Report
State Wildlife Grants
T-1-6

Endangered, Threatened and Rare Wildlife Conservation Projects

Progress Report for Project Year
September 1, 2010 – August 31, 2011

NJ Department of Environmental Protection

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

Conserve Wildlife
New Jersey Division of Fish & Wildlife
Endangered & Nongame Species Program

EXECUTIVE SUMMARY

Project:	**Bird Conservation**
Federal Aid Project:	T-1-6 (State Wildlife Grants)
Segment dates:	September 1, 2010 to August 31, 2011
Total Project Expenditures:	$636,432 ($413,432 Federal, $222,617) ('10-'11 year only)

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-three 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 63 volunteers last year.
  - In 2011, 105 eagle pairs were monitored during some or all of the season, of which 95 were active (exhibiting incubation) and 10 were territorial (maintained a nest area). An additional six pairs were probably active but their nests could not be observed to confirm.
  - During the 2011 nesting season, 71 nests were successful in producing 119 young, for a productivity rate of 1.25 young per active nest. This is close to the ten-year average in New Jersey of 1.30 young per active nest. Overall nest success rate was 75%, also close to the average of 77%. These results marked a return to average after poor nest success and fledging were recorded in 2010.
  - Twenty-one new eagle nests were discovered this season, the most ever. New pairs became active in 11 different counties: Cumberland had seven new pairs, followed by Atlantic, Cape May, Gloucester and Salem with two each. Bergen, Burlington, Warren, Ocean, Hunterdon and Sussex each had one new pair. Just three of the state's 21 counties do not have active nests.
  - Failures could not be attributed to any major events, but nestlings were lost when three nests were blown out of trees in different storms in February, May and June. One of those nests, Sea Breeze B, partially collapsed and one of the two nestlings was able to survive in the nest remains approximately 8-9 days, when ENSP biologists visited the nest to band and repaired the nest.
- ENSP biologists visited a sample of nests to band young with federal and color leg bands and to take blood samples. In 2011 we banded 24 eaglets at 14 nests. We took blood from all 24 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 (60%) 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 8-9, 2011. A total of 235 bald eagles was counted by volunteers and staff, down 29% from 2010's record count (Figure 2). Most eagles (197) were observed in southern New Jersey, primarily in the Delaware Bay region; northern New

Jersey had 41 bald eagles on the Delaware River and on inland reservoirs. The weather during the count was snowy and icy, with poor visibility on the first day; these conditions accounted for both less survey-hours and lower visibility of eagles, and thus the lower count. 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 USDOI Bureau of Land Management's Raptor Research and Technical Assistance Center, which compiles national winter eagle counts.

- Midwinter Survey location data was used to identify important wintering habitats. Locations were incorporated into Landscape Project critical habitat mapping. 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.
- Revision of the existing brochure for landowners was not completed, but is expected to be done in the next segment. The revision will include NJ-specific recommendations for nest and roost area protections that can be done by

Habitat protection and planning:

- All new nests 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 5, 2011, attended by approximately 40 project volunteers.
- Habitat types were assessed for suitability based on Level III land use-land cover types, for nesting, foraging, wintering and roosting. The assessment of suitability was conducted using bald eagle occupancy in NJ and relevant published literature. These habitat types will be used to identify suitable habitats using land use-land cover patches in the Landscape Project mapping (see NJ T-9-R-2).
- NJ State-specific eagle nest management guidelines were drafted but were not finalized; that is expected in the next segment.
- 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.

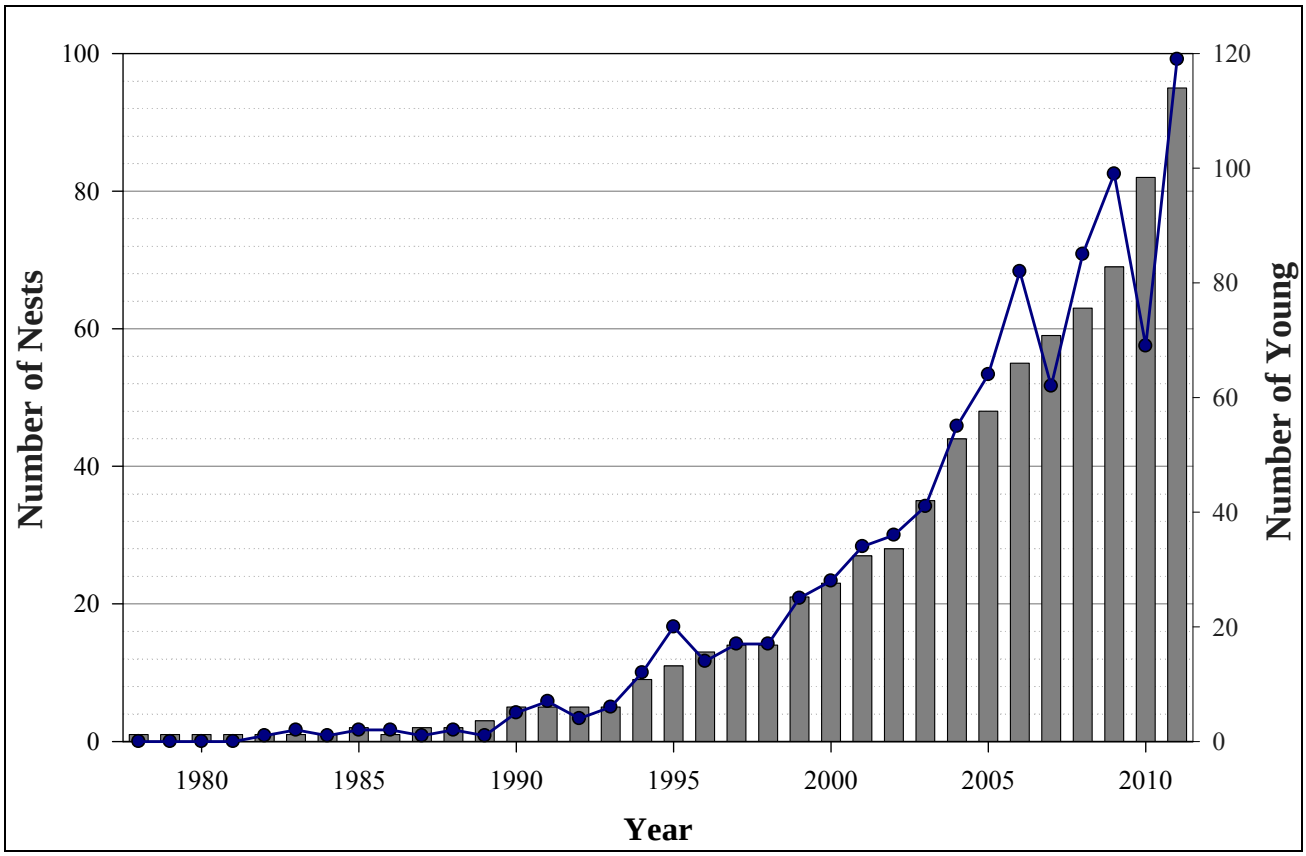

Figure 1. Number of bald eagle nests (bars) and young produced (line) in NJ, 1978-2011.

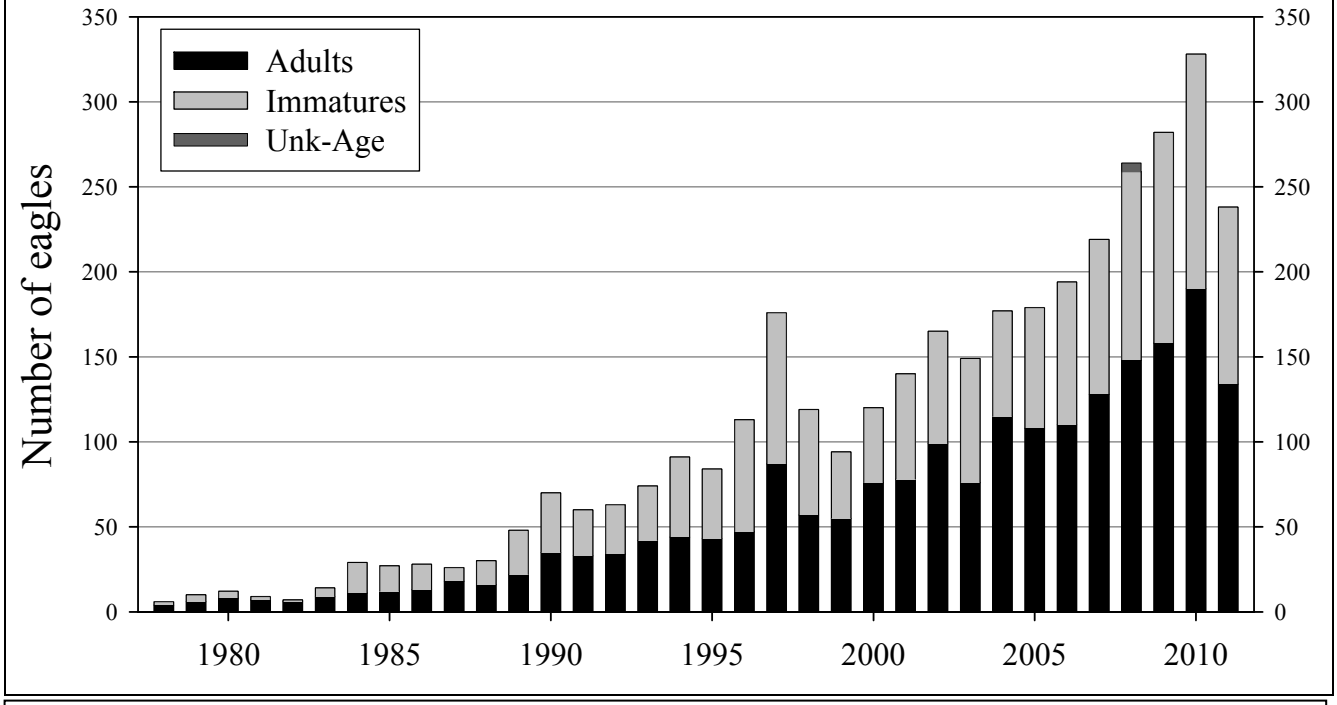

Figure 2. Number of bald eagles counted during the annual Midwinter Eagle Survey in NJ, 1978-2011.

Conclusions:

- The New Jersey bald eagle population has increased an average of 17% per year since 2000, a momentum that results from average productivity of 1.18 young per active nest (median=1.25 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 by biologists that includes nest-site protection in cooperation with landowners has been essential to success in NJ. In 2011, 23 new eagle nests were discovered, and expansion into unoccupied habitat is likely to continue in the next few years.
- In 2011 eagles seemed to rebound after one of the poorest years for nest success in 2010. Most of last year's failures were related to storms and heavy precipitation. Rainfall in 2011 set a new record for the State, which may have contributed to several nests falling (perhaps due to the increased water weight), but on the whole we could not attribute most failures to weather.
- 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 sought coordination with the USFWS in select cases to minimize disturbance and habitat loss to development and other activities.
- As observed last year, harsh weather conditions during sensitive incubation and early hatching periods can have a significant effect on nest success. It remains important to continue standardized monitoring for the foreseeable future to measure nest occupancy and success to assess eagle recovery in the state.
- 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 January, 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.

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 Kisiel, 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 on barrier island beaches along the entire Atlantic coast and back bay islands in Barnegat Bay. Colonies were located at eight nesting sites and observations were made at these locations for the duration of the nesting season. A total of 1,846 adults were present at these sites (based on a cumulative total of peak counts that occurred in the August 16-31 survey period). Once again, almost all (99%) of the known state's population was present at just one site during the peak count survey period, which was located at Seaview Harbor Marina (1,836).
- A peak count of 487 adult black skimmers was observed incubating, but that number is likely an underestimate because vegetation obstructs the observer's view of the nesting colony and some individuals may not have been detected.
- Black skimmer productivity was quite high, relatively speaking, with at least 767 fledglings produced statewide, or 1.57 chicks per pair. The productivity rate may have been lower, closer to .80 (calculated by dividing the peak adult count by two and then dividing it into the fledge count), if the peak incubating adult count was indeed an underestimate. Five sites fledged young, with almost all the young (99%) produced at one site, Seaview Harbor Marina. Tidal flooding, severe storms, extreme heat and predation (of adults by a great-horned owl) were responsible for poor reproductive rates at the other four sites. Seaview Harbor Marina continued to flourish despite weathering the same storms and heat, and some degree of predation.
- Since black skimmers are notoriously difficult to count from the ground since they often are obscured by vegetation, ENSP staff took advantage of an aerial flight for another project to count the birds from the air. Digital pictures were taken and later magnified on a computer. All individuals in the photographs were counted as an experiment to determine if the total counts would be higher than the ground counts. The total counted from the picture was slightly higher that what was counted in-person by air and higher than was counted on the ground. Zooming into images with a high resolution allowed biologists to count every individual.
- As in 2009 and 2010, black skimmers were once again observed nesting on salt marsh cord grass (*Spartina patens)*. This is a higher growing marsh species than the other vegetation that skimmers nest on. Although it is not known if this is in response to rising sea levels, it appears to be a positive development and it may prevent some loss of eggs and chicks during future flood events (though it does not seem to have a positive impact so far).

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 twenty nesting sites and observations were made at these locations for the duration of the nesting season. A total of 1,275 adults were present at these sites (based on a cumulative total of peak counts that occurred in the 1-15 June survey period). Significant colonies, with the highest peak counts of adults, were Sandy Hook–Critical Zone (208), Cape May Meadows (274) and Seaview Harbor Marina (261).
- A peak total of 785 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 390 fledglings produced statewide (0.49 chicks per pair, based on the peak number of incubating adults). This may even be an underestimation since a few locations were not surveyed fully enough to provide all fledge data. As in 2010, chick production was distributed rather evenly throughout the state. The primary limiting factor was predation, with predator identity ranging from gulls and crows to fox to peregrine falcons. Crows continued to be especially detrimental at Cape May Meadows. This is an especially 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 assuage the damage they cause.
- The least tern colony continued at Newark Airport. It was even more surprising this year since the "habitat" had deteriorated since 2010. A few nests were on the grassy area they have used previously, but many nests were right on the pavement, in the gravel cracks, which was quite unusual. 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. The primary issues for the birds are related to airstrikes and sun exposure for the young (there is very little vegetation tall enough to provide cover). The reproductive rate was dismal; with the 17 individuals that were counted only producing one fledge (.13 fledges/pair).
- The least tern colony was active at Townsends Inlet in 2011, which was the first time since 2008. It housed quite a big colony (148 peak adults) which is the largest it has been since 1987. This was a welcome addition to the roster of active colonies, but not entirely unexpected since the site received a beach nourishment the previous year and ENSP staff planted the nesting area with decoys. Staff also placed shelter boxes (to help the young combat the extreme heat) to supplement the small amount of cover that was present on-site.

<u>Piping Plover (Full Piping Plover reporting can be found in NJ E-1-35)</u>

- One hundred eleven (111) pairs of piping plovers nested in New Jersey in 2011, a 3% increase over 2010 (108 pairs). Despite the slight increase this year, the population has changed little over the past four years (111, 105, 108, and 111 pairs from 2008-2011, respectively). The 2011 population remained below the average number of pairs for the years since federal listing (119 pairs) and well below the peak of 144 pairs in 2003.
- The total number of adults recorded for the entire nesting season (228) was nearly the same as the count during the date-restricted survey conducted 1-9 June (222). However, the number of pairs tallied during the entire nesting season (111) was higher than those counted during the date-restricted survey (97), 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 account for most of the difference between the final season and the census pair counts.
- Pairs nested at 24 sites, up slightly from 2010 (22 sites), but still 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 35 nesting pairs (32% 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 2011 remained one of the lowest percentages of the state total since federal listing. This downward shift in the percentage of pairs monitored is the result of habitat conditions no longer being suitable at some of the sites monitored by NJDFW and the sharp jump in pairs at Sandy Hook (which is monitored by the National Park Service). NJDFW also regularly monitored 9 other potential breeding sites; breeding behavior was observed at most (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 2011 compared to 2010 (77% vs. 84%, respectively), but still well above the average for the period since

federal listing (66%). Looking at just NJDFW-monitored sites, pair-nest success was down strongly in 2011 compared to 2010 (63% vs. 79% respectively), but about average for the period since federal listing (67%), and 2010 was an especially strong year for hatch success.

- The statewide fledgling rate, which incorporates data collected by all the state cooperators was 1.18 fledges per pair, down from 2010 (1.39 fledges/pair), but it should be noted that 2010 was the highest rate ever recorded on a statewide basis. Although the 2011 statewide productivity rate was below both the 1.50 fledges/pair recovery goal and 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), it was still above average for New Jersey for the period since federal listing (1.01 fledges/pair). Productivity at NJDFW-monitored sites (0.77 fledges/pair for 35 pairs) was well below the 2011 statewide average, as well as below the rate for NJDFW-monitored sites in 2010 (0.94 fledges/pair).

Conclusions:

- The statewide black skimmer breeding population appears to have taken a slight dip this year. The peak adult total is the lowest posted in at least seven years. Over the past three field seasons the numbers have been dropping, not dramatically but consistently. Poor reproductive success in previous years, lack of suitable or attractive nesting areas, or birds selecting sites in other states may be responsible for this trend. It is unlikely that there were medium or large colonies of birds that went undetected since they would have been spotted during the long-legged wading bird survey (although skimmers are not a primary focus of that survey, they are always noted and their habitat is well covered by that survey's route).
- Black skimmer productivity was above average this year (1.57 chicks per pair). Coupled with last year's reproductive success, it may help reverse the recent declines and be enough to buoy the population as young skimmer mature and join the breeding population.
- 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 state's only other colony of note in the past few years, Mordecai Island, did not have enough suitable habitat to support a large number of birds and this year did not host any nesting.

- The statewide least tern breeding population was just one bird more in 2011 than 2010 (1,275 vs. 1,274 total adults, respectively), and on par with levels since 2004. 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 2011 (0.49 chicks per pair) was again higher than in some recent years, so hope for an increase in population remains strong.
- The number of active least tern colonies was stable compared to 2010 (20 vs. 19 active sites). 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 has increased this year. In addition to housing 99% of the black skimmer adult and fledge numbers, it also produced a little more than half of the least tern fledges for the entire state. In addition, there was also a very successful colony of common terns present and pairs of piping plover and American oystercatcher.

- New Jersey's piping plover population trend has remained flat over the past four years and below average for the period since federal listing. The flat trend was particularly discouraging in 2011 because 2010 saw the highest productivity for the state since coordinated monitoring began, and because annual population is closely correlated to productivity in the prior year (or two), we expected to see a sharper population increase this year. One factor which may explain why a bigger population increase was not seen statewide in 2011 is that the strongest productivity in 2010 (and in recent years) was recorded at Sandy Hook, so population growth was somewhat regionally limited. And, in fact, Sandy Hook has seen a steady population increase since 2006, accelerated the past three years by especially high fledgling rates (i.e. above the USFWS recovery goal of 1.50 chicks/pair in each of the past three years). A historic high of 49 pairs nested at Sandy Hook in 2011, compared to just 22 pairs in 2006, illustrating how population can dramatically increase over a short period of time when robust productivity occurs. Sustaining high productivity across the state (not just at

Sandy Hook) and more consistently from year to year remains the biggest challenge in trying to recover the piping plover population statewide in New Jersey.

- Although the factors that limit productivity continue 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, such as the piping plover. 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. 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; however 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 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 aerial survey, include them in the once every two weeks survey rotation.
- 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.
- Reduce suitability of habitat for least terns at Newark Airport by sealing cracks in pavement and spraying an herbicide to prevent grass from growing in. Although there are some positives about the site (low human disturbance, few mammalian predators), it is not a safe or productive site for these birds.
- 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.
- 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 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 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 2011 but 25 new nests were located during the course of nest checks by volunteers (Table 1), which raised the known nesting population to 531 pairs.
- In 2011 approximately 69% of the population was checked by 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 345 nests (Table 1). We grouped nests by watershed or water-body areas to which they were closest. Nest success averaged 2.07 young per active nest, one of the highest rates recorded by ENSP biologists and well above the rate necessary for a stable population. Nest productivity was similar between Delaware Bay and Atlantic coast colonies (2.10 vs. 2.07 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.
- Seven osprey eggs were collected during nest visits during the nestling-banding period. Eggs were collected only if they remained when nestlings were at least two weeks of age. Eggs were wrapped in aluminum foil and refrigerated, and will be opened and contents placed in chemically-clean jars and frozen. Eggshells will be rinsed and left to dry for $\geq$2 months.
- ENSP staff provided technical assistance and advice to the U.S. Coast Guard, the U.S. Army at Fort Monmouth, and communications companies, to deal with osprey nests in hazardous or unsafe locations.
- 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 information was gathered on fisheries' (menhaden and flounder species') trends to identify a potential correlation with osprey population parameters.
- No new volunteers were recruited for banding, but partner Conserve Wildlife Foundation of NJ organized volunteers to install over 15 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 at 500 pairs. Weather conditions during the nesting season were relatively mild, with no major storms to damage nests during incubation or young chick-rearing. The high productivity suggests that fish resources were more than adequate as well.
- ENSP's coordination of volunteers and licensed banders has made it possible to accurately track occupied nests and nest success as a measure of population stability.
- 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, assuming that the availability of dead trees will continue to be limited in the highly developed barrier islands of NJ.

- 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 2012 or 2013) to monitor population changes statewide and regionally. 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 additional volunteers to conduct nest checks. Investigate a data-reporting system to ease data handling.
- Continue to collect addled and unhatched eggs to archive for monitoring contaminant levels regionally and statewide.

Table 1. Osprey nesting and productivity in 2011 in all NJ nesting areas. Productivity determined by aerial and ground surveys in May-July. Productivity rates in 2007-2010 provided for comparison.

						Previous Years			
Nesting Area	**# Nests**	**Known-Outcome Nests**	**# Young**	**# Banded**	**Productivity 2011**	**2010**	**2009**	**2008**	**2007**
Delaware River & North Jersey	0 checked			n/a		n/a	n/a	n/a	n/a
Hackensack-Hudson Rivers	3	3	8	n/a	2.67				
Raritan Bay area (w/Cheesequake)	16	13	20	11	1.54	1.65	1.54	1.67	1.38
Monmouth County	17	14	28	n/a	2.00	1.86	1.25	n/a	n/a
Barnegat Bay	28	25	47	27	1.88	1.91	1.78	2.25	2.06
Sedge Islands WMA	25	21	50	40	2.38	1.29	1.57	1.75	1.15
Great Bay to Atlantic City	49	43	91	75	2.12	2.05	1.53	2.09	1.95
Great Egg Harbor/Ocean City	49	44	107	67	2.43	2.38	1.71	1.72	1.52
Sea Isle City	13	11	21	10	1.91	2.07	1.06	1.55	1.75
Avalon/Stone Harbor Bays	53	45	91	68	2.02	1.88	1.45	1.76	1.93
Wildwood Bays & Cape May	20	18	27	5	1.50	1.50	1.39	1.88	1.89
Maurice River & Estuary Marshes	64	50	103	102	2.06	2.10	1.78	2.11	2.07
Salem Co./ Artificial Island / Delaware Bay	8	8	19	9	2.38	2.50	1.81	1.80	1.70
TOTAL of Study Areas	**345**	**295**	**612**	**414**	**2.07**	**1.97**	**1.59**	1.88	1.78
Atlantic Coast only	273	237	490	303	2.07	1.92	1.53	1.82	1.72
Delaware Bay only	72	58	122	111	2.10	2.18	1.78	2.05	2.00
Total Statewide	**345**	**295**	**612**	**414**	--	**1.97**	**485**	**---**	**---**

JOB 1E: Colonial Waterbirds

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

OBJECTIVE 1: To census New Jersey's long-legged wading bird breeding populations through an aerial survey of the salt marshes of the Atlantic coast. Focal species will be great egret, snowy egret, glossy ibis, little blue heron, tricolored heron, yellow-crowned night-heron and black-crowned night-heron. In addition, conduct an inland heron survey (similar to the ground, volunteer-based effort of 2009) to capture the nesting night-herons inland and provide a better index of the state's populations of these two species.

Objective 1, Part 1: Aerial Wading Bird Survey

This part of the job was funded by Pittman-Robertson grant W-70-R-1, so the funds allocated to this task were held over to 2012 field season.

Objective 1, Part 2: Inland Heron Survey

Key Findings

- The inland night-heron survey time frame is May – November, so the survey was not completed by the end of this grant year. However, interim data is available and that is what will be reported here.
- Thirty-seven (37) sites were deemed suitable for surveys (i.e. they were active on the last survey period in 2009 or have been brought to ENSP's attention in the time since) this year. It was decided that the inland night-heron survey should be on the same rotation as the aerial survey to gain a better understanding on the night-heron population as a whole in the state (which was a recommendation from the 2009 survey SWG report). In the cases where it was possible, sites were surveyed the same week (and day in some instances) as the aerial survey for the middle survey period.
- Survey protocols were established in the 2009 survey and again worked very well. The survey protocol was developed using techniques described in Steinkamp et al. (2003). These were visual surveys in which observers were asked to visit each colony three times over the course of seven months. The first visit (1 May- 15 June) was timed early in the season to determine if the site was active and how many adults and nests were present. The second survey (1 July- 30 July) was timed to coincide with incubation/early brooding and observers counted the number of adults, nests and young/fledges that were visible (views are generally obscured during this survey by the leaves on trees). The final survey will take place in fall (15 October – 30 November) after the trees lose their leaves and the birds have migrated. Observers will be asked for a post-season nest count during this period. The stick nests that these species built are persistent and still present at this point, but the timing allowed for easier observation and no disturbance to the birds.
- In 2009, it was determined that the duration of the survey (7 months) may have led to observer fatigue resulting in a paucity of data submitted. To address that issue in 2011, the only volunteers asked to complete surveys were ones that ENSP has had success with in the past. All other sites were surveyed by staff. In total, four volunteers, one intern and seven staff members completed the surveys. 34 of the 37 colonies were visited at least one time (of the non- visited sites, two were locations submitted by the public and details regarding specific location could not be secured and the third was in an area deemed too dangerous for observers to visit as shootings had recently taken place in the vicinity).
- Of the 34 surveyed colonies, 18 were active (defined as at least one nesting pair present on at least one survey), 16 were inactive. One hundred-eighteen (118) total adults were counted, and 133 total fledges were observed. Eighty-eight (88) total nests were observed in the first two survey periods, but this number will likely increase after the third survey, when nests are easiest to view (due to leaves falling off trees). All nesting birds observed were yellow-crowned night-herons.

Conclusions:

- The data collected represents a much improved survey in 2011 compared with 2009. In 2009, 30 colonies were identified for inclusion in the survey but ENSP only received data back for 16 colonies. Of those surveyed, 9 sites were active and 27 adults, 25 fledges and 17 nests were tallied. In 2011, 37 sites were

identified for surveying and ENSP and volunteers collected data on 34 colonies. Due to this improved effort, 91 more adults, 108 more fledges and 71 more nests were counted in 2011.

- Conducting the survey with a combination of trusted volunteers and staff members led to much better return rate of data (53% in 2009, 92% in 2011).
- Although the number of pairs counted was much higher in 2011, the productivity of surveyed birds was relatively similar. In 2009 productivity was approximately 1.85 fledges/pair while in 2011 it was approximately 2.25 fledges/pair. The productivity necessary to maintain or grow a population in NJ is not well understood. Researchers studying black-crowned night-herons (a similar species) suggest that that 2.0-2.1 fledges/pair might be necessary for a stable population (Henny 1972). This indicates that inland night-herons may be producing enough young to help maintain the population, which is somewhat surprising considering the high degree of human impact and disturbance on many of these sites. However, reproductive rate estimates were not derived using the Mayfield method, so they are caveated with the note that they may be overestimating actual reproductive rates, by as much as 12% (Hothem et. al 2010).
- The total of 118 nesting birds is higher than the 95 yellow-crowned night-herons that were counted during the aerial survey of Atlantic coast marshes. It is known that the aerial survey underestimates dark-plumaged birds, so it is highly likely many more were nesting in the Atlantic coast marshes than were tallied. However, it is also likely that ENSP does not know the location of all the inland night-heron sites in the state and therefore the inland number could also be an underestimation. In any case, this survey highlights how important inland nesting sites are to the state population of adults and the production of young yellow-crowned night-herons.
- Regional, national and international meetings allow biologists to interact and share ideas on data collection and analysis as well better understand large-scale population trends. Interaction at this level accomplishes an ENSP goal of collaboration with regional biologists and understanding how they are working to recover species of conservation concern.
- Yellow-crowned night-herons appear to be far more likely to nest in residential areas, where many of these sites are located, than black-crowned night-herons.

Recommendations:

- Continue conducting the survey in the same year as the aerial survey takes place as it results in the most accurate state tally for night-herons. The next survey is slated for 2014.
- Continue using a combination of dependable volunteers and ENSP staff to ensure the most data is collected and reported on as possible.
- Consider changing second survey period to an earlier date. By July (and especially late July), it appeared that many birds had completed nesting for the season, which may have led to some fledges going uncounted as they may have already left the colony. The second survey period is currently 1-30 July. A better period may be 15 June – 15 July.
- Submit all data for inclusion into Biotics database and Landscape Project.

Literature Cited:

Henny, C. J. 1972. An analysis of the population dynamics of selected avian species with special reference to changes during the modern pesticide era. U.S. Fish Wildl. Serv. Res. Rept. No. 1.

Hothem, Roger L., Brianne E. Brussee and William E. Davis, Jr. 2010. Black-crowned Night-Heron (Nycticorax nycticorax), The Birds of North America Online (A. Poole, Ed.). Ithaca: Cornell Lab of Ornithology; Retrieved from the Birds of North America Online on 4 October 2011at http://bna.birds.cornell.edu/bna/species/074doi:10.2173/bna.74

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

Project Leader: Amanda Dey, PhD, 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.

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

- Adaptive Resource Management (ARM) Model and proposed harvest allocation method -- 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, none of the recommendations have been addressed by the ARM Technical Committee; however, a paper was published (McGowan et al. 2010).

  In late-2010 and early 2011, the newly formed Delaware Bay Ecosystem Technical Committee (Atlantic States Marine Fisheries Commission) met to review a new harvest allocation method proposed for use with the ARM Model. The model and allocation method were adopted by the ASMFC Horseshoe Crab Management Board in August, 2011, and will be included in the new harvest Addendum VII, available for public comment this fall.

  The new allocation method relies on genetic sampling from harvest trawls (~40 crabs/sample) to determine the proportion of Delaware Bay origin (DBO) crabs in each state's harvests. Delaware Bay Origin crabs are defined as spawning in Delaware Bay at least once. The proportion of DBO in the model (λ) was estimated, in most cases, from only one sample per state (NY, NJ, MD, VA). The consequence is that the allocation method fundamentally redefines breeding origin of horseshoe crab populations without rigorous data or testing and will increase the harvests of horseshoe crabs that breed in Delaware Bay. This undermines efforts by NJ and DE to reduce harvests. Moreover, the proportion of DBO has been accepted without the stated intention to conduct more rigorous genetic sampling from harvests to improve the estimate. This is critical to understanding how many Delaware Bay origin crabs are harvested annually. A minority report was filed, along with the Delaware Bay Ecosystem Technical Committee Report in August 2011, to address these and other concerns (Appendix I).

- New Jersey Moratorium on Horseshoe Crab Harvest – The New Jersey moratorium continued in 2011. The 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*, (Niles et al. 2007) and recovery targets identified in Niles et al. (2009).

- Beach Closures for migratory shorebirds -- 2011 marks the ninth year of beach closures during the shorebird migratory stopover on Delaware Bay (May 7-June 7). Thirteen sites on Delaware Bay and portions of two sites on the Atlantic coast were temporarily closed to allow shorebirds to forage and roost undisturbed by human recreation, (http://www.njfishandwildlife.com/ensp/beachclozmap.htm). Particularly during the last ten years of low egg densities, the 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.

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

- Mass Gains – As of this writing, Delaware capture data for 2011 were not yet available to update mass gains. We herein report further on mass gains to 2010 (in addition to the NJ T-1-5 report). We investigated the relationship between the proportion of knots in cannon-net catches (May 26-28) that achieved at least 180g and

egg densities by plotting these parameters using the median of the New Jersey and Delaware egg densities for May 14-27, 2005-2010, which shows a positive and significant relationship (Fig. 1). Therefore we are confident that conservation action to increase the densities of horseshoe crab eggs on the Delaware Bay beaches will be of real benefit to red knots in enabling them to achieve adequate departure mass by the time they need to leave for the Arctic.

