Report
State Wildlife Grants
T-1-3

Endangered, Threatened and Rare Wildlife Conservation Projects

Report for Project Year
September 1, 2005 – August 31, 2006

NJ Department of Environmental Protection

DIVISION OF FISH AND WILDLIFE

ENDANGERED AND NONGAME SPECIES PROGRAM

EXECUTIVE SUMMARY

Project:	**Bird Conservation**
Federal Aid Project:	T-1-3 (State Wildlife Grants)
Segment dates:	September 1, 2005 to August 31, 2006
Total Project Expenditures:	$624,500 ($468,375 Federal, $156,125 State)

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

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:

- ENSP biologists monitored all known nesting pairs, with the essential assistance of 54 eagle project volunteers. Nests were monitored approximately weekly from January through fledging in July.
- In 2006, 59 eagle pairs were monitored, 55 of those were active (with eggs), three were territorial (maintained a nest area), and one was not relocated (Figure 1).
- During the 2005 nesting season 47 nests were successful in producing 82 young, for a productivity rate of 1.49 young per active nest. This productivity rate is 50 percent higher than that required for population maintenance (0.9-1.1 young/active nest), and is above the past ten-year average in New Jersey of 1.26 young/active nest. In the last ten years, 75% of active nests on average were successful in producing young.
- In 2006, 6 active nests failed to produce viable hatchlings. The causes were not known for most. We suspect predation may have been responsible for most of these failures.
- Three nests with a history of contaminant-related failure produced their own young this year (Camden County, Rancocas Creek, Raccoon Creek). At least two of these pairs had new females nesting in 2006.
- Six new eagle nests were discovered: one along the Delaware River, two in central region, one in northern region, and two in southern region. Expansion in central and northern NJ is expected, and the Delaware River continues to expand slowly as a nesting area.
- ENSP biologists visited a sample of nests to band young with federal and color leg bands, and take blood samples. In 2006 we sampled 20 eaglets at 10 nests. All blood samples were stored for future analyses. No eggs were collected this season.
- In 2006 most nests (43, or 73%) were located on private land, compared to 27% of nests on public and conservation lands.
- ENSP biologists coordinated the Mid-winter Eagle Survey that took place January 14-15, 2006. A total of 192 bald eagles were counted by volunteers and staff, the highest count in New Jersey since the survey began in 1978 (Figure 2). Most eagles (152) were observed in southern New Jersey, primarily in the Delaware Bay region; northern New Jersey had 31 bald eagles on the Delaware River and on inland reservoirs. Surveyors recorded detailed data on eagle locations, and those data were compiled to help determine critical eagle wintering habitat.

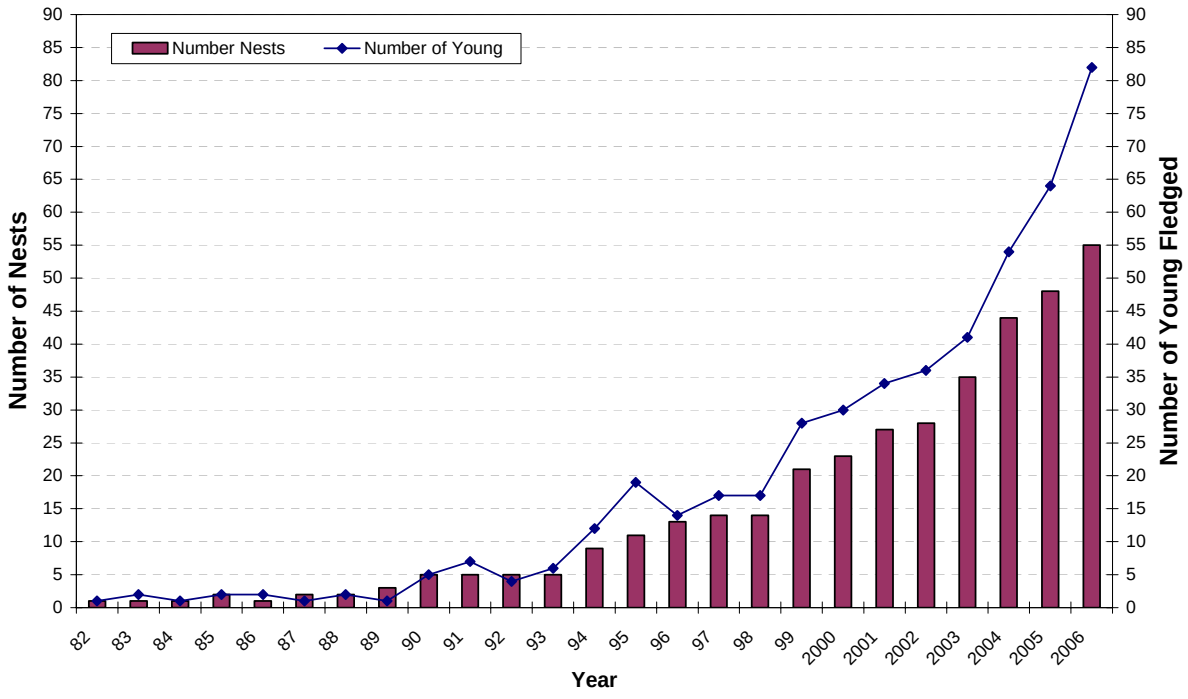


Figure 1. The number of active bald eagle nests and young produced in NJ, 1982-2006.

Conclusions:

- The New Jersey bald eagle population has increased each year and continues to maintain nest productivity well above the minimum necessary to maintain a stable population. The state's eagle population has been increasing since the late 1980's, when one nesting pair existed in the state. Management by biologists that includes nest-site protection in cooperation with landowners has been key to this success. In 2006, six new eagle nests were discovered, and this expansion into unoccupied habitat is likely to continue in the next few years.
- While the strength of the current recovery is encouraging, most of the population growth is very recent and must be viewed with some caution. Regulatory status, site protection and efforts by observers and landowners are key ingredients in the current recovery, and will be necessary to sustain any recovery.
- Disturbance is a major management issue at many nests, and posting and regular surveillance by staff and nest observers is essential to protecting nests and assuring success.
- Contaminants affect the outcome of at least five 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.
- The majority of nests are located on privately owned land, making landowners essential partners in the maintenance of the eagle population. While many landowners have become staunch advocates for the eagles and work closely with the ENSP staff, others have other goals for their land that may threaten long term habitat viability.

Recommendations:

- Continue to monitor population size, activity and productivity through weekly or bi-weekly observations of nests. These are conducted largely by a group of trained volunteer nest observers.
- Continue to monitor the New Jersey wintering population through the annual Mid-winter Eagle survey in January.
- 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.
- Develop proactive planning to identify and conserve suitable bald eagle habitat in anticipation of a fully recovered eagle population.

JOB 1B: Grassland Birds

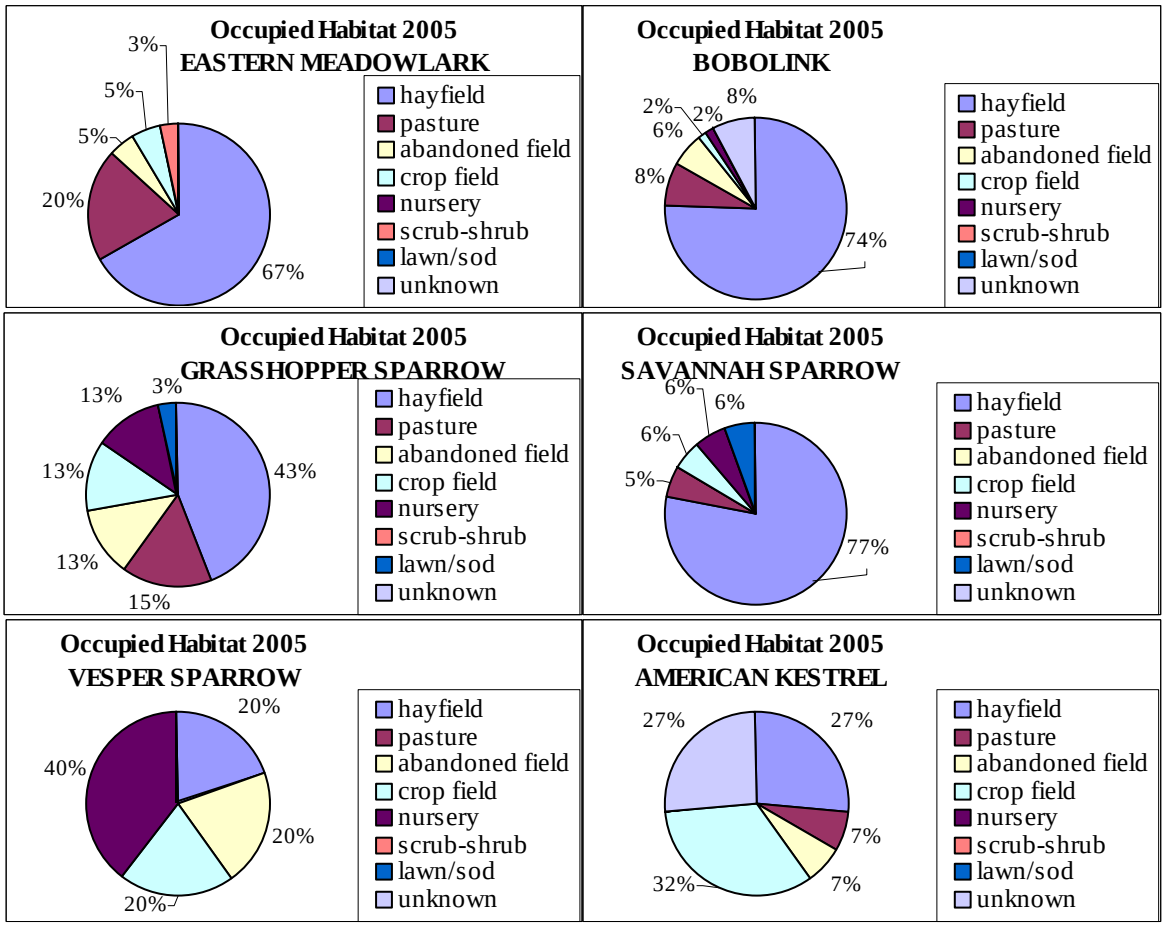
OBJECTIVE 1: To continue long-term monitoring and implement habitat management/conservation strategies to benefit endangered and threatened grassland-nesting birds: grasshopper sparrow (*Ammodramus savannarum*) (breeding), vesper sparrow (*Pooecetes gramineus*), bobolink (*Dolichonyx oryzivorus*), Henslow's sparrow (*Ammodramus henslowii*), savannah sparrow (*Passerculus sandwichensis*), upland sandpiper (*Bartramia longicauda*), and northern harrier (*Circus cyaneus*) (breeding).

Under the Landscape Project, management guidelines for grassland birds will be developed for use by natural resource managers, county and municipal utility authorities and planners, airports, and private landowners. Farmers, in particular, are significant partners in grassland bird conservation and will be part of the development of land management and conservation strategies. Resources currently available, including conservation easements, various habitat programs within the Farm Bill administered through USDA's NRCS office, USFWS's Partners for Fish and Wildlife Program, and the Landowner Incentive Program, will be employed to protect and manage habitat.

Key Findings:

- Data from the 2005 grassland bird survey were entered, digitized, and submitted for incorporation into the Landscape Project.
  - 799 "species occurrences" comprised of 995 individuals of 42 different species were incorporated in the Landscape project from the 2005 survey.
  - 230 (29%) of the 799 "species occurrences" consisted of 458 individuals of NJ's endangered or threatened species.
    - 77 (42,771.5 hectares) grassland/agriculture patches were updated with NJ's endangered and threatened species from the 2005 survey.
      - 31 (14,604.4 hectares) of the 77 grassland/agriculture patches had no prior record of an occurrence of NJ's endangered and threatened species.
    - 184 bobolinks were observed in 103 different locations; 136 eastern meadowlarks were observed in 111 different locations; 49 savannah sparrows were observed in 48 different locations; 45 grasshopper sparrows were observed in 42 different locations; 21 American kestrels were observed in 19 different locations; 14 horned larks were observed in 10 different locations; 9 vesper sparrows were observed in 9 different locations; no upland sandpipers, henslow's sparrows, or northern harriers were observed.
  - Habitat data for each of the 355 survey points surveyed in 2005 were digitized, ranked, and used to select points for the 2006 survey points that were paired with Landowner Incentive Program (LIP) survey points.

