- This species appears to be easily managed for by the creation of habitat gaps/openings and the removal of invasive plants. Several sites have been greatly improved with minimal effort. The food plant, *Senecio obovatus*, was found to have already spread/sprouted from seed banks in managed areas. Far greater areas of flowering were also observed for the food plant (the plant will grow in the shade but not flower). The areas where habitat management is ongoing are surrounded by potential but unoccupied habitat. If the core populations can be increased in number and dispersal corridors established it should be relatively easy for the core areas of this species to occupy satellite sites and become more robust and resilient to population decline at any one location. The habitat enhancement appears to have already increased dispersal at these sites and allowed individuals to disperse to areas previously unavailable to them.
- Since the Northern Metalmark can be often be found in relatively small and easily missed areas, the potential exists for the discovery of new populations in suitable habitat in the vicinity of known populations.

#### Recommendations:

- Continue surveys for new populations in suitable habitat and monitor known colonies to determine the effectiveness of our management activities. The observation of a larva in a managed area of *Senecio* gives hope that the effort is having a positive effect.
- Continue habitat management near known populations to increase dispersal opportunities and increase the resiliency of known colonies. Expand habitat management away from the current areas to allow for dispersal and colonization of adjacent, suitable sites.
- Begin habitat management at the Kittatinny Valley and Paulinskill Valley sites.

### **Job 2D: Arogos Skipper-North**

Project leader: Rob Somes, Senior Zoologist

OBJECTIVE: Identify, survey, protect, and manage Arogos Skipper populations and work to insure habitat protection and maintenance for the species. Work with appropriate land managers to promote beneficial habitat management through grassland management in northern New Jersey.

#### Key Findings:

- Due to limit staffing and other priority work commitments, no surveys were conducted this season for the Northern Arogos Skipper populations.
- Habitat restoration work was performed on public property in several areas of Arogos Skipper habitat on Division of Fish and Wildlife Property. This involved the removal of invasive plants and the planting of native grass/herbaceous plants species over an approximately 20 acre area of over grown fields and hedges.

#### Conclusions:

- This species appears to be easily managed for by the creation and maintenance of native, warm season grasslands.
- Further research is needed to determine more specific life history requirements. Suitable habitat appears to be widespread though the butterfly is not; there would appear to be an unknown limiting factor for this species.
- This species often occurs in small, isolated colonies that are easily missed during surveying.

Recommendations:

- Continue surveys to monitor and determine the distribution of known populations and to locate new colonies. Design and conduct research to determine factors behind the restricted distribution of Arogos Skipper in northern New Jersey.
- Continue to work with land managers to improve Arogos Skipper habitat on public property.

**Job 3E: Arogos Skipper-South**

Project leader: Rob Somes, Senior Zoologist

OBJECTIVE: Identify, survey, protect, and manage Arogos Skipper populations and work to insure habitat protection and maintenance for the species. Work with appropriate land managers to promote beneficial habitat management through forest fire management in the Pinelands region.

Key Findings:

- Surveys for Arogos Skipper were conducted at known sites on Ft. Dix Army Base and in potential habitat in the New Jersey Pinelands.
- The surveys of the Ft. Dix populations found Arogos Skipper to be present in many areas of habitat with numbers ranging between three and 22 individuals observed at four different locations.
- Prescribed burning schedules were developed with Ft. Dix land managers to insure that areas of suitable habitat were maintained.
- Surveys of potential habitat at five different sites did not yield new Arogos Skipper populations even though suitable habitat is present.

Conclusions:

- This species appears to be easily managed for by the creation and maintenance of native, reedgrass savannas through prescribed and wildfire impacts to the habitat.
- Large areas of potential, unoccupied habitat are present in several locations.
- This species often occurs in small, isolated colonies that are easily missed during surveying.

Recommendations:

- Continue surveys to monitor and determine the distribution of known populations and to locate new colonies.
- Continue to work with land managers to improve Arogos Skipper habitat on public property

**JOB 3: Rare Odonata Conservation**

Project leader: Jeanette Bowers Altman, Principal 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 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: Jeanette Bowers-Altman

**OBJECTIVE:** To monitor the progress of an effort to reintroduce the state endangered Gray Petaltail (*Tachopteryx thoreyi*). This effort began during 2007 with the collection of larvae out of state. An effort will be made to collect more larvae for transportation to the reintroduction site in Sussex County.