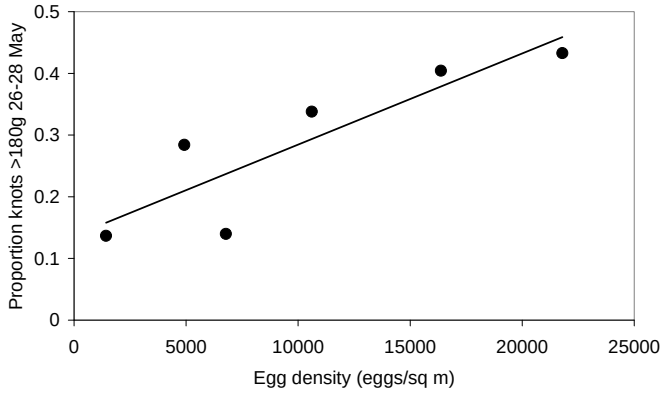

Fig. 1. Proportion of Red Knots in the >180 g body-mass category in Delaware Bay during 26-28 May plotted against the median horseshoe crab egg density during 14-27 May 2005-2010 for Delaware (excluding Mispillion Harbor) and New Jersey ($R_s = 0.94$, $p = 0.021$).

Like the red knot, ruddy turnstones have suffered reduced ability to reach departure mass. But reductions in both departure mass (g) and proportion of birds reaching threshold departure mass have not been as severe as seen in red knot (Sitters et al. 2009). Reduced ability to reach threshold departure mass in sanderlings is not significant (P=0.01) but is evident as slightly lower arrival and departure mass. Sanderling has apparently suffered the least of the three because it takes other prey, especially bivalves on Atlantic coast beaches. Turnstones can dig pits to find eggs, have a wider dietary breadth, and take prey from other habitats such as mussel spat in Atlantic coast marshes. This flexibility coupled with shorter migration distances may provide a temporal and energetic buffer against the loss of horseshoe crab eggs. Conversely, however, while semipalmated sandpipers forage mainly on Delaware Bay mudflats with some beach foraging, birds captured on Delaware Bay in May have demonstrated lower mass gain rates during 2000 to 2007 than were observed in the mid-1990's (Mizrahi and Peters, 2009).

It is clear that the spring stopover on Delaware Bay underpins successful migration and productivity of red knots and other Arctic-nesting species. However, because ruddy turnstone, sanderling and semipalmated sandpiper are less well studied in other periods of the year, the degree of impact from loss of the egg resources is not as well understood relative to threats that may exist elsewhere (e.g., wintering, breeding, other migratory stopovers). Recent winter surveys conducted in January 2011 in northern South America (Surinam, French Guiana, Brazil), however, showed significant declines (55–90%) in red knots, ruddy turnstones and semipalmated sandpipers (Mizrahi and Morrison, pers. comm.) from original Atlas counts in the early-to-mid 1980's (Morrison and Ross 1989) and supports the notion that shorebird populations are, in fact, declining not simply using another stopover outside of the Delaware Bay.

- Stopover Population Size on Delaware Bay - From 1986 to 2011, shorebirds in Delaware Bay were monitored by a weekly aerial count (May – early June) organized by K.E. Clark who retired from this task in 2008. This afforded an opportunity to reconsider the methodology. The aerial survey had covered the shoreline proper of Delaware Bay, but because the aircraft had flown out and back along the length of the Mispillion Harbor entrance channel, the inner harbor was poorly covered. Moreover, varying numbers of knots (from few to 4,000) routinely feed on mussel spat in the Atlantic marshes near Stone Harbor, NJ, an area not covered by the aerial survey; these birds may also feed in Delaware Bay. We acknowledge that including these two areas in the survey might show an increase that would only reflect more complete survey coverage.

  We used experimental methods in 2009 and 2010 to attempt to calibrate aerial surveys using ground surveys. As detailed in the 2010 NJ T-1-5 report, a variety of problems prevented reliable calibration of aerial surveys

with ground counts at enough sites to be useful. Comprehensive ground counts performed before the aerial survey (same day) provide a reasonable comparison for specific sites where large numbers of birds are present (e.g., Mispillion Harbor DE), and may be used in place of an aerial count if deemed more accurate. Ground counts are useful as a check against the overall baywide abundance relative to aerial counts. Aerial survey is still critical for detecting large numbers of birds that are inaccessible by ground (e.g., Egg Island Point, NJ). Therefore, we continued ground and aerial surveys together in 2011, particularly during periods of peak migration activity and on sites with large numbers of birds. However, we must note that one observer changed in the 2011 season surveys.

In 2011, the peak of red knots abundance occurred on May 23 (12,804) (Fig. 4). This count is 1,671 birds less than last year's peak on May 25 (14,475). Although lower, the 2011 count is within the margin of counting error of previous years, and red knot peak abundance is apparently comparable to 2010.

The peak count of ruddy turnstone in 2011 was 14,750 – the lowest abundance recorded in the history of the survey (Fig. 5). This peak count, recorded on May 19, must be treated with caution as a ground count for ruddy turnstone on May 23 was not conducted in Mispillion Harbor which may have produced a higher count for the season. Although we stopped counting sanderling and semipalmated sandpiper in 2008, peak counts are provided below. Stopover population size of these species is variable year to year and long-term trend is not apparent.

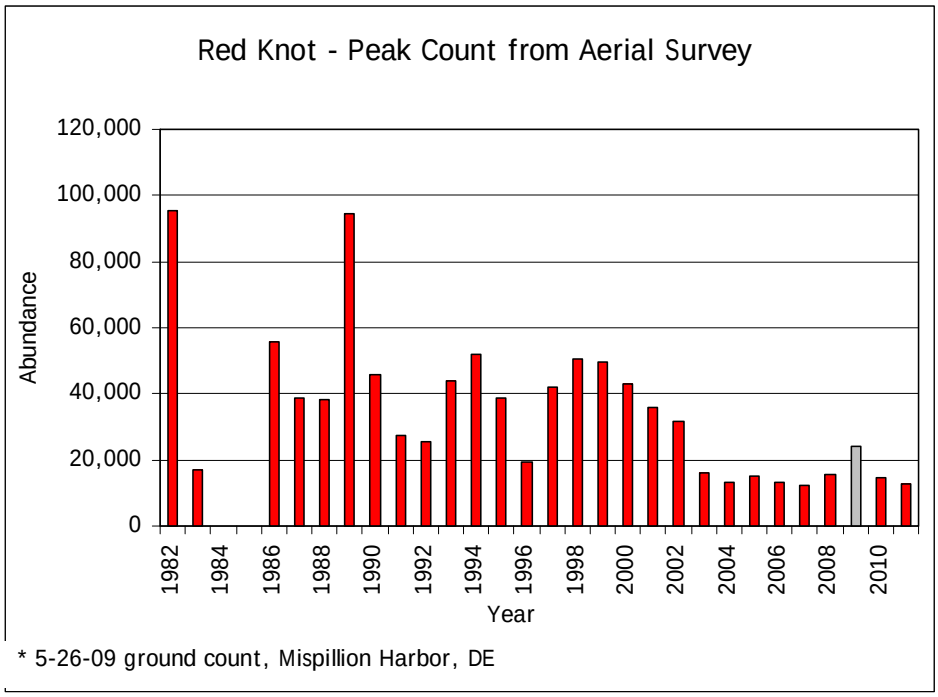

Fig. 4. Peak aerial count of Red Knots in Delaware Bay during spring stopover 1982-2011; the figure for 2009 is a ground count.

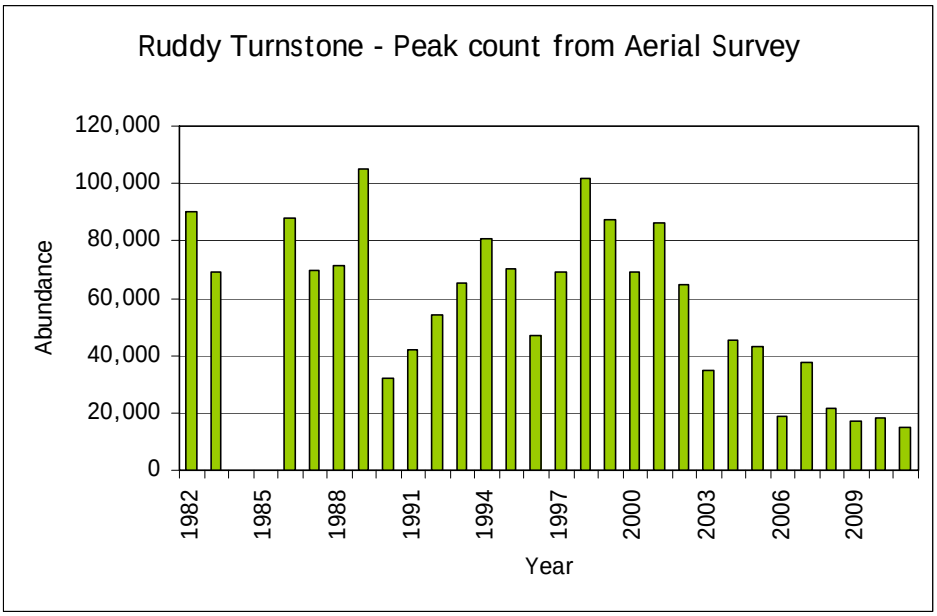

Fig. 5. Peak aerial count of Ruddy Turnstone in Delaware Bay during spring stopover 1982–2011.

- East Coast Aerial Survey – Counts for 2011, were not available for MD, VA, and NC at the time of this report. Therefore, we report herein the partial information available. Red knots stopping over along the US Atlantic coast during peak migration (May 20–24) were surveyed again in 2011 (Table 1). In 2011, states performed aerial and ground survey on May 23, NJ, DE, GA (aerial), FL (ground) and May 20-26 in SC (ground). Preliminary peak numbers in 2011 were 21,190. Coverage in SC was reported to be lacking in 2011 (F. Sanders pers. comm.); numbers in VA may have been lower than 2010 (B. Watts pers. comm.). Until counts from MD, VA and NC are reported, it is unclear how 2011 stacks up to previous years.

Despite the logistic difficulties of carrying out this survey, coverage of unsurveyed areas has improved (e.g., FL and MD) and states are making best efforts to coordinate survey dates to improve confidence in peak numbers detected. However, funding is now more critical because all states are experiencing budget cuts. To date, this survey has been mainly funded by the NJ Natural Lands Trust.

Table 1. Counts of Red Knots along the US east coast from Florida to Delaware Bay carried out over two consecutive days during 20-24 May in each year from 2006 to 2011.

State	**2006**	**2007**	**2008**	**2009**		**2010**	**2011**
New Jersey	7,860	4,445	10,045	7,631	(16,229)‡	8,945	7,737
Delaware	820	2,950	5,350	5,730		5,530	5,067
Maryland	NS	NS	663	78		5	**
Virginia	5,783	5,939	7,802	3,261		8,214	**
North Carolina	235	304	1,137	1,466		1,113	**
South Carolina	NS	125	180	10		1,220 †	315 †
Georgia	796	2,155	1,487	NS		260	3,071
Florida	NS	NS	868	800		41 †	5,000 †
TOTAL	**15,494**	**15,918**	**27,532**	18,976	**(21,844) ‡**	**25,328**	**21,190**

† Ground count

‡ Corrected 2009 NJ & DE aerial counts (calibrated by ground counts) and corrected 2009 east coast total; (Note: 2009 SWG report contained un-calibrated aerial counts for NJ & DE and differed from calibrated count reported in Niles et al. 2010).
** Aerial survey data not yet available

- Survival and population size estimates from resightings of marked birds – 2011 was the second year we collected ratios of marked to unmarked red knots on Delaware Bay. Jim Lyons of USFWS Patuxent has developed a model that uses ratios to estimate population size. No progress has been made on the development of survival estimates from resightings of individually-marked birds.

Objective 3: Assess recovery of the horseshoe crab egg resource

Key Findings:

- Horseshoe Crab Egg Densities -- New Jersey egg densities in 2009 and 2010 were only marginally lower than those recorded in 2005, the benchmark year for the egg density index and the first year eggs were counted on both sides of the bay using the same method. During 2005-2010, egg densities in Delaware were invariably higher on average than in New Jersey (Fig. 3a) and were far higher if Mispillion Harbor is included with the rest of the Delaware data. Densities in Mispillion Harbor averaged 769,000/m^2 in 2010 (Fig. 3b). Excluding this one site brought Delaware's average down to 33,006/m^2, which is similar to 2005 (Fig. 3a). Here we treat egg densities in Mispillion Harbor separately from the remainder of the Delaware shore to accurately reflect foraging conditions for shorebirds along the bayshore as a whole, while understanding that the egg resources in Mispillion Harbor likely has a very positive effect on Red Knots gaining weight. The knot population that the bay can support might be much lower if it were not for the extremely high egg densities in Mispillion Harbor.

Fig. 3a.

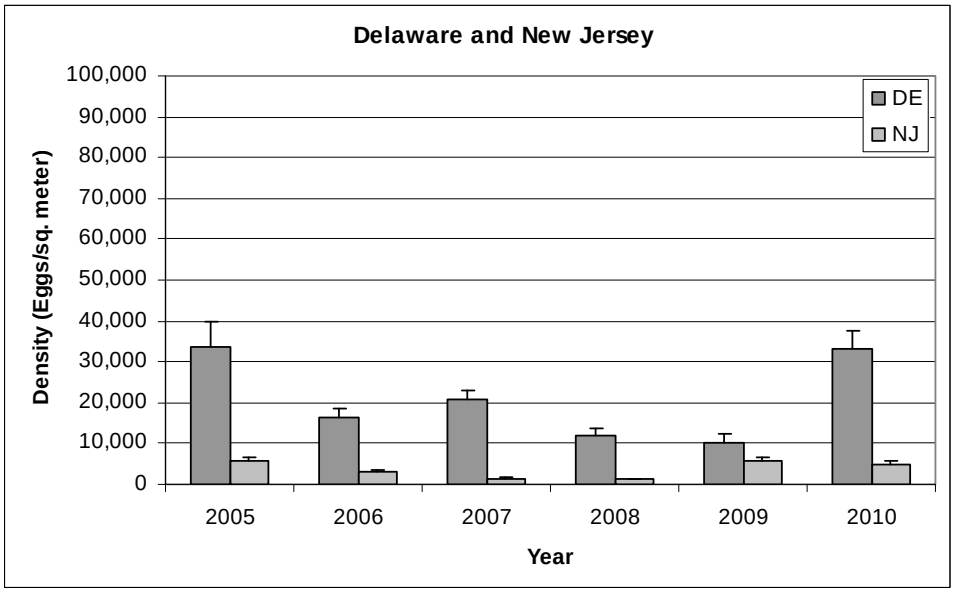

Fig. 3b.

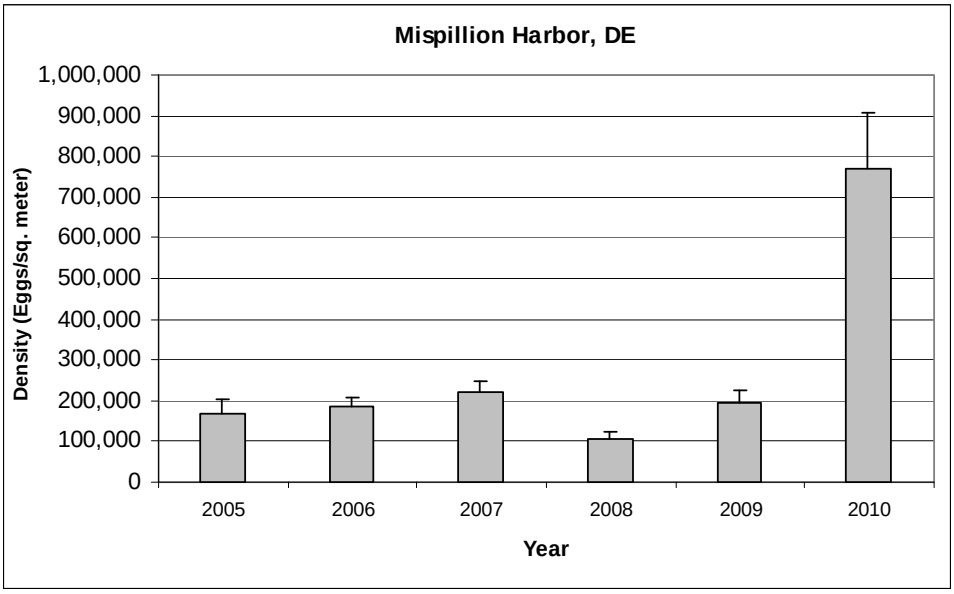

Fig. 3 a & b. Density of horseshoe crab eggs in the top 5 cm of sand of Delaware Bay beaches during May and early June 2005-2010: (a) the bay beaches of Delaware and New Jersey, (b) Mispillion Harbor; note difference in scale (Source: DE Division of Fish and Wildlife and the NJ Division of Fish and Wildlife).

There are three main surveys for horseshoe crabs:

- The Delaware 30-foot Trawl Survey showed lower numbers of adult horseshoe crabs in Delaware Bay in 2010 than in 2009 but no significant trend over 2004-2010. The 2010 average of 0.75 crabs/tow is far lower than that of 1989 when it was >7 crabs/tow (S. F. Michels pers comm.).
- The Delaware Bay Spawning Crab Survey shows that there has been no significant trend in the density of breeding females during 1999-2009, but males have shown a significant year-on-year increase and in 2010 outnumbered females by 4.2 to 1 (Michels *et al.* 2011). Overall, the mean densities of male crabs are similar between states (S. Michels and J. Zimmerman, pers. comm.).
- The Virginia Tech Benthic Trawl shows no significant change in the number of mature or newly mature males or females over 2001-2010 (Hata and Hallerman 2011). The ratio of mature males to mature females in this survey in 2009 was 2.19:1. The ratio of males to females increased in 2010 to approximately 2.64:1.

With little evidence of a significant increase in the mature horseshoe crab population in these surveys, it seems likely that the improved feeding conditions for Red Knots in 2009 and 2010 arose largely because of a closer match between the timing of crab spawning and the birds' stopover resulting from the unusually settled weather in both years.

Key Findings: South American and U.S. Wintering and Stopover Areas (*Funded by other sources, not SWG*)

- The number of red knots in Tierra del Fuego declined from 16,260 in 2010 to 9,850 in 2011, a 39% decline in the space of one year and an 81% decline since 2000 (Figure 7). This decline occurred after six years of apparent stability and indicates that conditions for long-distance red knots may be worsening. The Tierra del Fuego wintering population historically held the majority (70%, 53,232 individuals) of the South America wintering population (Morrison and Ross, 1989). As recently as 2000, Tierra del Fuego still held 51,225 red knots. This trajectory is consistent with extinction probabilities predicted by Baker et al. (2004).

- Recent winter counts of red knots in northern Brazil showed a 55% decline, from 8,846 in 1986 (Morrison and Ross 1989) to 3,980 in 2011 (Mizrahi and Morrison pers comm.). This is the first systematic count of this sector (Beleme to Sao Luis) conducted since the Shorebird Atlas. The west coast of Florida is one of the most important wintering areas for the *rufa* red knot in the US. The wintering population declined from an estimated 10,000 knots in the mid-1980's (B. Harrington pers. comm.) to 3,020 in 2006 (Niles et al. 2006), and may now

be less than 1,400 individuals as of 2010 (Dey et al. 2011). High levels of human disturbance on Florida beaches may be contributing to the decline in winter numbers there. Estimates of red knots wintering along the U.S. east coast (GA to VA) have apparently increased from 1,549 (2005) (Niles et al. 2006) to 2,454 (2011) (L. Niles, pers. comm.) although counts from VA are missing for this 2011 total.

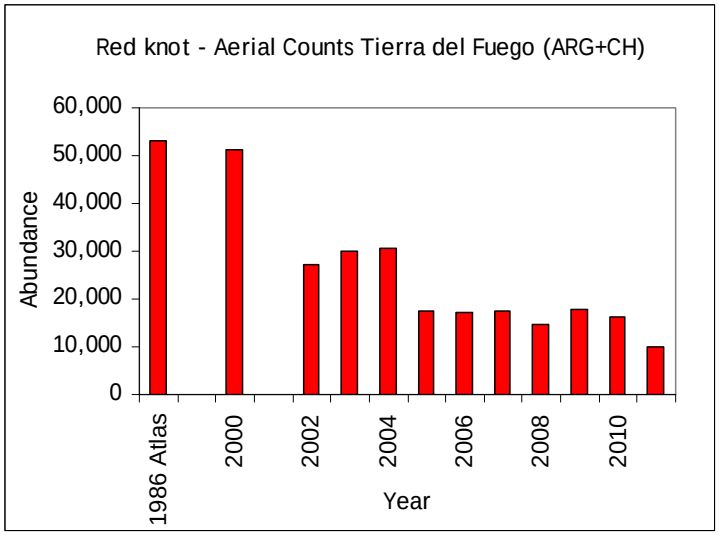

Figure 7. Red knot and Hudsonian godwit abundance on Tierra del Fuego (Chile and Argentina).

Conclusions: Delaware Bay

- There is little indication that the Delaware Bay horseshoe crab breeding population is increasing, and the population may be at a level too low to support even the reduced number of shorebirds that now use the Delaware Bay.
- Current NJ egg densities (mean = 5,969 eggs/m^2 in 2011) are not sufficient to support the migrant shorebird population; eggs must be increased to a minimum of 50,000 eggs/m^2 on 50% of suitable spawning beaches to recover the stopover.
- In 2011, the red knot population on Delaware Bay remained stable and abundance was commensurate with aerial counts of 2010. Ground and aerial surveys will continue to be carried out to capture baywide abundance and abundance inside Mispillion Harbor, DE and Stone Harbor Point, NJ.
- The improved conditions in crab spawning 2009 to 2011 (good weather and apparent increase in spawning activity) led to a greater proportion of red knots and other species gaining adequate departure weight in 2009 and 2010 although this was still well below the target threshold of 60 percent. The proportion of knots reaching threshold mass in 2011 was not yet available to report.
- Ruddy turnstones have suffered declining trends in departure mass gain and abundance similar to red knot but not to the same magnitude. It is likely that reduced mass gains on this last stopover before Arctic breeding impacts most shorebirds in a similar manner (reduced adult survival, reduced productivity) and may account for declines in abundances of these shorebirds on the Delaware Bay and in wintering areas.
- Analogous to red knot, semipalmated sandpipers have declined in the rate of mass gain while on Delaware Bay.
- Beach closures during peak migration continue to be a critical part of management for migratory shorebird populations on Delaware Bay. Recent studies of southbound migrant red knots, fitted with light-sensitive geolocators, have shown they make non-stop flights from the US to South America and rely on Atlantic Coast stopover sites in MA and NJ to build fat reserves before transocean flights to Brazil (Niles et al. 2010). Therefore, reduction of human disturbance on the most important Atlantic coast beaches, especially on roost sites, may be necessary for southbound migrant populations that begin arriving on the US east coast in mid-July at the height of recreational beach use.

Conclusions: South American and US Wintering and Stopover Areas

- Bahia Lomas in Tierra del Fuego remains the most important wintering site for red knots in the Western Hemisphere.
- The greatest threat to the Tierra del Fuego population – long-distance migrants that rely most heavily on Delaware Bay -- is limited horseshoe crab egg resources. In 2011, the red knot wintering population in Tierra del Fuego suffered a 39% decline, which is consistent with the extinction trajectory predicted in Baker et al. (2004).

Recommendations: Delaware Bay

- Continue current studies on Delaware Bay of shorebird numbers, rate of mass gain, and horseshoe crab egg densities, as continuing inputs for management models.
- Continue efforts to develop a system for annual determination of population size and status based on survey results, capture data and resightings of banded individuals in Delaware Bay and throughout the Atlantic Flyway. Develop annual estimates of productivity and juvenile survival as inputs for population models. Determine key southbound and northbound stopovers that account for at least 80% of stopover areas supporting at least 100 red knots, and develop coast wide surveillance of birds as they migrate.
- Reduce/control disturbance at all stopovers and wintering areas.
- Restore horseshoe crab egg resource to a level that will support a recovered red knot stopover population of 80,000 to 100,000 red knots.

Recommendations: South American and US Wintering/Stopover Areas

- Help to determine the genetic and breeding status of the three main wintering populations (Tierra del Fuego, Maranhao and Florida).
- Help to create a hemisphere-wide system of protected areas for each significant wintering, stopover and breeding area.
- Help to complete site assessment, using Western Hemisphere Shorebird Reserve Network (WHSRN) site assessment tools, for Bahia Lomas, Rio Grande, San Antonio Oeste, Lagoa do Piexe, Maranhao, the west coast of Florida, the Altamaha Region of Georgia, the Virginia Barrier Islands, Delaware Bay, Stone Harbor Point, James Bay, Southampton Island and King William Island.
- Help to delineate and propose protection measures for key habitats within the main wintering areas of Maranhao, Tierra del Fuego and Florida, and develop management plans to guide protection.

Literature cited:

Boyd, H. and T. Piersma. 2001. Changing balance between survival and recruitment explains population trends in Red Knots Calidris canutus islandica wintering in Britain, 1969-1995. Ardea 89: 301-317.

Baker, A. J., P. M. González, T. Piersma, L. J. Niles, I. L. S. do Nascimento, P. W. Atkinson, N. A. Clark, C. D. T. Minton, M. K. Peck, and G. Aarts. 2004. Rapid population decline in red knot: fitness consequences of decreased refueling rates and late arrival in Delaware Bay. Proceedings of the Royal Society B 25:125-129.

Dey, A. D., L. J. Niles, H. P. Sitters, K. Kalasz, R. I. G. Morrison. 2011. Update to the status of the red knot Calidris canutus in the Western Hemisphere, April 2011 (with revisions to July 14, 2011). Report provided to the USFWS for annual candidate status review; 15 pgs.

Gillings, S., P.W. Atkinson, A.J. Baker, K.A. Bennett, N.A. Clark, K.B. Cole, P.M. González, K.S. Kalasz, C.D. T. Minton, L.J. Niles, R.C. Porter, I.L. Serrano, H.P. Sitters & J.L. Woods. 2009. Staging behavior in Red Knot (*Calidris canutus)* in Delaware Bay: implications for monitoring mass and population size. *Auk* 126: 54-63.

Hata, D. & E. Hallerman. 2011. 2010 horseshoe crab trawl survey: Report to the Atlantic States Marine Fisheries Commission Horseshoe Crab Technical Committee. VA Tech., Blacksburg, VA. 28 pp.

Leschen, A. S. and S. J. Correia. 2010. Mortality in female horseshoe crabs (Limulus polyphemus) from biomedical bleeding and handling: Implications for fisheries management. Marine and Freshwater Behaviour and Physiology 43(2):135-147.

Michels, S. F., D.R. Smith & S. Bennett. 2011. Horseshoe crab spawning activity in

Delaware Bay: 1999 - 2010. Report to the Atlantic States Marine Fisheries Commission's Horseshoe Crab Technical Committee (May 30, 2011).

Michels, S. and J. Zimmerman, Delaware Department of Natural Resources and Environmental Control. Pers. comm. concerning interpretation of horseshoe crab spawning density (males).

Morrison, R. I. G. and B. A. Harrington. 1992. The migration system of the red knot *Calidris canutus rufa* in the New World. Wader Study Group Bulletin 64(Supplement): 71-84.

Morrison, R. I. G. and R. K. Ross. 1989. Atlas of Nearctic shorebirds on the coast of South America**.** 2 vols. Special Publication, Canadian Wildlife Service, Ottawa, Ontario. 325 pp.

Mizrahi, D. S. and K. A. Peters. 2009. Relationships between sandpipers and horseshoe crabs in Delaware Bay: A synthesis. In: J. T. Tanacredi, M. L. Botton, and D. R. Smith (eds.), *Biology and Conservation of Horseshoe Crabs*, Springer, NY.

Niles, L.J., Dey, A.D., Douglass, N.J., Clark, J.A., Clark, N.A., Gates, A.S., Harrington, B.A., Peck, M.K. & Sitters, H.P. 2006. Red Knots wintering in Florida: 2005/6 expedition. *Wader Study Group Bull.* 111: 86-99.

Niles, L. J., H. P. Sitters, A. D. Dey, A. J. Baker, R. I. G. Morrison, D. E. Hernandez, K. E. Clark, B. A. Harrington, M. K. Peck, P. M. Gonzalez, K. A. Bennett, K. S. Kalasz, P. W. Atkinson, N. A. Clark, C. D. T. Minton, C. Espoz, R. Matus N., I. L. Serrano. 2007. Status of the Red Knot (*Calidris canutus rufa*) in the Western Hemisphere. 270 pgs. Prepared for the US Fish and Wildlife Service, Ecological Services, Region 5, NJ Field Office, Pleasantville, NJ 08232.

Niles, L. J., H. P. Sitters, A. D. Dey, P. W. Atkinson, A. J. Baker, K. A. Bennett, R. Carmona, K. E. Clark, N. A. Clark, C. Espoz, P. M. González, B. A. Harrington, D. E. Hernández, K. S. Kalasz, R. G. Lathrop, R. N. Matus, C. D. T. Minton, R. I. G. Morrison, M. K. Peck, W. Pitts, R. A. Robinson & I. L. Serrano. 2008. Status of the Red Knot, *Calidris canutus rufa*, in the Western Hemisphere. *Studies Avian Biol.* 36: 1-185.

Niles, L.J., J. Bart, H. P. Sitters, A.D. Dey, K.E. Clark, P. W. Atkinson, A.J. Baker, K.A. Bennett, K. S. Kalasz, N. A. Clark, J. Clark, S. Gillings, A. S. Gates, P. M. Gonzalez, D. E. Hernandez, C. D. T. Minton, R. I. G. Morrison, R. R. Porter, R. K. Ross, and C. R. Veitch. 2009. Effects of Horseshoe Crab Harvest in Delaware Bay on Red Knots: Are Harvest Restrictions Working? Bioscience 59:153-164.

Niles, L.J., H.P. Sitters, A.D. Dey, N. Arch, P.W. Atkinson, V. Ayala-Perez, A.J. Baker, J. Buchanan, R. Carmona, N.A. Clark, C. Espoz, J.D. Fraser, P.M. Gonzalez, B.A. Harrington, D.E. Hernandez, K.S. Kalasz, R. Matus, B. McCaffery, C.D.T. Minton, R.I.G. Morrison, M.K. Peck, W. Pitts, I.L. Serrano, and B.D. Watts. Status of Red Knots *Calidris canutus* in the Western Hemisphere: February 2008 – April 2010.

Niles, L.J., H.P. Sitters, A.D. Dey, N. Arce, P.W. Atkinson, V. Ayala-Perez, A.J. Baker, J.B. Buchanon, R. Carmona, N.A. Clark, C. Espoz, J.D. Fraser, P.M. Gonzalez, B.A. Harrington, D.E. Hernandez, K.S. Kalasz, R. Matus, B.J. McCaffery, C.D.T. Minton, R.I.G. Morrison, M.K. Peck, W. Pitts, I.L. Serrano & B.D. Watts. 2010. Update to the Status of the Red Knot *Calidris canutus* in the Western Hemisphere, April 2010

Niles, L.J., J. Burger, R.R. Porter, A.D. Dey, C.D.T. Minton, P.M. Gonzalez, A.J. Baker, J.W. Fox, and C. Gordon. First results using light level geolocators to track Red Knots in the Western Hemisphere show rapid and long intercontinental flights and new details of migration pathways. Wader Study Group Bulletin 117 (2):123-130

McGowan, C. P., J.E. Hines, J.D. Nichols, J.E. Lyons, D.R. Smith, K.S. Kalasz, L.J. Niles, A.D. Dey, N.A. Clark, P.W. Atkinson, C.D.T. Minton, W. Kendall. 2011. Demographic consequences of migratory stopover: Linking red knot survival to horseshoe crab spawning abundance. Ecosphere 2(6): art69. doi:10.1890/ES11-00106.1.

Sitters, H. P. S., L. J. Niles, A. D. Dey. 2009. Why have red knots, ruddy turnstones and sanderlings reacted differently to the decline in horseshoe crab availability in Delaware Bay? Abstract; Proceedings of the stated meeting of the American Ornithologists Union, August 12-15, 2009.

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 2011 the New Jersey peregrine falcon population remained nearly steady at 24 known pairs (Figure 1). One nest site was moved and due to timing was unavailable for use in 2011. Two additional pairs were likely active in Newark and Kearny; their locations were unknown but recent fledglings were recovered from areas likely to support nesting. Other pairs recently discovered on bridges could not be monitored but were assumed to be territorial, especially two bridge pairs found in 2009 (Rt. 3/Hackensack where bridge construction occurred, and the Newark Bay Bridge). There were four occupied territories in cliff habitats, two of which were successful in fledging two each, the first success since 2008.