- 208 individuals with endangered, threatened, or special concern status in NJ were mapped to a precise location including:
  - 65 bobolinks: 49 (75.4%) were observed in hayfields, 5 (7.7%) in pasture, 4 (6.2%) in abandoned fields, 1 (1.5%) in spruce nursery, 1 (1.5%) in soybeans, and 5 (7.7%) were mapped without habitat type documented.
    - 60% (18 out of 30) of the occupied hayfields were mowed between April and July.
  - 60 eastern meadowlarks: 40 (66.7%) were observed in hayfields, 12 (20%) in pastures, 3 (5%) in abandoned fields, 3 (5%) in corn fields, and 2 (3.3%) in scrub shrub.
    - 69% (16 out of 23) of the occupied hayfields were mowed between April and July.
  - 32 grasshopper sparrows: 14 (43.8%) were observed in hayfields, 5 (15.6%) in pastures, 4 (12.5%) in abandoned fields, 4 (12.5%) in crop fields (corn and strawberry), 4 (12.5%) in nurseries, and 1(3.1%) in lawn/sod.
    - 30% (3 out of 10) of the occupied hayfields were mowed between April and July.
  - 18 savannah sparrows: 14 (77.6%) were observed in hayfields, 1 (5.6%) in pasture, 1 (5.6%) in corn field, 1 (5.6%) in nursery, and 1 (5.6%) in lawn/sod.
    - 80% (4 out of 5) of the occupied hayfields were mowed between April and July.
  - 15 American kestrels: 4 (26.6%) were observed in hayfields, 1 (6.7%) in pastures, 1 (6.7%) in abandoned fields, 1 (6.7%) near soybeans, 2 (13.3%) in unknown crops, 1(6.7%) in corn fields, 1 (6.7%) in strawberry fields, and 4 (26.6%) were mapped without habitat type documented.
  - 13 horned larks: 7 (54%) were observed in soybeans and 6 (46%) in corn fields.
  - 5 vesper sparrows: 1(20%) was observed in hayfield, 1 (20%) in abandoned field, 1 (20%) in crop field, and 2 (40%) in nurseries.
    - The one occupied hayfield was mowed between April and July.



- The 2005 survey protocol was revised for the 2006 survey based upon review of the results from the 2005 survey.
- The 2006 data is being entered for analyses to be conducted in 2007.

Conclusions:
- From the results of the 2005 survey, bobolinks and eastern meadowlarks were the most abundant and widely distributed grassland bird species detected while upland sandpipers, henslow's sparrows, northern harriers, and vesper sparrows were the least abundant.
- Hayfields appeared to be an important habitat type for grassland birds, especially savannah sparrows, bobolinks, eastern meadowlarks, and grasshopper sparrows.
- Hayfields also may be detrimental for nesting grassland birds as 61% of the hayfields known to be occupied by grassland birds were mowed at least once between April and July. In New Jersey, the peak nesting period for grassland birds occurs from early May through early July.

Recommendations:
- Grassland birds' surveys should continue and be expanded statewide to locate additional occupied habitats and compliment the USGS Breeding Bird Survey to estimate population trends.
- Hayfields occupied by grassland bird species should be targeted for land acquisition and/or incentive programs to allow for delayed mowing and higher productivity, especially for those fields that were mowed while occupied by Savannah sparrows or vesper sparrows.
- Research should be conducted to determine effectiveness of different habitat management techniques, including conversion to warm-season grasses and delayed mowing, on grassland bird populations in New Jersey.
- Research should be conducted to determine the value of agricultural lands (nurseries, crop fields, pasture) for breeding grassland birds.
- Targeted surveys should be conducted to determine the distribution of upland sandpipers, henslow's sparrows, and inland northern harriers in New Jersey. Areas containing any of the above species should be targeted for land acquisition, have higher priority within incentive programs, and immediate active management for the species.
- Research should be done to determine the best way to regulate habitat protection for grassland birds while managing the habitat for the species.

JOB 1C: Beachnesting Birds (Black Skimmer and Least Tern) Population Monitoring, Threat Assessment Studies and Management Planning

OBJECTIVE: To protect and restore nesting black skimmers (*Rynchops niger)* through continued monitoring of nesting sites and by studying the effects of watercraft on their reproductive success. To protect and restore least terns (*Sterna albifrons)* and other beach nesting birds through development of targeted predator management strategy.

Key Findings:
- Breeding surveys were conducted at all known black skimmer and least tern nesting sites along the Atlantic Coast by the ENSP and other cooperators/landowners. Surveys consisted of ground counts to determine the number of adults present, sitting/incubating adults (to estimate nesting pairs), and fledged chicks. Surveys were conducted every 2-3 weeks during the breeding season (May-September). New Jersey also participated with other Atlantic Coast states in a least tern breeding window census coordinated by the U.S. Fish and Wildlife Service, although results of that survey have not been released to date.
- Six (6) active black skimmer nesting sites were identified in 2006 for a total of 2,214 adult black skimmers (based on the highest statewide count during any one census period). Nearly all of state's black skimmers were concentrated in just two colonies, one at Mordecai Island (in southern Barnegat

Bay) and the other in Hereford Inlet. The Hereford Inlet colony was initially located at Stone Harbor Point, however, due to intense harassment and nest depredation by laughing gulls, the colony failed and subsequently relocated to Champagne Island, just a short distance away. Statewide productivity was estimated to be moderate (≥ 0.5 < 1.00 fledglings per pair). Coastal storms in August (including TS Ernesto) impacted productivity at both of the major colonies, with many of the nests and unfledged chicks still present at that time being lost to flooding.

- Twenty-four (24) active least tern breeding colonies were identified in 2006 for a total of 1,097 adults (based on the highest statewide count during any one census period). Statewide productivity was estimated to be low (> 0.0 < 0.5 fledglings per pair), with a large number of colonies completely failing. The cause of poor reproductive success varied from site to site, although predator problems predominated. Harassment and predation by red fox continued to be the major limiting factor at most Monmouth County sites. Laughing gulls were once again a problem for colonies located in or near Hereford Inlet, although some nest and chick losses in this region were also the result of flooding. One exception to the statewide trend of poor reproductive success was the Gull Island colony, a dredge site located along the Manasquan River, where 92 young fledged from a colony of 221 adults.
- ENSP and other beach nesting bird site managers in the state continued to identify predator threats at all active nesting sites. Minimizing those threats is especially difficult for colonial ground nesters such as black skimmers and least terns. As a result, an inter-agency team was formed this year in New Jersey to address the impacts of predators on the state's beach nesting birds.
    - Partners in this initiative include a variety of biologist, coastal natural resource managers, and predator management experts from the NJDFW, USFWS, National Park Service, U.S. Department of Agriculture-Wildlife Services, U.S. Coast Guard, as well as several non-governmental organizations. The group's efforts this year were focused on developing a comprehensive list of viable predator management options, as well as the biological and legal justifications for their implementation. This information will be incorporated into a "best management practices" document, which is expected to be completed in the upcoming year. ENSP also continued to work with USFWS and coastal municipalities to develop and implement beach nesting bird management plans, which include a strong component to address the impacts of predators.
- A research study was conducted during the 2006 breeding season to investigate the effects of watercraft on black skimmers nesting in Barnegat Bay. Controlled approaches of varying speeds and angles were made towards skimmer colonies in a small boat in order to determine the distances at which skimmers reacted. Data collected included date, time, colony identification, number of adults, number of nests, number of chicks, reproductive stage, and various behavioral measures. Preliminary analysis of the data indicate that skimmers first responded (by standing up, looking alert) to the boat at a mean distance of 268 feet, and that they first flew from the colony at 185 feet. These distances, however, varied during the season depending upon the stage in the reproductive cycle. Birds responded at the greatest distance during the pre-laying stage and again when they had large chicks. Skimmers allowed the closest approach before flying during the hatching period and when they had small chicks.

Conclusions:

- The statewide black skimmer population increased moderately in 2006 compared to 2005, and is at one of the higher levels since monitoring began 30 years ago. It should be noted, however, that the population was at one of its lowest levels only two years ago (2004). Particularly robust productivity at Mordecai Island from 2003-2005, one of the state's major colonies during that period, as well as high productivity at Stone Harbor in 2005, the state's largest colony that year, are likely a factor in the increase in population since 2004. Productivity was moderate in 2006 at these two colonies, which again accounted for nearly all of the state's population, but was probably sufficient to sustain current population levels. The number of active colonies remained low in 2006, continuing a long-term trend that has concentrated nearly all of the state's population in just 2-3 colonies. This trend leaves the state's black skimmer population vulnerable despite recent gains.

- The statewide least tern population remained low this year, although detecting a trend remains difficult because there are often large fluctuations between years and this is a difficult species to accurately survey. The first coordinated least tern survey among Atlantic Coast states was conducted in 2006 and over time should help shed better light on regional and statewide population changes. Statewide, least tern productivity has now been low for the past five years. There was a slight upturn in the number of young fledged in 2006 compared to the past several years, however that was largely the result of the success of one large colony (Gull Island – Manasquan River). Low population in recent years combined with chronically poor reproductive success continues to raise concerns about the status of least terns in the state.
- Predators continue to significantly impact the populations and reproductive success of colonial beach nesting species in New Jersey, such as black skimmers and least terns. Targeted mammalian trapping (which has been implemented at some sites using other funding sources) has been effective in some instances, but losses due to avian species, especially from the large laughing gull colonies located near Hereford Inlet, remain an unsolved challenge. The development of best management practices for predator management and implementation of beach nesting bird management plans, two initiatives ENSP is currently actively involved in, will not, in and of themselves, solve the predator issues currently threatening species recovery within the state, but they should provide a better framework for addressing the problems in a more effective and comprehensive manner.
- The mean distances at which small boats disturbed black skimmers varied depending on the stage of their reproductive cycle. Birds were less easily flushed during hatching or when they had small chicks, likely because they need to be more protective of young chicks during this period to avoid heat stress or depredation. Although these preliminary results suggest that shorter buffer distances might be sufficient during some key periods, breeding is not synchronous within skimmer colonies, so the maximum buffer distances are likely more appropriate. Based on the mean distances at which birds reacted when approached to by a small boat, at least a 333 foot disturbance buffer or set-back from the colony is necessarily to avoid any appreciable impact on birds during any stage of the reproductive cycle; or a 279 foot buffer to avoid flushing birds from the colony during any segment of the breeding season.

Recommendations:

- Continue to annually monitor population and productivity at all known coastal breeding sites at intervals of once every 2-3 weeks during the breeding season.
- Conduct periodic surveys of suitable nesting habitat not covered on regular coastal surveys, including at sand mines, gravel pits and industrial sites for least terns and in coastal marsh habitat for black skimmers.
- Continue to participate in the Atlantic Coast least tern breeding window census to help determine coast wide population and trends, as well to better assess recent population declines and poor productivity within New Jersey.
- Continue threat assessment, especially with regards to the effects of predators on reproductive success. Develop strategies for addressing avian predators, especially laughing gulls.
- Continue working with other partners in the state to address predator problems, in particular completing efforts begun this year to develop best management practices for minimizing the impact of predators on beach nesting birds.
- Continue to incorporate conservation strategies for black skimmers and least terns into new or revised beach management plans.
- Until recently, black skimmer colonies located on islands within Barnegat Bay have likely been less vulnerable to human disturbance than colonies located on heavily recreated coastal beaches. However, as boat and personal watercraft usage has dramatically increased in recent years, this may no longer be the case. Furthermore, colonies on back bay islands are less frequently monitored than those at beach sites. Consequently, establishing and enforcing disturbance buffers around important breeding sites is increasingly critical, especially since the skimmer population in New Jersey has been primarily concentrated in just a few, large colonies in recent years. Distances for disturbance buffers

around Barnegat Bay colonies should be developed based on a more in-depth analysis of the data, and possibly additional research, although preliminary study results suggest a buffer of nearly 100 yards may be necessary.
- Continue to incorporate breeding data into the Landscape Project and Biotics databases.

JOB 1D: Osprey Monitoring and Management Planning

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

Key Findings:
- ENSP biologists and volunteers conducted aerial and ground surveys of nesting ospreys in May and June, 2006. All survey data resulted in a statewide population count of 400 nesting pairs (Figure 1). This was an increase of 9.3% over the 2003 population estimate of 366 pairs. The aerial survey covered the coastal areas of Ocean, Burlington, Atlantic and Cape May counties. Ground surveys, many by volunteers, covered all other areas of Delaware Bay and River, Raritan Bay, and inland. Ground surveys in June-July were conducted in conjunction with nestling banding and covered every major nesting colony on the Atlantic and Delaware Bay coasts.
- ENSP determined the outcome of 235 nests, 59% of the 400 pairs nesting (Table 1). Nests were grouped by watershed or water-body areas to which they were closest. Nest success averaged 1.66 young per active nest, approximately double the rate needed to sustain a population. Nest success was slightly higher in Delaware Bay compared to Atlantic coast (1.88 vs. 1.61), and varied from 1.35 in Raritan Bay to 2.00 in northern Cape May County.
- Most nests (309, 77%) were along the Atlantic coast, but nesting is slowly increasing along Delaware Bay and north along the Delaware River. In the mid- to upper-Delaware River, most nests were found on cell-phone or power transmission towers, providing for higher nesting than other structures.
- All nest locations were maintained in Excel and GIS databases, tracking all occupied nests. Those databases were 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 was also updated with new information.