Key Findings:

- The Gray Petaltail (*Tachopteryx thoreyi*), which is listed as state Endangered was once reported sporadically from the Highlands, Ridge and Valley, and Northern Piedmont areas of NJ. Surveys over the past several years have failed to locate individuals of the species.
- The reintroduction of the Gray Petaltail was undertaken during May 2007 by our contractor Allen Barlow. Monitoring occurred at the reintroduction site for three subsequent years. The site chosen for the reintroduction is a large woodland seepage draining into Quick Pond in Sussex County and is protected as part of Trout Brook Wildlife Management Area.
- History of the reintroduction is as follows: In 2007, 31 Gray Petaltail larvae were collected at a seepage complex in State College, PA and transplanted at the reintroduction site. Eleven adults were observed during weekly monitoring through mid-July. Individuals were marked to establish an estimate of total number present. Based on markings, seven discrete individuals were recorded.
- In 2008, five live adults (four males, one female) were observed between late May and early July, with one dead male discovered in early June. The female was observed ovipositing (egg laying), suggesting that breeding had commenced within the population.
- During the 2009 season, no adults were observed at the Quick Pond site through much of June. This lack of adults is likely due to adverse weather conditions throughout much of the month, resulting in later than normal adult emergence.
- Six adult males were subsequently recorded during 17 visits to the site. No evidence of adult breeding activity was observed during the 2009 flight season. The presence of adults indicated that the transplanted colony was persisting, however. An attempt was made to search for larvae in late August. Two early instar larvae were located in the main seepage, providing further evidence that the colony was persisting.
- No adults were observed during 13 visits to the site in the 2010 flight period.
- No adults were observed during ten site visits conducted during the 2011 flight season. Larvae of various instar classes were dredged from the seeps.
- No adults or larvae were found during nine site visits conducted during May and June of 2012. It is now thought that this re-introduction effort may have failed. This is offset however by the re-discovery of this species by Robert Somes (ENSP biologist) and subsequent sighting by Allen Barlow in Bergen County.

Conclusions:

- It is possible that the initial number of larvae introduced to this site was insufficient and thus the population failed to gain necessary critical mass.

Recommendations:

- Cease monitoring of this site and prioritize surveys at Campgaw Mountain County Reservation to ascertain the size and specific location of Gray Petaltail colony there.

### **JOB 3B: Statewide Surveys and Monitoring of Listed Odonata**

Project leader: Jeanette Bowers-Altman

**OBJECTIVE:** To monitor populations and create conservation plans and strategies to aid in the recovery of state-listed species found throughout New Jersey, including the Gray Petaltail, Superb Jewelwing, Brook Snaketail, Robust Baskettail, Banner Clubtail, Harpoon Clubtail, and Kennedy's Emerald. To locate new populations of these species in areas not yet surveyed. To periodically re-visit known population to assess status and update the element occurrence.