- 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 24 young, for a productivity rate of 1.71 young per active nest, which is the long term average for New Jersey since 1986 when the population stabilized. Weather conditions during incubation and chick-rearing were fair, but there were more than the normal number of nests with reduced hatching that resulted in one-chick nests. Biologists treated <2 week old hatchlings with bird lice spray at two building sites and three tower sites to reduce infestations of parasitic flies (*Carnus hemapterus*); which have caused mortality of young hatchlings in recent years. One chick died at just one day of age at Forsythe-Brigantine due to this infestation, but its two siblings were successfully treated at the same age.
  - ⊕ Four pairs occupied territories in natural cliff habitat in northeastern NJ, down one from last year; ravens occupied one site used in 2010. Two of the four pairs were successful in fledging two young each, the first success since 2008. Pairs at two other sites were assumed to have failed since no post-hatching behaviors were observed.
  - ⊕ Of six pairs on bridges, four were known to have produced ten young, for a rate of 2.50 young/active nest, although two died shortly after fledging. Some previously occupied bridges (e.g., Trenton, Hackensack and Newark Bay) were not tracked due to insufficient staff or volunteers. New Jersey monitored three pairs on bridges spanning the NJ-PA border. Pairs on the Betsy Ross and Walt Whitman bridges raised four and three young, respectively; with the Whitman Bridge pair on the PA end of the bridge. We removed three of the four young from the Betsy Ross Bridge for hacking in WV; in a tragic demonstration of the perils of bridge nesting, the remaining young was killed on the roadway about a week after fledging. Pairs at Burlington-Bristol and Tacony-Palmyra bridges produced four and two young, respectively; three of the chicks from the Burlington Bridge were transferred to WV's hack program. One fledgling at the Tacony-Palmyra was killed on the roadway. Other bridges may have been occupied, but the program lacked monitors in northern NJ to document all possible sites.

- For a sixth year, NJ donated peregrine nestlings to the New River Gorge hack site in West Virginia. A total of 11 young were collected (six from bridges, three from coastal towers, and two found in north Jersey as recent fledglings). Ten of those eleven were delivered to and hacked at the New River Gorge hack site near Beckley, with oversight and direction from West Virginia DNR, the National Park Service and Three Rivers Avian Center. (One young was killed by a predator while temporarily held at Tri-State Bird Rescue). New Jersey supports the WV hacking program with peregrines because these young birds would face high competition if they remained in the coastal population (where production is above the minimum needed for population stability), and their transfer to the southern Appalachians supports the recovery of the peregrine in that part of the range.
- We banded all but five of the 38 young produced at 18 nests, using both a federal band and a bicolor band with an alpha-numeric code.

- Staff collected six 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. One adult carcass recovered in Atlantic City was necropsied, and brain and liver tissues were archived for future contaminant analysis.
- In 2011 we continued to use remote, motion-activated cameras to photograph peregrines at nests. Using this method we read the leg bands on 19 breeding adults at nine nest sites (three adults were identified at one site). An additional nine adults were identified using optics. The oldest birds identified were a 15 year old female at Ocean Gate (a nest that failed in 2011 and has produced just two young in the last four years) and a 12 year old male nesting at Swan Bay WMA. 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.
- Several peregrines were recovered or resighted in 2011. One female (black/red M/*S) was observed in a pair nesting on the Brooklyn Detention Complex. NY; she fledged from Jersey City in 2004. An adult male was spotted at the Verizon building in White Plains, NY; X/82 (black/green) was banded at the Alpine cliff nest in 2008. A peregrine banded last year in Tuckahoe was found dead in Northfield, NJ in March, 2011, having hit a house window.
- All nest sites were maintained during the non-nesting season. New predator guards were installed on one tower and repairs were made to guards on others. Gravel was cleaned or replaced at all coastal nests to reduce the over-winter survival of parasitic fly eggs (*Carnus hemapterus*), which seemed to help but did not eliminate the problem. The nest igloo at Heislerville was removed in February and set at a site two miles inland to reduce potential conflicts with migratory shorebirds using the Delaware Bayshore beaches. The replacement site was not finished until May 2, so this pair was displaced for the season; the male that had nested there since 2008, however, was resighted nesting in Sea Isle City, apparently displacing a younger male there.
- 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 proposed changes to the list of nongame wildlife (N.J.A.C. 7:25-4.17), which, if passed in early 2012, will change the non-breeding season status of NJ peregrines from endangered to special concern. That change, along with NJ Game Code changes, will allow NJ falconers to take passage peregrines in future years (under USFWS purview).

Conclusions:

- The peregrine population remained steady between 2010 and 2011, but nest success and productivity dropped back (from 2010) to an average level (Figure 1). Across all sites – towers, building, bridges and cliffs – nest success was 75% and produced 1.46 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 are to consider the historic habitat important for long term stability; targeted investigation of the cause of those losses is necessary to 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.

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.
- 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.

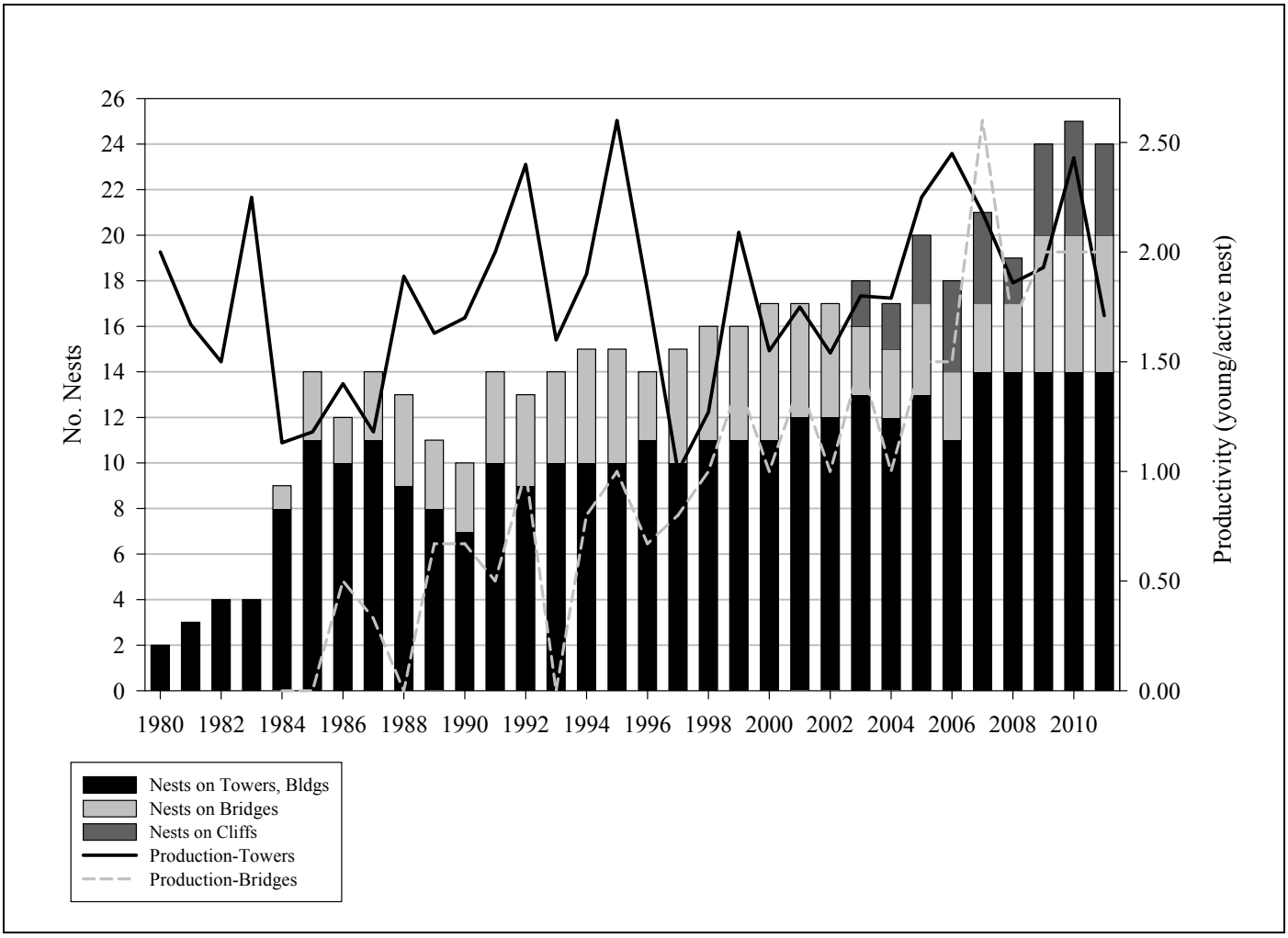

Figure 1. Nesting and productivity of peregrine falcons in New Jersey, with comparisons between towers/buildings, cliffs, and bridges.

Table 1. Site-specific results of peregrine falcon nesting in New Jersey, 2011.

Name	Occupied	Active	Eggs	Yng Hatched	Yng@ BandAge	Yng Fledged	Comments
Sedge Island WMA Tower	Y	Y	Unk	1	1	1	
Forsythe NWR/Brigantine Tower	Y	Y	3	3	2	2	1 hatchling died @1 d; Carnus fly infestation
Forsythe NWR/Barnegat Tower	Y	Y	4	1	1	1	Coll 2 eggs
Marmora WMA / Sea Isle Tower	Y	Y	4	1	1	1	Coll 2 broken eggs
Great Bay WMA/ water tower	single	N					
Heislerville WMA Tower	N/A						Box removed; set 5/2 @prison
Egg Island WMA Tower	Y	Y	4	4	4	4	3 transferred to WV
Swan Bay WMA Tower	Y	Y	4	2	2	2	
Tuckahoe WMA Tower	Y	Y	3	1	1	1	Coll. 2 eggs
Ocean Gate (AT&T) Tower	Y	Y	≥2	0	0	0	Unknown interference?
Stone Harbor marsh	Y	Y	3	3	3	3	
Margate marsh	Y	Y	Unk	Unk	Unk	≥1	Ospr nest 167-B-16; not banded
Hilton/The Grand Casino	Y	Y	5	2	2	2	Coll 2 eggs
101 Hudson, Jersey City	Y	Y	4	3	2	2	1 removed @1wk, rehabbed & unreleasable
Newark –*Unknown location*	U					1	Found, rehabbed, WV
Elizabeth-Union Co. Court House	Y	Y	3	3	3	3	
Sewaren building	U	U					
Refinery (Greenwich-Paulsboro)	Y	Y	unk	2	2	2	Not banded
SUBTOTAL TOWERS & BUILDINGS	***14***	***14***		***26***	***24***	***26***	
Natural Site C-1 (Alpine)	Y	Y	4	2	2	2	Banded 6/6
Natural Site C-2 (South)	Y	Y	Unk	≥2	2	2	Not banded
Natural Site C-3 (South)	N	N					
Natural Site C-4 (North)	Y	Y	Unk	0	0	0	
Natural Site C-5 (Tenafly)	PO	PA	?	?	0	0	
SUBTOTAL NATURAL SITES	***4***	***4***		***4***	***4***	***4***	
G. Washington Br. (Hudson River)	Y	Y					NY side/NY monitored
Betsy Ross Br. (Delaware River)	Y	Y	4	4	4	4	3 transferred to WV; 4th died on roadway
Walt Whitman Br. (Delaware R.)	Y	Y	?	3	3	3	PA
Ben Franklin Br. (Delaware River)	Y	Y	?	4	4	4	PA
NJ-PA Turnpike (Delaware River)	Y	Y	?	3	3	3	PA
Tacony-Palmyra (Delaware River)	Y	Y	?	2	2	2	1 died on roadway
Burlington-Bristol (Delaware R.)	Y	Y	4	4	4	4	3 transferred to WV
Rt 78-Scudders Falls Bridge	Y	Y	?	?			PA
Brigantine Bridge (A.C.)	N	N					
Vince Lombardi - NJTP Bridge	U	U					
Secaucus-Kearny NJTP Bridge	U	U					
Newark Bay Br. (NJTP or Conrail)	Y	Y	?	?	?	?	Conrail bridge?
Trenton RR Bridge	U	U					
Route 3 Br./Hackensack (NJDOT)	Y	Y	?	?	?	?	Unknown outcome
Route 35/Belmar Bridge	Y	Y	?	?	0	0	
SUBTOTAL BRIDGES	***6 (NJ)***	***6***		***10***	***≥10***	***≥10***	
TOTALS (NJ only)	**24**	**24**		**40**	**≥38**	**≥40**	**(incl. 11 yng to WV)**

JOB1H: Grassland Birds

Project leader: Kim Korth, Senior Zoologist

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

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

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

Key Findings:

- New Jersey Audubon (NJA) was again contracted to use trained Citizen Scientist volunteers to conduct bird surveys on 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 bird surveys per survey location to record the number of breeding target grassland birds. Volunteers were provided training to assure adherence to methodology and were instructed to record and map the location of individual target species.
    - Bird Survey I (May 15 to May 31, 2011)
    - Bird Survey II (June 1 to June 15, 2011)
  - During each of the two grassland bird surveys, staff and volunteers also conducted a general habitat assessment at each point location which included overall habitat category (upland or wetland), habitat class (e.g. fallow field, row crop, meadow, sod) and average vegetation height.
  - A total of 411 grassland bird survey points were assigned in the 2011 breeding season, including unmanaged roadside control points and managed Landowner Incentive Program (LIP), Wildlife Habitat Incentive Program (WHIP), Wildlife Management Areas (WMA), and landfill.
    - Assigned sites and points included:
      - Roadside control – 206 points
      - LIP managed –155 points
      - WHIP managed –26 points
      - WMA managed – 14 points
      - Landfill managed –10 points
- Two ENSP and two NJA staff conducted a more intensive bird survey (2 surveys during each period for a total of 4 per point) at 70 points of some of our larger LIP sites. This pilot was conducted to determine if there is a higher detection rate which will be important as we move into developing adaptive management plans for specific sites and species.
- The final evaluation of the effectiveness of management techniques continues to be worked on; attempts at data analysis highlighted inconsistencies with the datasets therefore standardization and correction of entry mistakes continue. In addition, our beginning attempts to analyze treatment effects highlighted issues we must address before robust statistical analysis can take place.

- 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.
- Species response to cool-season grass (CSG) fields varied (Fig. 2). Bobolink (BOBO) and Eastern meadowlark (EAME) show an overall increase in abundance at CSG sites, while grasshopper sparrow (GRSP) and horned lark (HOLA) show a more even slope. Yellow-breasted chat (YBCH), a scrub-shrub species, was not recorded in CSG fields from 2006-2010 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.
- Grassland bird survey data from the 2010 field season have been entered into the NJ DEP's Biotics (Biotics) database.
- Approximately 30% of the 2011 grassland bird data have been submitted to ENSP; we expect all the data by year's end, which will subsequently be entered in the Biotics database.

- In an effort to evaluate potential temporal and spatial differences in grass growth rates in 2011 staff conducted a two week focused sampling effort by surveying the most southern sites first and moving northward during the bird survey time period. Our sample was 70 points, including the 43 points that had increased bird survey effort.
- The predictive habitat model was not completed because we want to include the microhabitat data collected in the 2011 field season. The habitat data have been entered and will be included with the landscape variable and other covariates for the model; the model will be completed once the database is reformatted.
- Because the model was not completed, we were unable to use the model to identify areas of suitable habitat, create species-specific management plans or evaluate the model.
- The best management practices (BMPs) for target grassland species were not completed; however, a statistician is currently analyzing the microhabitat data. The results of the analyses will be the basis of the BMPs.
- Staff continued to coordinate with NJA for final evaluation of Landowner Incentive Programs region-wide. Staff also attended the grassland bird working group roundtable discussion, which was part of the Northeast Bird Conservation Conference October 19-21, 2010 in Plymouth, MA.
- 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 one of the key grassland bird species.

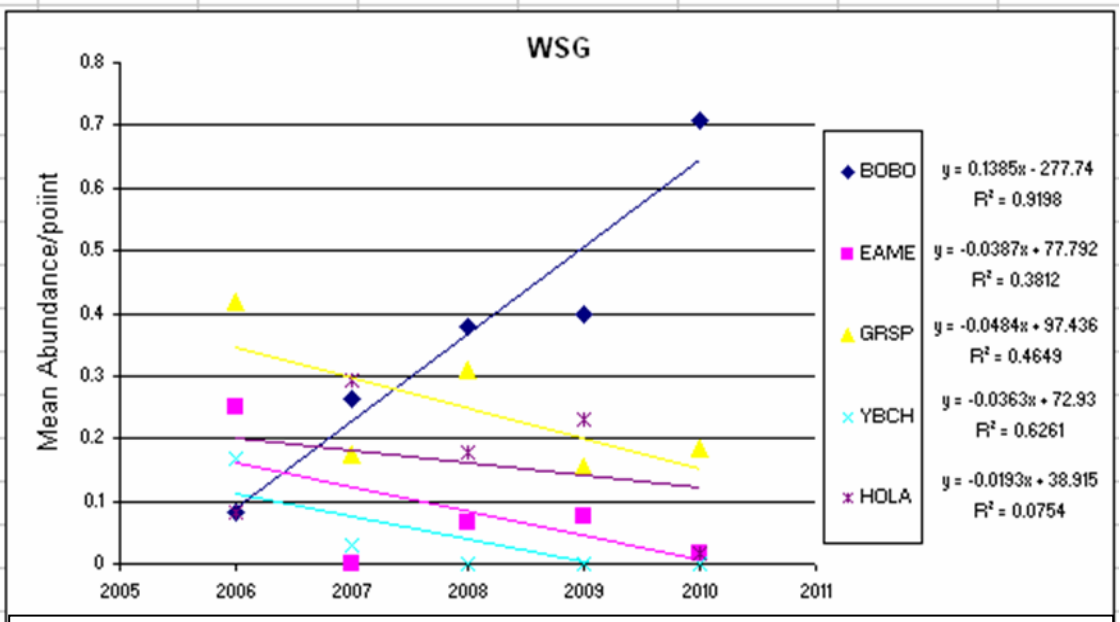

Fig. 1: Grassland bird use of WSG LIP sites, 2006- 2010. The number of converted WSG fields varied each year as fields were added to the program; conversion of crop/CSG to WSG declined in 2009-2010. As habitat structure of WSG fields changes over time, species composition may change as different species require different habitat characteristics.

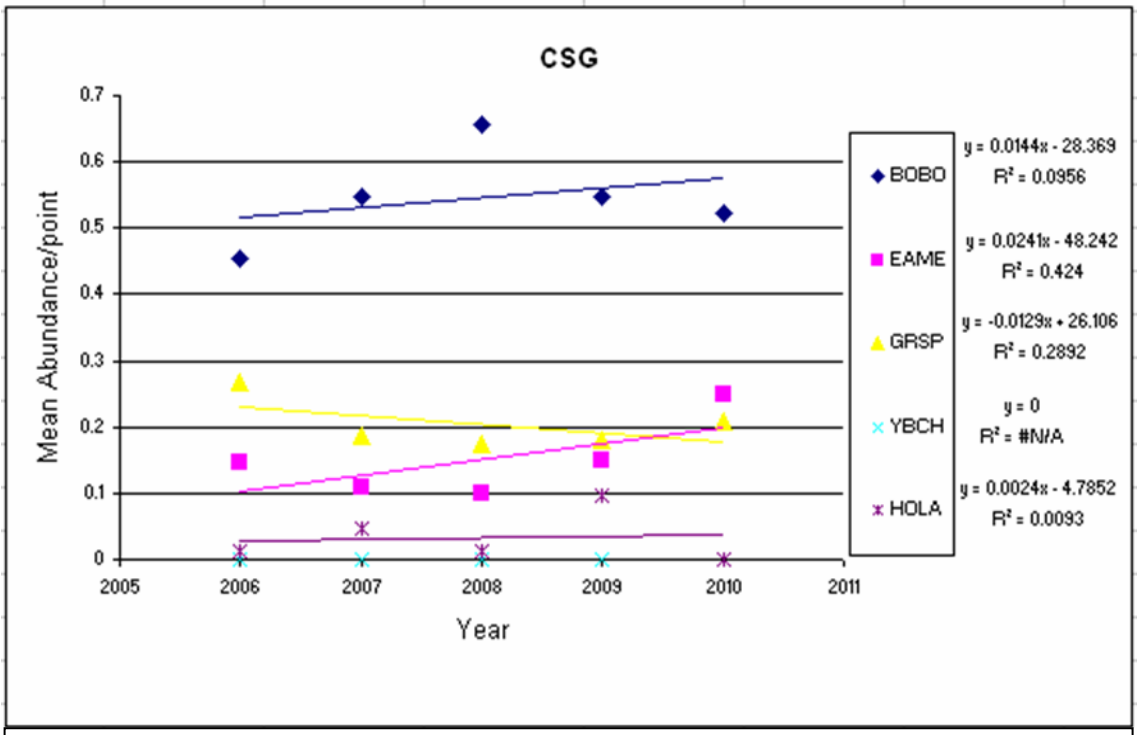

Fig. 2: Grassland bird use of CSG LIP sites, 2006-2010. BOBO and EAME showed an overall increase in abundance at CSG sites, while GRSP and HOLA showed little change. YBCH, a scrub-shrub species, was not recorded in CSG and may indicate a lack of management for this species.

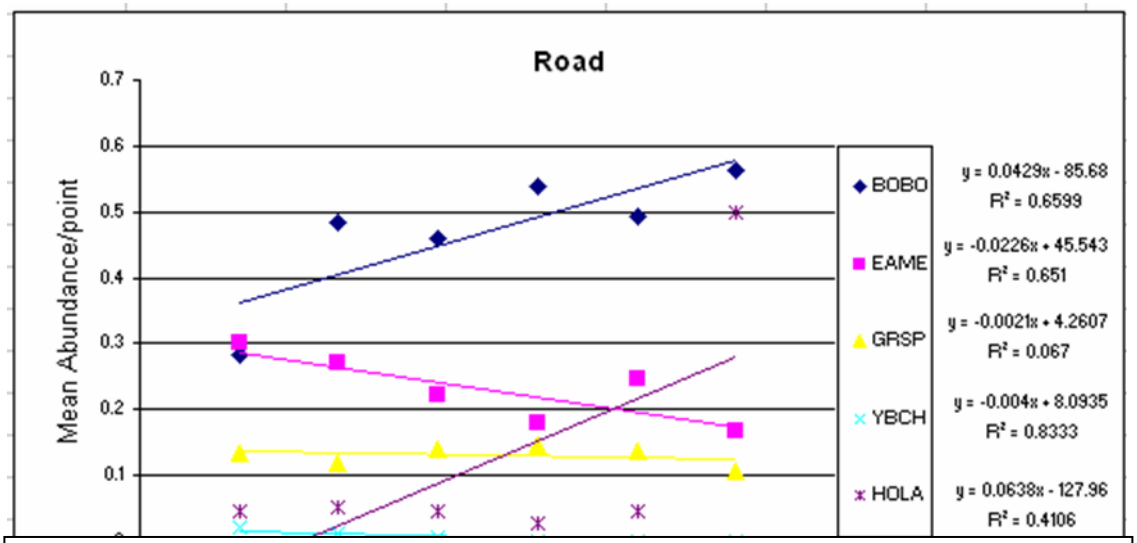

Fig. 3: Grassland bird use of control Roadside points, 2005-2010. Roadside points were chosen for proximity to suitable grassland bird habitat, although specific habitat types vary at each point. BOBO were the only species to steadily increase; EAME trended downward; GRSP remained steady. The spike in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

Conclusions:

- The use of Citizen Scientists for grassland bird surveys continues to be a necessary and efficient method to collect data. Of the 52 volunteers that were assigned sites for the 2011 grassland survey, 42 (80%) entered data online and returned their datasheets to NJA; 3 (5.8%) entered data but have not yet returned their datasheets; 6 (11.5%) have not entered data yet. One volunteer (1.9%) did not complete their assigned surveys in 2011, however, 7 of the 16 points assigned to this volunteer were surveyed by another participant and 5 points were surveyed by staff leaving only 4 points not surveyed. Six total staff members participated in the surveys (including staff from NJA, DFW and Conserve Wildlife Foundation) and were excluded from the above numbers.
- Since 2005, ENSP staff QA/QCd 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 sample of sites is possible based on our 2011 work. However, the sample of sites must also consider adequately representing management practices.
- Analysis of 2010 and 2011 microhabitat data will allow us to determine whether 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.
- 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.

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 grass growth rates using 2010 and 2011 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.
- Evaluate 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.
    - Use the predictive GIS model to identify areas of suitable and potentially suitable habitat where preserved farmlands and incentive programs for private landowners could improve quality and quantity of habitat for grassland bird species.
    - Create species-specific management plans for each property actively managed for endangered, threatened and special concern grassland birds (LIP, WHIP, state lands, etc.) based upon the results of a predictive model.
    - Evaluate and modify the predictive model as new data become available.
- Continue participating in NE CBM Grassland Working Group meetings and to coordinate efforts with interested parties and explore ways to potentially share data.
    - Use the predictive GIS model to identify areas of suitable and potentially suitable habitat where preserved farmlands and incentive programs for private landowners could improve quality and quantity of habitat for grassland bird species.
    - Create species-specific management plans for each property actively managed for endangered, threatened and special concern grassland birds (LIP, WHIP, state lands, etc.) based upon the results of a predictive model.
    - Evaluate and modify the predictive model as new data become available.
- Continue participating in NE CBM Grassland Working Group meetings and to coordinate efforts with interested parties and explore ways to potentially share data.

Estimated Cost: $50,000 Total ($25,000 Federal, $25,000 Match/In-kind)
Volunteer value: (Wildlife Conservation Corps: Survey): 15 people, 35 hours @ $24/ hour = $12,600 In-kind

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 the population trend 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 the changing land use.
  - A Bayesian ZIP model was fitted to the data and we are in the process of evaluating how well the model fits the data, and its predictive ability.

Conclusions:

- ENSP staff needs to continue to work with Edwin Green, Rutgers University, to complete this data analysis.

Recommendations:

- Once the population trend / habitat analysis is completed, ENSP staff must review the findings. Staff will use this study to evaluate the survey methods in the context of our goals to accurately identify population status and trends.

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

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

Job 1J, Part 4: Defining Core Habitats for Barred Owl and Red-shouldered Hawks

Key Findings:

- After additional review of the literature and ENSP data, ENSP biologists determined that the habitat model for red-shouldered hawks did not require a "core forest" distinction in the Landscape Project Map; this will be reflected in the next version of Landscape Project (Statewide V. 3.1).
- In ENSP habitat models, species identified as requiring core forest area value only those forests that meet a minimum size ($\geq$10 ha that excludes a 90-meter buffer from the forest edge). However, while ENSP biologists agree that barred owls do require a core forest habitat, it is unclear if the current metric is the proper figure for barred owls. As such, ENSP biologists have focused on evaluating

whether or not we are defining "core" habitat correctly for barred owls. Due to limited resources, ENSP biologists determined that surveys would target the following forest parcels:
  - Forest tracts meeting the current "core habitat" definition with one barred owl occurrence documented.
  - Forest tracts meeting the current "core habitat" definition with no previous barred owl occurrence documented.
- Additional parcels targeted for future surveys and assessment may include:
  - Forest tracts that meet the current "core habitat" definition with ≥1 barred owl documented occurrence.
  - Forest tracts that do not meet the current "core habitat" definition but are valued for barred owls because of documented observations.
  - Forest tracts that do not meet the current "core habitat" definition and are not valued for barred owls through documented observations.

Northern Region
- Four volunteers were recruited to survey 96 points. Eighteen locations were eliminated due to access issues or traffic/noise, 31 points contained suspect data and were excluded from this analysis; seven locations were added in the field. Survey points were located a minimum of 0.5 mi apart.
- Of the 54 remaining locations that were surveyed:
  - 35 survey sites were located within five forest tracts (size range=1,273–3,686 ac, median=1,288 ac) that met the core habitat requirement and were valued by one barred owl observation.
    - Barred owls were observed at eight locations within three forest tracts; thus, 60% of parcels with previous records had positive responses.
  - 19 survey sites were located within five forest tracts (size range=203–909 ac, median=536 ac) that met the core habitat requirement and were *not* valued by barred owl observations.
    - Barred owls were observed at four locations within three forest tracts; thus, 60% of previously unvalued parcels had positive responses.

Southern Region
- Two biologists surveyed 110 points. At four points, the maximum number of 4 survey visits was not conducted due to access or noise conflicts on one or two nights.
- At 110 surveyed points:
  - 27 survey points were located within 15 forest tracts (size range=71–4,371 ac, median=266 ac) that met the core habitat requirement and were valued by one previous barred owl observation. One additional point fell in core forest that had >1 previous observations.
    - Barred owls were observed at seven locations within six forest tracts; thus, 40% of parcels with previous records had positive responses.
  - 82 survey points were located within 59 forest tracts (size range=119–4,245 ac; median=457 ac) that met the core habitat requirement and were *not* valued by previous barred owl observations.
    - Barred owls were observed at 18 locations within 15 forest tracts; thus, 25% of previously unvalued parcels had positive responses.

For north and south Jersey combined, we found barred owls at 15 of 62 points (24%) in 45% of the parcels that previously had one documented occurrence. We found owls at 22 of 101 points (22%) in 28% of the parcels that previously had no documented occurrences.

Conclusions:
- In general, barred owls were found more frequently in forest parcels that met the core area requirement and had previous sightings elsewhere in the forest patch. However, we documented barred owls at 22 locations in 18 parcels (18%) that had none previously. Thus, this survey effort yielded good results for 1) adding documentation for forest patches that are already valued by one occurrence of a forest-

dependent species, and 2) for identifying and documenting additional forest patches that are suitable and occupied, especially within the constraints of limited resources.
- Additional analysis of these survey results is necessary before making all conclusions about the occurrence of barred owls across the range of parcel size and core-area size.
- The differences in habitat types and forest parcel size between northern and southern NJ are probably too great to allow us to combine survey results. However, this system of stratifying survey effort to target large forest parcels may be most effective for yielding a more thorough survey for forest-interior species anywhere in the state.

Recommendations:
- Surveys in the northern region were scant due to limited volunteer availability. Surveys should be contracted in 2012 to ensure a greater number of 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, Senior 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:
- ENSP recreated a predictive American kestrel patch model (patch sizes 0-250 ha, 250-1,000 ha, and >1,000 ha.) for suitable kestrel habitat in NJ using the NJDEP 2007 Land Use Land Cover and compared the model across all available years (1986, 1995, 2002 and 2007).
  - For the 21-year period (1986-2007) the model results show a fragmenting of potential kestrel habitat
    - ~75,402 ha of potential kestrel habitat was lost (~4,000 ha/year) (Fig. 1)
    - Overall, the number of patches increased; however, in the top 2 categories (>250 ha, preferred kestrel habitat) the number of patches, sum and average patch size all decreased (Fig. 2).

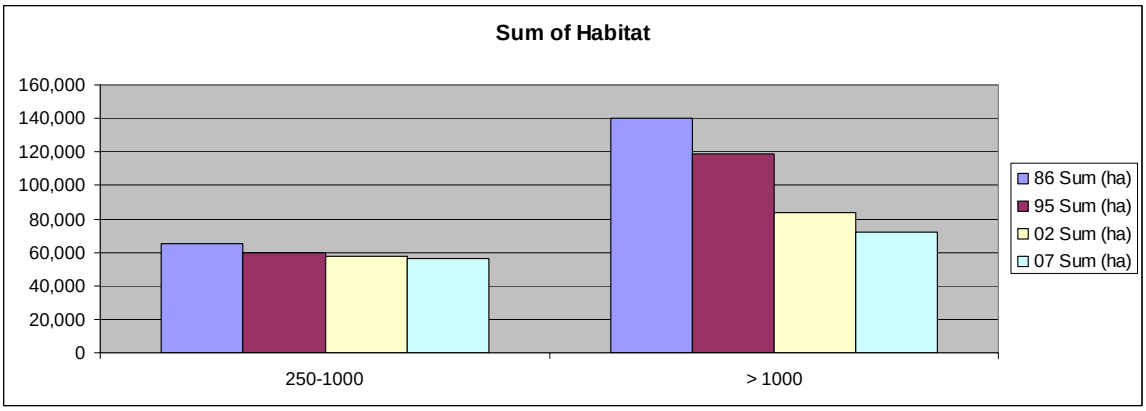

Figure 1. Total habitat for the top 2 categories, 250-1,000 ha and > 1,000 ha

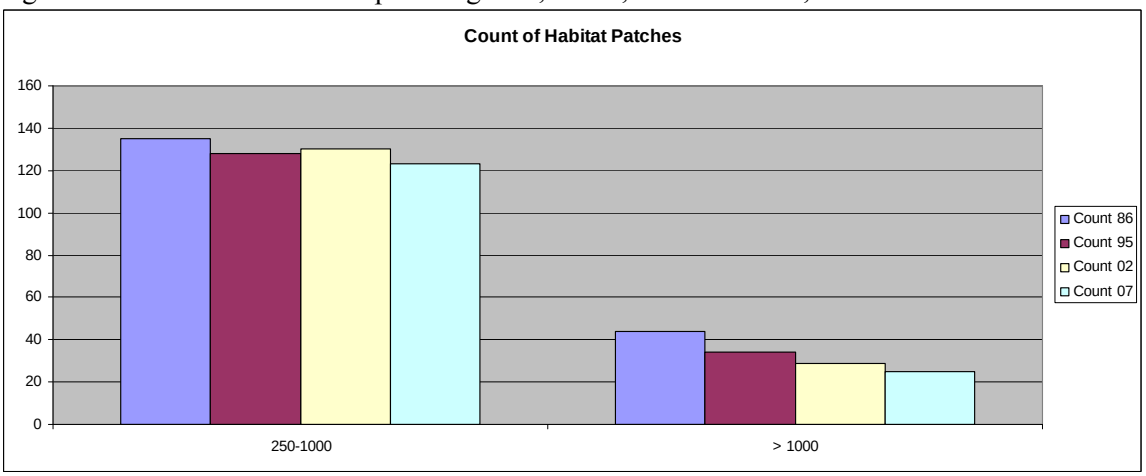

Figure 2. Number of habitat patches for the top two categories, 250-1,000 ha and >1,000 ha

- Suitable sites for American kestrels were identified using a GIS predictive model based on the NJ Department of Environmental Protection's 2002 Level III Land Use/Land Cover data layer (LU/LC) and kestrel occupancy data from Dr. Smallwood of Montclair State University. Areas of contiguous kestrel habitat were 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).