Conclusions:
- The census in 2006 resulted in a new milestone as the population reached 400 nesting pairs. The high productivity rate indicated that conditions during the nesting season, primarily weather and prey abundance, were excellent.
- The rate of population growth has slowed in recent years 1999-2006 (9.9 nests/year) from the period of 1990-1999 (19.2 nests/year). This is expected as the population begins to reach limits of suitable nest structures and prey abundance. However, it is likely that several years of poor production in the late 1990s (apparently caused by low fish availability) contributed to a setback in new nesting pairs. In recent years production has been above the maintenance level, suggesting that the population will continue to grow, though at a slower rate as other factors limit new nesting.
- Ospreys' reliance on human-made structures for nesting emphasizes the importance of building and maintaining nests. This is a long-term job necessary to maintaining the osprey population in the state.

Recommendations:
- Conduct a population census every three years (next survey due in 2009) to monitor population changes statewide and regionally. Maintain integrated databases on the population and nest locations on an annual basis.
- Continue to measure annual productivity of ospreys to monitor regional conditions and changes (e.g., Atlantic vs. Delaware Bay regions, and Atlantic subregional comparisons). Recruit and train more volunteers to assist with 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.

- Gather information on fisheries trends (particularly menhaden and flounder species) for potential correlation with osprey population parameters.

Table 1. Osprey nesting and productivity in 2006 in all NJ nesting areas. Population determined by aerial and ground surveys in May-June; productivity determined by ground surveys in June-July. Productivity rates in 2003-2005 provided for comparison.

Nesting Area	#Nests Surveyed	Known-Outcome Nests	%Known	#Young	#Banded	Prod. Rate 2006	2005	2004	2003
Raritan Bay area	32	17	53%	23	3	1.35	1.91	1.15	1.07
Sedge Islands WMA	28	28	100%	44	38	1.57	1.33	1.70	0.83
Barnegat Bay (except Sedge Is)	31	5	*16%*	0	0	*0.00*	n/a	n/a	n/a
Great Bay, Atlantic City, LEH	41	16	39%	25	11	1.56	1.91	1.91	0.78
Great Egg Harbor/Ocean City	42	23	55%	38	29	1.65	1.44	1.06	0.87
Sea Isle City	12	10	83%	21	3	2.10	1.22	1.20	1.13
Avalon/Stone Harbor Bays	67	44	66%	72	50	1.64	1.28	1.81	0.48
Wildwood Bays & Cape May	36	27	75%	51	35	1.89	1.89	1.67	0.46
Maurice River & Del Bay	55	45	82%	83	96	1.84	1.37	2.00	1.09
Salem & Cohansey River	24	12	50%	24	0	2.00	n/a	n/a	1.00
Delaware River	12	1	*8%*	1	0	*1.00*	n/a	n/a	n/a
Other-Atlantic (no area designation)	20	7	35%	9	0	1.29	n/a	n/a	n/a
Total of all study areas	400	235	59%	391	265	1.66	1.54	1.56	0.86
Atlantic Coast only	289	170	59%	274	169	1.61	1.53	1.57	0.73
Delaware Bay only	79	57	72%	107	96	1.88	1.37	2.00	1.09
Statewide population estimate	400								366

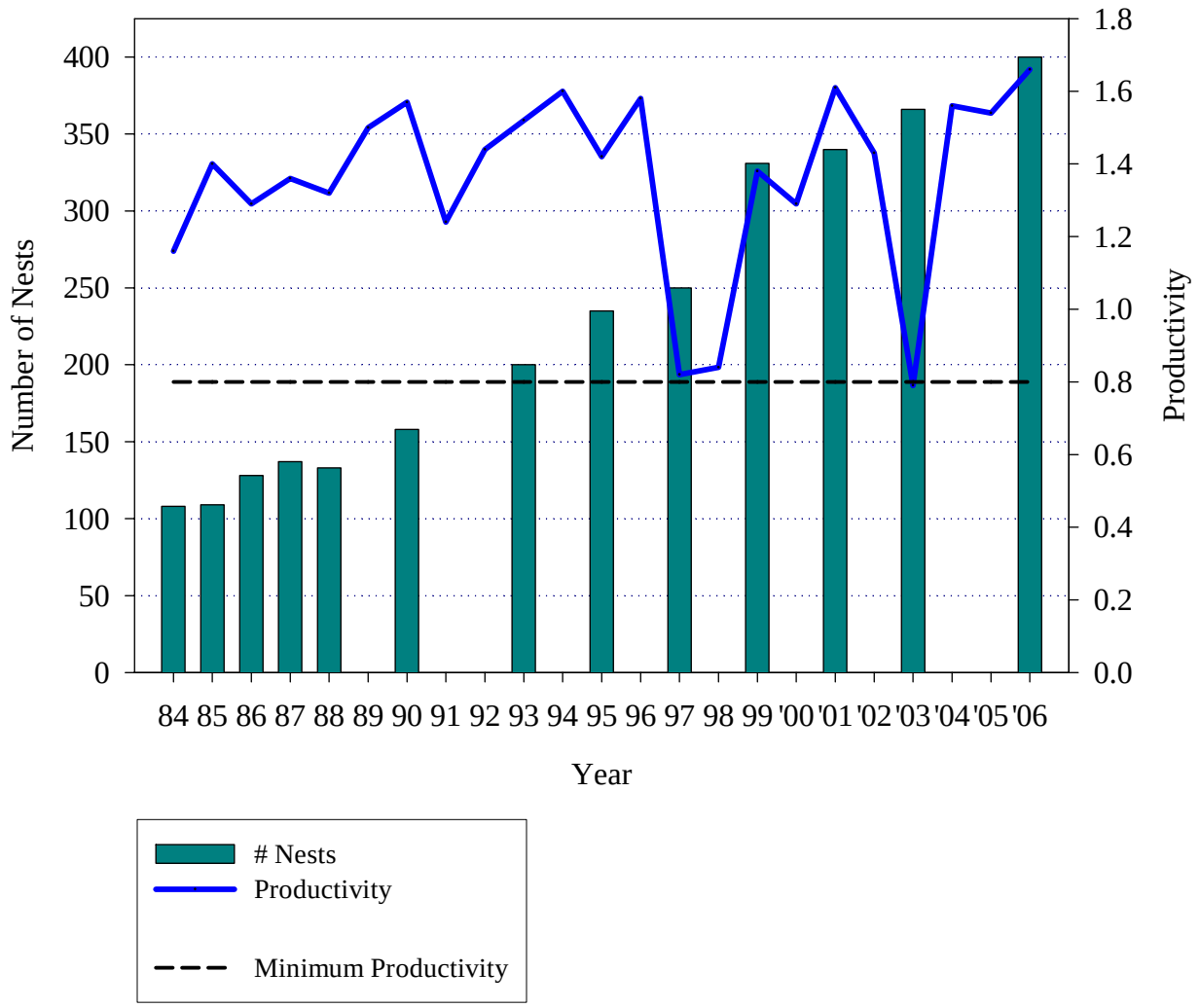


Figure 1. Osprey nesting population and productivity in New Jersey, 1984-2006. The population growth rate has slowed from 19.2 nests/year in 1990-1999 to 9.9 nests/year in 1999-2006. Low productivity in the late 1990s may have contributed to slower growth rate, but in general nest success has been well above the minimum necessary to maintain the population.

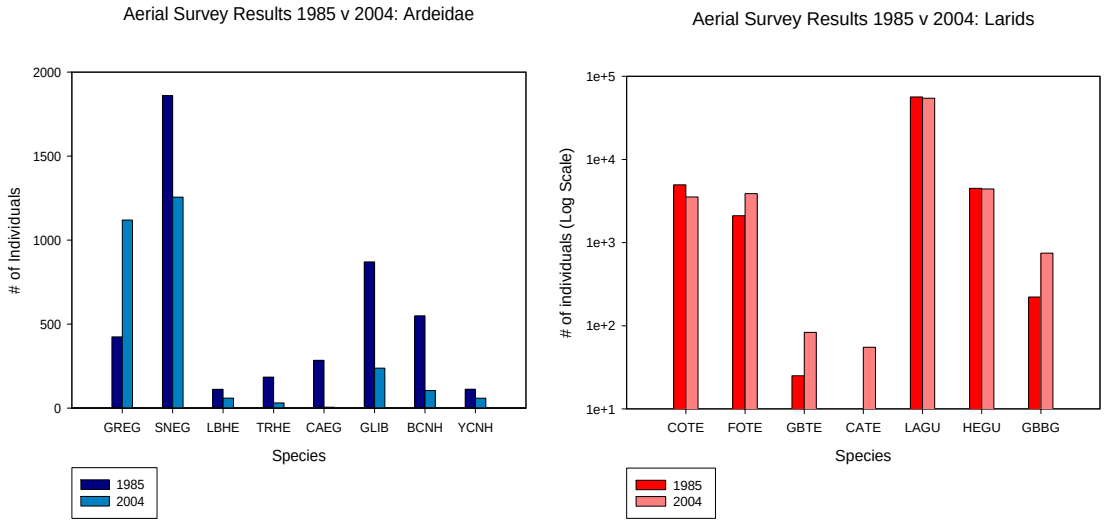
JOB 1E: Colonial Waterbirds

OBJECTIVE 1: To study and analyze population distribution and trends for nesting populations of colonial waterbirds. Particular attention will be given to New Jersey's state endangered and threatened species, species of species concern and regional priority species, such as yellow-crowned night-herons (*Nyctanassa violacea*), tri-colored herons (*Hydranassa tricolor)* and snowy egrets (*Egretta thula*).

Key Findings:

- The populations of the Ardeidae that are surveyed on the aerial coastal survey (great egret, snowy egret, little blue heron, tricolored heron, glossy ibis, yellow-crowned night heron, black-crowned night heron and cattle egret) appear to be declining, with the exception of great egrets (see graphs

below- note that Larids are on a log scale so as to represent all Larid species on one graph since their individual populations were on different magnitudes). Prior SWG research has shown that the aerial survey underestimates the populations of these species. However, the protocol of the aerial survey has remained the same since its inception in 1985. Therefore, although the number of birds counted each year may be inaccurate, the assumption of a constant error rate due to strict adherence to the protocol allows for the presumption that these populations are undergoing an overall downward trend.



- All the species that are listed as threatened or special concern (yellow-crowned night heron, black-crowned night heron, snowy egret, little blue heron and tricolored heron) are all experiencing a decline in numbers. Of special note are the declines of black-crowned night herons and tricolored herons, which in 2004 were 19% and 16% of their 1985 coastal survey totals.
- The populations of all the terns that are surveyed (Forster's tern, common tern, gull-billed tern, and Caspian tern) appear to be stable over the twenty year period of the aerial coastal survey.
- The populations of the gull species that are surveyed (laughing gull, greater black-backed gull and herring gull) have a mixed result. The laughing gull population has varied considerably over the time period of the survey, ranging from 39,085 to 80, 253 individuals. The herring gull population has remained steady, and the greater black-backed population has increased over three-fold.
- The number of Ardeidae (long-legged waders) nest sites was 44 in 1985 and 40 in 2004.
- The number of Larid (gulls and terns) nesting sites was 171 in 1985 and 175 in 2004.
- There were a number of complaints recorded this season from the public regarding nesting night herons on their properties. Although ENSP does not formally track the number of complaints received, the staff consensus was that these calls represented an increase over prior years.
- Continued analysis of the different methodologies to count nesting sites in the marsh has still not revealed the best method to obtain the most accurate counts.

Conclusions:

- If there is an actual decline occurring among Ardeidae, the limiting factor does not appear to be loss of habitat. The coastal marsh islands are by and large protected from development and the number of colonies overall has not declined.
- The coastal aerial survey does not capture the individuals of those species that also nest in the interior of the state, including the state threatened yellow and black-crowned night herons and the special concern great blue heron. The great blue heron population is counted during a separate survey (see NJDEP 2005). At present, however, there is no mechanism to capture the other species, except through the non-standardized (in terms of state-wide coverage) sighting report forms that are opportunistically reported by the public.

- The increases, decreases and stabilizations of the surveyed species are consistent among all species surveyed with the status of these birds along the entire Atlantic Seaboard (Erwin, 1995) which lends further substantiation to the hypothesis that NJ Ardeidae are experiencing a downward trend.
- The number of colonies for Ardeidae and Larids appears to be steady over the twenty-year period that the survey has taken place.
- The sharp drop that some species (little blue heron, tricolored heron) have experienced is cause for concern.