#### Key findings:

- As in previous years, we contracted Allen Barlow to conduct surveys for listed and rare Odonata throughout the state. A total of 57 sites were sampled during the project period. Of the 57 sites sampled, 25 previously surveyed sites were visited for monitoring purposes and 32 new sites were surveyed. Monitoring sites were specifically chosen to focus on watersheds severely impacted by Hurricane Irene and Tropical Storm Lee.
- Sampling was primarily conducted via the collection and identification of larvae and exuvial shells. Adult observations were also used to survey for Odonata.
- Two new breeding colonies of Spatterdock Darner (*Rhionaeschna mutata*) were located in Hardwick Township, Warren County in June. One is situated with the Delaware River Nat'l Recreation Area. The other is within a wetland owned and protected by The Ridge & Valley Conservancy. Mating and oviposition was observed at both locations.
- A single female Brush-tipped Emerald (*Somatochlora walshii*) was netted, identified and released at a limestone fen with the NJ Natural Lands Trust Crissman Farm Preserve in July. Habitat of this type tends to be ideal for this species. The site will be re-visited next year to better ascertain the size of this colony.
- A total of four male and 11 female Harpoon Clubtail (*Gomphus descriptus*) were observed foraging in and early succession meadow adjacent to the Paulinskill in Frankfort Township, Sussex County. This is only the second observation of this species in the Paulinskill watershed. All adults observed were juveniles and most certainly originated from this river.
- Five male Rapids Clubtail (*Gomphus quadricolor*) were observed on the Musconetcong River in Mansfield Township, Warren County. This species has been sought at this location in previous years. It is likely that upstream dam removals have allowed larvae to move into new suitable stream segments.
- Robust Baskettail (*Epitheca spinosa*) was discovered in significant numbers upstream of Willow Grove in Cumberland County. A total of 93 exuvial shells were collected over a stream segment of 100 meters.
- Banner Clubtail (*Gomphus apomyius*) persists on the Scotland Run and Maurice River. Exuviae was collected below Wilson Lake and Malaga Lake in late April. The total count at Wilson Lake was significantly lower than observed in previous years.
- Pine Barrens Bluet (*Enallagma recurvatum*) was found at four of 12 new water bodies surveyed in Cape May, Cumberland, Atlantic and Burlington counties. This species was absent at three sites where it had been previously documented.
- New England Bluet (*Enallagma laterale*) was found in small numbers at Lake Aeroflex in Sussex County. Further surveys are planned to better understand this population.
- Several segments of the upper and middle Flatbrook watershed were surveyed for rare Odonata in the wake of impacts from Hurricane Irene and Tropical Storm Lee. This watershed saw severe physical impacts as result of flooding, stream bank erosion and stream course changes. The following species were absent from localized segments where they have consistently been observed for the past decade: Superb Jewelwing (*Calopteryx amata*), Sable Clubtail (*Gomphus rogersi*) and Maine Snaketail (*Ophiogomphus mainensis*). In addition, the following species were observed in significantly reduced numbers at other segments: Brook Snaketail (*Ophiogomphus aspersus*) and Harpoon Clubtail (*Gomphus descriptus*). It is not clear whether a direct correlation exists between storm impacts and population fluctuations. These sites will be monitored closely going forward.
- All locations found to have listed Odonata from these surveys 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 Odonata populations.

#### Conclusions:

- Much remains to be learned about the Odonata fauna of New Jersey. It is unclear what factors are impacting our rarest species, and whether they are natural or manmade. It is quite clear however that the value of many of the more sensitive species as environment indicators is great. The apparent decline or failure of many listed species within segments of the Flatbrook, Paulinskill and other watersheds is possibly due to impacts arising from two late summer tropical storms. While natural in origin much of the flooding was a result of failing drainage infrastructure such as culverts and impoundments. Watersheds regularly are impacted by natural events but the presence of poorly maintained man-made structures compounds these effects.

Recommendations:

- Continue to monitor known populations of rare Odonata throughout New Jersey.
- Occurrences not associated with breeding habitat or where no breeding activity was confirmed need further study.
- Continue to identify and survey new habitats in an effort to locate further populations of rare Odonata.
- In cases where known populations are declining, continue monitoring and attempt to ascertain possible cause(s) of the decline.
- In light of significant habitat damage sustained in the wake of Hurricane Irene and Tropical Storm Lee, some Odonata populations may have been severely impaired. A list of priority species and associated sites should be identified and surveyed in 2013 to ascertain what if any impact these significant events had.

**JOB 3C: Range distances for Priority Species – Mark and Recapture Study**

Project leader: Jeanette Bowers-Altman, Principal Zoologist

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

Key Findings:

- As in previous years, we contracted Allen Barlow to perform a mark-recapture study to determine range distances for priority Odonata species.
- As compared to previous years, the number of target species was significantly reduced (see previous comments pertaining to Hurricane Irene and Tropical Storm Lee). During mid- to late May, a total of 129 newly emerged Snaketails (43 Brook, 31 Maine, and 55 Rusty) were captured adjacent to the Big Flat Brook within Walpack Wildlife Area.
- Each Snaketail was marked on its hindwings with a large white patch created with “Whiteout” that could be obviously observed when the marked individual took flight. Individuals were released at the same location once markings were affixed on the hindwings. Subsequent re-captured adults had a second unique marking placed on the wings. These re-marked individuals were then searched for elsewhere.
- Surrounding foraging fields searched in 2012 were re-visited with a total of 8 recaptures at four sites: a) Walpack Center, approximately 2.6 miles from the capture area b) Quick Pond, approximately 3 miles from the capture area and c) Arctic Meadows TNC Preserve, approximately 2.4 miles from the capture area and d) a rocky bald area at the top of the Kittatinny Ridge, approximately 3.5 miles from the capture area.