Table 1. Percentage of active nest boxes in patches >250 ha (NJDEP 2007 LULC source for patches) in size 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%

- For the 2011 season, ENSP targeted a subset (85) of the existing 275 boxes for monitoring, while maintaining some representation within all study areas (Clinton, Amwell Valley, Assunpink) to focus our monitoring efforts 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).

- A total of 85 nest boxes were monitored every 12-15 days from April through August 2011. Of those 85 nest boxes, 30 (35%) were occupied by American kestrels. Of the occupied boxes twenty-three (77%) boxes were successful, defined by the nest attempt resulting in nestlings that reached bandable age of 14-22 days. Seven nesting attempts (23%) resulted in failures.
- Four new nest box volunteer monitors were recruited and trained.

- The 2011 nest box field season resulted in the following:
  - 94 kestrels were banded: 85 young (48 female, 33 male, 4 unknown) and 9 adults (8 female, 1 male) at 26 nest boxes.
  - Three previously banded adults were recaptured (2 female, 1 male). Two females were banded at ENSP nest boxes in 2007 and 2009. Those two females successfully raised 5 and 4 chicks this season.
  - Ten volunteers monitored 66 nest boxes while staff monitored 19 boxes.
- All data collected continued to be entered online through a Google documents online interface.
- All banding data was supplied to the Bird Banding Lab via BandIt.
- All 2006-2010 nest box data were entered into NJ DEP's Biotics database.
- Due to lack of staff time and resources ENSP did not create a nest box manual or a comprehensive report for the program website.
- Staff concluded the use of cameras to be too costly in terms of funding and manpower; the resulting data would be too time consuming to analyze and not likely to provide useful information.
- Due to lack of staff time and our focus on monitoring nest boxes, the call playback survey results were not utilized to develop other surveys 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. These 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 and 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 Kisiel, 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 have never been surveyed as a group by ENSP (with the exception of occasional surveys of black rails). The northern part of the state has been surveyed over the past three field seasons but 2011 marked the first year for the survey to be conducted in the south.
- 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 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 will be heard and not seen. Southern New Jersey is a Mecca for birders, however, so finding surveyors proved to be fairly easy. Seven people were contracted to complete surveys, which consisted of visiting assigned points three times over the course of 10 weeks. Each contractor was assigned a different number of points (ranging from 8-23). All of the contractors completed all of their surveys.
- 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 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 easily 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).
- Each point was surveyed once between 1-31 May, 1-30 June, and 1-15 July (3x total). Surveys took place in conditions where winds were <12 mph and between the hours of sunrise and 10 am (11 am at the latest). For those surveying with 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 (black rail, least bittern, sora, Virgina rail, king rail, clapper rail, American bittern, common moorhen) call 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 50 m radius from the point (100m diameter circle).

- 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. Ninety-one (91) species were heard or seen on the surveys. Of those, four were target secretive marsh birds species – least bittern, Virginia rail, common moorhen and clapper rail. Two were target breeding marsh birds – seaside sparrow and saltmarsh sparrow. The breakdown of the other species was as follows: 45 passerines, 11 shorebirds, 8 waders, 8 terns/gulls, 6 waterfowl, and 7 raptors.
- Of the four secretive marsh birds that were detected, only clapper rail was heard with any regularity. It was detected in all hexagons and on almost all survey periods (the only exception was a hexagon on Great Bay Boulevard that only had 2 points in it. No clapper rails were detected on these points during the June survey, though they were heard in May and July).
- Virginia rail was detected eleven times (i.e. eleven individuals) – four times in the Fortescue hexagon (once each in May, June and July but at different points), six times in the Dividing Creek area (three times in June, once in July), and once in July in a hexagon near the Tuckahoe River.
- Common moorhen was detected once in May in the hexagon near Somers point.
- Least bittern was detected seven times – twice in June near the Tuckahoe River, four times near Dividing Creek (all in July) and once in July in the Fortescue 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 SHAPR 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, some generalizations can be made. First, seaside sparrows were more common than saltmarsh sparrows. They were observed in every hexagon many times for almost every time period (the only two times periods they were not heard was the July visit for the hexagon near Somers Point and the July visit for the lower Great bay Boulevard hexagon, which only contained two survey points). Saltmarsh sparrows occurred far less frequently. They were only observed in four (one hexagon near the Tuckahoe River, one near North Brigantine Natural Area and one near Great Bay Boulevard) of the nine hexagons and the numbers in which they encountered were far less than seaside. In locations where it was detected, it was recorded in all three survey periods, except in the hexagon near North Brigantine natural Area where it was only observed once during the second survey period.
- 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, bobolink, osprey and yellow-crowned night-heron. Special Concern species detected included American oystercatcher, caspian tern, common moorhen, common tern, glossy ibis, least bittern and Virginia rail *(Note: Species conservations status follows the proposed changes to the state ENSCA rule, pending adoption)*
- 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 .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, 156 rails were counted in May, 144 rails in June and 113 rails in July (note: this does not include clapper rails from the Turkey Point hexagon and from four points in the Fortescue hexagon since that data was recorded incorrectly on datasheet and hard to interpret). Of the data available, the area with the greatest density of clapper rails was in the Great Bay Boulevard area and the lowest densities were in the hexagon north of the Tuckahoe River.
- The use of an iPhone, or other smart phone device, in conjunction with Google Earth images was 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 a direct route between each one as efficiently as possible.

- Ending the survey by 11 am 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 an overall 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 and led to complications surround data being recorded correctly (ultimately leading to it not being able to be used).
- Although the number of species recorded across all sites was relatively high, the number of secretive marsh birds detected was quite low. Of special concern was the absence of black rails, which is a species known to be declining rapidly in the region. The caliber of observer skill was 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.

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 around midnight.
- Change the order of the surveys points on each of the three visits. The survey protocol called for each point to be visited in the same order each time. 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 am compared to 6 am).
- Conduct a training session prior to the start of the survey. The protocol and datasheet were more complicated than anticipated and the result was that some data was not salvageable. This can be avoided by ensuring that all observers (whether they are experienced surveyors, as was the case in this situation, or not) understand the detailed data collection protocol.
- 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 am instead of 10/11 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 this project. 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 in future years. In 2011, 68 points were surveyed. As time and observer recruitment allow, grow the survey area to include more marshes in southern New Jersey.
- 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 (a non-SWG funded effort, so not reported on here). 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:

- Logistic regression was used to relate measured variables to the probability of GWWA (O_G) and BWWA (O_B) site occupancy on utility rights-of-way (ROWs) (Table 2B-1). The data for each of the independent variables were randomly divided into two sets: a fitting set and validation set. The fitting set comprised approximately 2/3 of the data while the validation set was made up of the remaining 1/3 (Table 2B-2).
    - The parameter estimates (Table 2B-4) and odds-ratios (Table 2B-5) indicate the following about golden-winged and blue-winged warbler preference when occupying utility ROWs:
        - ROW width (ROW): Golden-winged and blue-winged warblers have similar responses to ROW width with a slight preference for narrower (<100m) ROWs.
        - % Herbaceous cover (HERB): This parameter was only a predictor of blue-winged warbler occupancy when climate variables were not included and indicates that blue-winged warblers preferred areas with greater herbaceous cover.
        - % Shrub cover (SHRB): This parameter was only a predictor of blue-winged warbler occupancy and indicates that blue-winged warblers preferred areas with greater shrub cover.
        - % Tree cover (TREE): This parameter was only a predictor of golden-winged warbler occupancy when climate variables were also included and indicates that golden-winged warblers preferred areas with less tree cover.

- % Dead vegetation cover (DEAD): Golden-winged warblers preferred areas with greater dead vegetation cover while blue-winged warblers preferred areas with less dead vegetation cover.
- Proportion of wet areas (WET): Golden-winged warblers preferred wetter areas while blue-winged warblers preferred upland areas.
- Tree height (CAN): This parameter was only a predictor of golden-winged warbler occupancy when climate variables were also included and indicates that golden-winged warblers preferred areas with greater tree height.
- Distance to nearest agriculture (D_A): Blue-winged warblers can tolerate areas closer to agriculture than golden-winged warblers
- Distance to nearest urban (D_U): Golden-winged warblers can tolerate areas closer to residential areas than blue-winged warblers
- Distance to nearest large wetland (D_W): Golden-winged and blue-winged warblers have similar responses to distance from large wetlands with a preference to occupy areas farther from wetlands.
- Distance to nearest major road (D_{MR}): Golden-winged warblers can tolerate areas closer to major roads than blue-winged warblers.
- Distance to nearest paved road (D_{pr}): Golden-winged warblers can tolerate areas closer to major roads than blue-winged warblers.
- May rainfall (R_M): This parameter was only a predictor of golden-winged warbler occupancy when climate variables were also included and indicate golden-winged warblers were more likely to occupy ROWs when there was more rain in May.
- High temperature in May (Hi_M): Golden-winged warblers were more likely to occupy ROWs during warmer days in May while blue-winged warblers were less likely to occupy ROWs in those conditions.
- High temperature in May (Hi_J): This parameter was only a predictor of blue-winged warbler occupancy when climate variables were also included and indicate blue-winged warblers were more likely to occupy ROWs during warmer days in June.
- Low temperature in May (Lo_M): Golden-winged warblers were less likely to occupy ROWs during cooler nights in May while blue-winged warblers were more likely to occupy ROWs in those conditions.

- Management of selected ROW spans for golden-winged warblers has been delayed due to permitting issues.
- Management for golden-winged warblers on Sparta Mountain Wildlife Management Area and TNC's Minisink Preserve is in progress. In Sparta Mountain, areas to be cut for golden-winged warblers were marked and assessed for value, and the information was set out to bid for loggers to make the cuts. Post-management surveys were not conducted because habitat management had not been implemented. In the Minisink Preserve, work has begun to reclaim an old gravel mine and restore it to young forest/scrub-shrub conditions.
- Pre-treatment surveys consisting of 5 survey points were conducted at Sparta Mountain WMA and along portions of the Susquehanna-Roseland transmission line. One Brewster's was found along the Susquehanna-Roseland transmission line.
- The no-harm management guidelines have been revised and included in the permits of utility companies and draft management guidelines for golden-winged warblers in NJ have been created for management on Sparta Mountain Wildlife Management Area.
  - Foresters were not contacted because the management guidelines are still in progress.
- Data on golden-winged warbler occupancy and habitat were collected in 2011as part of the 2011 Golden-winged Warbler Atlas run by Cornell Lab of Ornithology. Biologists surveyed 151 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 151 points surveyed were new (not surveyed in 2008, 2009, or 2010) and 28 were repeated from 2008, 2009 and/or 2010.

- Habitat data were collected at all survey points in 2011**.** Approximately 43% of the survey points were in predominately wetland habitat, and 57% of the points were in predominately upland habitat.
  - The majority of the survey points were in upland shrubby fields (30%), other wetlands (16%), upland utility ROWs (12%), and wetland successional forests (11%). The remainder of the survey points were in bogs or fens (9%), upland successional forest (8%), wetland utility ROWs (5%), pasture or abandoned farmland (3%), other upland (3%), beaver wetlands (2%), and residential (1%) (Fig. 2B-2).
  - Most (87%) of the survey points contained <50% tree cover, with the majority of those (62%) containing 25-50% tree cover (Fig. 2B-2).
  - Most (72%) of the survey points contained <50% herbaceous cover with the majority of those (43%) containing 25-50% herbaceous cover (Fig. 2B-2).
  - Most (73%) of the survey points contained <50% shrub cover with the majority of those (62%) containing 25-50% shrub cover (Fig. 2B-2).
  - All of the survey points contained <25% dead vegetative cover with the majority of those (95%) containing no dead vegetative cover (Fig. 2B-2).
  - The height of the vegetation at survey points was <2 m tall at most (62%) points, but 38% of the points had vegetation >2m tall (Figure 2B-3).
  - The majority of points (60%) had swamp or wet ground present; 33% had no water visible (Fig. 2B-4).
- Twenty golden-winged warblers, six hybrids, and 78 blue-winged warblers were observed during the 2011 survey (Fig. 2B-5). Nineteen golden-winged observations were males while one was a female mated to blue-winged warblers. One of the golden-winged males was observed with a blue-winged warbler female. The 6 hybrids comprised of 5 Brewster's males and 1 Lawrence's female.
  - Of the 20 golden-winged warblers observed, five (25.0%) were in upland utility ROWs, four (20%) in shrubby wetlands, three (15%) in wetland utility ROWs, two (10%) in upland shrubby fields, two (10%) in abandoned farmland, one (5%) in a beaver wetland, one (5%) in a fen, one (5%) in successional forest wetlands, and one (5%) in other upland habitat (Fig. 2B-1).
  - Most (72%) of the golden-winged warblers were observed in areas with 25-50% herbaceous cover and 25-50% shrub cover. All golden-winged warblers were observed in areas with <50% tree cover dead vegetation cover. More than half of the GWWAs occurred in areas where the average vegetation height was 0-2 m. Most (78%) of the GWWAs occurred in areas where a swamp or wet ground was observed (Fig. 2B-2).
  - Ten percent (10/104) of new (non-repeated) 2011 survey locations were occupied by golden-winged warblers, 46% by blue-winged warblers, 3% by a hybrid (Fig. 2B-6).
  - More than half (8/14) of the 2010 survey locations occupied by golden-winged warblers were not occupied in 2011 (Fig. 2B-7).

- Staff attended the Golden-winged Warbler Land Manager's Workshop in Dingman's Ferry, PA from August 25-26, 2011.
  - Staff reviewed management guidelines created for PA and MD and visited sites managed specifically for GWWAs
- The data will be submitted for entry into the NJ DEP's Biotics database by mid-November.

Table 2B-1. Δ_{AIC} values for all candidate models and stepwise selection criteria using fitting data.

Dependent variable	Climate variables?[1]	Sample Size	Δ_{AIC}[2]			
			intercept only	stepwise	forward	backward
O_G	Yes	4477	1204.3	0	1.2	1.038
O_G	No	4477	760.5	6.2	6.2	0
O_B	Yes	4477	645.0	6.2	6.2	0
O_B	No	4477	413.9	6.7	6.7	0

[1] – Denotes whether climate variables were included as potential independent variables.

Table 3. Validation results for all six models.

Dependent	Climate	Sample	Number[2]		Successful prediction (%)[3]	
variable	variables?[1]	size	0's	1's	0	1
O_G	Yes	2898	2102	796	80.2	75.4
O_G	No	2898	2102	796	80.8	70.1
O_B	Yes	2898	1892	1006	71.0	67.0
O_B	No	2898	1892	1006	70.0	60.1

[1] – Denotes whether climate variables were included as potential independent variables.
[2] – The number of 0's and 1's in the validation data.
[3] – P(actual = i | prediction = i) × 100, i = 1, 2.

Table 4. Parameter estimates, sample sizes, and AIC for final models.

Climate variables?	Yes	No	Yes	No
Dependent variable	O_G	O_G	O_B	O_B
intercept	8.7712	3.1242	-9.2276	1.5639
ROW	-0.0238	-0.0261	-0.0171	-0.0105
HERB				0.3606
SHRB			0.4287	0.7050
TREE	-0.9871			
DEAD	0.6134	0.6248	-0.6545	-0.4145
WET	0.4320	0.3298	-0.4932	-0.4303
CAN	0.0303			
D_A		0.00033	-0.00087	-0.00104
D_U	-0.00061	-0.00104	0.00151	0.00172
D_W	-0.00426	-0.00194	-0.00659	-0.00769
D_{MR}	-0.00080	-0.00041	0.00039	0.00020
D_{PR}	-0.00239	-0.00235	-0.00053	-0.00043
R_M	0.1835			
Hi_M	0.0916		-0.1303	
Hi_J			0.1395	
Lo_M	-0.2636		0.2043	
n	7375	7375	7375	7375
AIC	6551.043	7283.037	8535.942	8867.656

Table 5. Adjusted odds-ratios for parameters in final models.

Climate variables?		Yes	No	Yes	No
Dependent variable	units (*u*)	O_G	O_G	O_B	O_B
ROW	10 *m*	0.788	0.770	0.843	0.900
HERB	10%				36.825
SHRB	10%			72.774	>999.99
TREE	10%	<0.001			
DEAD	10%	461.123	516.813	0.001	0.016
WET	10%	75.184	27.046	0.007	0.014
CAN	10%	1.534			
D_A	100 *m*		1.034	0.916	0.901
D_U	100 *m*	0.941	0.901	1.163	1.187
D_W	100 *m*	0.653	0.824	0.518	0.463
D_{MR}	100 *m*	0.923	0.960	1.039	1.021
D_{PR}	100 *m*	0.788	0.791	0.948	0.958
R_M	0.1 *cm*	1.019			
Hi_M	5º	1.581		0.521	
Hi_J	5º			2.009	
Lo_M	5º	0.268		2.777	

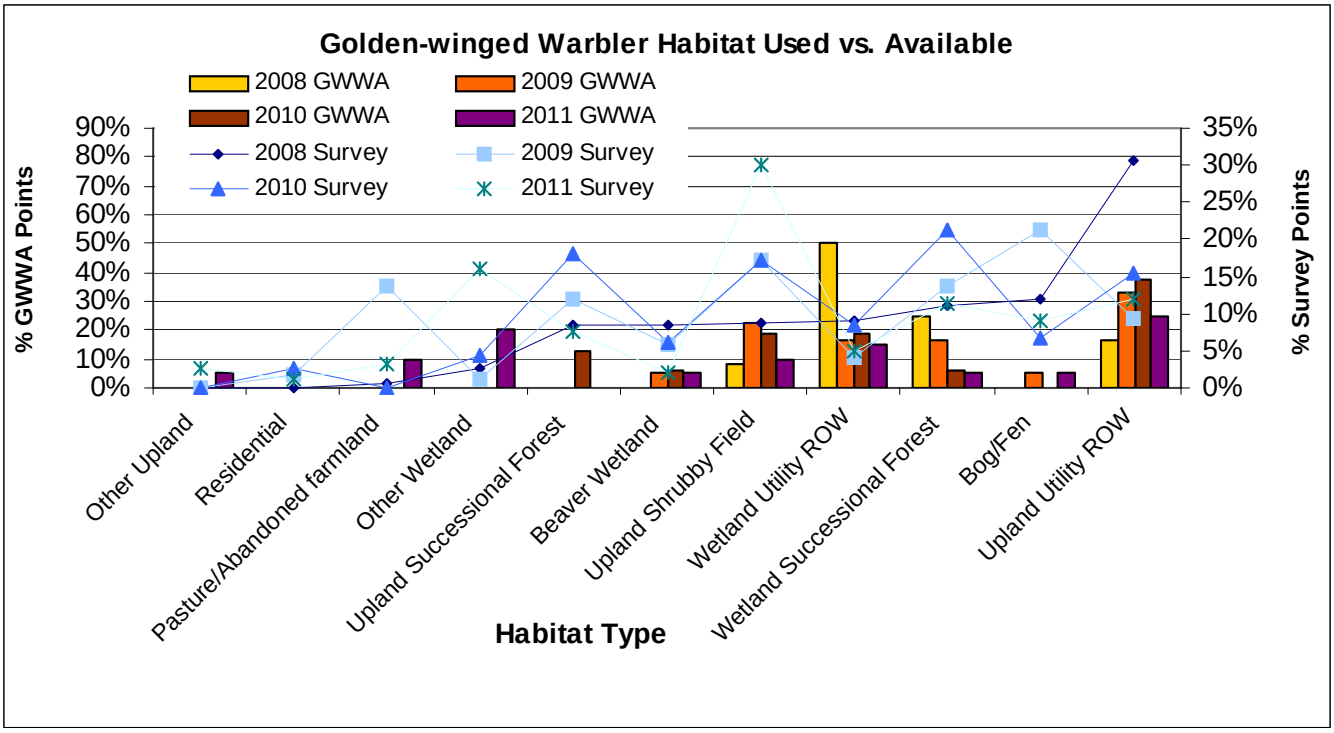

Figure 2B-1. Habitats used by golden-winged warblers (GWWA) vs. available habitat surveyed, 2008-2011.

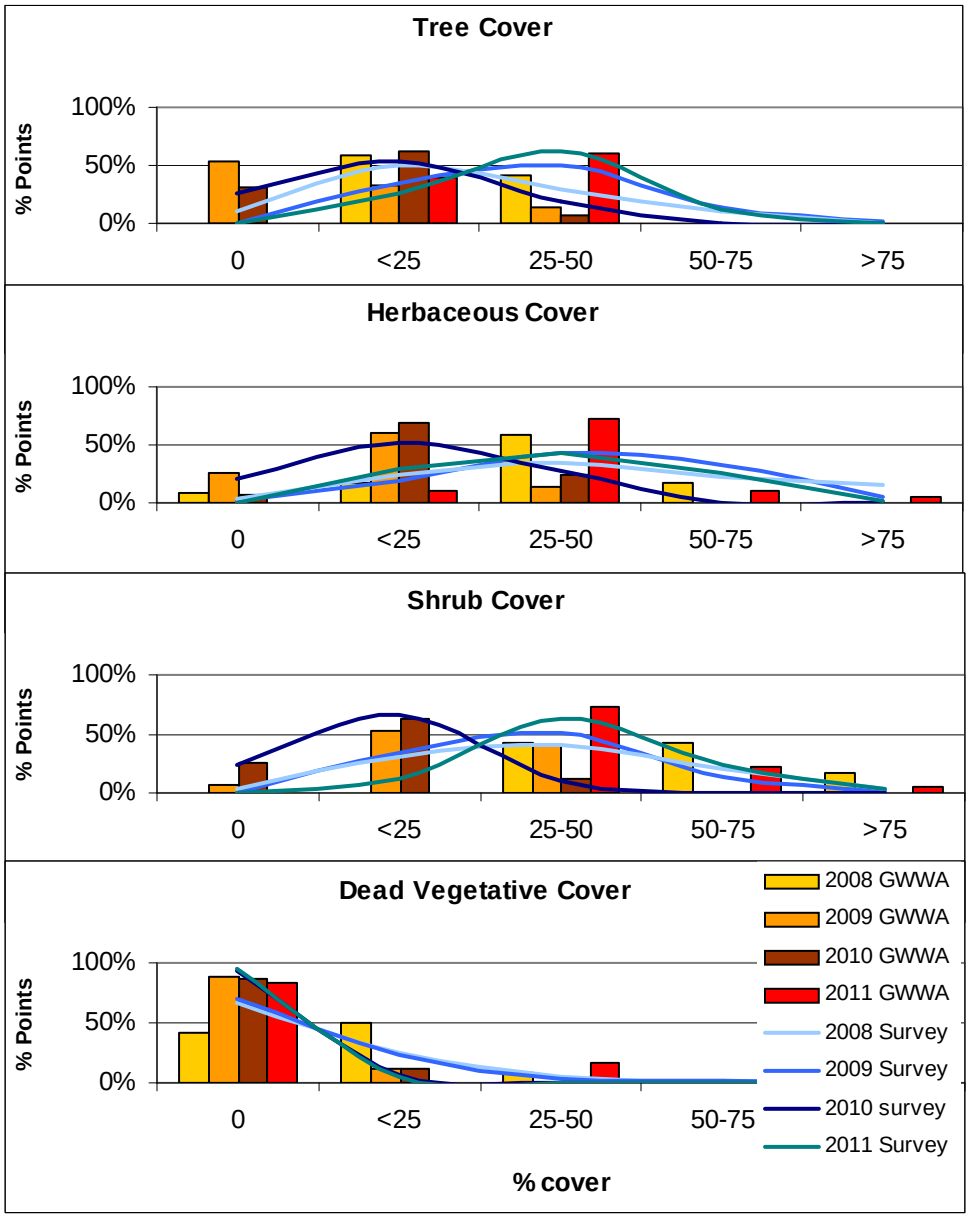

Figure 2B-2. Percent cover type used by golden-winged warblers (GWWA) vs what was available (Survey) during the 2008-2011 surveys.

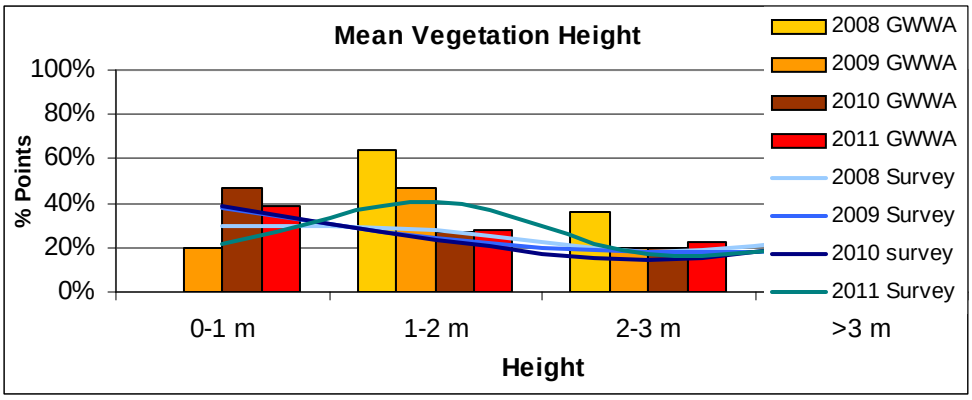

Figure 2B-3. Mean vegetation height in the area used by golden-winged warblers (GWWA) vs what was available (Survey) during the 2008-2011 surveys.

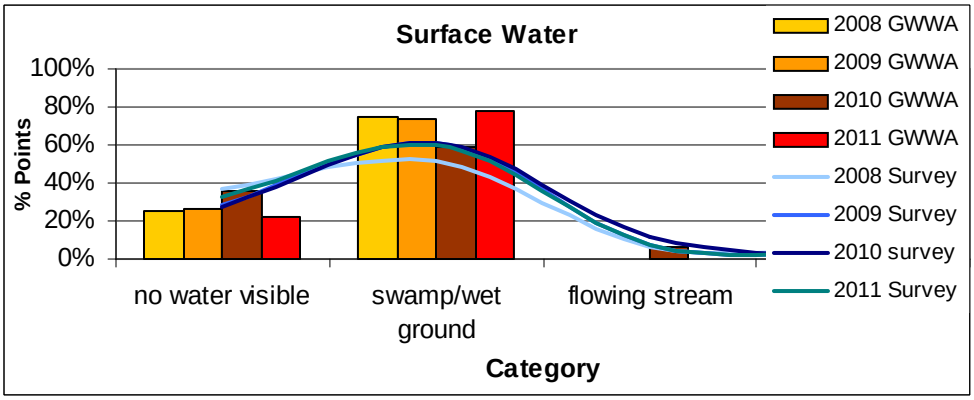

Figure 2B-4. Surface water observed in the area used by golden-winged warblers (GWWA) vs what was available (Survey) during the 2008-2011 surveys.

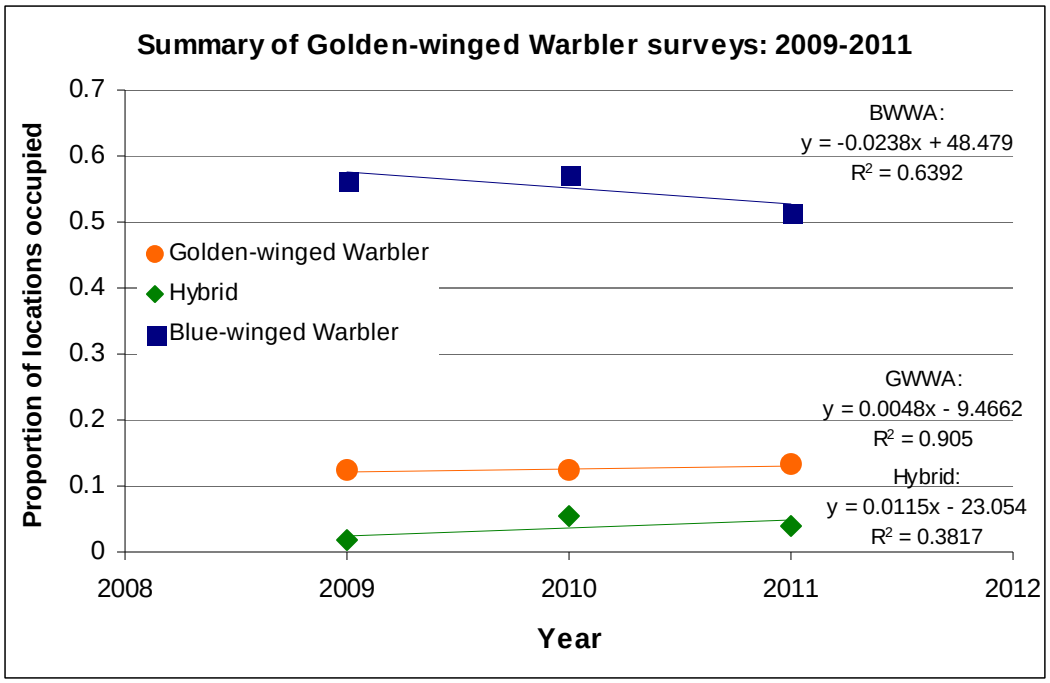

Figure 2B-5. Proportion of golden-winged warblers, blue-winged warblers, and hybrids observed per survey location during the 2009 (n=179), 2010 (n=117), and 2011 (n=151) surveys. The survey from 2008 was not included due to low detectability and a large sample size.

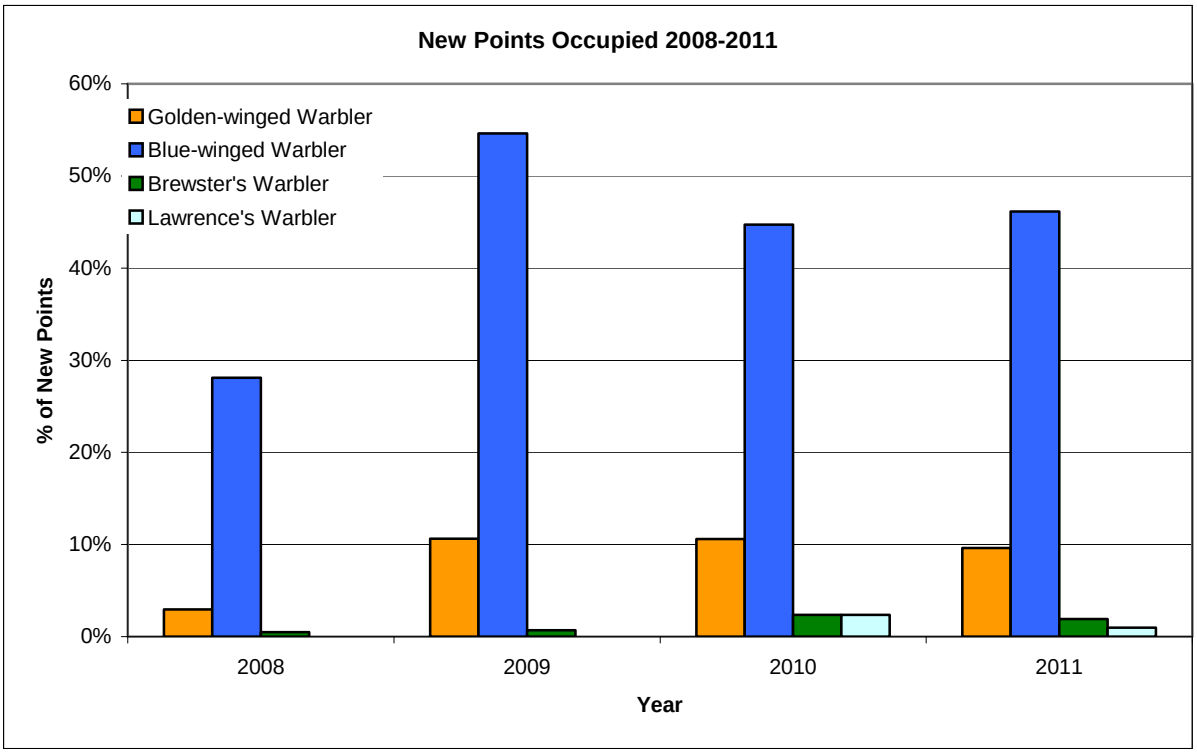

Figure 2B-6. Percentage of new (non-repeated) survey locations occupied by golden-winged warblers, blue-winged warblers, or hybrids during 2008 (n=405), 2009 (n=141), 2010 (n=85), and 2011 (n=104) surveys.