Recommendations:
- Restore or enhance marsh island habitat to attract additional marsh nesting birds to NJ. Although it was noted above that a loss of habitat does not appear to be the primary impetus of the decline, habitat improvements should always play an integral role in recovery efforts.
- Increase efforts to locate and map populations of species that nest in the interior sections of the state.
- Collaborate with other agencies along the eastern seaboard to generate new methods to accurately count the birds that nest in the colonies in NJ.
- Investigate the recovery efforts that other regions are undertaking for the declining species.
- Continue to post colonies with explanatory signage to reduce or eliminate any human disturbance.
- Determine the limiting factor to population increase for the species that are experiencing declines. Possible channels to investigate include predation rates, contamination issues, quality of nesting habitat and emigration to nesting sites in other states.
- Continue the aerial survey effort as it represents one of the longest, most consistently completed surveys for nongame species in New Jersey. Despite its limitations, it is still the best tool currently available for determining trends of colonial waterbird populations in this state.
- Track the number of complaints received regarding nesting night herons on a yearly basis. Identify techniques to reduce the homeowner conflicts while protecting the best interests of the herons.

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

OBJECTIVE: Protect critical habitats and resources on the Delaware Bay stopover for migratory shorebirds through reduction/reversal of horseshoe crab population decline, reduction of anthropogenic disturbance to shorebirds, enhancement/creation of coastal habitat and impoundments, and monitoring abundance and condition of red knots and other shorebird species of regional priority.

Key Findings:
- ENSP carried out year four of a radio telemetry study to track movements of red knots in the bay. We deployed 18 automated tracking stations at key sites in Delaware Bay. Twenty red knots were outfitted with transmitters on the Atlantic coast of New Jersey to assess the potential for differential habitat use by knots using coastal habitats. Concurrently, via collaboration with Virginia Polytechnic Institute, 45 red knots were outfitted with transmitters on coastal Virginia to assess coastal habitat use and track migration through Delaware Bay. Three important results were observed:
  - Again in 2006, the baywide population of red knots roosted on Stone Harbor Point on the highest spring tides making this roost area one of the most important in the Bay and stressing the need to create safe roost areas elsewhere in the Bay.
  - While NJ coast knots were found to use habitats throughout the bay, Virginia coast knots were not detected on Delaware Bay.
  - Abundant bivalves (*Donax variabilis*) combined with undisturbed foraging opportunities on The Nature Conservancy's Virginia Coast Preserve provided sufficient food to allow VA knots to migrate directly to the Arctic bypassing Delaware Bay.
- Preliminary efforts to develop a model using shorebird counts and egg densities have not yielded a statistically-robust model.

- ENSP biologists cleaned and prepared all available capture-recapture data, and coded all the beaches so that we can match the capture-recapture data with the aerial survey data and the horseshoe crab egg density data.
  - All data can now be referenced by site, a necessary precursor to our model and all future modeling attempts.
  - A Bayesian model of individual bird weight as a function of measured bird characteristics and total number of birds present has been developed.
  - The number of eggs available did not appear to aid in explaining the weight of captured birds. As it has already been determined through experimentation and observation, the birds' weight gain depends on the density of eggs, so the model's inadequacy arises either out of failure to adequately sample eggs or inadequate interpretation of the egg data. The former is possible because of the extraordinary variation in the density of eggs within a beach. Recent sampling efforts conducted in 2006 will help us develop new parameters to characterize this variability. New survey transects were added to the original sampling design for key beaches that were more closely aligned with the actual location of foraging shorebirds. We are currently working on an improved method for modeling egg availability to improve the weight model.

- Despite low egg densities, weight gain on the Delaware Bay was adequate because of low shorebird numbers. The most important measure of the function of the Delaware Bay stopover is the ability of shorebirds to gain weight. Red knots must attain weights of at least 185 grams ("Threshold Departure Weight") to have sufficient energy to reach the Arctic and initiate nesting. In 2006 red knot weight gain was erratic and generally less than average of the last ten (Figure 1) but by the end of the season weight gain was adequate for their migration. For the entire period of the catch, mean catch weights from 1997 through 2002 were generally at or above the mean for the entire period (1997 - 2006) while mean catch weights for 2003 to 2006 were generally below the mean for the period.

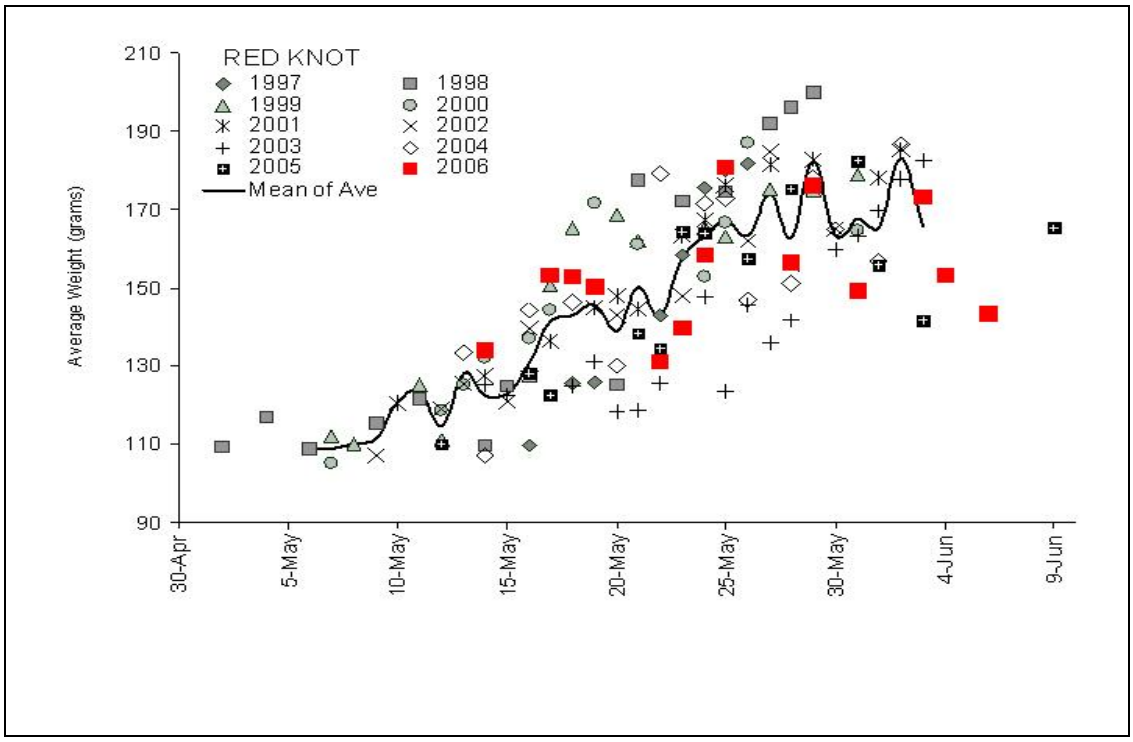


Figure 1. Mean weight of red knot catches on Delaware Bay during spring migration 1997 to 2006.

- Using these data and the survey of knots referenced above, we calculated an index of the number of knots reaching threshold departure weights from 1997 to 2006 (Figure 2). Overall the number has dropped dramatically falling from a high of over 33,000 birds in 1999 to a low of less than a thousand in 2003. The number marginally increased to 5,378 in 2006.

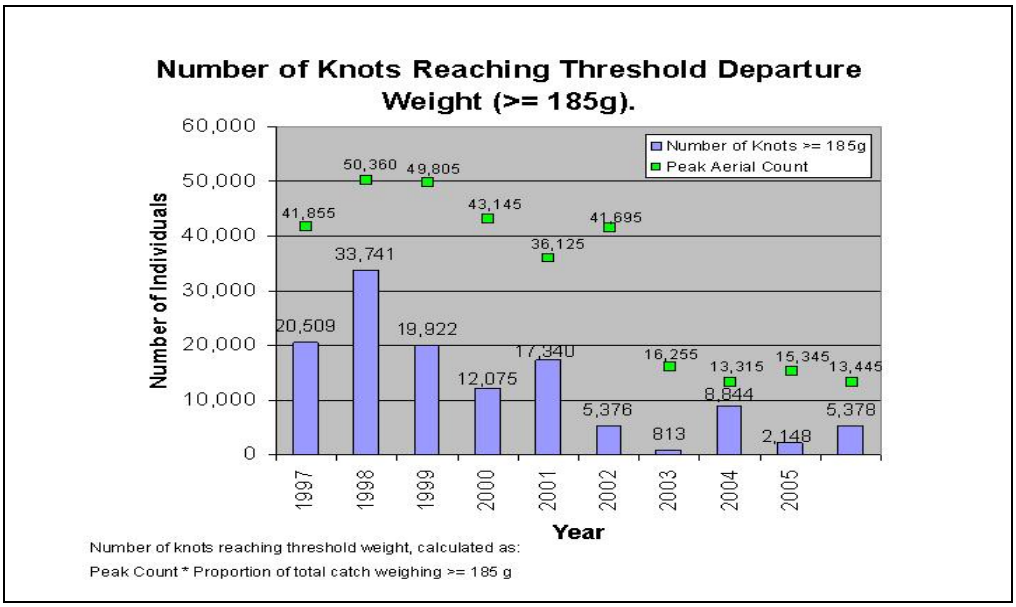


Figure 2. Number of red knot migrants reaching threshold departure weight (≥ 185 g) on the Delaware Bay stopover.

- Weekly surveys on the Delaware Bay continue to reflect a decline in the baywide population, now lower than at any other time of the survey (Figure 3). Numbers of other species, including ruddy turnstone, decreased sharply this year.

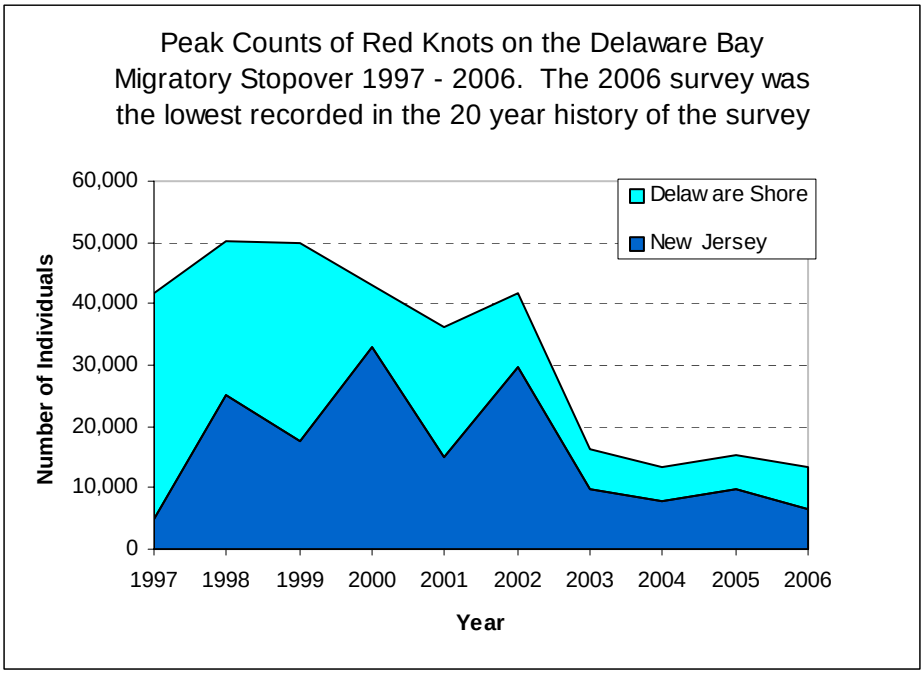


Figure 3. Peak Counts of Red Knots on the Delaware Bay Migratory Stopover 1997 - 2006. The 2006 survey was the lowest recorded in the 20 year history of the survey

- Weekly ground counts were conducted during spring and fall migration for shorebirds on the Atlantic coast and impoundments. See *JOB 2A: Techniques for Bird Population Monitoring (Citizen Scientists)* of this report.

- Instead of ground counts to validate the weekly aerial surveys on Delaware Bay (NJ & DE), ENSP engaged state biologists from VA, NC and GA to conduct aerial counts along the Atlantic coast. This coast-wide count coincided with the weekly count on Delaware Bay during the peak of spring shorebird migration. We asked each state to fly a survey on May 23, 2006, to derive a "snapshot" of red knot distribution on Atlantic coast stopovers, an estimate of the knot migrant population size, and assist ENSP to determine if knots are bypassing Delaware Bay. The number of red knots counted along the east coast on May 23 (Table 1) indicates most red knots are coming to Delaware Bay and are being detected in the Delaware Bay aerial survey. An additional count on May 30 in Delaware Bay and Virginia adds certainty that a large proportion of knots are migrating to Delaware Bay, although telemetry on radio-tagged knots from VA indicate some proportion of birds did bypass the Delaware Bay in 2006. In 2007, we will attempt to engage all east-coast states to fly surveys both during peak migration and peak of Delaware Bay counts to derive more accurate snapshot of knot movements.