Conclusions:

- Anecdotal information suggests that Odonata range far from their breeding sites while foraging for prey, seeking shelter or reproducing. There have been no significant studies, however, with the intent of quantifying distances traveled or elevations surmounted.
- While this is an initial study, our data would suggest that Snaketails will fly relatively long distances to visit preferred foraging sites. It was unclear until this year, however, whether these

foraging adults ever return to their breeding streams or if this is in essence a one-way trip. The observation of three adults returning to the breeding area, essentially a “round trip” suggests that the special occurrence area for this genus of dragonflies is significantly larger than previously thought.

- Based on this four year study using mark recapture method it may be prudent to consider increasing the size of protective buffers around known breeding sites for the threatened Brook snaketail (*Ophiogomphus aspersus*).

#### Recommendations:

- Develop models for potential species occurrence area to consider foraging, sheltering and breeding areas in addition to traditional buffers around occurrence points.
- Conduct similar studies on other priority Odonata species from other families. Ultimately, it may be possible to recommend scientifically based protective buffers (and Species Occurrence Areas as represented in Biotics and the Landscape Project) that take into account not only breeding habitat but crucial field and forested uplands.
- Publish the results of this study in a relevant new journal (e.g., *Bulletin of American Odonatology* or *Argia*). The intent of this would be to disseminate this knowledge to other researchers in hopes that the study might be replicated and more data gathered,

### **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. Research work will concentrate on rare species of Tiger Beetles (*Cicindela* spp.).

#### Key Findings:

- Surveys for Cobblestone Tiger Beetle (*Cicindela marginipennis*) were conducted at three different sites in the Delaware Water Gap with none observed.
- Claybank Tiger Beetle (*C. limbalis*) was observed in New Jersey for the first time in 20 years. A small population was discovered in the Northeastern portion of the state with two individuals observed during September 2011 and five observed during March of 2012.
- Surveys for New Jersey Pine Barrens Tiger Beetle (*C. patruela*) found several large populations in the Pinelands region. Large areas of suitable habitat were found with this species occupying most of it.

#### Conclusions:

- The Cobblestone Tiger Beetle surveys were conducted after several flooding events and it is likely any adult beetles were dispersed by the flooding.
- The discovery of Claybank Tiger Beetle still present in one location gives us hope to find more undiscovered colonies in the same vicinity.
- Large areas of potential, unsurveyed Pine Barrens Tiger Beetle habitat are found throughout the New Jersey Pinelands, which may be a stronghold for the species.

#### Recommendations:

- Continue surveys to monitor and determine the distribution of known populations and to locate new occurrences of rare Tiger Beetle species to build up our database in support of a future status assessment.
- Survey upper Delaware River islands for Cobblestone Tiger Beetle.



- Suitable habitat in the vicinity of the known Claybank Tiger Beetle site should be surveyed to determine whether it is occupied as well.