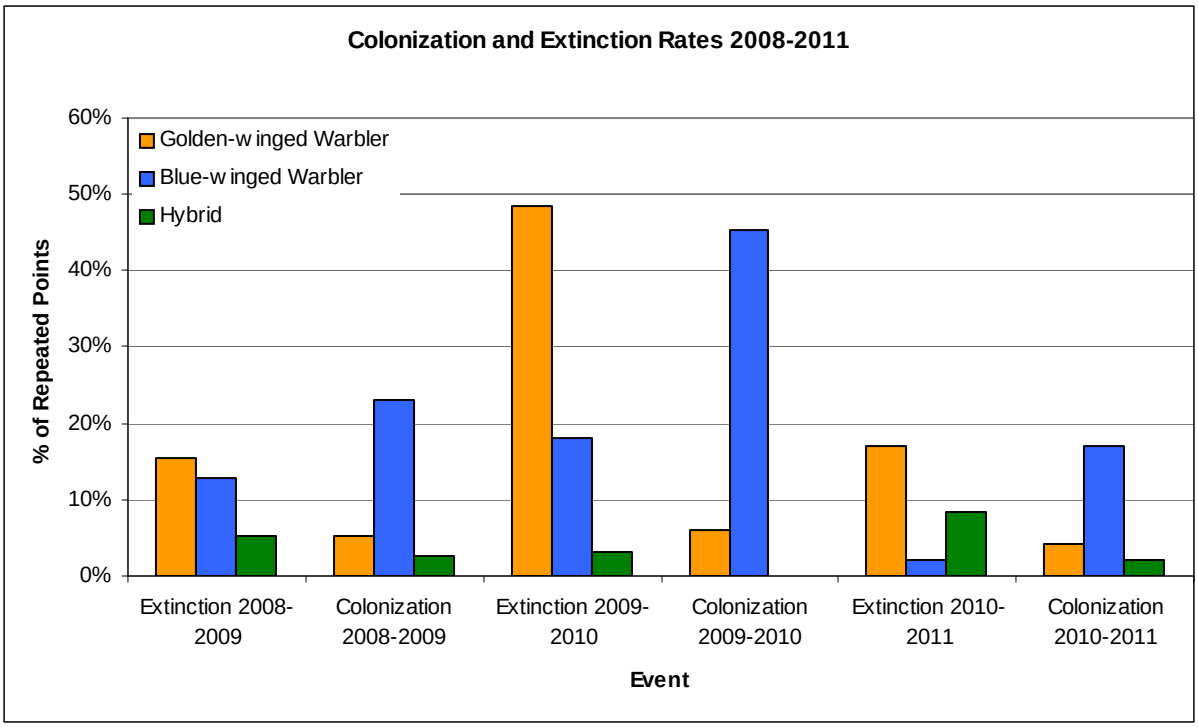

Figure 2B-7. Percentage of golden-winged warblers, blue-winged warblers, and hybrids undergoing colonization or extinction events at each repeated survey location during 2008-2009 (n=39), 2009-2010 (n=33), and 2010-2011 (n=47) surveys.

Conclusions:

- Golden-winged warblers in NJ do not appear to consistently breed in the same location each year. This would mean that golden-winged warblers may be shifting habitats often and/or declining precipitously in NJ. Because golden-winged warblers can have high site fidelity (Confer 1992) even when habitat on their territory had been altered (Petzinger unpub. data), it is more likely that the most of the males did not return because they did not survive another year while some males shifted territories to avoid blue-winged warblers or find a female.
- Although habitat exists in NJ for golden-winged warblers and it appears the population has not changed since 2008 (Figure 1), the extinction rate of a point occupied in the previous year is greater than the colonization rate of a point not occupied in the same previous year, where the inverse is true for blue-winged warblers (Figures 2 & 3).
- The number of hybrids, particularly Lawrence's warbler, has increased since 2008.

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.
- Creative a predictive GIS model for golden-winged warbler potential habitat in NJ using the results of the logistic regression.

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 2011, two trained volunteers, with assistance from one untrained volunteer, mist-netted in Bear Swamp, Cumberland County for approximately 400 net hours on seven different days from May through August. This is the 18th consecutive year of operation at this station.
  - Forty-two individual birds of 14 different species were mist-netted, 35 of these were new captures (34 banded) and seven were recaptures from previous years.
  - The majority of the birds netted were ovenbirds (16), followed by worm-eating warblers (6), common grackles (4), and black-and-white warblers (4).
  - The mean species abundance in Bear Swamp from 1995–2011 was 70.89 (± 6.81); mean species richness was 17.67 (± 1.02)
  - One period was not run in 2011, which significantly reduces the banding effort, so the species abundance and richness cannot be directly compared to other years (Figure 2C-1).
  - Even with reduced effort, 2011 had the 2nd highest productivity - 42% (18) of banded individuals were juveniles (Figure 2C-2).
- 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.

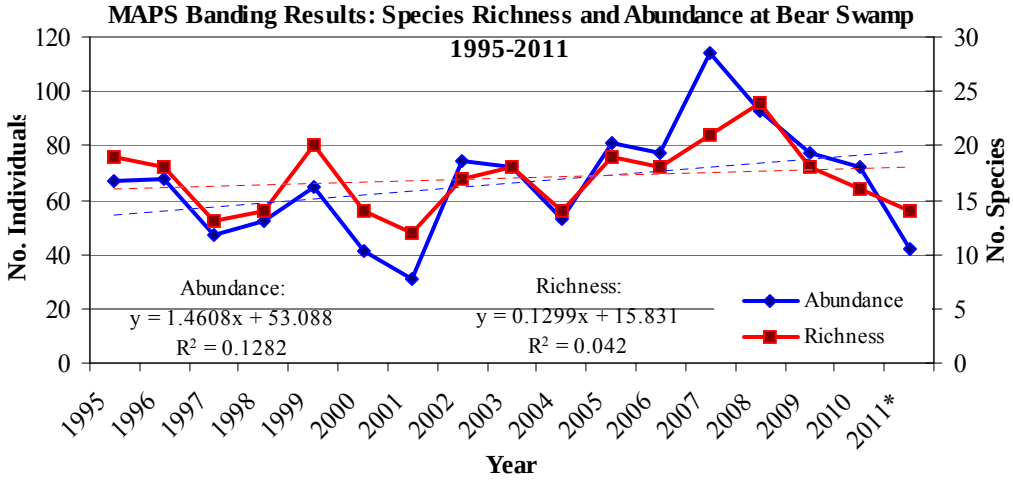

Figure 2C-1. Species richness and abundance at the Bear Swamp banding station 1995–2011 (1994 banding results were omitted due to inconsistencies/bias of the first year).
* Period 9 was missed in 2011 due to inclement weather

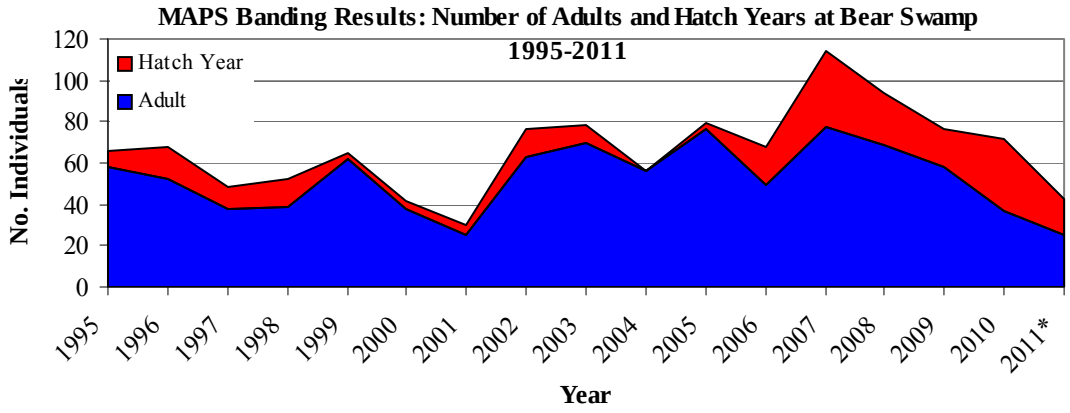

Figure 2C-2. Number of adults and hatch-year birds at the Bear Swamp banding station 1995–2011 (1994 banding results were omitted due to inconsistencies/bias of the first year).
* Period 9 was missed in 2011 due to inclement weather

Conclusions:

- Bear Swamp continues to be a stable community for forest birds. Both species abundance and richness show a positive trend and productivity is still above the mean of the last 18 years.

Recommendations:

- Continue the long-term monitoring project and supplement the Institute for Bird Populations with data. Investigate comparing this data with trends from other forest songbird surveys.

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 Kisiel, Senior Environmental Specialist

OBJECTIVE 1: Determine statewide distribution of wintering populations of American oystercatcher (*Haematopus palliates*).
OBJECTIVE 2: Determine breeding population and reproductive success of American oystercatchers that utilize beach strand habitat (i.e. Atlantic coastal beaches, inlet beaches, inlet sand islands).
OBJECTIVE 3: Continue collaborative range-wide research and survey efforts, especially band resighting, coordinated and facilitated through the American Oystercatcher Working Group.

Key Findings:

- A survey of wintering American oystercatchers, encompassing nine inlet areas from Barnegat Inlet to Cape May (Canal) Inlet, was conducted 6-16 December 2010. Additional ground surveys were also

conducted later in the season (6-16 January 2011 and 6-16 February 2011); the sixth consecutive year late winter surveys were completed. The surveys were conducted by ground or watercraft within an hour of high tide to determine the total number of birds present, the ratio of adults and juveniles, and the presence of banded individuals.

- A total of 715 birds were counted during the 2010 December winter survey. This total is 11% lower than the December 2009 survey (807 birds), but about average (698 birds) for the period since 2004 that similar surveys have been conducted.
- Four high tide roost flocks were identified during the 2010 December survey, the largest being the two large flocks present within Hereford and Absecon Inlets.
  - Absecon Inlet (Brigantine Cove/Rum Point) and Hereford Inlet (Champagne Island) had 445 and 190 birds present, respectively. This accounted for 89% of the state total, nearly the same as the previous two years for these two inlets combined. Furthermore, this was a similar overall trend for the seven years that ground surveys have been conducted in December.
  - The remaining birds recorded during the December survey were found at high tide roosts within Great Egg Harbor Inlet (North Ocean City) and Townsend's Inlet, with 72 birds and 8 birds, respectively.
- Far fewer birds (436, or 61% of the December count) were present during the January 2011 survey, similar to the trend for January surveys over the past several years. And about half as many birds (214) were present in February 2011 as in January 2011.
  - The vast majority of the birds (326 or 75% of the total) present in the January 2011 survey were found in Absecon Inlet. Smaller numbers were found in Great Egg Harbor and Hereford Inlets (71 and 39 birds, respectively).
  - Similarly, most of the birds (155 or 72% of the total) observed during the February 2011 survey were also found in Absecon Inlet. Again, the only other sites where birds where present in February were within Great Egg Harbor and Hereford Inlets (55 and 4 birds, respectively).

- American oystercatcher breeding surveys were conducted in 2011 at all Atlantic coast barrier/inlet island beach strand sites. Intensive surveys were completed in conjunction with piping plover and other beach nesting bird surveys by ENSP and other cooperators throughout the coastal region.
  - 79 nesting pairs were identified at 29 beach sites.
    - About one-third (32%) of the beach nesting pairs hatched young.
    - Productivity was 0.35 chicks fledged per beach nesting pair.
    - Gateway National Recreation Area (Sandy Hook) accounted for over a fifth (22%) of the beach nesting pairs. Hatch success (71%) and productivity (0.71 chicks fledged per pair) at Sandy Hook remained well above average for the state, although not as high as the past two years. However, the National Park Service experienced some monitoring difficulties this year, thus the fledgling rate may have actually been higher than detected and reported.
    - Nest failure due to flooding was high this year, especially at major sites such as Stone Harbor Point, although predator activity, especially from red fox, was also a major limiting factor at Stone Harbor Point, as well as likely at Edwin B Forsythe NWR – Holgate.
      - For the third year in a row, no oystercatcher nests hatched Holgate. No nests hatched at Stone Harbor Point either, following a relatively strong year for productivity at that site in 2010.
- The resighting of banded American oystercatchers is ongoing and is being conducted by ENSP, the Conserve Wildlife Foundation of N.J., various federal agencies in the state (National Park Service, U.S. Fish and Wildlife Service, and U.S. Coast Guard), and the public. A total of 25 banded individuals were resighted on the breeding grounds and confirmed as nesters. Forty (40) band resights were observed during the winter surveys, the majority being birds banded in New Jersey, with a small number being Massachusetts breeders.
- All breeding and wintering populations were documented using GIS for incorporation into NJ DEP's Biotics database and ENSP's Landscape Project.

Conclusions:

- The state's wintering population of American oystercatcher (as determined from the December survey period) has varied considerably over the years since 2004 when ground surveys have been conducted using consistent protocols. Totals have ranged from 546 to 807 birds, although the 715 birds recorded in 2010 was about average for the period (698 birds). No apparent trend can be discerned over the period for the overall winter population. In all years (2005-2010) that January and February surveys were conducted, there were significantly fewer birds present in the late winter, especially on the February surveys. Absecon Inlet stands out as the most important winter roost site in the state across all three survey periods, and typically accounts for the majority of birds statewide in the late winter. Hereford Inlet remains the other important winter roost location, although often less so late in the late winter, as was the case in 2010/11. Characteristics that make the Absecon Inlet site especially desirable for oystercatchers are not well understood. High numbers of birds being present at this site late in the winter would suggest resources and habitat exist to support oystercatchers throughout the entire winter period in New Jersey, although significant numbers of birds do not consistently remain in the state past mid-December at any of the other sites.
- Prior to 2011, for the period since 2003 when comprehensive monitoring began, the average number of breeding pairs of American oystercatcher on barrier/beach strand (the beach nesting portion of the population) was 59 pairs. In 2011, 79 pairs were recorded, although most of this increase was the result of the 12 pairs found at Edwin B. Forsythe NWR – Little Beach, which had not been surveyed prior to this year. The rest of the increase this year can be primarily attributed to an increase of 6 pairs at Gateway National Recreation Area (Sandy Hook).
- Pair hatch success for beach nesting American oystercatchers in 2011 (32% of the pairs hatched young) was well below last year's record level (49% of the pairs hatched young). However, it was about average (29%) for the years prior to this year. Last year's high hatch success was attributed to low levels of nest loss due to flooding at several key sites. However, this year flooding was a major limiting factor at Stone Harbor Point, and predation played a large role at other sites (i.e., Holgate).
- Productivity for beach nesting American oystercatchers in 2011 was 0.35 chicks fledged per pair, nearly half the level in 2010 (0.66 chicks fledged per pair). However, productivity in 2010 was the highest recorded for the period since 2003 when comprehensive monitoring began, and this year's productivity was about average (0.32 chicks fledged per pair) for the period prior to this year. Sandy Hook continued to be a most productive beach nesting oystercatcher site in the state.
- The number of active nesting sites (29) for beach nesting American oystercatchers in 2011 was the highest recorded for the period since 2003 when comprehensive monitoring began and the first time any significant variability was recorded from the previous average of 21 sites. Most of the increase this year was the result of an expansion of sites used at Sandy Hook (and the addition of Little Beach as a newly surveyed site).
- Resight data continues to indicate strong site fidelity to both breeding sites and winter high tide roost locations in New Jersey, as well as at wintering sites outside the state. Birds banded as chicks have just begun to reach reproductive age the past several years, and preliminary results show a strong propensity towards returning to natal sites, although there are also a number of birds that have dispersed to other states with no apparent pattern evident.

Recommendations:

- Continue to track American oystercatcher wintering population and distribution annually. However, discontinue the late season surveys in January and February as six years of surveys have already shown distinct patterns. Just two significant roosts are typically active at this time of the year; existing data have already established their ongoing importance. Furthermore, very few band resights are collected during this period and band resighting efforts conducted with other funding sources have shown that the post-breeding and fall migratory period to be much more productive in collecting band

resights. Although the December survey should be continued annually as an ongoing window count of the winter population for the state, conducting such surveys under this grant initiative is not currently necessary as other funding sources have been secured. A range wide aerial winter survey, duplicating the one conducted as a baseline survey in 2002/03, is being planned by the American Oystercatcher Working Group for the winter of 2012/13. Collaborating on and participating in this effort should be a high priority.

- Continue to monitor breeding population size and productivity of beach-nesting American oystercatchers on an annual basis. Monitor population and productivity of oystercatchers breeding in other habitat types (i.e., back bay marsh island, dredged material areas), as resources allow.
- Conduct a statewide breeding survey in all suitable habitat types (beaches, back bay marsh/dredged material areas) along the Atlantic coast and Delaware and Raritan Bays in coordination with a range wide breeding survey being planned collaboratively with the American Oystercatcher Working Group. Tentative plans call for the survey during the 2013 breeding season.
- Continue to individually mark American oystercatchers as part of an Atlantic/Gulf coast initiative to study productivity/site fidelity, migratory movements, and generate key demographic metrics.
- Continue to incorporate breeding and wintering 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 Northeast Coordinated Bird Conservation Conference from October 19-21, 2010 in Plymouth, MA to discuss data management, bird monitoring needs, and planning for the next Northeast Bird Conservation Conference to be held in Plymouth, MA in October 2010.
  - Two biologists attended various seminars and participated in different working groups to discuss issues related to research, monitoring, and management
- Staff attended the Appalachian Mountain Joint Venture Technical Meeting in Roan Mtn, TN from August 8-10, 2011.
  - One biologist participated in group discussions about conservation planning for cerulean warblers and mapped out focal areas throughout the region
- Twenty-five out of twenty-eight routes were assigned in 2011 using 21 volunteers and 2 staff and 17 were surveyed. Five volunteers and one staff did not turn in data in 2011
- As part of the NJ Coordinated Bird Monitoring Plan, biologists from NJ DFW collaborated for the seventh year to conduct a joint waterfowl breeding population index (BPI) and endangered and threatened waterbird survey.
  - A total 39 state endangered, 86 state threatened, and 353 state special concern individuals were observed in 2011.
  - Trends can be detected in the saltmarsh strata for great egrets, snowy egrets, tricolored herons, little blue herons and black-crowned night-herons (Figure 3B-1).
  - Trends from the waterfowl BPI are different from trends from the waterbird colony count.

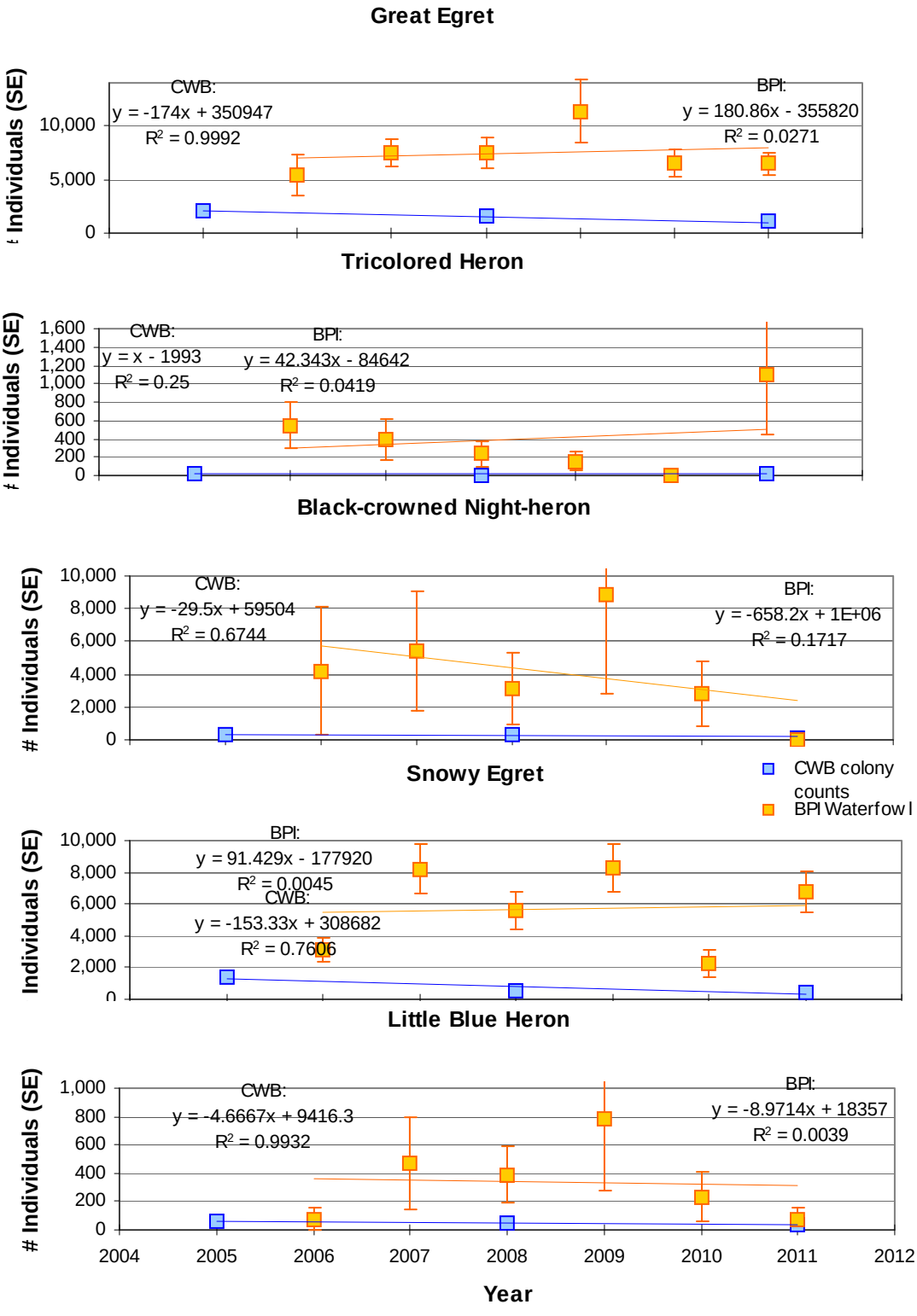

Figure 3B-1. Trends of the BPI waterfowl surveys, 2006–2011 (yellow), and the colonial waterbird aerial colony count, 2005–2011 (blue). The year 2005 was dropped from the BPI waterfowl survey due to first-year bias.

Conclusions:

- Collaboration with other states and regions is critical for large-scale bird monitoring and should be a high priority for the state of New Jersey.
- Trends from the BPI cannot be directly compared with results of the colonial waterbird surveys due to discrepancies in protocol and analyses (area ground search for population index versus systematic aerial colony count).
- Collaborating waterfowl and waterbird surveys within state may provide results and should be continued at least one more year to while a statistician determines whether the waterfowl survey can adequately replace the more expensive waterbird surveys.

Recommendations:

- Consult with a statistician to determine if the sampling design of the waterfowl BPI survey can adequately sample species with a clustered distribution and which statistics or correction factor is needed.
- Continue to participate in the Northeast Coordinated Bird Monitoring Working Groups and other regional coordination efforts.

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

Project leader: Amanda Dey, Principal Zoologist

OBJECTIVE: The primary objective for 2008 is to continue ENSP staff participation in the final phases of the current IBBA project. Completed objectives include development of digital IBBA maps and compilation of endangered/threatened species data from the nomination process. As important bird and birding sites have now been identified and mapped, the NJ IBBA Project will seek to ensure continued viability of these sites through development of management plans, increased public awareness, and by providing public access to digital mapping of important bird areas both on the Audubon website and the NJ Department of Environmental Protection's interactive mapping website.

Key Findings:

Key Findings:

- ENSP contracted with NJ Audubon (NJAS), whose staff completed implementation of GIS methodology for delineating boundaries for IBAs using NJDEP's Landscape Project Version 2.1 and 3.0 for the Highlands Region, Metadata and a comprehensive attribute table including detailed site information accompany the GIS layer's boundary data (see Appendix A – Final IBBA Report). These data were used to produce maps of IBAs for download from the IBBA Program website. As part of ENSP's Landscape Project mapping, the IBA boundaries will be available to the public on the Department's interactive mapping application, download on the Department's GIS download page or on CD by request.
- There were no new sites nominated, including urban IBAs, during the period of 2008-2009.
- No new endangered/threatened species data were submitted to be incorporated into Landscape Project critical habitat mapping and the NJ DEP's Biotics (Biotics) database.
- A total of 123 Important Bird Areas and 28 Important Birding Areas were identified. All 2007 and 2008 data collected in the nomination process with accompanying attribute table of the GIS IBA boundary data were vetted and submitted to the ENSP's Biotics database. However not all of those data met the strict requirements for inclusion in Biotics.
- Comprehensive conservation plans were developed for Mannington Meadows IBA (MMIBA), the Cohansey River Corridor IBA (CRCIBA), Cape Island IBA (CIIBA) and the Southern Pinelands IBA. Through this process, the IBBA Program developed Conservation Templates that demonstrate techniques for protecting and improving habitat within Important Bird Areas.

- NJAS staff hosted 25 free public workshops for landowners and other stakeholders reaching over 250 landowners throughout the Cohansey River Corridor IBA, Cape Island IBA, Southern Pinelands IBA and the Mannington Meadows IBA.
- The IBBA Program provided technical support to communities interested in making informed decisions about natural resource management.
- The IBBA Program's comprehensive guide to the NJ's IBAs, "The Important Bird Areas of New Jersey" was published in late 2009.
- The IBBA Program identified additional opportunities to expand conservation efforts, implement habitat restoration plans and conduct outreach in priority IBAs. Current and proposed projects directly implement priority goals for habitat management and species recovery in the State Wildlife Action Plan

Recommendations:

- The IBBA Program should continue annual submission of avian data from IBAs to the state's database to inform the Landscape Project and avoid discrepancies between the two databases.
- ENSP should update IBA boundaries when Landscape Project Version 3.1 data or new Land Use/ Land Cover data become available. Consider the inclusion of IBA boundaries in NJ DEP's i-Map and Landscape Project, Version 3.1.
- The IBBA Program should analyze data collected during avian and vegetation monitoring at IBAs to allow for the assessment of pre- and post-management impacts;
- Identify new opportunities within priority IBAs to implement habitat restoration as well as expand ongoing conservation efforts.
- Continue community involvement in the protection and restoration of IBAs through participation in the Adopt-an-IBA Program;
- Continue outreach and education for citizens and landowners about the goals of IBBA, the importance of habitat conservation, and the various state and federal incentive programs available to landowners;
- Continue to initiate and foster partnerships with local governments, citizens groups and professional planning organizations to facilitate the identification and protection of important bird habitat within communities.

EXECUTIVE SUMMARY

Project:	**Mammal Conservation**
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) ('10-'11 year only)

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 225 trap/days resulted in the capture of two bobcats using box traps baited with beaver carcasses. One adult female bobcat (18.5 lbs.) was trapped on private property in Allamuchy Township, Warren County, NJ on 2/13/11. The animal appeared to be in excellent condition and 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. The animal was held overnight for observation and released at the point of capture on 2/14/11.
- An adult male (30 lbs.) bobcat was live-trapped at Picatinny Arsenal, Morris County, NJ on 2/18/11. The animal appeared to be in excellent condition and 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. The animal was held overnight for observation and released at the point of capture on 2/19/11.
- The radio collared bobcats are tracked using VHF radio telemetry approximately every 2 weeks to locate the animals and ensure that the collars are still functioning properly. Tracking at this rate will be continued until the collars fall off. The collars are programmed to fall off on 1/29/12 (female) and on 2/3/12 (male).
- On 3/5/11 biologists used strut-mounted antennas attached to a Cessna 180 to locate the adult male bobcat that was trapped and collared on 2/21/10 in Allamuchy Township and the adult female bobcat that was trapped and collared on 2/1/10 in Jefferson Township. The adult male collar was located and recovered but the adult female collar was not. It is believed that the female's collar failed sometime during the fall of 2010. The female bobcat was routinely located from the time of capture through the early fall of 2010. During October 2010 volunteer trackers reported that they had failed to pick up the signal after attempting to locate the bobcat for several weeks. Coordinated ground searches were performed using several volunteers walking pre-determined transects. No signal was ever detected after September 2010.
- On 3/20/11, the bobcat project leader gave a presentation to the NJ Fur Harvester's Association at their annual meeting. The presentation covered the current status of bobcat research in NJ. Trappers were encouraged to cooperate with the Division of Fish and Wildlife by immediately

reporting incidentally trapped bobcats that are captured during the legal trapping season. Trappers were also asked to report sightings of bobcats in southern NJ.

- A preliminary analysis of within home range habitat use has begun. Satellite and GPS collar data (used locations) from 7 bobcats (4 males, 3 females) ranging in year from 2002 – 2011 (Fig. 1) were compared to randomly generated points (unused locations) within each bobcat's home range (95% minimum convex polygon). Seven hundred random points were generated at least 60m away from any existing bobcat location within each home range. Location data from 2002-2004 and from 2005 – 2011 were related to 2002 and 2007 land use land cover data, respectively. GIS layers have been generated (using ArcGIS 10 and Land Facet Corridor Designer Tools for ArcGIS 10) for 16 habitat variables and comparisons between used and unused locations have been performed using t-tests and logistic regression (Table 1). The within home range analysis will inform a landscape level analysis aimed at updating the existing bobcat predictive habitat model that was developed in 2006.
    - Variables significantly different (t-test, $p<0.05$) between used and unused locations include stream density, forest/wetlands diversity index, forest/wetlands/agricultural diversity index, forest density, distance to wetlands. All variables except distance to wetlands had significantly higher means at the used locations compared to the unused locations. Conversely, used locations were significantly closer to wetlands than unused locations.
    - A predictive model using logistic regression has not resulted in a model with >65% classification success of used and unused locations at this point, but additional variables and buffer sizes still need to be generated and analyzed.
- Habitat change analyses will not be completed until an updated landscape-level predictive habitat model is produced.
- Collar data and bobcat scat location data were used to inform the land use/land cover layers to include in the updated Landscape Project mapping.
- A draft bobcat habitat corridor model was produced as a means of testing GIS corridor modeling tools that have been developed in other states where biologists have produced statewide connectivity maps including Corridor Designer and Circuitscape. The bobcat corridors were built using the bobcat predictive model built in 2006. Staff have developed a detailed work plan, but have not yet formed the connectivity mapping working group (SWG Job 3F) that will be developing the statewide connectivity map.
- Staff did not monitor culverts during this reporting period. The roads and wildlife working group (SWG Job 3A) has started developing a culvert inventory datasheet, protocol, and database to help identify crossing structures that could be retrofitted or need to be replaced in order to function effectively. Once the datasheet and protocol are finalized, a procedure will then be in place when the updated bobcat corridor mapping is complete and work can immediately begin on evaluating road segments that are crossed by a mapped corridor. This can be used to establish a set of guidelines that identify specific actions to increase road permeability for bobcats.
- 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.
- Scat, tissue, and collar data from 2002-2011 were summarized and staff met with a statistician from Rutgers to discuss a capture-recapture model to evaluate sex ratio, population size, and survival rate of the bobcat population in Northern New Jersey.
- Bobcat observation data from the public (n=19) have been entered into the Biotics database in time to be incorporated into the next version (3.1) of the Landscape Project.
- An additional 9 tissue samples were obtained from NJ road-killed bobcats and 27 from bobcats in Pennsylvania (provided by those states) for the regional genetic variability study. This

completes the set of tissues that are being used for the analysis. The study is aimed at understanding the genetic structure of the New Jersey population. The tissues have all been sent to the U.S. Forest Service Rocky Mountain Research Station lab (Montana) for analyses. Between 2007 and 2011, bobcat tissue samples from New Jersey (n=53), New York (n=62), Pennsylvania (n=98) and Maine (n=32) (Figure 2) have been sent to the lab. The lab has performed a preliminary analysis using nuclear DNA sequencing and analysis on a total of 218 tissue samples (of 252 sent in after accounting for those that did not yield quality DNA or were duplicates).

    - Preliminary results from the DNA analysis suggest that the NJ samples represent only one group genetically and there is high gene flow within the NJ population. The results also suggest that Maine and New Jersey are highly related, although substantial genetic drift has occurred between these two groups. There is no evidence that New Jersey bobcats that persisted prior to extinction from the state remain, unless their genetic profile is closely related to Pennsylvania. There is well supported subdivision between Pennsylvania and New Jersey; however it appears that migrants can move among populations. Comparing all of the samples together (NJ, PA, NY, and ME) suggests that there are possibly 2-3 distinct groups, but the analysis also suggests that there is not a strong barrier to movement. Lastly, the lab estimated an effective population size (Ne) of bobcats in New Jersey using a linkage disequilibrium approach. They estimated the Ne to be 50.6 (95% CI 29.9 – 107.0).