Table 1. Aerial counts of red knots, Atlantic Coast, May 23 (Peak Migration) and May 30 (Peak Delaware Bay) 2006.

			Aerial Survey Summaries
23-May	2006	5,783	Virginia Total
23-May	2006	235	North Carolina Total
23-May	2006	8,680	Delaware Bay Total
24-May	2006	796	Georgia Total
		15,494	
30-May	2006	2,201	Virginia Total
30-May	2006	13,445	Delaware Bay Total
		15,646	

- The viability of Delaware Bay remains impaired because low density of horseshoe crab eggs. The number of horseshoe crabs remains at record lows and has yet to show signs of improvement (Smith et al. 2005 ASMFC 2006). The result is an inadequate availability of eggs on Delaware Bay necessary to allow birds to refuel and go on to breed in the Arctic. Surveys of horseshoe crab eggs conducted over the last six years show no signs of improvement (D. Hernandez pers. comm. 2006) (Figure 4).

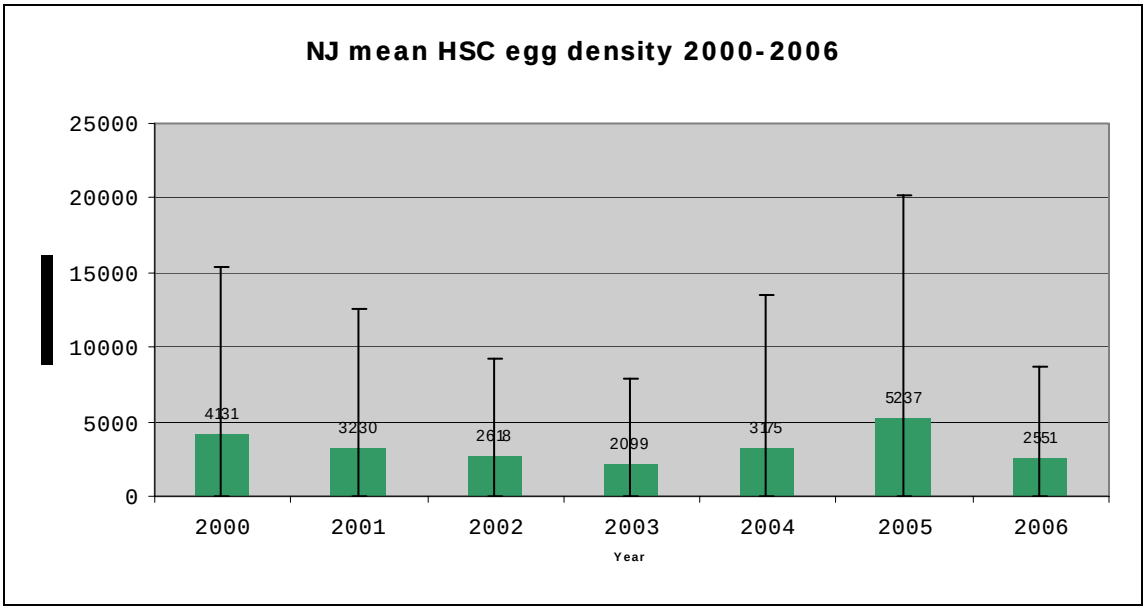


Figure 4. Mean density of eggs/m^2 counted on NJ side of the Delaware Bay 2000 to 2006.

- All current data substantiates the prediction that the red knot will be extinct within 5 years. Overall the picture is gloomy.
  - Baker et al. (2004) estimated the extinction probability of the red knot based on survival rates and weight gain from Delaware Bay that predicted extinction of the red knot by about 2010.
  - Using actual counts conducted in Tierra del Fuego including 2006, the model predicting extinction by 2010 remains accurate (Figure 5).

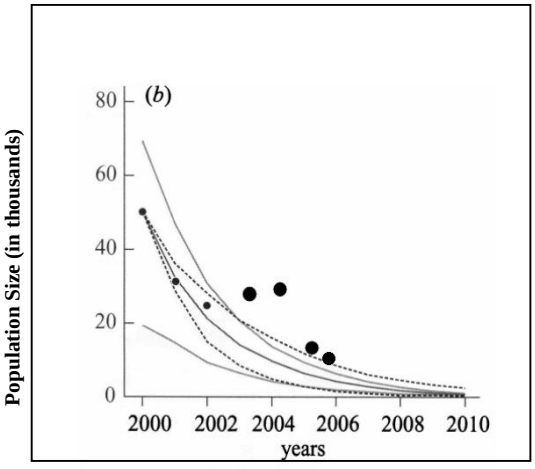


Figure 5. The projected population of red knot (2000 to 2010) based on survival rate determined by resightings of marked birds. The model predicts extinction by 2010 because of decline in adult survival. Large dots represent surveys of red knots from South American wintering sites in Tierra del Fuego. The 2006 survey fell within the model prediction.

- 2006 was the third year ENSP marked red knots with individually-engraved flags. Preliminary update of survival estimates can be made with three years of data and strengthened with an additional resighting effort in coming years. Updated survival estimates should be available in early 2007. 2006 marks year two of marking ruddy turnstones and sanderlings with individually-engraved flags. Preliminary estimates of adult survival will be forthcoming for turnstones and sanderlings in late 2007.
- Gull exclosures were erected to reduce horseshoe crab egg depletion by laughing gulls and increase foraging opportunities for shorebirds on prime horseshoe crab spawning areas on Reed's Beach and Kimble's Beach. We observed four important results:
  - Gull exclosures are successful in preventing depletion of horseshoe crab eggs by laughing gulls.

- Most shorebirds were also deterred from feeding inside the exclosed area except semipalmated sandpipers.
- The buildup of crab eggs within the exclosure, and the subsequent outwash of those eggs, created productive foraging for red knots at the edges of the exclosures, and knots were able to maintain occupancy of those areas. In the past, gulls would blanket a productive foraging area and completely exclude shorebirds.
- In 2006, fewer laughing gulls were feeding on Delaware Bay beaches at any given time than in 2005. This occurred because gull nesting was successful in 2006, therefore half of adult laughing gulls were incubating eggs on Atlantic Coast marshes while the other half were feeding on bayshore beaches. This reduced the number of gulls feeding on the Delaware Bay at any given time. In 2005, all gull nesting was destroyed by high tides and the entire laughing gull population was feeding on Delaware Bay beaches during peak shorebird migration.

- The NJ Division of Fish and Wildlife (DFW) and the Conserve Wildlife Foundation (CWF) biologists have initiated several innovative management programs to improve conditions for knots and crabs.
  - This year, all important beaches on the Delaware Bay were closed to human use to prevent the disturbance of feeding shorebirds.
  - Protection was expanded to include two Atlantic coast areas important for roosting and foraging -- Stone Harbor Point/Hereford Inlet and Malibu Beach Wildlife Management Area (a.k.a., Longport sod banks).
  - Volunteer stewards explained the reasons for closure to the public and conservation officers were available to help stewards deal with people contrary to the message.

Conclusions:

- The red knot population remains low and may still be in decline. Current numbers are consistent with the model predicting extinction in 2010.
- Horseshoe crab egg densities remain at near record lows as do horseshoe crab numbers despite significant harvest reductions.
- Other shorebirds, including the ruddy turnstone and semipalmated sandpiper, appear to be following declining trends similar to red knot.
- Weight gain by all species appeared adequate because of the low number of shorebirds relative to available resources.
- Modeling egg densities sufficient for the entire shorebird population remains difficult because of inadequate egg sampling.
- Simultaneous surveys in the Delaware Bay and Atlantic from NJ to GA suggest previous population estimates of the red knot are accurate.

Recommendations:

- ENSP and research partners must continue to monitor the condition of migrating red knots on Delaware Bay including measuring abundance via aerial surveys, surveillance of weight-gains, survival, horseshoe crab egg densities, and baywide shorebird movements relative to foraging/roosting resources.
- NJ moratorium must be extended to DE and MD to immediately increase crab egg densities to a level that will halt the decline of red knots and other migratory shorebird populations.
- Control of the impact of recreational use via beach closures and outreach programs is necessary to improve shorebird use, and should be expanded.
- Habitat improvement is necessary to accelerate recovery of crabs and bird populations, particularly in reclaimed beaches like Moore's Beach and Thompson’s beach and degraded beaches like Reeds and Fortescue. This work should be incorporated into Atlantic Coast beach replenishment projects or dredging projects on the Delaware Bay.
- ENSP must continue the development of a model to assist managers in predicting the optimal population of horseshoe crabs for the existing and future populations of all shorebird species. A powerful model will require at a minimum the existing survey effort on both crabs and shorebirds.

JOB 1G: Shorebirds - Conservation of Red Knot Breeding Areas, Nunavut Territory, Canada

OBJECTIVE: Monitor nesting density of red knots (*Calidrus canutus rufa*) and American golden plover (a non-Delaware Bay migratory shorebird) on Arctic breeding grounds to assess the relative impacts of predator pressure in the Arctic and impacts related to the decline of the Delaware Bay stopover.

Key Findings:

- The resighting of color marked birds on Delaware Bay suggests the South American wintering population of red knots move through the Delaware Bay while Southern US winterers migrate up the Atlantic coast bypassing the bay. In 2006, ENSP and partners from Virginia Polytechnic Institute and Stockton College searched for birds in the Arctic in an attempt to determine if the two wintering groups occur in separate Arctic breeding areas. Preliminarily it appears South American and SE US winterers breed in separate areas.
  - 65 red knots on the Atlantic Coast of VA and NJ and ten on the Delaware Bay of NJ were outfitted with radio transmitters to 1) assist habitat and movement research on Atlantic Coast and Delaware Bay and 2) to assess breeding regions for different wintering populations.
  - Breeding areas were searched from King William Island to Southampton Island, previously surveyed in 2000 and 2003, and found 0 of 65 birds (0%) instrumented with transmitters on Atlantic Coast of NJ and VA and two of ten (20%) birds instrumented on the Delaware Bay (Figure 6). The latter recovery rate was consisted with the previous surveys of birds instrumented on the bay

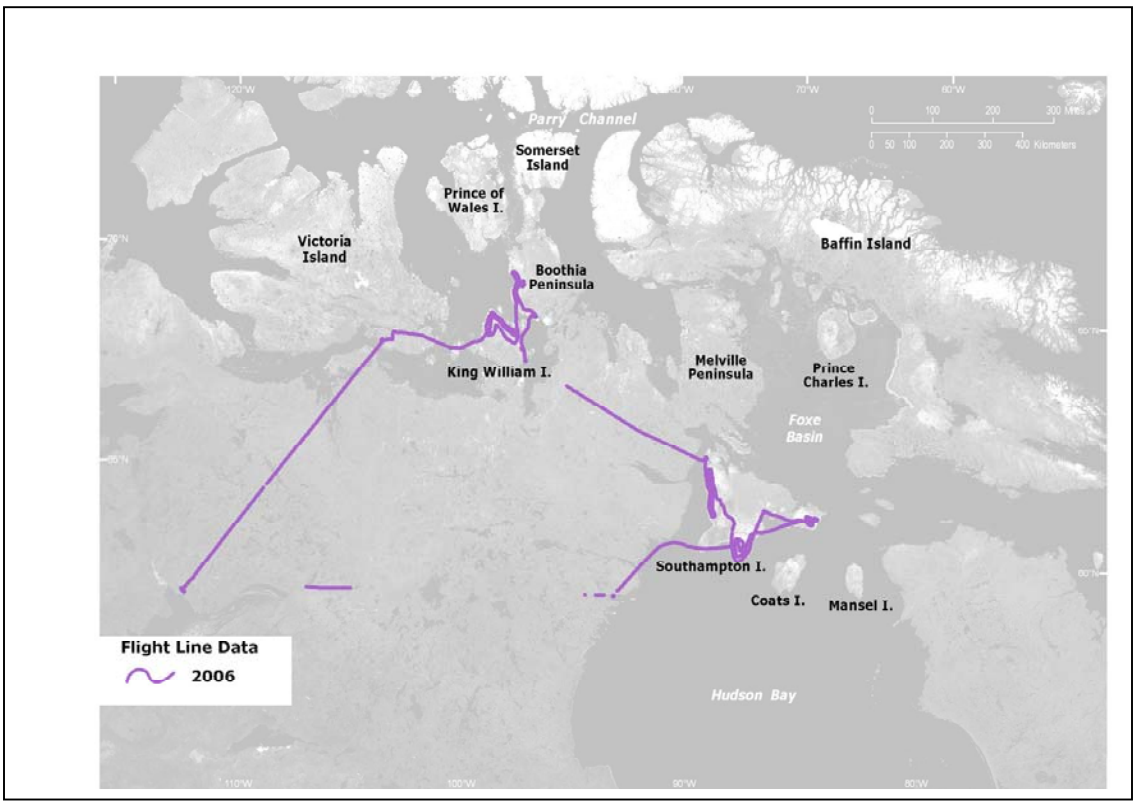


Figure 6. The flight path of the 2006 aerial search for instrumented red knots. The search began in King William Island and moved to Southampton Island, the two known breeding areas for birds using the Delaware Bay.