## **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 which dams (large and small) were slated for removal within the next two years. In 2011, staff at BDSFC prepared a list of dams anticipated to be removed. Permit applications had either been submitted to the BDSFC or were in preparation. These dams were as follows: Finesville dam (Musconetcong River), Nevios and Roberts Streets dams (Raritan River), Old Lake Forge dam (Rancocas Creek), Suntan Lake dam (Wanaque River tributary), Riegelsville dam (Musconetcong River), Quakertown Preserve dam (Capoolong Creek tributary), Calco dam (Raritan River), and Mine Hill Reservoir dam (Mine Brook, Musconetcong River tributary).
- A segment of Mine Brook downstream of the dam was once again surveyed in 2012 for the presence of state listed Odonata. The impoundment itself was also surveyed. Based on last year's survey of adults, larvae and exuviae, no priority species were found utilizing the impoundment or Mine Brook. Species documented were those well known to be highly elastic and as such found in a wide variety of habitats. Examples of Odonata found in abundance at the reservoir were Lancet clubtail (*Gomphus exilis*) and Ashy clubtail (*Gomphus lividus*). The most abundant species found along Mine Brook was the Ebony jewelwing (*Calopteryx maculata*) and Fawn darner (*Boyeria vinosa*). None of these species or others found can be considered as indicators of high quality water or habitat. In addition to species documented in 2011, two other Odonata were found breeding in Mine Brook; the Twin-spotted spiketail (*Cordulegaster maculata*) and Eastern least clubtail (*Stylogomphus albistylus*). Neither of these species is currently of conservation concern in NJ.
- A segment of the Musconetcong River downstream of the Finesville dam was again surveyed during 2012 for the presence or absence of state listed Odonata. While most of the species previously documented were highly elastic and of no conservation concern, one high priority species was documented (Brook snaketail, *Ophiogomphus aspersus*). This species was present in large numbers during a June survey (maximum count 32 adults). River jewelwing (*Calopteryx aequabilis*) was also abundant (maximum count 64 adults). A late summer survey resulted in the discovery of the uncommon Arrow clubtail (*Stylurus spiniceps*). While not a listed species, this is another indicator of water and habitat quality. This small segment should be considered an anomaly in this part of the Musconetcong watershed. In addition to Odonata surveys, we conducted a freshwater mussel habitat assessment at the Finesville dam. Habitat was found to be unsuitable just above and below the dam (from the dam to approx. 250 m above and below), with rocky substrate, extremely strong current, and debris throughout the area. We located suitable habitat several miles upstream, just below Hughesville. The segment, which is a trout stocked area of the Musconetcong River, contained sandy substrate, and shallow, relatively calm water.

- We continued Odonata surveys at Old Lake Forge dam. Freshwater mussel surveys were not conducted since pH readings were 4.3 at the site, well below the pH required by mussels to support shell development. Preliminary Odonata surveys immediately up and downstream of the dam were conducted, resulting in the following list of species for 2012: Slaty skimmer (*Libellula incesta*), Eastern amberwing (*Perithemis tenera*); Blue dasher (*Pachydiplax longipennis*), Widow skimmer (*Libellula luctosa*), Violet dancer (*Argia fumipennis violacea*), Black saddlebags (*Tramea lacerata*), and Common baskettail (*Epithera cynosura*)- downstream at Retreat Road – Slaty skimmer, Silver spotted skimmer (*Argyrothemis argentea*), and Common sanddragon (*Progomphus obscurus*).
- Habitat suitability for freshwater mussels was assessed at the Raritan River's Roberts Street dam. The river in this segment is dominated by rocky substrate both upstream and downstream of the dam with little observable suitable habitat for Odonata larvae or freshwater mussels in the main channel. Two pairs of Eastern elliptio (*Elliptio complanata*) valves and a single shell were observed. In addition, numerous Asiatic clam shells were observed. Odonata recorded at the site were Powdered dancer (*Argia moesta*), Stream bluet (*Enallagma traviatum*), including several mating pairs, Common whitetail (*Plathemis lydia*), Eastern Pondhawk (*Erythemis simplicicollis*), and Swift River Cruiser (*Macromia illinoensis*). The dam was slated for removal from July - September of 2012.

#### Conclusions:

- All Odonata species documented at Mine Brook are extremely elastic and will likely benefit greatly from the removal of this dam. Further, it is expected that other more habitat specific species will colonize this stream once the dam is removed and stream flow is normalized. The complete absence of indicator species at the Mine Brook site is not surprising given the size of the dam and the steep gradient of the stream.
- Biodiversity drops off rapidly at 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.
- None of the Odonata species found at the Old Forge Lake dam site are considered to be rare. Species located both up and downstream are ranked S5 and fairly representative of Odonata fauna in the area. However, more surveys spanning spring through early fall are needed a year to establish a complete species list for the site.

#### 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 to thoroughly document any impacts to the Brook snaketail. In addition, conduct freshwater mussel surveys in suitable habitat above the dam and monitor changes in populations over time.
- Continue Odonata surveys at Old Forge Lake dam and develop a comprehensive species list above and below the dam prior to its removal.