- A status assessment and recovery plan have not been completed for bobcats because vital baseline data are still being gathered and analyzed and are needed to inform the assessment and recovery plan. The baseline data include the results of the regional genetic variability study, the updated landscape level predictive model to assess distribution of habitat and habitat change over time, the bobcat corridor model that also will depict 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:

- Further analysis of additional habitat variables, varying buffer sizes, incorporation of factors such as sex and season, and potentially different unused point sample sizes and distribution are necessary to complete the within home range habitat analysis. The variables that are significant in the preliminary analyses agree with what has been reported in the literature and support what staff have anecdotally observed in the field.
- The corridor modeling tools were successfully used for bobcats as a test run.
- It is highly likely that bobcats will be chosen as a focal species by the connectivity mapping working group and, therefore, bobcat corridor modeling will be a component of the statewide connectivity mapping effort. Staff decided to delay culvert monitoring until the bobcat corridor mapping is complete and the culvert inventory protocol is finalized to maximize effectiveness of the effort.
- The results of the genetic variability study, so far, are generally in line with what staff have expected. We expected to learn that NJ samples were similar to ME samples suggesting that the translocation of bobcats from ME to NJ in the late 1970's and early 1980's was a success. It is very likely that the Division's bobcat restoration project has resulted in the recent increase in the bobcat population in northern NJ. The lack of strong barriers to movement also was expected because we know from our collar data and anecdotal reports that bobcats have crossed the Delaware River, though not very regularly given that the data support a subdivision

between New Jersey and Pennsylvania. The small Ne is of concern and suggests that we should expect substantial genetic drift in the future unless connectivity to other populations is maintained.

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 by season.
    - Use results to inform landscape level analysis to build an updated predictive habitat model using scat data collected in 2007, 2008 and 2011.
- Use updated landscape level habitat predictive map to inform the bobcat corridor modeling effort, either as part of the statewide connectivity mapping effort if bobcat is chosen as a focal species, or apart from that effort if it is not a chose focal species.
- Begin monitoring culverts using the culvert inventory protocol being developed by the Roads and Wildlife Working Group in areas where the updated bobcat corridor model intersects roads to determine whether bobcats are using culverts or other structures in those areas and evaluate ways in which they can be retrofitted or replaced to increase road permeability.
- Use the dog-handler team, cameras, and collar data to help validate bobcat corridor mapping when it is complete.
- Continue surveying with Bear to opportunistically collect tissue samples and use newly available collar data to feed into the capture-recapture model for updated estimates of sex ratio, population size, and survival rates.
- Continue to update the Biotics database with data collected by the public and staff.
- Continue collecting reproductive tracts and teeth to gain a better understanding of the age structure, fecundity and pregnancy rates of the population.
- Continue to work with the genetics lab to determine the action plan to complete the genetic variability analysis. Components of the future work plan should include looking for historical bobcat specimens for extraction of DNA from museums or other collections to establish the historic genetic profile of New Jersey bobcats. Also, to date the lab has used nuclear DNA sequencing but has suggested that it may be possible to use mitochondrial DNA to help further analyze the genetic data..
- 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.

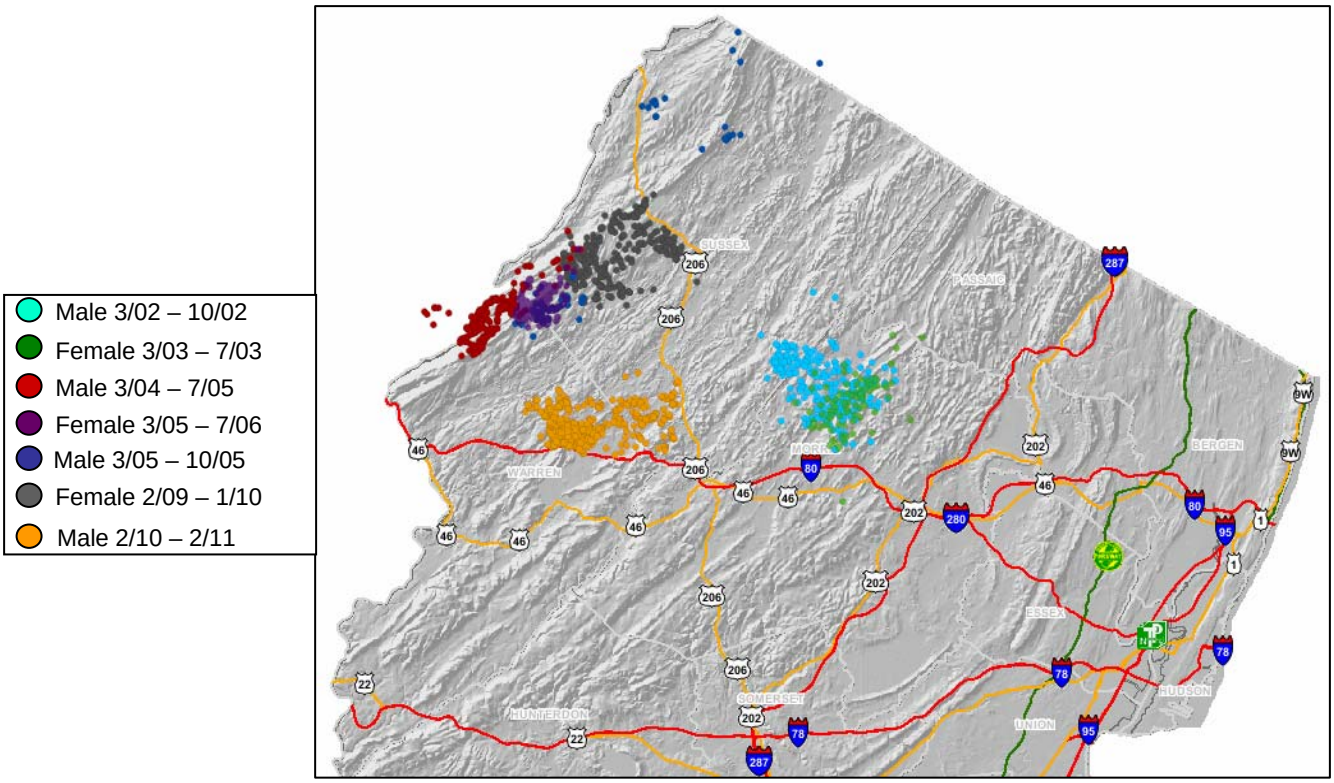

Figure 1. Distribution of bobcat satellite and GPS data from 7 collared bobcats in northwestern New Jersey between 2002 and 2011.

Table 1. Habitat variables compared between used and used locations of bobcats within 7 home ranges in northwestern New Jersey. Density and diversity index values were calculated based on both 100m and 250m radii from the location point.

Variables	Significant (t-test, $p<0.05$)
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	

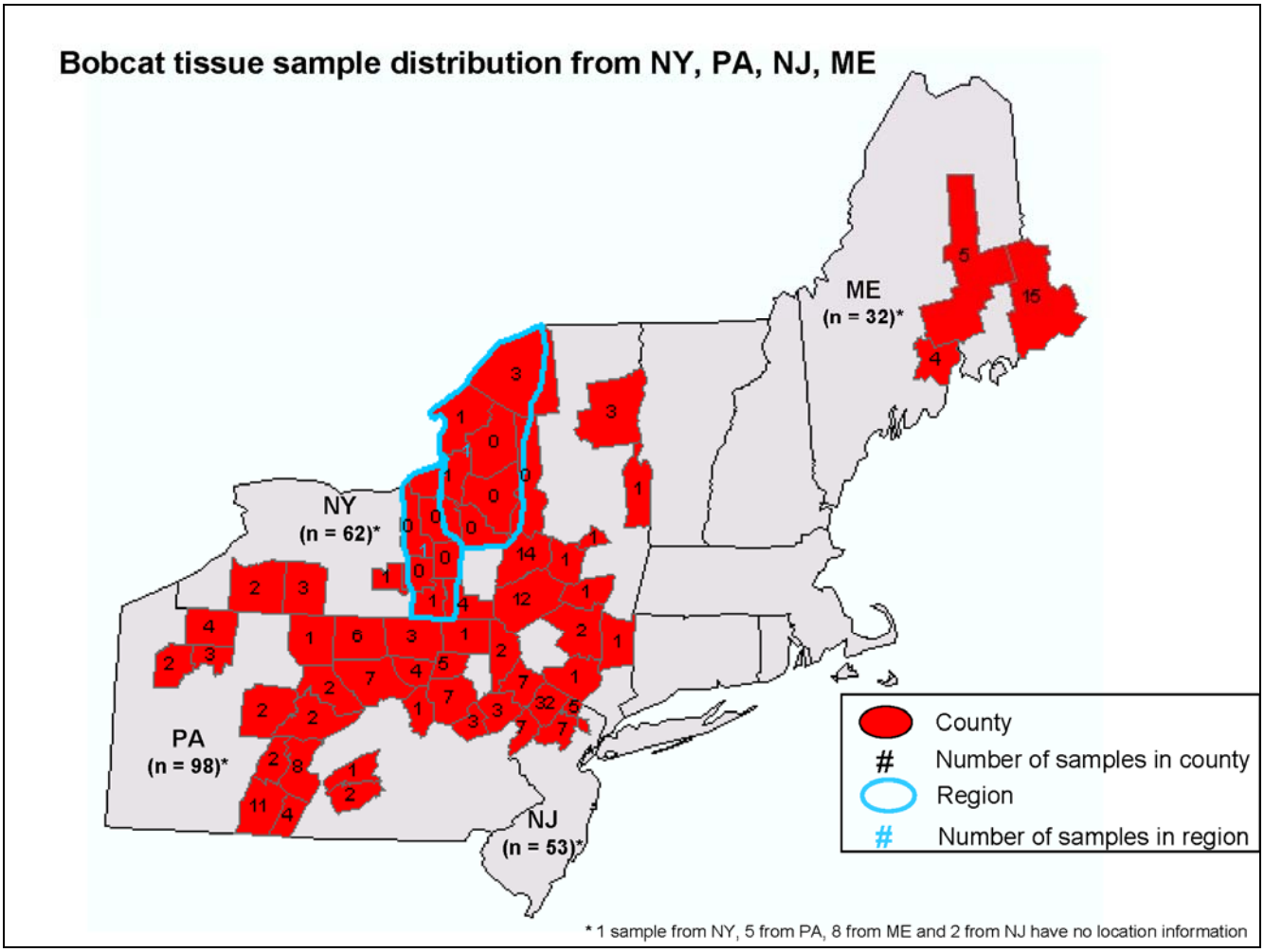

Figure 2. Distribution of bobcat tissue samples collected from Pennsylvania, New York, New Jersey, and Maine for a regional genetic analysis.

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 October 8 and 9, 2010. 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 increased in 2010 to 16 unique individuals. Woodrat numbers (based on capture index) have been declining at the Palisades site since 2006. The capture index (# of individuals captured/10 trap nights) was 2.0 compared to 1.13 in 2008 and 2009.
    - Captured animals consisted of nine adult males, four adult females, one juvenile male and one juvenile female. One male animal escaped prior to being weighed so no age determination was made.
    - Two males and three females were recaptures from 2009.
        - No movement information could be obtained because ear tags were not used in 2009 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 and marked by attaching a numbered ear tag. 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 at a rate of 10 – 15 baits per acre surrounding the active woodrat sites in an effort to interrupt egg shedding by infected raccoons. Additional treated baits were distributed along the shoreline of the Hudson River below the active woodrat sites as this serves as a travel corridor for raccoons. Treated baits were distributed at the site on September 30th and again on October 29, 2010. Several of the baited locations were monitored with motion-sensitive cameras in an effort to determine what species were taking the baits. Raccoons were documented at several of the bait locations consuming the baits.
- Two polyvinyl chloride bait stations were used again at the Palisades. Each dispenser was filled with piperazine-treated baits (capacity approx. 40 baits each) and monitored using motion-sensitive cameras. Raccoons quickly discovered the bait stations and readily consumed the baits. Only raccoons were recorded taking baits while the bait dispensers were monitored by the cameras. No non-target animals were detected taking the baits. In addition, the bait dispensers present a less labor intensive approach to distributing baits and they are inexpensive, portable and weather-resistant.
- Supplemental feeding was conducted at several locations within the Palisades woodrat site for the second consecutive year. This year, flags marking successful trap locations were left in place at the site and mast was distributed at the flagged locations. Approx. 20 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, supplemental feeding was conducted at a long-term monitoring site in Pennsylvania and it was suggested that the population may have had a positive response to this management technique (Mengak, et al 2008).
- 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 anthelminthic-treated baits is being used to control the *B. procyonis* egg loads in raccoon scat.

Conclusions:

- For the first time in four years the Allegheny woodrat capture index has increased suggesting a possible upward trend in the woodrat population at the Palisades Interstate Park. Although there is no way to prove the effectiveness of supplemental feeding, the population has apparently increased for the first time in four years following the initial year of supplemental feeding. Regardless, the Palisades population is totally isolated from any other extant population of Allegheny woodrats. Genetic analysis (Smyser, unpublished report) has indicated that inbreeding depression is a real concern for the NJ woodrat population. Five individuals were recaptured from the previous year 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 (LoGuidice 2000, McGowan 1993) 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 anthelminthic 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).

Fig. 1. A raccoon removing a piperazine-treated bait from a bait dispenser. The design of the bait dispensers greatly decreased the chance that non-target animals will acquire and consume baits.

- 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.

Literature Cited

Boulanger, J. R., L. L. Bigler, P. D. Curtis, D. H. Lein and A. J. Lembo Jr. 2006. A polyvinyl chloride bait station for dispensing rabies vaccine to raccoons in suburban landscapes. Wildlife Society Bulletin 34:1206-1211.

LoGuidice, Kathleen. 2000. *Baylisascaris procyonis* and the decline of the Allegheny woodrat (*Neotoma magister*). Ph.D. dissertation, Rutgers, The State University of New Jersey, 101pp.

McGowan, E. 1993. Experimental release and fate study of the Allegheny woodrat (*Neotoma magister*). Unpublished report of New York State Department of Environmental Conservation, Endangered Species Unit. 15 pp.

Mengak, M. T., Butchkoski, C. M., Feller, D. J. and Johnson, S. A. 2008. Lessons from long-term monitoring of woodrat populations. *In* The Allegheny Woodrat: Ecology, Conservation and Management of a Declining Species, eds. J. D. Peles and J. Wright, pp. 109-125. Springer Science + Business Media, New York, NY.

Smyser, T. 2009. Genetic analysis of the Allegheny woodrat population at the Palisades Interstate Park in New Jersey. Unpublished report to the NJ Division of Fish and Wildlife, Endangered and Nongame Species Program. 2pp.

JOB 1C: Small Mammal Survey

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

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

Key Findings:

- Solicited bids from contractors to develop and conduct a pilot project to sample several species of terrestrial small mammals throughout several habitat types within the Upper Delaware River Valley and Kittatinny Ridge Conservation Zone (as defined in the NJ Wildlife Action Plan).
- Dr. Randall FitzGerald of Montclair State University (NJ School of Conservation) was awarded the contract to perform the small mammal survey. A contract between Dr. FitzGerald and the NJ Division of Fish and Wildlife has been executed and the small mammal sampling is being conducted between September 2011 and June 1, 2012. A final project report is due from the contractor by July 31, 2012.
- All field materials and supplies have been purchased including Sherman live traps, drift fencing, pitfall traps and flagging to mark trap locations. All materials were delivered to Dr. Fitzgerald at the NJ School of Conservation in late August 2011.
- The sampling methods being used include a pitfall trap array and Sherman live trap grid within each of the habitat types sampled. The pitfall array consists of a "Y" configuration with each arm extending 15m and pitfalls spaced at 3m intervals along each arm for a total of 16 pitfalls. Plastic drift fencing is used to connect the pitfalls. The Sherman trap grids consist of a 50m x 50m grid for a total of 25 traps each. The pitfall arrays and Sherman trap grids are being operated for 10 consecutive days for a total of 410 trap nights within each habitat type sampled.

Conclusions:

- None, project is on-going at this time.

Recommendations:

- Based on the success of the pilot project, small mammal sampling should be expanded to other areas of the state to establish species occurrence and distribution information and to determine the presence/absence of some peripheral species that may or may not occur in the state but have previously not been documented as occurring here. The species and habitat data collected will be used to develop predictive models for several species of small mammals in an effort to predict their distribution. Future sampling will be used to test the precision of the models.

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

JOB 3. Pinniped Research and Conservation - Inactive

EXECUTIVE SUMMARY

Project:	**Reptile and Amphibian Conservation**
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) ('10-11 year only)

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 2010-11 reporting period, ENSP and ENSP-volunteers surveyed a total of 31 sites for the presence of bog turtles and 66 wetlands were assessed for current habitat suitability. During this effort a total of 79 bog turtles were captured from 15 sites by: 1) ENSP staff and 2) volunteers.
  - ENSP Staff Surveys: ENSP conducted visual surveys following general Phase II bog turtle survey guidelines at a total of 21 sites. Thirty-six surveys were performed and 8 sites were visited more than once. Thirty-two individual turtles were captured in Sussex, Warren, and Hunterdon counties.
    - Turtles were captured at 6 of the 21 surveyed sites, including one site that was characterized as a low/unknown density population. Turtles captured at 2 of the 21 sites included juveniles or hatchlings.
    - At the remaining 15 sites in which turtles were not observed, 14 were characterized as low/unknown density populations. Full Phase II survey protocols were not followed at all of these sites, however, and some sites were only visited once.
    - Sixty-six wetlands that were assessed for habitat suitability in the 1990s were re-assessed in the spring and summer of 2011; these wetlands had no documented occurrences of bog turtle. They were given ranks based on habitat features and surveyor opinion:
      - 5 habitats were ranked "no habitat"
      - 18 habitats were ranked "low probability"
      - 25 habitats were ranked "suitable, but need significant improvement"
      - 15 habitat were ranked "suitable with some improvement"
      - 3 were ranked "highly suitable"
  - Volunteer Surveys: ENSP enlisted the assistance of 21 qualified New Jersey bog turtle surveyors to opportunistically locate bog turtles at known sites (typically with number of documented turtles > 15) as part of an experimental mark-recapture population estimate study. Surveyors were asked to spend 1 hour at a site once per week during the Phase II survey window beginning in May following Phase II bog turtle survey guidelines. Not all data associated with this project has been submitted by the surveyors, but the 6 volunteers that submitted data captured 47 turtles at 7 sites.
    - With 15 volunteers still needed to submit their data, there is insufficient data at this time to render a defensible population estimate. Additional data collected in subsequent field seasons will also contribute to this estimate.

- At this time, NJDEP lands management staff is not engaged in managing state-owned bog turtle wetlands. ENSP will continue work with lands management staff in the future to assist with woody vegetation and invasive plant removal.
- No sites were monitored exclusively for determining use of habitat post-restoration.
- No surveys were done this reporting period with the dog-handler team.
- No nests were protected using fencing. Detected nests were already depredated or were depredated by the time staff returned with fencing. Two nests were detected and subsequently depredated upon return with fencing and the failure of radio-telemetry equipment prohibited the detection of at maximum 3 nests in a separate wetland.
- 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. This package will be finalized and shared in the fall of 2011.
- Two staff members attended 2011 Northeast Partners in Amphibian and Reptile Conservation (NEPARC) annual meeting and both are now members of the NEPARC steering committee.
- Figures below depict snapshots of raw bog turtle occurrences and distribution.
  - New Jersey features a number of suitable habitats, but the majority is only known to support a small number of turtles (Figure 1).
  - Permanent preservation, through purchase or easement, of important wetlands is a major goal of the federal recovery plan (Figure 2).
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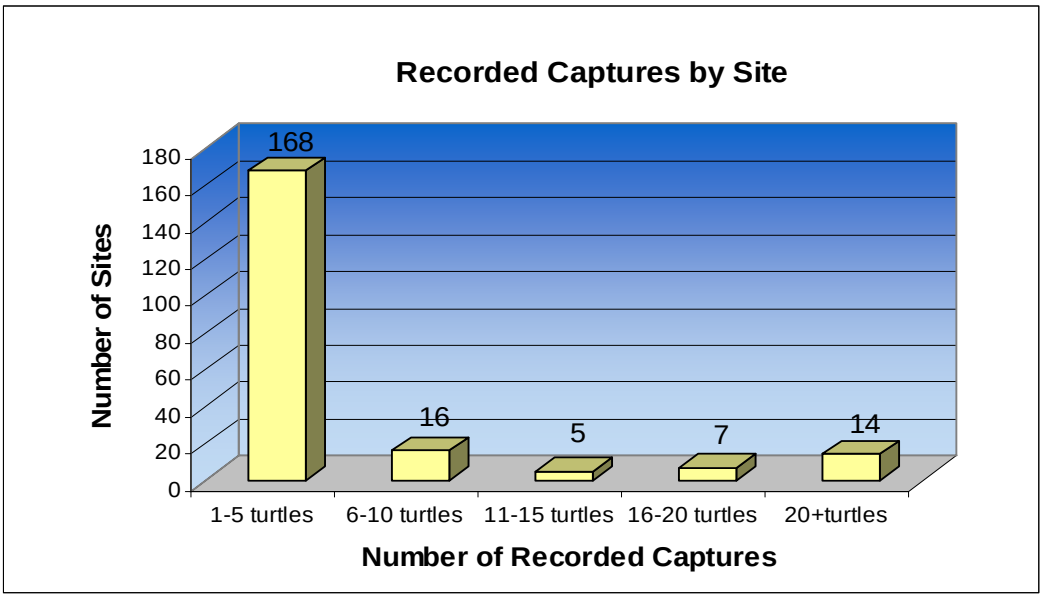

Figure 1. A large percentage of bog turtle wetlands are only known to support a small number of individual turtles. Relative to the number of turtles marked in the state, few sites appear to support viable populations. Data presented is for 1993-2011, but only includes sites that have been validated for use in Landscape Project habitat mapping. .

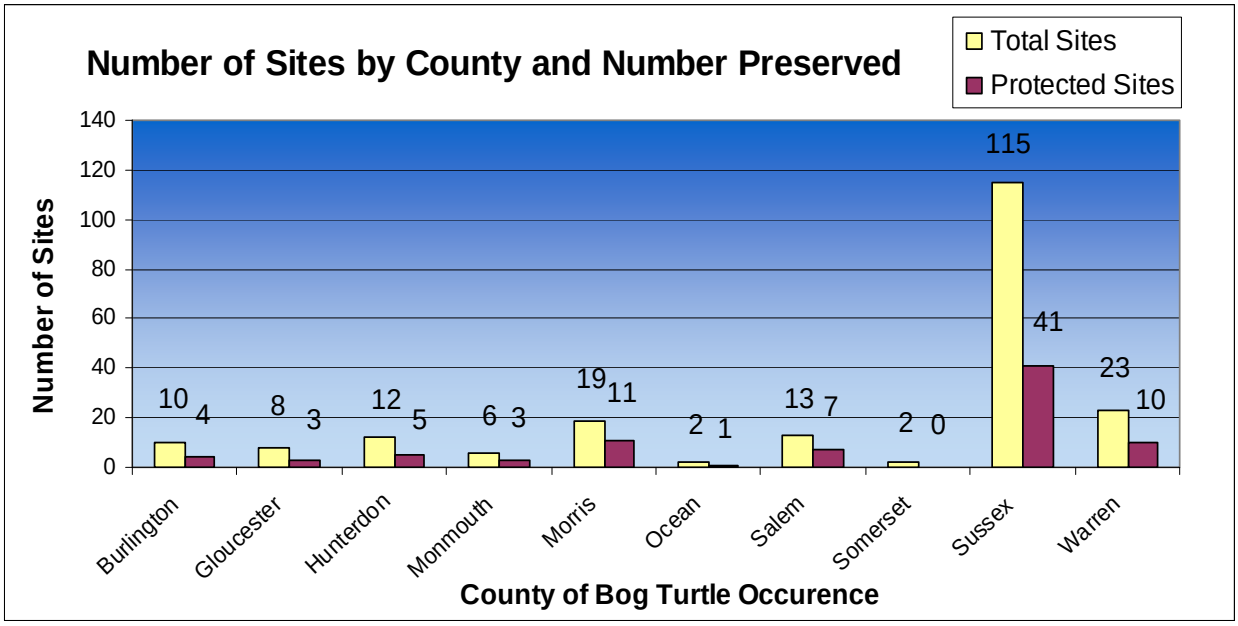

Figure 2. Low mobility and fidelity to suitable habitats make preservation of occupied habitats a key recovery goal.

Conclusions:

- A number of wetlands feature habitat that is suitable for bog turtles, but survey efforts (often minimal) have not revealed turtle presence at these sites. 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.
- The majority of known bog turtle sites in New Jersey appear to support low numbers of turtles, with 80% of the sites having fewer than 6 documented bog turtle captures.
- Permanent protection has been achieved at 40% of the known bog turtle sites. Furthermore, a total of 50% of the sites with >20 documented turtles are preserved. Two additional high density sites are under temporary easements that are set to expire in 2012, but strong landowner relationships are established and we do not expect to lose access or the ability to maintain the habitat.

Recommendations:

- Assess volunteer surveyor dataset for use in preliminary population estimate. This is planned for the winter of 2011/2012. Consider continuing to survey the same sites in 2012 using the same time and date constrained parameters.

- Prioritize low/unknown density sites for targeted surveys based upon quality of habitat, date of most recent observation, proximity to other known observations, and access permissions.
- Prioritize 2012 surveys in suitable habitats without occurrences.
- Pursue funding to conduct a nesting study at a low density site to implement a new predator exclusion fencing design.

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:

- 2010 Fall Surveys
    - ENSP staff conducted visual surveys along 40 stream segments in Sussex, Warren, Morris, Hunterdon, Somerset, Middlesex, Mercer, and Burlington counties. These 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.
        - Five turtles were captured at 3 of the stream transects surveyed in Sussex and Hunterdon counties. The captures included 1 juvenile/subadult and 4 adult males.
        - Only 1 site was visited twice and resulted in no turtle observations.
- 2011 Spring Surveys
    - ENSP staff conducted visual surveys along 21 stream segments in Warren, Morris, Hunterdon, Middlesex, Burlington, and Ocean counties. These segments were selected because they were proximate to occurrences over that were at least 15-years old. Seven of the stream segments were revisited from the fall survey. As with the fall survey, the spring survey goals were to assess habitat suitability and add occurrence data to these areas with limited observations and "historic" data.
        - Seven turtles were captured at 7 of the stream transects surveyed in Warren, Morris, Hunterdon and Hunterdon counties. The captures included 1 juvenile/subadult, 1 adult female, and 5 adult males.
        - Three streams revisited from the fall produced new turtle observations and in one of these segments we did not find a turtle until our third visit in the spring.
- A site described the last reporting period on a public trust property in Morris County, NJ was revisited to assess use of 2 artificial nesting mounds. The southern mound, since its installation, has not received any use and appears to receive too much tree canopy cover/shade, particularly in the afternoon. We plan on relocating this pit over the winter to a more suitable location. The northern mound was visited in June 2011 and 2 depredated nests were observed, one on the mound itself and another immediately adjacent. Wood turtle and eastern box turtle are the only known turtles to occupy that portion of the property. One of the depredated nests appeared to be from a wood turtle and the other from a box turtle. This distinction was made based on the number of eggshell fragments at each nest, but these conclusions are only speculation. To date, only 2 adult female wood turtles are known to persist in the population and 1 of the females was observed displaying nesting behavior at the same mound in 2010. All observations of nesting at

these artificially nest pits were made without the use of motion-activated cameras or radio-telemetry.
- No progress was made to train a scent-detection dog on wood turtles. We plan on initiating this training in the fall of 2011.
- No work began on a species status assessment or recovery plan. We are awaiting response on RCN proposal that addresses some of the status assessment needs.

Conclusions:
- Wood turtles continue to be documented in locations where records were 15-years old or older, 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.
- The use of the artificial nest mounds at the Morris County property is encouraging, although predation continues to be an issue at this site.

Recommendations:
- Following the bog turtle model, develop survey protocols to determine presence/absence of wood turtles. Document survey effort per area surveyed, along with other relevant variables.
- 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.
- We intend to install a semi-permanent predator excluder nest around the northern nest mound at the property in Morris County. This work will commence in the fall and winter of 2011.

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 44 rattlesnake sightings were entered into NJ DEP's Biotics database (Biotics) and these data will ultimately make it into the Landscape Project mapping. An additional 44 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.

PINELANDS REGION

- Conservation and research partners from the NJ Conservation Foundation (NJCF):
  - Radio-tracked one male rattlesnake to a previously undocumented den in October 2010. The transmitter was removed in the spring 2011.

- Although NJCF personnel reported observing multiple gravid female rattlesnakes in sections of their preserve, they did not locate candidate males for potential radio-telemetry tracking.
- NJCF worked with a neighboring landowner to establish suitable gestation habitat in an area where females had formerly used artificial habitat. The landowner had removed a portion of the artificial habitat in early April and the balance of material is scheduled for removal this fall. NJCF installed 11 mason-dumptruck loads of tree stumps having observed gestating females using stumps elsewhere. Additionally, NJCF staff provided "response team" support to the landowner's contractors to ensure the safety of the snakes and workers as they removed the equipment that had served as artificial habitat for snakes in the area. NJCF continues to work with the landowner to develop suitable habitat management plans that will benefit the rattlesnakes and other species.

- The sub-adult male timber rattlesnake collected in August 2010 and held overwinter at NJ's licensed venomous snake rehabilitator was not implanted with a transmitter or released. ENSP biologists had concerns regarding the legitimacy of this snake's capture location (i.e. whether he had been relocated by a person or actually inhabited the area). As such, for public and the snake's safety, the snake would have been tracked regularly (3-4 times per week) given ENSP was uncertain of how (and where) the snake would move. This was of particular concern because of the close proximity of a residential community. By tracking regularly, staff would be able to detect if the snake was disoriented (indicating it had been relocated) and recapture the snake. However, due to limited resources staff could not make the time commitment nor identify anyone available to track so frequently. The snake remains in captivity with NJ's licensed venomous snake rehabilitator and will be used for educational purposes.
- ENSP did not play an *active* role in identifying timber rattlesnake critical habitats in the Pinelands during this funding cycle but has continued to partner with NJCF in their efforts.

HIGHLANDS REGION & KITTATINNY RIDGE

- Over the past year, ENSP staff spent an unexpected and inordinate amount of time reviewing and providing technical assistance on 4 projects related to utilities and rights-of-way proposed through the State permit process and 1 project related to construction on a military base (Picatinny Arsenal). Due to the potential impact to timber rattlesnakes, these proposals took an inordinate amount of staff time to review and provide assistance/guidance. Serving as technical advisors to NJ DEP, ENSP staff was required to prepare recommendations regarding surveys, timing and activity restrictions, and participate in meetings and conference calls with the applicants and other DEP staff. This activity is reported on in more detail under the "Technical Assistance" SWG Job, but the unexpected workload detracted from this project forcing staff to hold fewer response team trainings, no community educational programs and minimizing den and gestation survey efforts.
- Do to limited resources, no effort was made to review and test additional landscape-scale features in order to refine the 2009 den model.
- During the 2008-2010 funding cycles, ENSP staff created a broad outline for the development of recovery plans and species' status assessments.
- ENSP outlined a strategy to return to known dens in the northern region to: a) confirm continued presence of rattlesnakes at these sites, b) identify varied age classes, and c) assess overall appearance and well-being of the snakes present.
  - Prior to emergence 2011, ENSP met with Dr. Howard Reinert from The College of New Jersey to discuss potential complications and refine the survey methodology. Dr. Reinert confirmed the difficulties in assessing dens in our region due to numerous variables including: multiple entries/exits for dens, annual individuals' variations with regard to post-emergence basking and emergence variability (weather, den aspect, individuals, etc.).
  - ENSP has [temporarily] abandoned the aforementioned effort.