Conclusions:

- Our survey indicates that discrete wintering populations are breeding in separate areas of the Arctic. This increases the degree of threat to an already rapidly-dwindling population -- the effective size of discrete breeding populations will be much smaller and more vulnerable to genetic drift and inbreeding characteristic of small populations of animals, and random shifts in productivity and survival characteristic of arctic breeding shorebirds; (See *JOB 1H: Shorebirds- Conservation of Red Knot Wintering Areas, Tierra del Fuego, Chile and Argentina* for further details).

Recommendations:

- An intensive effort to locate the breeding area of red knots wintering in the SE US will be necessary to understand the threat to the entire population. It will be necessary to instrument birds on the Delaware Bay and the Atlantic Coast and search a wider area in the Arctic.
- The ground survey of red knots should be reestablished. The study provides useful data on a number of Arctic Breeders particularly the Golden Plover which provides a useful comparison to the knot. Feather samples for isotope and genetic analyses to determine wintering areas (isotopes) and potentially differentiate C.c. *rufa* and *C. c. roselaari* subspecies (genetics).
- Collaborate with US and Canadian biologists to initiate study on red knots in the Copper River Delta, AK, and in western Canada where the *roselaari* subspecies is believed to breed.

JOB 1H: Shorebirds- Conservation of Red Knot Wintering Areas, Tierra del Fuego, Chile and Argentina

OBJECTIVE: Monitor population trend of red knots (*Calidrus canutus rufa*) and other shorebirds on wintering grounds in Tierra del Fuego, Chile, and Argentina; assist South American countries' biologists obtain WHSRN (Western Hemisphere Shorebird Reserve Network) and RAMSAR [Convention on Wetlands (RAMSAR Iran 1971)] designations for important wintering and stopover sites in South America.

Key Findings:

- The number of red knots in Tierra del Fuego continued to decline slightly this year. While the number of knots in Bahia Lomas remained stable (Figure 7), the number in Rio Grande fell by two thousand birds.

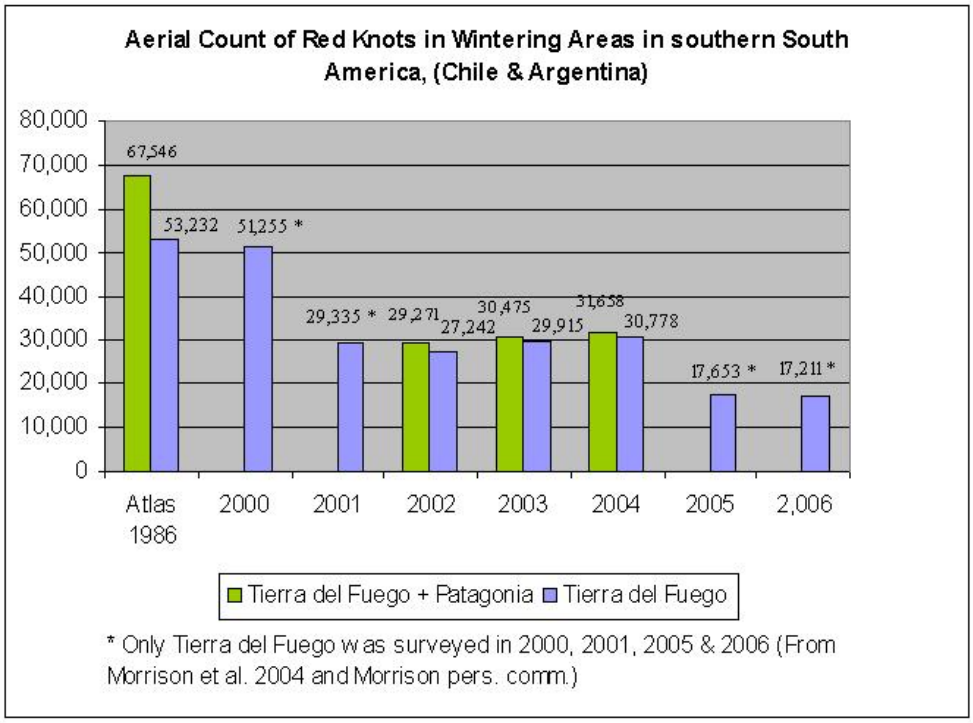


Figure 7. Number of red knots in South American wintering areas 1985-2005. The 2006 count is the lowest of the survey which started in 1986.

- The number of knots in Tierra del Fuego is consistent with the model predicting extinction by 2010 (Figure 5, above, under *Job 1F: Shorebirds - Conservation of Red Knot; Delaware Bay*).
- Bahia Lomas was proposed as a RAMSAR site by the federal government of Chile and approved last year.
- Work conducted on the three main wintering sites, including Tierra del Fuego, Brazil and Florida, suggests a total red knot population of approximately 30,000 birds, much lower than an original estimate of over 150,000 birds.
- Stable isotope analyses of feathers from knots captured on Delaware Bay and resighting of birds banded on various wintering and stopover locations suggest the impact of diminished horseshoe crab resources falls primarily on knots wintering in Tierra del Fuego.

Conclusions:

- Bahia Lomas remains the most important wintering site for red knots in the Western Hemisphere.
- The greatest threat to the Tierra del Fuego population is declining horseshoe crab egg resources on Delaware Bay
- The Chilean government is willing to increase protection on Bahia Lomas with the professional and monetary assistance from groups in the US.

Recommendations:

- The survey and banding of red knots in Tierra del Fuego must continue to determine the status of the wintering population and evaluate the status of the entire hemisphere population.
- A complete conservation assessment should be done for all wintering sites including Tierra del Fuego. The assessments should follow a method proposed by WHRSN and Conservation International designed for that purpose. A consistent approach across all sites will allow comparison and prioritization of threats and conservation action(s).

- This work and conservation assessment must be expanded to include all important wintering sites including northern Brazil, and western Florida.

JOB 1I: Piping Plover

OBJECTIVE: To improve piping plover (*Charadrius melodus*) reproductive success by creating and maintaining additional foraging opportunities (artificial ponds) for chicks in areas sheltered from human disturbance. This project meets recommendations of the USFWS Piping Plover Recovery Plan, where one goal is to "draw down or create coastal ponds to make more feeding habitat available".

Key Findings:

- When a plot was excavated in a location subject to constant wind, the plot filled in with sand over time. The plot at TRACEN retained its shape throughout the entire season, while the 2 Mile plot had to be reestablished twice. The grain size of the sand may also have played a role in this—the sand at TRACEN is coarser and larger, and may be less likely to be blown away compared to the "sugar sand" at 2 Mile.
- The original installation method chosen for the well point and well casing, a driven well, failed due to equipment malfunction. As an alternative installation method the pipes were successfully jetted in with a high velocity stream of water. They were removed at the end of the season using the same method.
- Since this was the first year that this project was attempted, the water distribution system went through many design modifications to determine the optimum model. PVC or CPVC pipe was always used as the outtake material, but the sizes of slits or holes in the pipe were positioned at different intervals until an optimal design was determined. Slits were ruled out early on (too much water loss), and drilled holes at 1/16", 3/32", 7/64" located at 6" or 8" apart were all experimented with. The best design ("best" being defined as water flowing freely through the entire length of the 32' pipe) was 1/2" CPVC pipe with 1/16" holes drilled 8" apart.
- With full sun, the system pumped 44 gallons/hour, which was predicted to be an adequate amount. This prediction was based on a similar experiment that was done by The Nature Conservancy (TNC). However, in practice this was not enough water to keep the 10' x 30' plot moist. The prediction failed because of methodology differences in the two experiments, namely that TNC experiment delivered the same amount of water to a plot over a much shorter time period than this experiment did. This larger plot was then reconfigured into a 6"x 32' linear plot intended to mimic a wrack line. This simulated wrack line stayed moist, although the original design is still the preferred model.
- Plots were treated with two factors (wrack and fish emulsifier), each at two levels (present or absent). Invertebrate measurements were taken using the established method of coating paint stirrers with Tanglefoot© and placing them vertically and horizontally in the plots for 30 minute intervals.
    - Wrack vs. no wrack made a difference in the amount of moisture retained (determined through a visual inspection of the area and by probing into the sand to observe the depth of moist substrate). *Having no quantifiable way* to measure the moisture was not an issue since the plots with no wrack (n=2) did not retain any water, while the plots with wrack did (n=2), so the difference became one of presence or absence.
    - Fish emulsifier attracted a larger number of invertebrates where it was applied to plots (n=2) than where it was not applied (n=2).
    - Fish emulsifier when coupled with wrack (n=1) attracted the largest number of invertebrates than plots with no fertilizer (n=2) or with fish fertilizer and no wrack (n=1).
    - All invertebrates were small (0-1 cm) and many were winged insects.
- No plovers used the artificial foraging areas, but this was expected because the plots were not located in areas that plovers nested. The exception was at the end of the season on 2 Mile Beach when the plover brood that hatched about a half mile away moved towards the foraging station. However, since

the birds were on a beach where there was no human disturbance they foraged at the shoreline and did not need an alternative area to escape human pressure.

Conclusions:
- Although TRACEN and 2-Mile did not have any piping plovers to use the foraging stations, they were excellent site choices since the lack of human presence prevented the systems being subjected to human disturbance.
- The well casing and well point do not need to be constructed of metal. Since the "jetting" method is the way future wells will be installed, PVC pipe can be used in its stead. PVC pipe is less expensive and more resistant to the rigors of the coastal environment.
- The pump was undersized for the amount of water needed to fulfill the requirements of the original plot specifications (10'x30') of the project.
- The solar power configuration was a great success. It had a straightforward operation, and the panel worked well during the season, even through tropical depressions at the end of the season that sent heavy rain and wind through the areas.
- Wrack was determined to be imperative to keeping the plots moist. Fish emulsifier was necessary to increase the number of invertebrates. The combination of wrack with fish emulsifier was the best treatment to maximize the number of invertebrates.

Recommendations:
- Expand the number of sites that artificial foraging areas are created at, including areas where many pairs of piping plovers are present.
- Avoid placing foraging stations in areas that are susceptible to high, constant winds.
- Transition from using metal for the well casing and well point to PVC pipe.
- Increase the diameter of the well and intake pipe and the size of the pump to allow for a larger amount of water to be available for distribution.
- Refine invertebrate surveys around the foraging stations to ensure the best method for collecting invertebrates in the area is utilized. Strive to categorize the species in the area down to the smallest taxon possible.

JOB 1J: Raptors

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: Develop a long-term monitoring and habitat conservation strategy that includes management for American kestrel on state and private lands (preserved farmland, Landowner Incentive Program). Initially this strategy will include an experimental nest box program to determine if nest cavities are limiting the NJ population, and closer monitoring to identify causes of recent declines.

Job 1J, Part 1: Woodland Raptors
Key Findings:
- ENSP worked with the Morris County Park Commission to protect a new red-shouldered hawk nest on their property. The nest failed, suspected great-horned owl predation/ harassment.
- The NJ DEP's 2002 Land Use/ Land Cover data is not complete. It is scheduled for completion December 2006, therefore analysis reviewing raptor presence and associated habitat types of the 1988-89 and 2001-02 data using the most recent land use coverage could not be conducted. In addition, surveys conducted in 2006 will not be analyzed in comparison between raptor presence and

habitat as no current available land use coverage is available. Presence/ absence data collected in 2006 will continue to provide information regarding the raptor populations' trends regardless of land cover.