- Monitor the Roberts Street dam site over time to document changes in Odonata and freshwater mussel diversity.
- 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, 2011 to August 31, 2012

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### **JOB 1: Species Status Review and Listing**

Project leaders: Mick Valen, 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. All indigenous, terrestrial nongame mammals were included in the status review. The list of nongame mammals was taken from, 'New Jersey's Wildlife, A Checklist of Birds, Mammals, Reptiles and Amphibians'. In addition, although the bobcat (*Lynx rufus*) is listed as a game species with a closed season, it was included in the review because the Division recommended the bobcat for endangered status in 1991. After consultation with staff from the Bureau of Wildlife Management, it was agreed upon that the fisher (*Martes pennanti*) would be included in the nongame mammal 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).
- Round 1 began on September 1, 2011 and Round 4, the final round, was completed on June 8, 2012.
- Consensus was achieved on 37 out of 39 species (Table 1). Twelve species were voted Secure/Stable, 4 species were voted Special Concern, 1 species was voted Threatened, 6 species were voted Endangered, 3 species were determined to be Not Applicable because they are not native to New Jersey, and 11 species were voted Undetermined. Two species were unresolved after 4 rounds of review (southern bog lemming and meadow jumping mouse).
- The results are required to be presented to and voted on by the Endangered & Nongame Species Advisory Council (ENSAC). This is scheduled to take place during the January, 2013, meeting.

##### *SINGLE-SPECIES FISH REVIEW: ATLANTIC STURGEON:*

- During the January, 2011, ENSAC meeting, a motion was made to request that the ENSP conduct a single species status review on Atlantic sturgeon in advance of changes to the current federal status.
- Seven reviewers were asked to participate in the Atlantic Sturgeon assessment. Reviewers were chosen based on their expertise in fisheries biology and experience conducting sturgeon research. Reviewers represented such organizations as the NJ Division of Fish and Wildlife's Bureau of Marine Fisheries, Delaware Division of Fish and Wildlife, NY Department of Environmental Conservation, Rutgers University Marine Field Station, Delaware State University, and fisheries consulting groups. We requested reviewers to submit names and contact information of any potential qualified participants; names suggested by reviewers were already on our initial Delphi panelist list.
- At the onset, reviewers were sent information pertaining to Atlantic sturgeon, including an ASMFC Atlantic sturgeon bycatch report for the mid-Atlantic and northeast, the Federal Register proposed rule describing the five DPS and justification for listing, a master's thesis on movement and habitat use of Atlantic sturgeon in the Delaware River estuary, progress reports from DE Division of Fish and Wildlife's Atlantic sturgeon project, reports from Delaware State University on Delaware River on spawning areas, and journal articles relating to 1) vessel strikes in the Delaware Estuary 2) bycatch

morality and 3) stock structure and DPS delineation. Information was provided to each reviewer via email.

- One round of review was completed during the last reporting period. Rounds 2 and 3 were completed during this project period, with no consensus achieved after three rounds.
- Final results were as follows (shown are vote tallies and mean “confidence level” (CL) on a scale of 1-8): 4 Endangered (6.5 CL), 1 Threatened (6.0 CL), 1 Special Concern (8 CL).
- On February 6, 2012, NMFS published the final rule to list the NY Bight DPS as Federally Endangered, effective April 6, 2012. The Federal listing has implications for legal status in NJ, since under N.J.S.A. 23:2A-3c, State Endangered status is granted to any species that appears on the Federal Endangered list.
- Results were presented to the Endangered and Nongame Species Advisory Committee on March 21, 2012. Based on reviewer status selections, comments and the pending federal listing, ENSAC members voted to recommend that Atlantic sturgeon be assigned a state status of Endangered.

**Conclusions:**

- A status review of NJ terrestrial mammals was successfully conducted for the first time. Close to one-third of the species up for review were voted as “Undetermined-Unknown,” indicating that little is known about many terrestrial mammal species in the state. The recommendations for status changes based on this review will be made by the ENSAC and the NJ DEP in the coming year.
- A single-species review was conducted to evaluate the current status of Atlantic sturgeon. As a result it was recommended for State Endangered status.

**Recommendations:**

- Meet with Delphi reviewers, local universities, and Division of Fish and Wildlife staff to explore ways of gathering data on the terrestrial mammal species that were voted as “Undetermined-Unknown” in order to better understand their population status in the state. Implement the results of those discussions.
- Present the results of the terrestrial mammal status assessment to ENSAC for their recommendations on legal status changes. Plan to conduct another terrestrial mammal status review in approximately 5 years.
- Identify the next taxon or taxa that should be evaluated for status review. One of those taxa up for re-evaluation should be freshwater mussels.
- Proceed with new status assignments through the regulatory (rulemaking) process.