- No timber rattlesnakes observed in 2011 exhibited symptoms of a potential pathogen/disease similar to those observed in New England populations (i.e., open wounds with prolonged healing periods resulting in altered behavior).
- ENSP focused den survey efforts on confirming previously reported den areas.
  - Site 1: ENSP conducted one survey of suitable habitat within an approximately 26-acre area during spring emergence. This survey covering two previously reported, but unconfirmed, den areas. No snakes were observed, however, the habitat appears suitable for this species.
    - Site 2: ENSP conducted one survey of suitable habitat within the area alone and returned a second day (two days later) with two experienced volunteers to survey suitable habitat spanning approximately 77 acres (31.1 ha) of the targeted mountain top and slopes. There was one previously reported but unconfirmed den within the target area. During the survey, the group located 17 timber rattlesnakes in 11 locations spanning over approximately 8 acres.
- Six timber rattlesnakes were captured during the 2011 active season that could not be linked to any documented dens. Five of these snakes were captured within a construction zone and held in captivity briefly to keep them out of harms way. All were returned to the field with transmitters (4 external and 1 implanted), but due to a number of transmitter problems none of our radio-tracking efforts resulted in us locating hibernacula for these snakes.
- ENSP agreed to assist the Picatinny Arsenal (PICA) in a preliminary habitat assessment and gestation survey within and including a 200-meter buffer around a proposed construction area. ENSP identified five areas for targeted.
  - Survey 1: Due to difficulties gaining access and then recruiting enough assistance, the first survey began later than desired (two weeks late). A team (two ENSP personnel, three experienced volunteers, PICA biologist) conducted the initial survey of the five targeted areas on 2011 August 21, after birthing had begun in the northern region of New Jersey. The team located one timber rattlesnake (under a rock, rattling) outside of the 200-meter buffer, three adult females with two neonates at a birthing site in close proximity to (within 75 meters of) the proposed work area and one of undetermined sex and age class foraging within the primary proposed area of construction. ENSP and trained volunteers visited PICA on three occasions and conducted survey. A total of 6 adult (or sub-adult) rattlesnakes were observed during these three visits along with 10 neonates snakes. A detail report of ENSP's finding can be found in our complete report to PICA (attached*:* " Preliminary Habitat Assessment and Gestation/Birthing Site Surveys for Timber Rattlesnakes and Northern Copperheads within and adjacent to Picatinny Arsenal's Proposed SAFER Site").
- During winter/spring 2011, ENSP biologist held two handling trainings, each for one newly recruited responder.
- ENSP identified seven areas across the northern region where targeted surveys will be conducted to identify potential sites to carry out habitat management. The survey area range in size from approximately 207.5 – 766 acres and management will include creating basking habitat within the forest and away from the forest edge-residential communities' interface.
  - ENSP biologist accompanied a seasonal worker (funded through an alternate source) one day to show examples of basking habitats and begin assessing one area to provide instruction on how to survey the areas, note and record appropriate features, and rank areas according to the features present and the amount of required habitat management to achieve our objective.
  - Seasonal worker continued to assess three targeted areas (through alternate funding source).
  - Due to limited resources and time constraints, targeted areas were not identified until late summer and therefore, no surveys were conducted in search of snakes. ENSP also determined it would likely be more successful to use cameras to monitor the sites so there is a [relatively] continuous log of data rather than manual surveys 1-2 times per week.
- Due to contractors' time constraints, they were unable to conduct contracted den and gestation surveys. The funding was reallocated to the purchase of field cameras to be used in the pre-

management surveys of potential basking sites. ENSP is planning to begin pre-management surveys in 2012.

- Venomous Snake Response Team:
  - Staff made no extensive effort (i.e. outreach) to recruit and encourage citizens to report rattlesnake observations to help populate the Biotics database. The members of the Venomous Snake Response Team, many of whom are local animal control officers and park staff, 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.
  - Seven Venomous Snake Response Team members reported responding to 21 "snake complaints" on private lands during the 2011 field season; 13 were confirmed to be timber rattlesnakes (3 northern copperheads, the remaining were non-venomous snakes).
  - Of the 77 active members of the Venomous Snake Response Team (70 in the northern region, 7 in the Pinelands), excluding federal personnel, only 32 submitted official timesheets reporting their 2011 response activity in time for this report.
- No road-related mortality hotspots have been identified thus far as snakes observed "dead-on-road" (DOR) are scattered and do not appear to be traveling through defined corridors. However, DORs and snakes alive-on-road (AORs) were reported, and recorded, over the course of the 2011 field season.
- No strategy has been developed to recruit law enforcement officers to monitor den locations for illegal collection. Due to limited available staff, the Bureau of Law Enforcement (BLE) was again unable to monitor the areas that ENSP biologists identified as potential collection sites. ENSP staff continued to consider the potential positive and negative effects of releasing den location data to those outside the Department of Environmental Protection.

Conclusions:

PINELANDS REGION

- Due to limited resources, ENSP relies on conservation and research partners, such as the New Jersey Conservation Foundation, to help protect and improve rattlesnake habitat.
- Obtaining completed timesheets from volunteers of the Venomous Snake Response Team continues to be challenging. However, volunteers play an important role in protecting rattlesnakes, provide important rattlesnake distribution data, and are essential in educating the public about the conservation of this species.

HIGHLANDS REGION & KITTATINNY RIDGE

- It continues to be difficult to complete an adequate number of den and gestation surveys with volunteers due to their personal and professional obligations and time constraints.
- Den surveys conducted in spring 2011 indicate that the area previously reported as a den (Site 1) *may* be inaccurate in the depiction of its location but correct in acknowledging the presence of a den area nearby which may contain multiple den "pockets". No evidence (snakes or shed skins) were found at Site 2. While Site 2 appears to contain suitable habitat, it is undetermined if timber rattlesnakes still inhabit or have ever inhabited the area.
- While externally-attached transmitters provide an opportunity to track snakes found late in the season, they have (over the years) failed more than succeeded at providing useful data.
- Given that ENSP continues to locate previously undocumented dens, gestation/birthing areas and important basking areas, it seems likely that additional undocumented critical sites (dens, gestation/birthing and basking areas) exist throughout the Highlands region and Kittatinny Ridge.
- 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.

- 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 and recruiting our citizens to assist in this endeavor.
- Increasing development and roads continue to impede and/or threaten travel between habitats, isolate populations, and limit habitat use.

Recommendations:

PINELANDS REGION

- Continue to maintain the Pinelands Venomous Snake Response Team.

HIGHLANDS REGION & KITTATINNY RIDGE

- Continue to maintain the Northern Region's Venomous Snake Response Team and attempt to recruit and train new members.
- Review and test additional landscape-scale features to refine the 2009 den model.
- Locate transmitter-implanted male timber rattlesnake in the fall, 2011, to identify a potentially previously undocumented den and remove the transmitter in the spring, 2012. Attempt to locate second male with externally attached transmitter.
- In an effort to locate additional undocumented den, continue to implant transmitters in adult and sub-adult male timber rattlesnakes located in areas where they can not be linked to documented dens.
- 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 survey and validate previously reported but unconfirmed dens.
- Attempt to locate other critical habitats (gestation and birthing sites, basking/shed sites) to prevent (or minimize) their destruction in the future.
- Continue to assess areas for the creation/recreation of potential basking areas on public lands; begin pre-management surveys to determine if the sites are currently used by rattlesnakes.
- Continue to watch for timber rattlesnakes that may be exhibiting symptoms of a disease or pathogen that would warrant [temporary] capture and potential testing.

Literature cited

McGowan, E., K. Michell, J.W. Jaycox. 2006. Non-surgical attachment of external transmitters on timber rattlesnakes for monitoring short-term movements. Northeast Natural History Conference, Albany, N.Y. (Presented by K. Michell)

JOB 1D: Northern Pine Snake

Project leader: Dave Golden, 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

- In 2011 the Endangered and Nongame Species Program worked with its research partner, Herpetological Associates, to complete the fifth year of a long-term (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 past field season a total of 14 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 "moved" snakes were relocated and have been considered a "control group" (non-moved) group in this long-term study. This year we also carried out data analysis on the 2010 field season. Details of these activities are summarized below.

  Data Collection During the 2011 Field Season: As in previous years (beginning in 2007), we determined the location of each study snake roughly every other day throughout the 2011 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 2011, data collection for this field season was still ongoing and, therefore, data analysis has not yet been carried out on the 2011 field data.

  Data Analysis Conducted During 2010: During this reporting period data analysis was carried out on the radio-tracking data originally collected during the 2010 field season. A total of 819 radio-telemetry relocations were made on 19 pine snakes during the 2010 field season. As in previous years of this study, most relocations of pine snakes were made in pine or pine oak forests (Figure 1).

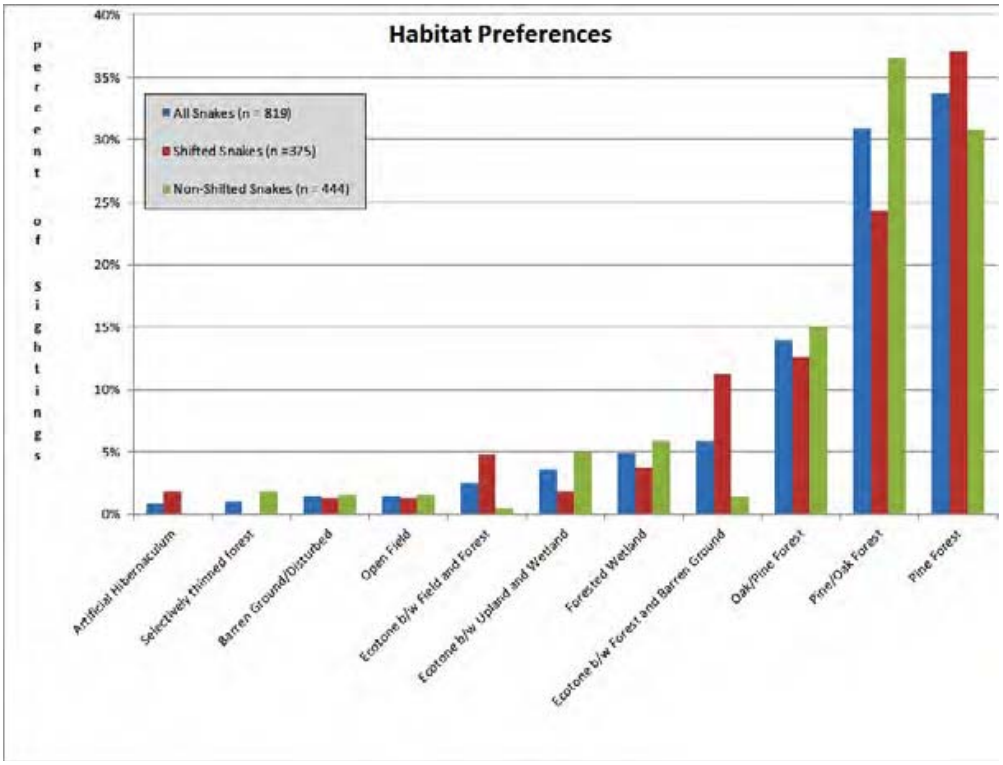

Figure 1. Frequency of habitats selected by radio-tracked pine snakes.

- ENSP also work with research partner Drexel University (Laboratory of Pinelands Research) who radio-tracked 32 adult northern pine snakes (NPS) at Warren Grove Gunnery Range (WGR) from April through October 2011.

  Radio-tracking study
  - 23 pine snakes from known dens were tracked for the entire 2011 field season
  - 7 individual pine snakes (incidental encounters) were captured and radio-tracked for a portion of the season to determine the location of new hibernacula.
  - 3 pine snakes were tracked for part of the field season but were depredated and therefore lost from the study.
  - Approximately 1,800 relocations were made over the 2011 field season.

  Hibernacula Study
  - During 2011, there was a 90.6% adult survivorship of radio-telemetered snakes.
  - Fourteen previously undocumented pine snake hibernacula were identified on WGR in 2011. These hibernacula will be monitored in spring 2012.
  - In April 2011, known hibernacula were monitored (WGR (n=6) and Stafford Forge (n=3)) and 51 individuals (adults/juveniles) egressed from these corralled hibernacula. From this monitoring, a mean snakes per den calculation has been estimated and this will be used as a method to calculated snake densities over the next year.
  - Two hibernacula have been identified on the Franklin Parker Preserve (Chatsworth, NJ) via radio-telemetry and both will be corralled and monitored in the spring of the 2012.

  Population Genetic Study
  - 98 genetic samples (blood and/or tissue) were collected during the 2011 field season.
    - 23 blood samples were collected from the Ed's Place Snake Dig (March 2011)
    - 29 blood samples were collected from Stafford Forge (April 2011)
    - 15 blood samples were collected from Warren Grove Range.
    - 22 neonate shed skin samples (2 clutches, n=9 and n=13) from Stafford Forge
    - 9 tissue samples were collected from DOR throughout the state. All occurrences were reported to NJ Biotics via rare species encounter forms.

  Road Study
  - A pilot study to evaluate how NPS move across road surfaces was conducted in 2011.
  - During fall ingress (October 2011) Drexel captured 13 adult NPS and evaluated their behavior (time remaining stationary), movement direction, and rate of movement across three substrates: asphalt, concrete, sand.
  - Data will be analyzed after three additional field seasons; Spring 2012, Summer 2012, and Fall 2012.

  Culvert Study
  - During this reporting period a pilot study was initiated to determine the efficacy of using a culvert system to permit pine snake movements under roads rather across the top of roads where they often killed. This pilot study is collaboration between ENSP, Drexel University's Laboratory of Pinelands Research, and the New Jersey Air National Guard 177th Fighter Wing, and NJ DOT.
  - In September 2011, 6 culverts measuring 12" in diameter and 60-feet long were installed under a runway at WGR.

- Installation of silt-fencing and box traps for monitoring snake movement through the culverts will be installed April 2012 and snake use of these culverts will be monitored throughout the 2012 field season.

Conclusions

- 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.
- We have initiated a pine snake culvert-use study by installing culverts under a runway at the WGR. This study will help us understand if culverts installed under roads are an effective way to mitigate road impacts to pine snakes.
- Estimates of mean number of pine snake using hibernacula have been calculated at the WGR and at our Stafford Forge study site. These data will be used in the development of a model to estimate pine snake population size over the next year.

Recommendations

- Continue to collect and analyze population data and develop a model to estimate the northern pine snake population size in New Jersey.
- Continue to collect and analyze movement data at Stafford Forge and Warren Grove Range.
- Continue to identify the location of new hibernacula at WGR and Stafford Forge to compare differences in hibernacula density between sites.
- Continue road surface study throughout the field season and identify seasonal differences in movement rates across different simulated road surface substrates
- 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.
- Continue to examine the usefulness of culverts as a method for allowing pine snakes to avoid road barriers and mortality.

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:

- One additional northern copperhead location was identified through a random observation by a citizen. The observation occurred in an area that can not be linked to any known den, but the snake was not captured for transmitter implant or attachment as the information reached ENSP days after the observation. Additional observations from other citizens and land stewards within the same general area have been made since the initial observation over the course of the summer 2011.
- ENSP attempted to work with a research partner at the Turtleback Zoo, West Orange, NJ, for the second year on a radio-telemetry study of a northern copperhead population in Morris County, NJ. However, due to our partner's limited resources and time constraints, the project did not occur.

- ENSP intended for the Zoo staff to focus spring 2011 efforts on den and early emergence basking sites' surveys in an effort to obtain additional data that could help refine search efforts in 2012.
- The research partner has not provided any data to ENSP and it is unclear if any effort was made in 2011 to refine the targeted search area.

- One adult male northern copperhead was found dead on top of the snow and ice in a sun-exposed area, approximately 100ft (30m) from the closest documented den. No tracks of any kind were in the area. The copperhead appeared to exhibit symptoms that have been observed in the timber rattlesnake populations of New England (facial lesions, hardened, leathery skin, damaged eyes and pits, emaciation; photos 1 & 2). This prompted ENSP's decision to have the snake tested. Laboratory findings reported the following:
  - Tissue inflammation, localized area of ulceration and crust formation with bacteria and fungi present on several surfaces of the skin. Lesions on the facial soft tissues, dental arcades, and pulp cavity of the teeth.
  - "Severe ulcerative dermatitis, facial cellulitis, stomatitis, and pulpitis with intralesional bacteria and fungi."
  - Histologic changes are consistent with mixed bacterial and fungal infection. These fungi somewhat resemble *Fusarium sp*., although they could possibly also represent the *Chrysosporium anamorph* of *Nannizziopsis vriesii* (commonly referred to as CANV). Both fungi have been associated with mycotic infections of the skin and oral cavities of reptiles. However, a limited literature search (Jacobson, 2007) has indicated that historically infected reptiles may have been misdiagnosed with *Fusarium sp.* (or other fungi) when they were actually infected with the mycotic pathogen CANV.
  - The laboratory recommended a fungal culture and/or a polymerase chain reaction (PCR) test to determine which fungi is present.

Photographs 1 and 2: Eyes and pit deteriorated, lesions on head and neck. Northern copperhead was emaciated although internal organs appeared healthy overall.

- Venomous Snake Response Team:
  - The members of the Venomous Snake Response Team (many of whom are local animal control officers and park staff) continued to educate citizens and encourage citizen involvement in copperhead conservation by reporting observations and sharing their knowledge of snake behavior, needs and protection with friends and neighbors. However, no extensive outreach

effort was made to recruit and encourage citizens to report northern copperhead observations to help populate the Biotics database.
    - Seven Venomous Snake Response Team members reported responding to 21 complaints on private lands during the 2011 field season, 3 were confirmed to be northern copperheads. Of the remaining, 13 were timber rattlesnakes and 5 were non-venomous snakes).
    - Of the 77 active members of the northern Venomous Snake Response Team, excluding federal personnel, 32 submitted official timesheets reporting their 2011 response time in time for this report (as reported under Timber Rattlesnake, Job 1C).
- Den search volunteers targeting potential timber rattlesnake dens, but, despite extensive searches, did not observe any northern copperheads.

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.
- A northern copperhead that was found dead on the snow may have attempted to bask in an effort to heal itself. The exact cause of death for this snake is not yet known, but ENSP is investigating a number of possible pathogens. ENSP will remain vigilant for other copperheads exhibiting symptoms of a disease or pathogen that would warrant testing.

Recommendations:
- Continue to obtain northern copperhead location data.
    - Recruit assistance from conservation organizations.
    - Recruit assistance from the Division of Parks and Forestry.
    - 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.
- Discontinue partnership with Turtleback Zoo until more formal plans can be arranged and implemented.

Literature cited:
Pare, Jean A. and Elliot R. Jacobson. 2007. Mycotic diseases of reptiles. Pp. 527-545, *In* Infectious Diseases and Pathology of Reptiles: Color Atlas and Text. CRC Press, Taylor and Francis Group, Boca Raton, Florida.

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:
- We contracted the Conserve Wildlife Foundation of NJ (CWF) to begin developing a GIS-based predictive model that would determine when sea turtle captures are most likely to occur at the Oyster Creek Nuclear Generating Station (OCNGS), Forked River, NJ. CWF agreed to: 1) compile and

analyze available meteorological data and compare to previous capture of sea turtles at the OCNGS within the Biotics database; 2) compile and review OCNGS sea turtles take data to determine night vs. day captures, along with incidents of dilution vs. circulation water intake captures, and; 3) using variables shown to have possible influences on sea turtle occurrences, begin developing a predictive model to determine when (month and day) captures are most likely to occur.

- CWF staff compiled data from the ENSP's Biotics database for three sea turtle species (Atlantic Green, Atlantic Loggerhead, and Kemp's Ridley) impinged at the OCNGS between 1992 and 2011. Data included date and time of impingement/take, species, carapace length, weight, condition (live vs. dead), intake of impingement (circulation water intake (CWI) vs. dilution water intake (DWI)), number of pumps running, and water temperature.
- CWF staff also compiled meteorological data for dates when sea turtles were impinged. Data compiled included air temperature, air temperature difference from the date prior to impingement, precipitation amount, wind speed and wind direction. Oceanographic data, such as tide and approximate distance to the Gulf Stream (latitude of the Gulf Stream and the Gulf Stream north wall index) were also compiled for impingement dates.
- The following websites were used when compiling meteorological and oceanographic data: Rutgers, NJ Agriculture Experiment Station; NJ Weather & Climate Network (http://climate.rutgers.edu/njwxnet), Weather Underground (http://www.wunderground.com), NOAA National Weather Service Forecast Office (http://www.erh.noaa.gov), NOAA (http://tidesandcurrents.noaa.gov), Wikipedia entry "Latitude of the Gulf Stream and the Gulf Stream north wall index", last modified 2011-06-07: http://en.wikipedia.org/wiki/Latitude_of_the_Gulf_Stream_and_the_Gulf_Stream_north_wall_index.
- CWF staff examined available GIS data for the study to determine whether it would be applicable in predicting the probability of sea turtle presence and/or impingement at Oyster Creek.
- We performed a preliminary analysis (using Microsoft Excel) to determine relationships between OCNGS sea turtle impingements and variables such as air temperature changes (Delta T, daily maximum temp. – daily minimum temp.), and wind direction between 1992 to the present, including the 2011 Hurricane Irene event. Meteorological data used during the analysis were downloaded from Weather Underground (see above) and compared to sea turtle impingements recorded in Biotics. 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:

- Sea turtle impingements at OCNGS have been rising steadily since 1992. It is unknown whether increased catches are due to an increase in east coast abundance, an increase in local (i.e. Barnegat Bay) or NJ abundance, or other factors such as increasing numbers of storms.
- Preliminary analysis indicate that there may be an association between number of impingements and 1) air temperature (daily Delta T and Delta T two days prior to impingement), 2) wind speed, and 3) hurricanes. Catches during Hurricane Irene (n=2) indicate that wind speed during the day of the hurricane had a stronger influence on catch than air temperature changes. In addition, the last catch of the month (late August 2011, n = 1) was associated with wind speed two days prior to the impingement.

Recommendations:

- Continue analysis of OCNGS sea turtle impingements vs. weather/meteorological factors, including the position of the Gulf Stream by month and year.
- Obtain data from the National Marine Fisheries Service (NMFS) and other states to determine if sea turtle populations are increasing in the mid-Atlantic region.

- Build files to show surface oceanic temperatures along sea turtle migration routes over time from 1992 through the present to begin model development.
- Based on the model, develop a mechanism whereby a routine daily analysis of applicable variables in summer and fall will alert appropriate staff that conditions are favorable for sea turtles to be present in the OCNGS vicinity.
- Work with OCGNS and NMFS staff to establish voluntary protocols to be implemented during model-predicted times of likely occurrence. Possible protocols aimed at minimizing sea turtle impingement may include: a) increased inspection and cleaning of the dilution water intake and circulatory water intake trash racks; b) increased inspection of canals by boat; c) video camera surveillance of the intake canal to look for surfaced turtles, and; d) inspection of bridges along Rt. 9.
- Investigate feasibility of assessing threats associated with commercial and recreational fishing gear interactions to sea turtles in NJ waters. Work with Bureau of Marine Fisheries staff to explore whether undertaking research to determine the role of bycatch on listed marine species is warranted and achievable. Investigate the potential to map fished areas by gear type and overlay with listed species occurrences to identify threats. In addition, continue to work with BMF on issues related to the sea turtle observer rule. In 2009, we provided the BMF with all sea turtle locations recorded in Biotics. The information was to be used to allocate NJ port coverage as part of the sea turtle observer rule, with the focus on placing observers on commercial fishing vessels closest to known sea turtle occurrence areas. The process of port allocation was to continue in 2010, however, we have not been contacted to provide further assistance. Provide assistance to BMF as necessary.

JOB 1G: Turtle Harvest Investigations

Project leader: Brian Zarate, Senior Zoologist

OBJECTIVE: Two species of turtle which natively occur in 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 can not remain viable under current harvest rates.

Key findings:

- There is both a recreational and commercial harvest of common snapping turtles in NJ administered by the Division of Fish & Wildlife's Bureau of Freshwater Fisheries (BFF).
- ENSP held meetings with BFF to gain a fuller understanding of harvest seasons, harvest methods, harvest pressures, and to gather harvest data. The outcome of this "investigation" is summarized below.
    - Recreational Harvest
        - Anyone with a valid NJ fishing license may harvest up to 3 snapping turtles per day, except between May 1 and June 15.
        - Method of take includes spears, hooks, dip nets, traps, or by hand.
        - There is no reporting requirement for recreational harvest.
    - Commercial Harvest
        - With a valid NJ fishing license, one can apply for a commercial harvest permit for an additional $2.
        - Closed season is between May 1 and June 15.
        - Method of take includes spears, hooks, dip nets, traps, or by hand.
        - There is no limit to the number of waterbodies harvested.
        - There is no limit to the catch.
        - There is a monthly reporting requirement for commercial harvest.

- Harvest Summaries
  - Historically there has been poor recordkeeping for the commercial harvest.
    - No data on number of approved applications or harvest numbers is available.
  - Approved commercial harvest permits 2008: Estimate of 15-30
  - Approved commercial harvest permits 2009: 64
    - 37 applicants reported zero take
    - 27 permittees reported 3,154 turtles harvested
      - For some individual waterbodies, harvest may represent 30% take assuming maximum turtle density.
  - Approved commercial harvest permits 2010: ~73 (pending final tally from BFF).

- Presented harvest concerns and data/regulations from surrounding States to the Director and Assistant Director of NJ Fish & Wildlife, as well as ENSP staff. No presentations were made to Fish and Game Council (snapping turtles) or Marine Fisheries Council (diamondback terrapins) during this report period.
- Developed snapping turtle harvest and toxicity study with graduate students from Montclair State University.
- ENSP has not yet proposed any modifications to turtle harvest permits.
- ENSP did investigate possible trap restrictions or design that might result in a reduced by-catch of turtles.
- 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 for harvest based on age, size, or daily/annual bag limit.
- The number of commercial applications for snapping turtle harvest has increased since 2008.
- Snapping turtle harvest may be unsustainable in certain waterbodies based on recommendations in the literature.

Recommendations:

- Close all harvest of snapping turtles until we can determine if current harvest is sustainable.
- Expand the closed season for snapping turtle harvest to limit take.
- Implement a daily or annual bag limit by waterbody based on waterbody size.
- Limit repeat harvest of individual waterbodies from year to year.
- 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/ Southern (Cope's) gray treefrog

Project leader: Dave Golden, 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:

- 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 and they seemed interested and willing to partner in the project. However, due to limitations in staff time, no follow-up conversations on this data exchange or analysis have taken place.
- ENSP assessed the vulnerability of New Jersey's 15 tiger salamander sites to a number of existing threats including sea-level rise, habitat fragmentation (lack of connectivity with other sites), roads, illegal collection, and natural succession. As a result of this assessment ENSP identified two sites, both located in Cape May County, that hold the best potential to support eastern tiger salamanders over the long term. These sites became the basis for what is now ENSP's new management plan for eastern tiger salamanders, which entails creating optimal breeding habitat in areas immediately adjacent to these productive breeding sites. The ultimate goal of this new approach will be to link existing salamander sites together in order to restore the metapopulation dynamics that have been lost for this species. ENSP hopes to accomplish this by creating suitable breeding habitats in the matrix between sites. These two focal tiger salamander sites are separated by roughly two miles, and the habitat in between them currently holds little suitable breeding habitat.
- After identifying the two sites (Lizard Tail Swamp WMA & a USFWS refuge) that have the highest likelihood of supporting tiger salamanders in the long term, ENSP worked with an engineering firm to design the construction of 10 new vernal ponds in the area surrounding the Lizard Tail Swamp tiger salamander population. Construction of these ponds will begin in Nov. 2011.
- ENSP worked with the landowner of a tiger salamander pond in Rio Grande, NJ and the NJ Division of Fish and Wildlife's Bureau of Freshwater Fisheries to remove predaceous fish that became established in this breeding pond. The pond was drained and the fish were seined and moved into a different (more permanent) pond.
- Tiger salamander surveys were carried out during the spring of 2011, however, no new locations were documented during these surveys.
- ENSP collected water samples from ponds at each of 15 tiger salamander sites in the state. These samples were analyzed for a variety of water quality parameters (including pesticides, metals, nutrients, phosphorus, nitrogen, etc.). All the samples came back within normal ranges for the chemicals for which we tested.

Conclusion:

- ENSP is now focusing its management efforts for tiger salamanders on select sites that appear to hold the most value for maintaining the long term persistence of tiger salamanders in New Jersey. These sites are in the center of the Cape May Peninsula and are therefore at relatively low risk of being impacted by sea-level rise.
- Management to enhance tiger salamander breeding habitat likely holds the most promise for increasing tiger salamander abundance at key sites.

- Vernal pool constructions (which is a form of breeding habitat enhancement) at Lizard Tail Swamp WMA will begin in November 2011.

Recommendations:

- Move forward with the planned vernal pool construction at Lizard Tail Swamp WMA.
- Continue planning tiger salamander breeding habitat enhancement projects that will contribute to linking together the Lizard Tail Swamp WMA tiger salamander population and the population of tiger salamanders located on the USFWS refuge property.

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

Project leaders: David Golden, Principal Zoologist; Bill Pitts, Wildlife Technician

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

Key Findings:

- Last year ENSP awarded two students at Montclair University a small grant (from state tax check-off funding) to initiate screening for this pathogen in New Jersey. Chytrid was detected in 2 out of the 27 samples that were screened during this pilot project. These samples were taken from only two ponds, but created the interest in initiating a more extensive and widespread monitoring effort for this pathogen New Jersey.
- Between September 2010 and December 2010, ENSP used GIS software to identify 24 survey sites (six per Landscape Region) that were in close proximity to Calling Amphibian Monitoring Program (CAMP) stops and on State protected lands. Between January 2011 and March 2011, Montclair staff and ENSP biologists scouted these survey sites and determined that not all of the original survey sites were on suitable habitat. This site selection process was therefore abandoned because it was unnecessarily limiting to the number of sites that could be sampled. Instead, Montclair staff and students surveyed sites in northern New Jersey, while ENSP surveyed sites in southern and central New Jersey.
- Amphibian samples were collected from early March (Run 1), through April and May (Runs 2 & 3) and were completed by the end of June (Run 4). Montclair State University provided all necessary sample collection materials such as eppendorf tubes, swabs, and datasheets for all *Bd* samples to be collected. Location and general habitat information was recorded at all sites. Water and sediment samples were also collected from each pond.
- Amphibians were captured by hand or by using a net and then 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 conducted. Toe-clipping also provided a method to mark frogs as "sampled" which helped to minimize the likelihood that unmarked individuals were resampled for chytrid during each sampling time period.

- *Bd* samples were delivered to Montclair University at the completion of each sampling time period for Real Time PCR analysis. 907 samples were collected statewide, and are currently be analyzed. Ranavirus samples were also delivered to Montclair at the end of each sampling period for traditional PCR analysis. 426 samples were collected statewide. Montclair has already detected ranavirus from samples collected at Stafford Business Park.

Conclusions:

- As there were a limited number of sites that were accessible on State lands that corresponded to surveying "stops" along CAMP routes. Therefore tying survey routes to CAMP stops proved to be an unproductive way to test for the statewide prevalence of *Bd* in New Jersey.
- *Bd* and ranavirus have both been positively identified in New Jersey, and we should continue to monitor the spread of these amphibian pathogens statewide.
- Partnering with Universities such as Montclair is an effective approach to share the burden and cost of carrying out a statewide research project such as this and therefore results in a much more thorough project than ENSP could carry out independently. There is also an educational benefit to this type of partnership since graduate students gain from the experiences of wildlife professionals.

Recommendations:

- Continue to monitor for *Bd* in New Jersey to evaluate the extent of this threat to NJ amphibians. However, instead of using a Landscape approach for surveying, a watershed approach should be employed.
- 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 partner with other organizations and/or municipalities that operate amphibian crossings to collect additional Bd samples.

JOB 3: Herp Atlas Database

Project leader: Dave Golden, Principal Zoologist

OBJECTIVE: 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.

Key Findings:

- In cooperation with USGS, 63 calling amphibian survey routes were established in New Jersey in 2003. In 2011, volunteers surveyed a total of 35 of these routes. Many of the routes were surveyed multiple times resulting in a total of 83 surveys as part of this project. All sixteen anuran species that occur in New Jersey were detected during the 2011 CAMP surveys. These data were incorporated into New Jersey's state database as well as into the North American Amphibian Monitoring Program's (NAAMP) national database.
- There were 33 volunteers participating in this project in 2011 and they logged a total of 272 volunteer hours.

Conclusions:
- The Calling Amphibian Monitoring Project continues to provide valuable anuran distribution data for ENSP. The number of routes surveyed as part of the Calling Amphibian Monitoring Program (CAMP) increased from 27 (in 2010) to 35 in 2011. The total number of surveys that were conducted increased from 57 to 83 over this same time period.

Recommendations:
- Continue to recruit and train volunteers for the Calling Amphibian Monitoring Program in an effort increase the number of New Jersey frog-calling routes that are surveyed in 2012.

JOB 4: Vernal Pools

Project leader: Brian Zarate, Senior Zoologist

OBJECTIVE: Vernal habitats are a type of regulated wetland in New Jersey. Data collected by NJDEP staff and WCC volunteers are stored in an independent vernal pool database and from there data is than 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.

Key Findings:
- Developed worksheet of suggested improvements to existing vernal pool database. Implementation of the suggestion improvements will begin in the winter of 2012.
- Updated vernal pool database with all backlogged vernal pool data
  - 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
- Exported vernal pool data for integration into state Biotics database and Landscape Project Mapping
- No volunteer vernal pool surveys were performed this reporting cycle.