- Surveyors discovered at four survey stations along three routes, diurnal raptors (two Cooper's hawks and two red-shouldered hawks) responded more readily to conspecific calls rather than the competitor call (great horned owl) as dictated by the survey protocol. It is noteworthy to identify that the red-shouldered hawks were observed along a known successful route. Had the surveyor not tested the conspecific call, the birds would not have been observed.
- Incidental sightings include broad-winged hawks and sharp-shinned hawks, both state species of special concern and regional priority. Broad-winged hawks were observed at three stations along two routes in southern New Jersey (two of the stations were consecutive, it is possible it was the same bird). In northern New Jersey, broad-wings were located at four stations along three routes and sharp-shins were located at two stations along two routes. Surveyors were instructed to cease diurnal raptor surveys at stations where broad-winged and sharp-shinned hawks were located to minimize disturbance to potential nesting pairs.
- Survey methodologies of other states were not evaluated; instead the focus was directed to repeating previous points and transects from the earlier surveys to document population trend. Surveys for barred owls and red-shouldered hawks were conducted from March 1 to May 31 due to their early nesting period; Cooper's hawks and northern goshawk surveys were conducted from March 15 to June 15.
    - *Southern New Jersey*
        - In total, woodland raptors were located at 59% (88 stations) of the 150 stations surveyed during the 2006 survey.
            - 112 barred owls were observed at 48% (72 of 150) of the stations surveyed.
            - 19 Cooper's hawks were observed at 11% (17 of 150) of the stations surveyed.
            - 4 red-shouldered hawks were observed at 2.7% (4 of 150) of the stations surveyed.
            - No northern goshawks were observed in southern New Jersey at the surveyed stations.
            - Six stations had both barred owls and Cooper's hawks, two stations had both barred owls and red-shouldered hawks.
        - Comparatively, reviewing only those stations that were repeated (not altered, added, or deleted) in 2002 and 2006: The 2002 woodland raptors' surveys yielded a 39% response rate/presence (raptors observed at 37 of 95 stations surveyed). Surveys at these same stations in 2006 yielded a 56% response rate (raptors observed at 53 of 95 stations surveyed). In 2002, two stations had both barred owls and Cooper's hawks, one station had both barred owls and red-shouldered hawks. In 2006, six stations had both barred owls and Cooper's hawks and one station had both barred owls and red-shouldered hawks. The stations in 2002 and 2006 that had both owls and red-shouldered hawks are less the ½ mile apart.
            - Barred owls
                - In 2002, 41 barred owls were observed at 35% (33 of 95) of the stations surveyed.
                - In 2006, 68 barred owls were observed at 46% (44 of 95) of the stations surveyed.
            - Cooper's hawks
                - In 2002, 7 Cooper's hawks were observed at 6.4% (6 of 93) of the stations surveyed.
                - In 2006, 16 Cooper's hawks were observed at 15% (14 of 93) of the stations surveyed.
            - Red-shouldered hawks
                - In 2002, 1 red-shouldered hawk was observed at 1% (1 of 93) of the stations surveyed.
                - In 2006, 2 red-shouldered hawks were observed at 2% (2 of 93) of the stations surveyed.
            - This comparison indicates an increase in woodland raptors' response rates between the 2002 and 2006 surveys at these survey stations.

- One route (S-9) was eliminated in 2006 due to excessive development and habitat loss. Prior findings include:
  - Barred owl surveys conducted in 1988-89 yielded a 20% presence/response rate along this route (2 owls at 2 of 10 stations surveyed).
  - Barred owl surveys conducted in 2001 yielded a 62.5% presence/response rate along this route (5 owls at 5 of 8 stations surveyed).
  - Diurnal raptor surveys conducted in 2001 yielded a 25% presence/response rate along this route (2 Cooper's hawks at 2 of 8 stations surveyed).
- Along five routes surveyed in 1988-89 and 2001 for barred owls (S-1, S-4, S-6, S-7, S-S), surveys conducted in 2006 yielded a 49% presence (37 owls at 24 of 49 stations surveyed). Diurnal raptor surveys were conducted on these five routes in 2001, 2006 surveys yielded an 8% presence (1 red-shouldered hawk at 1 station and 3 Cooper's hawks at 3 stations of 49 stations surveyed, with no overlap of species).
  - Barred owl surveys conducted in 1988-89 along these mutual routes, yielded a 61% presence (30 owls at 30 of 49 stations surveyed).
  - Barred owl surveys conducted in 2001 along these mutual routes, yielded a 38% presence (22 owls at 22 of 58 stations surveyed).
  - Diurnal raptor surveys conducted in 2001along these mutual routes, yielded a 2% presence (1 Cooper's hawk at 1 site of 50 stations surveyed).
  - These surveys indicate an increase in barred owl response rate between the 2001 and 2006 surveys along these routes, after a significant decline was indicated between the 1988-89 and the 2001 surveys. The diurnal raptor response rate has increased. One of the five original routes was altered prior to the 2001 surveys and a second prior to the 2006 survey (by changing $\geq$1 survey station on each) due to development and habitat alteration.
- Along five routes surveyed in 1987 and 2002 for barred owls (S-10, S-11, S-12, S-13, S-15), surveys conducted in 2006 yielded a 51% presence (43 owls at 27 of 53 stations surveyed).
  - Barred owl surveys conducted in 1987 along these mutual routes, yielded a 12% presence/response rate (5 owls at 6 of 50 stations surveyed, one owl traveled to next station).
  - Barred owl surveys conducted in 2002 along these mutual routes, yielded a 36% presence (23 owls at 19 of 53 stations surveyed).
  - These surveys indicate an increasing barred owl response rate between the 1987 and 2006 along these routes. Four of the five original routes were altered prior to the 2002 survey and again, prior to the 2006 survey (by changing $\geq$1 survey station on each) due to development, habitat alteration, and inaccessible stations. The fifth route was altered prior to the 2006 survey (by changing $\geq$1 survey station on each) due to development.
- Along five route surveyed in 2002 for barred owls (S-2, S-3, S-5, S-8, S-14), surveys conducted in 2006 yielded a 44% presence (32 owls at 21 of 48 stations surveyed).
  - Surveys conducted in 2002 along this route, yielded a 30% presence (19 owls at 15 of 50 stations surveyed).
  - This survey indicates an increase in barred owl response rate between the 2002 and 2006 along this route. However, four of the five survey stations were altered prior to the 2006 survey (by changing $\geq$1 survey station on each) due to development, habitat alteration, and inaccessible stations.
- Along ten routes surveyed for diurnal raptors in 2002 (S-2, S-3, S-5, S-7, S-10, S-11, S-12, S-13, S-14, S-15), 2006 surveys yielded a 17% presence (3 red-shouldered hawks at 3 stations and 16 Cooper's hawks at 14 stations of 101stations surveyed, with no overlap of species).
  - Diurnal raptor surveys conducted in 2002 along these mutual routes, yielded a 7% presence (1 red-shouldered hawk at 1 site and 7 Cooper's hawks at 6 sites of 101 stations surveyed, with no overlap of species present).
  - These surveys indicate an increase in diurnal raptor response rate between the 2002 and 2006 surveys along these routes. However, five of the ten routes were altered prior to the

2006 survey (by changing ≥1 survey station on each) due to development, habitat alteration, or inaccessible areas.

- *Northern New Jersey*
  - In total, woodland raptors were located at 49% (132 stations) of the 268 stations surveyed during the 2006 survey.
    - 159-160 barred owls were observed at 40% (108 of 267) of the stations surveyed.
    - 40 Cooper's hawks were observed at 14% (37 of 268) of the stations surveyed.
    - 26-28 red-shouldered hawks were observed at 8% (22 of 268) of the stations surveyed.
    - 1 northern goshawk was observed at 0.3% (1 of 268) of the stations surveyed.
    - Twenty-three stations had both barred owls and Cooper's hawks, 17 stations had both barred owls and red-shouldered hawks.
  - Comparatively, reviewing only those stations that were repeated (not altered or shifted more than 200m, added, or deleted) in 2001-2002 and 2006: The 2001-2002 woodland raptors' surveys yielded a 41% response rate/presence (raptors observed at 105 of 257 stations surveyed). Surveys at these same stations in 2006 yielded a 48% response rate (raptors observed at 124 of 257 stations surveyed). In 2002, seven stations had both barred owls and Cooper's hawks, seventeen stations had both barred owls and red-shouldered hawks. In 2006, twenty-two stations had both barred owls and Cooper's hawks, sixteen stations had both barred owls and red-shouldered hawks, and one station had both Cooper's hawks and red-shouldered hawks.
    - Barred owls
      - In 2001-2002, 132-135 barred owls were observed at 32% (82 of 257) of the stations surveyed.
      - In 2006, 154 barred owls were observed at 41% (105 of 257) of the stations surveyed.
    - Cooper's hawks
      - In 2001-2002, 23 Cooper's hawks were observed at 9.6% (23 of 240) of the stations surveyed.
      - In 2006, 37 Cooper's hawks were observed at 14% (34 of 240) of the stations surveyed.
    - Red-shouldered hawks
      - In 2001-2002, 29 red-shouldered hawk was observed at 9.6% (23 of 240) of the stations surveyed.
      - In 2006, 25-27 red-shouldered hawks were observed at 8% (21 of 240) of the stations surveyed.
    - Northern goshawks
      - In 2001-2002, 1 northern goshawk was observed at .4% (1 of 240) of the stations surveyed.
      - In 2006, 1 northern goshawk was observed at .4% (1 of 240) of the stations surveyed.
      - The 2001-2002 and 2006 observations were at different locations.
    - This comparison indicates a slight increase in woodland raptors' response rates due to the increase in barred owls and Cooper's hawks between the 2001-2002 and 2006 surveys at these survey stations. Red-shouldered hawks declined slightly.
  - Along seventeen routes surveyed in 1986 and 2001-2002 for barred owls (N-1, N-2, N-3, N-5, N-6, N-7, N-11, N-12, N-13, N-14, N-16, N-19, N-20, N-21, N-22, N-23, N-39), surveys conducted in 2006 yielded a 37% presence (62-63 owls at 68 of 184 stations surveyed).
    - Surveys conducted in 1986 along these mutual routes, yielded a 30.5% presence (23 owls at 18 of 59 stations surveyed).
    - Surveys conducted in 2001-2002 along these mutual routes, yielded a 29.5% presence (90-91 owls at 57 of 193 stations surveyed).
    - These surveys indicate an increase in barred owl response rate between the 1986 and 2006 surveys along these routes, after a slight decline was indicated during the 2001-02 surveys. However, all 17 original routes were altered, both prior to the 2001-02 survey and again,

prior to the 2006 survey (by changing ≥1 survey station on each) due to development and habitat alteration.

- Along ten routes surveyed in 1988-89 and 2001-2002 for diurnal raptors (N-1, N-2, N-6, N-9, N-12, N-15, N-17, N-18, N-22, N-23), surveys conducted in 2006 yielded a 20% presence (8 red-shouldered hawks at 7 stations and 15 Cooper's hawks at 15 stations of 109 stations surveyed, with no overlap of species).
  - Surveys conducted in 1988-89 along these mutual routes, yielded a 6% presence (2 red-shouldered hawks at 2 sites and 3 Cooper's hawks at 3 sites of 80 stations surveyed, with no overlap of species present).
  - Surveys conducted in 2001-2002 along these mutual routes, yielded a 16% presence (8 red-shouldered hawks at 7 sites, 11 Cooper's hawks at 11 sites, and 1 northern goshawk at 1 site of 115 sites surveyed, with no overlap of species present).
  - These surveys indicate an increase in diurnal raptor response rate between the 1988 and 2006 surveys along these routes. However, all ten original routes were altered prior to the 2001-02 survey and three routes were altered prior to the 2006 survey (by changing ≥1 survey station on each) due to development and habitat alteration.
- Along 8 routes surveyed in 2001-2002 for barred owls (N-4, N-8, N-9, N-10, N-15, N-17, N-18, N-40), 2006 surveys yielded a 48% presence (50-52 owls at 39 of 81 stations surveyed). Along four routes surveyed in 2001-02 for diurnal raptors, 2006 surveys yielded a 26% presence (7-9 red-shouldered hawks at 7sites and 7 Cooper's hawks at 7 sites of 53 stations surveyed, with one site having 1 Cooper's hawk and 1-2 red-shouldered hawk(s)).
  - Surveys conducted in 2001-2002 along these mutual routes, yielded a 35% barred owl presence (53 owls at 31 of 88 stations surveyed) and a 27% diurnal raptor presence (13 red-shouldered hawks at 9 sites and 7 Cooper's hawks at 7 sites of 53 stations surveyed, with no overlap of species present).
  - These surveys indicate an increase in barred owl response rate between the 2001-02 and 2006 surveys along these routes, and a slight decline in diurnal raptor response rate. However, four of eight barred owl routes surveyed in 2001-02 and three of the four diurnal raptor routes surveyed in 2001-02 were altered prior to the 2006 survey (by changing ≥1 survey station on each) due to development and habitat alteration.
- In 2004, ENSP reported that we had established 14 new routes (N-3, N-4, N-5, N-7, N-8, N-10, N-11. N-13, N-14, N-16. N-19, N-20, N-21, N-39, N-40) and surveyed them in 2001-2002 to develop baseline data for woodland raptors (2004 SWG report). This statement was incorrect. Ten of these routes (all but N-4, N-8, N-10, N-40) had been surveyed for barred owls in 1986.

Conclusions:

- Alterations to survey routes (including number of survey stations) prior to each survey period may provide inaccurate conclusions (e.g. response rate) overall.
- Increases in raptor response were found in nearly all areas between the 2001-02 and the 2006 surveys, after 2001-02 surveys had indicated a number of decreasing populations since the late 1980's surveys. This fluctuation may be due to surveyors altering the survey routes to target suitable habitat.
- Diurnal raptor surveys conducted using ENSP's accepted woodland raptor survey protocol may not successfully elicit a response from the target species.