**Table 1.** Results of the Terrestrial Mammal Status Review after four rounds.

Scientific Name	Common Name	Current NJ Status	Consensus Reached Round #	Consensus Status	Confidence Level
<i>Blarina brevicauda</i>	Short-tailed shrew	None	1	Secure/Stable	6.5
<i>Clethrionomys gapperi</i>	Red-backed vole	None	1	Secure/Stable	6.4
<i>Condylura cristata</i>	Star-nosed mole	None	2	Secure/Stable	5.2
<i>Cryptotis parva</i>	Least shrew	None	2	Undetermined	5.33
<i>Eptesicus fuscus</i>	Big brown bat	None	3	Special Concern	5.33
<i>Erethizon dorsatum</i>	Porcupine	None	1	Secure/Stable	6.29
<i>Glaucomys sabrinus</i>	Northern flying squirrel	None	2	Undetermined	6.5
<i>Glaucomys volans</i>	Southern flying squirrel	None	3	Secure/Stable	5.67
<i>Lasionycteris noctivagans</i>	Silver-haired bat	None	3	Special Concern	5.14

<i>Lasiurus borealis</i>	Red bat	None	3	Special Concern	5
<i>Lasiurus cinereus</i>	Hoary bat	None	2	Special Concern	5
<i>Lynx rufus</i>	Bobcat	Endangered	3	Threatened	6
<i>Martes pennanti</i>	Fisher	None	4	Undetermined	5.57
<i>Microtus pennsylvanicus</i>	Meadow vole	None	1	Secure/Stable	7.43
<i>Microtus pinetorum</i>	Pine vole	None	1	Secure/Stable	6.25
<i>Mus musculus</i>	House mouse	None	1	Not Applicable <sup>1</sup>	
<i>Myotis leibii</i>	Eastern small-footed myotis	None	3	Endangered	5.83
<i>Myotis lucifugus</i>	Little brown bat	None	3	Endangered	5.57
<i>Myotis septentrionalis</i>	Northern long-eared bat	None	3	Endangered	6
<i>Myotis sodalis</i>	Indiana bat	Endangered	2	Endangered	6.86
<i>Napaeozapus insignis</i>	Woodland jumping mouse	None	3	Undetermined	5.86
<i>Neotoma magister</i>	Allegheny woodrat	Endangered	1	Endangered	7.6
<i>Oryzomys palustris</i>	Marsh rice rat	None	2	Undetermined	5.33
<i>Parascalops breweri</i>	Hairy-tailed mole	None	1	Undetermined	5.25
<i>Perimyotis subflavus</i>	Tri-colored bat	None	3	Endangered	5.83
<i>Peromyscus leucopus</i>	White-footed mouse	None	1	Secure/Stable	7.17
<i>Rattus norvegicus</i>	Norway rat	None	1	Not Applicable <sup>1</sup>	
<i>Rattus rattus</i>	Black rat	None	1	Not Applicable <sup>1</sup>	
<i>Scalopus aquaticus</i>	Eastern mole	None	1	Secure/Stable	6.4
<i>Sorex cinereus</i>	Masked shrew	None	1	Secure/Stable	5.83
<i>Sorex cinereus nigriculus</i>	Tuckahoe masked shrew	None	2	Undetermined	6
<i>Sorex dispar</i>	Long-tailed shrew	None	1	Undetermined	5.67
<i>Sorex fumeus</i>	Smokey shrew	None	2	Undetermined	5.71
<i>Sorex hoyi</i>	Pygmy shrew	None	2	Undetermined	5.5
<i>Sorex palustris</i>	Water shrew	None	1	Undetermined	6
<i>Synaptomys cooperi</i>	Southern bog lemming	None	4	No consensus	
<i>Tamias striatus</i>	Eastern chipmunk	None	1	Secure/Stable	7.33
<i>Tamiasciurus hudsonicus</i>	Red squirrel	None	1	Secure/Stable	6.57
<i>Zapus hudsonius</i>	Meadow jumping mouse	None	4	No consensus	

<sup>1</sup> The status of “Not Applicable” was based upon the fact that these species are not native to New Jersey.