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 10 and address existing flaws.
- Discuss reinstating vernal pool volunteer survey effort to increase the number of certified vernal pools, which can be afforded protection by the NJDEP's wetland regulations.

JOB 5: Italian Wall Lizard Survey

Project leaders: Bill Pitts, Wildlife Technician and David Golden, Principal Zoologist

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

Key Findings:

- In 2007, ENSP determined that a breeding colony of Italian Wall Lizards had established itself in New Jersey. 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.
- After documenting the presence of this exotic species, and upon further examination, it was determined that 120 lizards had been released on Canterbury Rd in 1984 by a local resident.
- ENSP conducted visual surveys from May 26 to July 2, 2011 to determine the 'presence/ absence' of wall lizards in habitats (urban, suburban, and natural) radiating 2 km from the documented breeding population located in Mt. Laurel, NJ.

- Between July 14 and July 22, 2011, ENSP captured lizards by using small sticky traps strategically placed around residences in several neighborhoods surrounding the original release location. Oil was applied around the lizards to dissolve the glue and release them from the sticky traps unharmed. Each lizard was individually marked with a three color combination using paint marking pens. There were a total of 123 lizards marked.

- From July 26- August 1, 2011, ENSP surveyed the neighborhoods where the marked lizards were released. All areas were scanned to obtain a marked/unmarked ratio of lizards observed. There were 284 lizards observed within the catch locations, and only five of them were marked (i.e., recaptures). ENSP analyzed this data using the Lincoln-Peterson population estimator and estimate the population of Italian wall lizards to be roughly 7,000 individuals.
- On September 8, 2011 a sighting, accompanied by a photo, was submitted from a neighborhood (Rancocas Woods) that is over 6 km from the core survey area. ENSP conducted a survey within the week, but was unable to find any evidence that a new population had established itself there.

Conclusions:

- Upon completion of the 2011 survey in Mt. Laurel, it initially appeared that the breeding population had not dispersed from the locations documented in 2008. However, the addition of a sighting from Rancocas Woods, has cast some doubt on this conclusion.
- With an estimate of thousands to tens-of-thousands of lizards in the core study area, it is apparent that this breeding population has indeed increased from the 120 that were originally released. However, the rate of increase is not certain at this point.
- After cross-referencing ENSP's Biotics database, and following a thorough survey of the core study area, it does not appear that Italian Wall Lizards pose any immanent threat to any indigenous reptiles or amphibians. Additionally, after numerous interviews with residents of these neighborhoods, and photo evidence from Queens, NY, it is evident these lizards are prey items for various species of birds and cats.

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.
- Another population estimate study should be conducted in several years and compared to the baseline estimates from this study. In the future, it would be advisable to carry out multiple consecutive catches in each neighborhood to be able to produce a more robust population estimate. Additionally, a single color painted down the length of the lizard to differentiate to different catch locations would suffice. This would also improve the detectability of marked lizards.

EXECUTIVE SUMMARY

Project:	**Invertebrate Conservation**
Federal Aid Project:	T-1-6 (State Wildlife Grants)
Segment dates:	September 1, 2009 to August 31, 2010
Total Project Expenditures:	$116,000 ($75,400 Federal, $40,600 State) ('10-11 year only)

JOB 1: State Listed Mollusks

Project leader: Jeanette Bowers Altman, Principal Zoologist

This job is jointly supported by State Wildlife Grants and Section Six funding.

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 15 stream sites in six 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 16 additional sites in six waterways to determine if larger surveys were warranted.
- EPA Habitat Assessment Field Data Sheet scores (high and low gradient combined) ranged from 73 (Wickecheoke Creek, Hunterdon County) to 152 (Mantua Creek, Gloucester County), out of a possible 200. Previous ENSP studies have shown that mussels occur in a habitat score range of 68-173. All sites surveyed scored within the preferred habitat range.
- We completed a preliminary 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.
- Using 1) data collected during 2000-2011 surveys 2) information submitted by volunteers and 3) data recorded in Biotics, CWF biologists produced range maps for all of NJ's freshwater mussel species. Maps were created on a sub-watershed scale and can be viewed on the CWF website: (http://www.conservewildlifenj.org/protecting/projects/freshwaterinvertebrates/mussels/). Maps will also be placed on the AMNH NY-NJ freshwater mussel website, and will be part of the online NJ Freshwater Mussel Atlas.
- Water quality values were as follows: pH ranged from 6.6 to 8.2, water temperatures ranged from 15.0 to 30.0 Celsius, dissolved oxygen ranged from 5.5 to 11.3 ppm.
- Catch per unit effort (CPUE) for all species combined during time searches was highest in Barton Run, Burlington County, with 3.333 live + shells/minute.
- We continued testing a new type of sampling gear we designed last season. It is essentially a rake with a cross sectional opening 12 inches wide and 2 and ¼ inches deep. A steel-meshed basket was welded to the rake opening with diamond-shaped mesh openings of ¼ inch by ¾ inches. Our new gear type is designed to facilitate sampling fine to coarse sediments that are used by particular species of mussels.

- Testing of the rake in the Pequest and Salem rivers showed promising results, yielding several listed species, including Dwarf wedgemussels and Triangle floaters. 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.
- We inspected four sites in the Cohansey River to determine effects of a major August flooding event on freshwater mussels. We were unable to inspect areas in the northern part of the state due to numerous road closures and bridge outages.
- We found eight species of freshwater mussels during field activities, including the Dwarf wedgemussel, Triangle floater, Eastern pondmussel, Eastern elliptio, Eastern floater, Alewife floater, Paper pondshell and the Lilliput. The Eastern elliptio was by far the most prevalent and widespread mussel species documented. Species richness was highest in the Stony Brook, Mercer County, with four species recorded.
- We continued searches for the Chinese pond mussel in Wickecheoke Creek and the Delaware River. Last season, we documented the first North American occurrence of the highly invasive Chinese pond mussel (*Sinanodonta woodiana*) from ponds owned by the NJ Conservation Foundation. The ponds had formerly been used as part of a fish farm operation for holding bighead carp and other fish species. Genetic testing by Dr. Arthur Bogan and staff of the North Carolina Natural History Museum confirmed the species identification. To date, we have found shells of the species in Wickecheoke Creek just downstream of the ponds (n=15), but no live individuals.
- The federal/state endangered Dwarf wedgemussel was present at one location. We found a fresh Dwarf wedgemussel valve in the Pequest River, Great Meadows, Warren County, in an area where Dwarf wedgemussel shells were previously documented.
- We found two live Brook floaters (State E) and one Brook floater shell at a new location in the Stony Brook. A triangle floater shell was also documented at the site.
- We found three Lilliput shells in Salem Creek. The species appears to be limited in NJ to this particular site. Despite numerous survey efforts above and below the known location, we have been unable to find live individuals or shells outside of a small stretch (200 m) of the creek.
- Volunteers 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. USGS surveys in the Flatbrook and Delaware River, private consultants for the Paulins Kill, 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 mussels). We attended several internal stakeholder meetings and submitted a write-up on the ENSP's efforts to develop a C1 site selection protocol for the DEP's white paper entitled "An Evaluation of NJDEP C1 Antidegradation Designation Protocols.".

Conclusions:

- Based on habitat suitability assessments and preliminary searches, six out of 16 sites warrant further survey work to determine freshwater mussel species composition and abundance.
- Habitat characteristic analyses, once refined, may eventually provide resource managers with important information regarding species' habitat requirements.
- The rake sampler shows great promise in sampling fine and coarse sand substrates that have no embedded tree branches or cobble. Preliminary results for finding smaller species like the dwarf wedgemussel indicate that the rake is a useful sampling tool if the goal is to document rare species.

- There was much freshwater mussel mortality associated with August flooding in the Cohansey River, as well as in other southern NJ waterways. Mussels located in the Cohansey River through Bridgeton were especially impacted, with numbers too high to count found dead in Seely Pond (lowered because of dam concerns, mussels left dry), along Mayor Aiken Drive (mussels washed over the bank), near the township zoo (pond completely dried presumably due to a water diversion) and in Sunset Lake (lowered, mussels left dry). All mussels found dead were common (Eastern elliptio, Eastern floater, Alewife floater, Paper pondshell).
- 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 mussel habitat type. 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. Last season, the ponds underwent a rotenone treatment to eliminate the big head carp and were lowered over the winter.
- Discovery of Dwarf wedgemussels and Brook floaters 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.
- 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. Investigate methodology to quantify results and continue to compare with 0.25 m quadrat sampler.
- Focus survey efforts in the Pequest River to determine Dwarf wedgemussel population boundaries and size.
- Continue searches in the Cohansey River to determine impacts of flooding on known Eastern pondmussel occurrences.
- Continue searches the Lamington River to document distribution of Brook floaters.
- species.
- 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 co-leaders: Dave Golden, Principal Zoologist and Robert Somes, Assistant Zoologist

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:

- We surveyed four known and five potential Silver-bordered Fritillary sites four times each between April and August 2011. Silver-bordered Fritillary was not found at any historic location during this survey. One new occurrence was discovered in a previously unsurveyed, suitable site in southern New Jersey. The new site is going to be part of a larger habitat restoration project conducted by the New Jersey Division of Fish and Wildlife and the Nature Conservancy. The species will now be included in the site's conservation plans in order to avoid harm to the population and potentially improve the species' habitat at this location.
- A total of twelve locations were surveyed for Bronze Copper over the course of twelve days. Fifteen individuals were observed at four different locations in both northern and southern New Jersey.
- Surveys were conducted for Harris's Checkerspot at three historic locations. This species appears to have now been extirpated from New Jersey and has not been seen at any historic location for at least ten years.
- Surveys were conducted for Hoary Elfin at seven potential locations with suitable habitat. The species was found to be present at all locations.
- Surveys were conducted for Hessell's Hairstreak at two potential locations. The species was found to be present at one new location.
- Surveys were also conducted for rare but non-listed Lepidoptera in northern New Jersey to establish baseline data for the purpose of a future status assessment. Surveys were conducted at three locations for Acadian Hairstreak and one location for Arctic Skipper with no observations made of either species. Both of these species are rare in New Jersey and appear to be on the verge of being extirpated from the State after the loss of populations at several known locations.
- Surveys have been coordinated with the North American Butterfly Association chapter and survey data were extensively shared during this past field season. These coordinated research efforts will greatly benefit the conservation of butterfly species in New Jersey.

Conclusions:

- There is the potential to find new occurrences of many rare butterfly species in New Jersey with this year's survey documenting new populations of several rare species.
- Harris's Checkerspot appears to have been extirpated from several historic locations.
- Several rare non-listed species appear to have declined or been extirpated from known locations and may need to be considered for listing in the future.
- Coordinating data sharing and surveying with the North American Butterfly Association has been very successful and greatly increased the amount of data that can be collected.

Recommendations:

- Continue surveys for listed species and monitor known populations.
- Surveys should be conducted for rare but non-listed species within New Jersey in order to determine their status and if there is need for protection.

- Hoary Elfin is another wild fire dependent species in the New Jersey Pinelands. Further efforts should be made to coordinate prescribed fire projects with the New Jersey Forest Fire Service in order to benefit this species.

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 this 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 historic sites surveyed, along with adjacent areas of suitable habitat. Many areas still have large populations of Frosted Elfin and the site that had been heavily flooded during the previous year appeared to have partially recovered.
- The site that had been flooded is scheduled to undergo a large habitat restoration that will include extensive creation/restoration of Frosted Elfin habitat. This project will be conducted in conjunction with The Nature Conservancy and the Division of Fish and Wildlife. This project is temporarily on hold while going through the environmental permit review process to ensure there are no conflicts with other rare species at the site.
- Several areas that were heavily herbicided last year did not have Frosted Elfin present this year. This species is able to quickly recolonize suitable habitat, so it is hoped that as the sites regenerate they will be recolonized. Many of the sprayed sites lacked extensive suitable habitat to begin with due to over growth and hadn't had any or only small numbers of Elfins in previous surveys.
- *Baptisia* distribution at sites that are scheduled for habitat restoration were mapped.

Conclusions:
- Frosted Elfin continue to exist in good 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.
- There are still areas of unsurveyed, potential habitat at many nearby locations that may support undocumented populations.

Recommendations:
- Continue surveys of known populations to determine their population status.
- Revisit historic sites that did not have Frosted Elfins this year to determine if they are recolonized.
- Survey new potential sites to locate new populations with a concentration in the area of the Atlantic City Airport population.

JOB 2C: Northern Metalmark
Project leader: Rob Somes, Senior Zoologist

OBJECTIVE: Identify, survey, protect, and manage Northern Metalmark populations and work to insure habitat protection and maintenance for this 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 (a total of eleven locations) Northern Metalmark populations and adjacent, suitable habitats were surveyed at least twice over the course of eight days. Northern Metalmarks were at six known locations and one new location with a total of 61 individuals observed. Many known/historic locations no longer contain suitable habitat owing to succession and the invasion of exotic species.
- Habitat management was conducted at two locations in winter and early spring to remove invasive plants and open up the tree canopy. One location was 1 acre in size and the other site was around 3 acres in size. The 1 ac site had not had Metalmarks present over the last ten years but was found to have been recolonized already during this year's survey following the restoration of the habitat at this location.
- 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 through the creation of habitat gaps/openings and the removal of invasive plants. Several sites have been greatly improved with minimal effort.
- Since Northern Metalmark's 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.
- Continue habitat management near known populations to increase dispersal opportunities and increase the resiliency of known colonies.

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 this species. Work with appropriate land managers to promote beneficial habitat management for this species through grassland management in Northern New Jersey.

Key Findings:

- We surveyed seven known/historic sites for Arogos Skipper in Northern New Jersey four times each during the flight period. Three sites had Arogos Skipper present with one, four, and three individuals observed at the three locations.
- Meetings were held with the Lands Management staff of the Division of Fish and Wildlife to improve habitat management at several Arogos sites on Division property. Several sites are now being managed by the Division of Fish and Wildlife in order to encourage the growth of warm season grasses through improved mowing schedules and controlled burning by the New Jersey Forest Fire Service as well as the removal of invasive plants.

Conclusions:

- Arogos Skippers continue to persist in northern New Jersey in low numbers.

- Through better habitat management at several public property locations, it is hoped that the population will able to be made more viable.

Recommendations:

- Continue habitat management coordination with public property owners and survey managed areas to determine success.
- Continue surveying for new populations near known occurrences. There are areas of potential habitat in close proximity to known sites and it is hoped that these areas might also be occupied by the species.

JOB 2E: 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 this species. Work with appropriate land managers to promote beneficial habitat management for this species through forest fire management in the Pinelands region.

Key Findings:

- Four southern New Jersey locations were surveyed this year with no Arogos Skippers observed. Many of the southern New Jersey locations are becoming overgrown and are no longer suitable due to fire suppression. One suitable area adjacent to the known Arogos Skipper sites was prescribed burned during the early spring which we expect to sufficiently open up more suitable habitat in the area. We will conduct surveys at this location next year. Meetings were held with the New Jersey Forest Fire Service to have prescribed burns conducted at two Arogos Skipper locations during this upcoming winter.

Conclusions:

- This species appears to have declined significantly in southern New Jersey.
- Through minimal effort, habitat can be created for this species through the use of prescribed fire. It is hoped that if new pockets of suitable habitat are created, these areas will be colonized.

Recommendations:

- Continue to work with and assist the New Jersey Forest Fire Service to have areas of known and potential habitat managed through prescribed fires to improve conditions for Arogos Skipper.
- Work together with the U.S. Military to conduct surveys of the Fort Dix populations. We haven't been able to survey this area for several years due to security concerns.

JOB 3: Rare Odonata Conservation

Objectives: 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, Principal Zoologist

OBJECTIVE: To monitor progress of an effort to reintroduce the soon-to-be listed as State Endangered Gray Petaltail (*Tachopteryx thoreyi*). This project began in 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 soon to-be-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 located individuals of the species.
- The reintroduction of the Gray Petaltail was undertaken during May 2007, with monitoring occurring 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.
- In 2007, 31 Gray Petaltail larvae were collected at a large 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 discreet 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. This weather related impact was observed with most early season Odonata species in the region.
- 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. It is unclear whether this indicates a failure of the colony.
- No adults were observed during 10 site visits conducted for this species during the 2011 flight season. Larvae of various instar classes were dredged from the seeps.

Conclusions:

- It is likely that persistent cool damp weather during the flight season may have negatively impacted this year's adult activity.

Recommendations:

- Continue to monitor reintroduction site during May-July 2012. If no adults or larvae are found at this time, the project should be re-evaluated to determine whether or not it should be continued.
- Monitor nearby suitable habitat within a radius of one mile from the reintroduction site for the presence of stray adults.
- Continue to identify suitable habitat elsewhere and conduct surveys for the presence or absence of this species.

JOB 3B: Statewide Surveys and Monitoring of State-listed Odonata

Project leader: Jeanette Bowers-Altman, Principal Zoologist

OBJECTIVE: To monitor populations and create conservation plans and strategies to aid in the recover 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 revisit known populations to assess status and update the element occurrence.

Key findings:

- Surveys for soon-to-be listed and rare Odonata were conducted throughout the state. A total of 54 sites were sampled during the project period. Of the 54 sites sampled, 18 previously surveyed sites were visited for monitoring purposes and 36 new sites were surveyed.
- Sampling was primarily conducted via the collection and identification of larvae and exuvial shells. Adult observations were also used to survey for Odonata.
- A new breeding colony of Brook Snaketail (*Ophiogomphus aspersus*) was found at the NJ Natural Lands Trust Bear Creek Preserve in Warren County, with five adults observed adjacent to Bear Creek. Males were displaying territorial behavior and one female was observed ovipositing in the stream.
- Eight Brook Snaketail adults were also observed foraging in a field adjacent to Minisink Island along the Delaware River. These were teneral adults suggesting local emergence. It is currently unclear where the precise breeding site is located. Ten years of larval and exuviae sampling from this segment of the Delaware River have failed to show it breeds here.
- A small colony of Arrowhead Spiketail (*Cordulegaster obliqua*) was discovered in a tributary to Luse Pond in Warren County. Males were observed flying methodical patrols of the stream and two females were observed laying eggs in muddy substrates.
- Adult Spatterdock Darner (*Rhinoaeschna mutata*) were encountered foraging in agricultural fields at the NLT Bear Creek Preserve and TNC Johnsonburg Preserve (both in Warren County). It is unclear where the breeding habitat is precisely located but future surveys are planned.
- Big Lost Pond (Mashipicong Pond Preserve) in Sussex County was re-visited and Crimson-ringed Whiteface (*Leucorrhinia glacialis*) was found to be abundant. A single juvenile Forcipate Emerald (*Somatochlora forcipata*) was netted, identified and then released.
- A total of 16 juvenile Midland Clubtails (*Gomphus fraternus*) were observed on the shoreline of the Wallkill River within the Wallkill River NWR in Sussex County. Exuviae was also collected and identified to be this species.
- Pine Barrens Bluet (*Enallagma recurvatum*) was found at eight of ten new water bodies surveyed in Ocean, Atlantic and Burlington counties. This species was absent at nine sites where it had been previously documented.
- New England Bluet (*Enallagma laterale*) is still abundant at Ramapo Lake (Bergen/Passaic County). Several hundred adults were observed along the entire shoreline of the lake. The previously documented populations at Little Swartswood Lake and Wolf Lake (Sussex County) appear to be extirpated.
- A total of 14 sites were surveyed within the Flatbrook watershed as a follow-up to last year's Superb Jewelwing *(Calopteryx amata*) surveys. The species was found to be reasonably abundant at all sites visited.
- All locations found to have soon-to-be 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 decline and ultimate failure of two New England populations needs to be studied in greater detail to ascertain the causes and any potential remedial action that might be needed.
- The little known Midland Clubtail appears to be well established along one segment of the Wallkill River in Sussex County. Further monitoring is planned to gain a better perspective on the size of this population.
- A new colony of Brook Snaketail is now known from elsewhere in the Pequest watershed. This, in addition to other priority aquatic invertebrates occurring here highlights the importance of this watershed. With other known colonies of this rare species declining it will be important to ascertain the size and geographical extent of this occurrence.

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 will be identified and should be surveyed in 2012 to ascertain what if any impact these significant events had.

Job 3C: Range Distances for Priority Species – Occurrence area buffer delineation
Project leader: Jeanette Bowers-Altman, Principal Zoologist

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

Key Findings:
- During mid-to-late May, a total of 243 newly emerged Snaketails (96 Brook, 104 Maine, and 43 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 2010 were re-visited with a total of 19 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 (Fig. 1.). Three of the re-captured and additionally marked adults were observed again near an initial capture site along the Big Flat Brook, a significant observation.

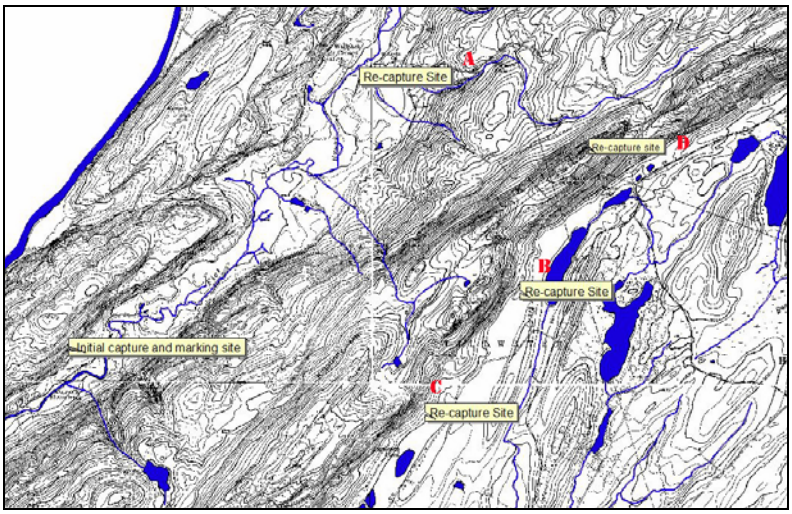

Fig. 1. Map of study area showing the initial capture site and recapture sites a) Walpack Center b) Quick Pond c) Arctic Meadows TNC Preserve and d) Ridge top site.

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 significant larger than previously thought.
- Based on this three year study using mark recapture method it may be prudent to consider increasing the size of protective buffers around known breeding sites for the soon-to-be listed Brook snaketail (*Ophiogomphus aspersus*).

Recommendations:

- Develop models for potential species occurrence area to consider foraging, sheltering and breeding areas in addition to tradition 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 (*Cincindela* spp.).

Key Findings:

- *Cicindela limbalis* was rediscovered in northern New Jersey after an absence of records in excess of 30 years with ten individuals observed at one location.
- *C. marginipennis* was rediscovered on the Delaware River after an absence of sightings over the last 10 years with six individuals observed at one location.
- *C. patruela consentea* was found in large numbers (10s -100s) in several locations in the New Jersey Pine Barrens.
- Surveys for *C. dorsalis dorsalis* were unsuccessful in locating any individuals at Sandy Hook and it is possible that this population is no longer extant.

Conclusions:

- Several rare tiger beetle species were rediscovered this year and hopefully through better survey efforts a status of their populations will be able to be determined.
- *C. lepida* and *C. patruela consentea* appear to be very wild fire dependent and often found in areas that have experienced wildfires or prescribed fires in the recent past.

Recommendations:

- Continue survey efforts for rare Coleoptera species to improve baseline data for a future status assessment of these species.
- Determine distribution of *C. marginipennis* on the Delaware River.
- Conduct surveys for *C. dorsalis media* in southern New Jersey. This species is believed to still occur in two locations but surveys have not been conducted for ten-plus years.

JOB 5. Impact of Dam Removals on Macroinvertebrates

Project leader: Jeanette Bowers-Altman, Principal Zoologist

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

Key Findings:

- We contacted the NJDEP's Bureau of Dam Safety and Flood Control (BDSFC) to request that staff identify which dams were slated for removal within the next two years. Staff at BDSFC prepared a list of four dams. Permit applications had either been submitted to the BDSFC or were in preparation. The dams identified for removal were the Riegelsville dam (Musconetcong River), Quakertown Preserve dam (Capoolong Creek tributary), Calco dam (Raritan River), and Mine Hill Reservoir dam (Mine Brook, Musconetcong River tributary).
- Of the four dams slated for removal, the Riegelsville dam consisted of a few remnants from a previous breach, the Quakertown Preserve dam was next to a small tributary of Capoolong Creek and habitat unsuitable for either freshwater mussels or Odonata, and the Calco dam was in unsuitable, urban habitat, serving as a conduit for wastewater transport. The Mine Hill Reservoir dam appeared suitable for the purposes Odonata surveys but fairly unsuitable for freshwater mussel surveys.

- In August 2011, we received additional information from the BDSFC that five additional dams were slated for removal, though the office had not yet received permit applications. These dams were as follows: Finesville (Musconetcong River), Nevios and Roberts Streets dams (Raritan River), Old Lake Forge dam (Rancocas Creek) and Suntan Lake dam (Wanaque River tributary).
- We surveyed a segment of Mine Brook Reservoir (just upstream of the dam) in May 2011 for presence or absence of state listed Odonata. Based on an extensive 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 (just downstream of the dam) was the Ebony jewelwing (*Calopteryx maculata*) and Fawn darner (*Boyeria vinosa*).
- In addition to Odonata, Eastern floater (*Pyganodon cataracta*) shells were observed on the shore of the Mine Brook reservoir. No freshwater mussels were observed downstream of the dam.
- A segment of the Musconetcong River downstream of the Finesville Dam was surveyed in May for the presence or absence of state listed Odonata. While most of the species present were highly elastic and of no conservation concern, one high priority species was documented. Based on adult observations and larval collections a breeding population of the state threatened Brook snaketail (*Ophiogomphus aspersus*) was documented and mapped in detail. This is one of the states rarest Odonata and is a key indicator species. The larvae have extremely narrow habitat requirements regarding substrate, dissolved oxygen and water temperature.
- We also documented the uncommon River jewelwing (*Calopteryx aequabilis*) at the Finesville Dam. Although this species is not listed in New Jersey its occurrence is worth note as it too is a consistent indicator species.
- We attempted to survey for freshwater mussels at Old Forge Lake dam. However, pH readings were 4.3 at the site, well below the pH required by mussels to support shell development. Preliminary Odonata surveys up and downstream of the dam were conducted, resulting in the following list of species: lake side (upstream) – Swamp darner (*Epiaschna heros*), Fawn darner, Slaty skimmer (*Libellula incesta*), Eastern pondhawk (*Erythemis simplicicollis*), Eastern amberwing (*Perithemis tenera*); creek side (downstream) – Eastern amberwing, Blue dasher (*Pachydiplax longipennis*), Slaty skimmer, Eastern pondhawk.
- We were alerted by a consulting firm to the presence of spent Eastern pondmussel (*Ligumia nasuta*) shells (State T) along the edges of a former lake bed along Barton Run in Evesham Township, Burlington County. Kenilworth Lake had been lowered to prevent further damage to a dam severely impacted by flooding in 2004. The lake has remained in a lowered condition since then, with much of the lake bed returning to a vegetated state. The presence of spent Eastern pondmussel shells may indicate that the former lake had been supporting a population of the species. Eastern pondmussels are known to utilize the shallower areas around lakes and ponds.
- We conducted surveys at several sites up and downstream of the damaged Kenilworth Lake dam. Although Eastern elliptio (*Elliptio complanata*) were abundant at each location, we were unable to locate either live Eastern pondmussel or shells.
- Survey efforts were severely impacted by August flooding. We were unable to survey for freshwater mussels at the Finesville dam and dams slated for removal in the Raritan River because of unprecedented high water and strong currents caused by a mid-August 2011 storm and then exacerbated by Hurricane Irene.

Conclusions:

- None of the Odonata species found either in Mine Brook or the reservoir can be considered indicators of high quality of water or habitat. The complete absence of indicator species at this site is not at all surprising given the size of the dam in place and the steep gradient of the stream.

- The Eastern floater is common in New Jersey and a highly elastic species. Its presence here may be the result of fish stocking.
- With the removal of the Finesville dam, it is entirely possible that the documented colony of Brook snaketail may be negatively impacted.
- 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.
- Removal of the dam in Evesham Township may have contributed to the mortality of an Eastern Pondmussel population in Kenilworth Lake. More surveys are needed to determine whether the species occurs in either Barton Run or several hydrologically connected lakes. The suspected loss of this Threatened species population underscores the need for long-term research into the effects of dam removal and extensive lake lowering to protect damaged dams on macroinvertebrates using deeper water habitats above dam sites.

Recommendations:

- Monitor Odonata following removal of the Mine Brook Reservoir dam as a small suite of forest species are likely to colonize this stream segment once natural flow is restored. In addition, conduct freshwater mussel surveys prior to dam removal to determine if species other than the eastern floater are present and if monitoring is warranted.
- Conduct freshwater mussel surveys at the Finesville dam site prior to removal to establish species composition and abundance. In addition, it is recommended that the Finesville dam site be monitored and any impact to the Brook snaketail be thoroughly documented. Ultimately the benefits of restoring natural flow to this river out-weigh the potential loss of one colony of this rare species. It is possible that the river will be colonized by other indicator species once it has stabilized to a more natural flow regime.
- Continue Odonata surveys at Old Forge Lake dam and develop a comprehensive species list above and below the dam prior to its removal.
- Continue surveys in Barton Run to determine extent of Eastern pondmussel population and impacts of the Kenilworth lake lowering to the species.
- 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, 2009 to August 31, 2010
Total Project Expenditures:	$14,000 ($9,100 Federal, $4,900 State) ('10-11 year only)

JOB 1: Species Status Review and Listing

Project leader: Kathleen Clark, Supervising Zoologist

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

Key Findings:

TERRESTRIAL NONGAME MAMMALS:

- Thirty-nine species in this group were selected for status review with eight reviewers agreeing to participate. Reviewers were selected based on their experience working with, and expertise in, small mammal life history and behavior, and represented such organizations as NJ Division of Fish and Wildlife, several in and out of state universities and colleges and the NJ State Museum.
- Round 1 was initiated during the reporting period. For the review, the panel was asked to choose a status and confidence level for 39 terrestrial mammals. Definitions for status (endangered, threatened, special concern, undetermined, not applicable or no opinion) were provided to panelists, along with a numeric scale reflecting the confidence level in their status selection. Reviewers were asked to provide comments supporting their status selections. Species were chosen for review based on the existing list of NJ nongame species and other sources documenting potential presence within the state.
- Reviewers were provided with various sources of information pertaining to the species under review, including ENSP unpublished reports and data, gray literature and unpublished theses. Information was provided to each reviewer via CD and a secure website.
- Round 1 was initiated during this segment but not completed. It is anticipated that the process will be completed prior to the end of the next reporting period.

SINGLE-SPECIES FISH REVIEW: ATLANTIC STURGEON:

- During the January 2011 Endangered and Nongame Species Advisory Committee (ENSAC) meeting, a motion was made to request that the ENSP conduct a single species Delphi review on Atlantic Sturgeon in advance of changes to the current federal status.
- Seven reviewers were asked to participate in the Atlantic Sturgeon Delphi process. 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.
- For the review, each panelist was asked to choose a status and confidence level for the Atlantic sturgeon. Definitions for status (endangered, threatened, special concern, undetermined, not applicable or no opinion) were provided to panelists, along with a numeric scale reflecting confidence level. Reviewers were asked to provide comments supporting their status selections.
- During Round 1, reviewers were sent various sources of 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 was completed during this segment. Upon completion of the first round, voting was as follows, 3 E (average confidence level 6.7), 3 T (average confidence level 5.7). One reviewer declined to continue participating in the process. Votes and comments were compiled and Round Two was sent to reviewers. Only one reviewer submitted Round Two by the end of this segment. This review will continue until consensus is reached or consensus is not possible by the panel.

STATUS CHANGES and REGULATIONS

- ENSP staff reviewed and provided comments to regulatory amendments that would update the lists of endangered and nongame wildlife. The amendments were proposed in January 2011, and ENSP was asked to respond to public comments received. The lists are scheduled to be adopted into regulation in early 2012. These amendments will update the lists of species' statuses, and will also amend the definitions of some statuses, including defining the status of special concern.

Conclusions:

- The Endangered and Nongame Species Program and its advisory Endangered and Nongame Species Advisory Committee have affirmed the Delphi technique (Clark et al. 2006) is an appropriate, objective method for determining species status, which should continue to be the method used by the Division.

Recommendations:

- Continue the Delphi process review for Atlantic sturgeon and present results to the Endangered and Nongame Species Advisory Committee for recommendations on new status assignments.
- Continue the Delphi status review for terrestrial mammals and present the results to the Endangered and Nongame Species Advisory Committee for recommendations on status assignments.
- 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, if any, through the regulatory (rulemaking) process.

Literature cited

Clark, K.E., J.A. Applegate, L.J. Niles, and D.S. Dobkin. 2006. An objective means of species status assessment: adapting the Delphi Technique. Wildlife Society Bulletin 34:419-425.