Recommendations:

- Analysis of raptor presence compared to available suitable habitat must be conducted using the NJDEP's 2002 Land Use/ Land Cover, once available, to evaluate population trends as they pertain to habitat and land use on a survey station by survey station basis rather than per route.
  - Analysis of trends in population and habitat alteration will only be conducted with the 1980's to early 2000 data as 2006 Land Use/Land Cover data will not be available. Data from 2006 will be reviewed solely with reference to changing populations.
- The woodland raptor survey protocol as it pertains to diurnal raptors must be tested to determine the success rate of the survey method to elicit a response from the target species.
  - Once the survey protocol is tested and proved or revised, the ENSP should conduct extensive suitable habitat surveys for diurnal raptors (Cooper's hawk, red-shoulder, and northern goshawk).
- Investigate telemetry as a means of measuring home range of select raptors (especially barred owl) in the different forest types of southern and northern NJ.

Job 1J, Part 2: American Kestrel

Key findings:

- Suitable sites for American kestrels were identified by using a GIS predictive model based on land use/land cover data and kestrel nest box data from Dr. Smallwood of Montclair State University. Areas of contiguous kestrel habitat were divided into four patch sizes: 0-50 hectares, 50-250 hectares, 250-1000 hectares, and >1000 hectares.
- A total of 133 nest boxes were placed in suitable habitat as identified by the GIS predictive model. Boxes were concentrated in two major study areas (identified as Clinton and Amwell Valley), with a small number of boxes in a third study area (Assunpink) and a few placed outside of the study areas. Summary of kestrel habitat and nest boxes installed within each of the four patch sizes:

Patch Size	# Patches	Total Ha of Kestrel Habitat	# Boxes
0-50 hectares	5595	24,497 ha	17
50-250 hectares	234	24,682 ha	25
250-1000 hectares	47	22,113 ha	46
>1000 hectares	13	38,853 ha	45

- Each nest box was monitored once every 21 days from April through August. Out of 133 nest boxes, 18 were occupied by American kestrels. Three boxes were predated, resulting in failed nesting by kestrels.
- A total of 27 young (10 female, 8 male, 9 unknown sex) and 2 adult females were banded at 7 nest boxes.

Conclusions:

- Contacting individual landowners for permission, and locating suitable nest box sites on trees and available building structures, is time consuming and inefficient. Obtaining permission from utility companies to use utility poles would greatly reduce the time required.
- In order to test the GIS habitat model effectively, we need to expand the number of nest boxes in each of the patch sizes to better populate the model area.

Recommendations:

- Continue to hang up nest boxes in suitable kestrel habitat. Target nest box placement to achieve approximately 33 boxes in each of the three largest patch sizes within four study areas statewide, for a total of approximately 400 boxes.
- Continue to target areas that are not in jeopardy of development pressure.
- Recruit and train a group of dedicated Citizen Scientist volunteers to monitor nest box activity throughout the breeding season.
- Establish partnership with New Jersey utility companies to install nest boxes on poles in suitable kestrel habitat. Focus nest box placement on public lands, open space, and preserved farmlands to minimize interactions with private landowners.
- Expand the current GIS habitat patch model to incorporate 2002 Land Use Land Cover data.

JOB 1K: Coastal Marsh Birds

OBJECTIVE 1: To develop a long-term monitoring and habitat management/conservation strategy to benefit endangered marsh nesting bird populations: northern harrier (*Circus cyaneus*), sedge wren (*Cistothorus platensis*), and black rail (*Laterallus jamaicensus*).

Key Findings:

- In 2006, this survey targeted black rails in the Delaware Bay region. Eleven sites last surveyed and found occupied in 1988 were identified, mapped and revisited. Another 15 sites were identified and mapped for surveying based on accessibility to marsh habitat in between known sites. A new site was >800 m (0.5 mile) from any previously surveyed point.
- The survey method followed the marsh bird survey protocols recommended by the North American Waterbird Conservation Plan. Based on habitat types to be surveyed, ENSP biologists made call-playback compact discs with black rail and Virginia rail calls, to elicit responses from either species. Call types and timing were set by marsh bird survey protocol. Sites were surveyed after dark and in early-morning periods, and were surveyed three times from May 15 to June 30. Conspecific calls were not played again at a site after a species was detected there.
- Black rails were detected at three (27%) of the 11 sites previously occupied. Virginia rails were detected at six of the 11 sites, co-occurring with black rail at one site.
- Black rails were detected at one of the 15 new survey sites. Virginia rails were detected at five of the 15 sites.
- Incidental to surveys, least bitterns (NJ special concern) were detected at two of the historic sites, in both cases co-occurring with Virginia rails.
- Habitat was generally assessed at survey sites. Black rails were found at sites dominated by *Spartina patens*, indicative of higher marsh than many areas dominated by *S. alterniflora*.
- An analysis of the condition and quantity of suitable high marsh habitat remains to be done. This task may be impossible due to the difficulty in distinguishing marsh types by remote sensing using aerial photography.

Conclusions:

- Sites occupied by black rails in the late 1980s were largely abandoned by 2006. In that time period 6,000 acres of Delaware Bay habitat were changed relatively quickly by a 1990s effort designed to restore diked high marsh (dominated by *Spartina patens*) to create low marsh (*S. alterniflora*) for the benefit of fish reproduction. This was a major habitat change for the Delaware Bay black rail population, and is likely the major cause of the drop from 11 known sites in the 1980s to four this year.
- A high proportion of Delaware Bay and Atlantic marshland is in conservation ownership (state, conservation organizations, and conservation-deeded), but two of the four black rail locations were

located on private land. One site is an active salt hay farm, which supports good black rail habitat and farming practice that generally does not pose the threat of nest destruction during the nesting season.

Recommendations:

- Gather data on the location, quantity and ownership of high marsh habitats suitable for black rails. Conduct surveys over two to three seasons to determine density and nest success at sites dominated by high marsh (*S. patens*) compared to sites where *S. patens* becomes more patchy.
- Survey for Northern harrier, sedge wren and barn owl (*Tyto alba*) to identify areas and habitats of co-occurrence with black rail. These areas should be recognized as important habitat communities that support multiple listed and special concern species. Investigate and seek partnerships with local watershed and Audubon groups to initiate a breeding season survey for all four species that can be carried out long term.
- Identify and recommend to managers appropriate marsh management for high marsh habitats where black rail populations (and similar community member-species) occur. Do this using the Landscape Project mapping and the NJ Wildlife Action Plan.

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 2A: Techniques for Bird Population Monitoring (Citizen Scientists)

OBJECTIVE: Continuing in 2006, design and experimentally implement techniques for long term monitoring of populations at regional levels in NJ. These techniques should be efficient in terms of cost and time, and should provide measurable results for detection of trends. Continue to survey previous locations to monitor populations (Pinelands) using previous methods until survey techniques are decided upon.

Migrant shorebird survey along New Jersey's Atlantic and Delaware Bay coasts

OBJECTIVE 1: Assess status and changes in shorebird populations during spring and fall migration through New Jersey.

OBJECTIVE 2: Participate and contribute to the Program for Regional and International Shorebird Monitoring (PRISM), an initiative to coordinate and expand existing shorebird survey efforts throughout North America designed to meet the monitoring goals of the U.S. and Canadian Shorebird Plans.

OBJECTIVE 3: Devise a protocol for monitoring shorebird populations using volunteer efforts in undertaking surveys.

Key findings:

- Initiated July 2004, volunteers continued surveys in mid-July to November 2005 (fall migration), May- early June 2006 (spring migration) and mid-July to November of 2006 (fall migration).
- Surveys were conducted by approximately 40 volunteers. Some of these were returning volunteers, while others were recruited through postings at New Jersey Audubon Society (NJAS) centers and website, and others became interested word of mouth. At least 12 of these volunteers have been participating in the survey since its first year.
    - Numbers are listed as approximate because of volunteer involvement of students from Haddonfield High School and of interns at Holgate. The principal shorebird counter, a science teacher from Haddonfield HS did not consistently report student participation on each date of their survey.

- Two training workshops were held, one on April 1st in conjunction with a volunteer meeting organized by ENSP for all shorebird volunteers, and one at Haddonfield High School on March 16th. A total of 12 citizen scientists from the shorebirds' survey participated in the April workshop. In addition, 15 students from Haddonfield High School and their environmental club participated in the training at their school and undertook shorebird counts during the month of May. A field outing to Forsythe took place on May 6th, 2006.
  - New participants were trained in shorebird identification, bird survey methods, and the counting protocols. Returning participants reviewed the information and shared their experiences. Volunteers received the necessary information to complete their surveys.
- Volunteers conducted surveys during the 2005 fall and 2006 spring shorebird migrations.
  - 25 volunteers and an additional 12 volunteers from the Governor's School conducted fall shorebird migration surveys three times per month, from the middle of July until the end of October, at 15 sites. These surveys were conducted at the same sites as the spring 2005 and fall 2004 surveys. Sites with very low bird numbers in 2004 were excluded from the 2005 surveys. Most of these surveyors were returning volunteers from the 2005 spring migration survey.
  - 22 volunteers conducted 2006 spring shorebird migration surveys, 1 count per week for a total of 5 weekly surveys between May 1 and June 7, 2006, at 18 sites, mostly in South New Jersey. Participants surveyed the same beach or mudflat each week, counting total number of birds seen on their site. In addition, High School students or interns accompanied some of the principal surveyors on their counts.
  - Approximately 25 volunteers have been conducting 2006 fall shorebird migration surveys three times per month, starting at about the middle of July and planning to continue until the end of October, at 15 sites. All of these surveyors were returning volunteers from the spring migration survey and no further recruiting took place for this fall survey.
  - Volunteers submitted regular reports to the Citizen Science program and maintained contact with the NJAS through e-mail, telephone, listserve and facsimile.
  - Volunteers spent at least 635 hours in this project, and traveled at least 6716 miles. This figure underestimates the contributions of volunteers, as many of them are involved in scouting beaches, advocacy and other activities that support the Delaware Bay shorebird project and shorebird conservation in general, but do not report these hours as part of the survey. Furthermore, many students, interns, and other interesting partied have participated in these surveys but do not report their hours. About 200 hours of staff time were dedicated to recruiting, training, and managing these volunteers.
- During the fall 2005 counts between September 1 and October 31st), a total of 22,841 shorebirds were counted. Of these over 10,000 birds were counted at Stone Harbor, North Brigantine, Two-mile Beach, and Malibu Beach, and over 8,000 birds were counted at Holgate.
  - Maximum numbers of birds seen during a single count were 1,000 at Stone Harbor, 1,120 at North Brigantine, 1,947 at Two-mile Beach, and 950 at Malibu Beach.
  - Maximum numbers of red knots seen during a single count were 982 at Stone Harbor. Maximum numbers of American Oystercatchers were 250 at Stone Harbor and 85 at Malibu Beach.
- During the spring 2006 counts, a total of 59,694 shorebirds were counted. Over 1,000 shorebirds were counted at Holgate, North Brigantine, Bivalve, Whale Beach (Strathmere-Sea Isle), Thompson's Beach, Gandy's Beach, Two Mile Beach, Absecon Wildlife Management Area, Stone Harbor and Avalon.
  - Maximum numbers of shorebirds seen during a single count were over 6,000 at Holgate, Stone Harbor, and Bivalve, and over 4,000 at Thompson's Beach and Absecon. Over 1,000 shorebirds were seen at North Brigantine, Gandy's Beach, Whale Beach, and Avalon Beach
  - Maximum numbers of red knots were seen at Stone Harbor Point (estimated at 6300) Holgate (679), and Absecon (650).
- Data from the fall migration 2006 survey are still being collected.
- A survey protocol was designed to collect behavioral observations of shorebirds to determine the effects of human disturbance on them. A limited number of volunteers were asked to collect data in the field to determine the accuracy and usefulness of the data.

- Preliminary data from North Brigantine reveal that 74% of the disturbances consisted of car traffic on the beach, 11% of the disturbances were people, and 15% of the disturbances were caused by other birds (gulls or a Peregrine Falcon)
- Car traffic on the beach causes the birds to fly away 43% of the time, while 57% of the time birds were not disturbed.
- Director of citizen science (NJAS) has been working with the Program for Regional and International Shorebird Monitoring (PRISM) and has been providing feedback to them on improving coordinated bird monitoring through the use of volunteers in states that have been unable to implement volunteer surveys to date. This lack of surveyors has caused inconsistency in the collection of shorebird data over the past three years.
- Citizen Science staff has spent approximately 300 hours during the year coordinating and overseeing volunteers and moderating the shorebird volunteer listserve, and 50-100 hours involved in data entry. There is currently no option for online data entry for this project.
- More than 90% of the volunteers have been submitting their datasheets on time. More than 70% of the volunteers have conducted at least 3 surveys since the program was initiated.
- Beyond their contribution to a shorebird database that can be used to monitor long term trends in shorebird populations, the citizen scientists have contributed immensely to improving the recognition of important shorebird sites and protecting them.
- Two volunteers have shown a great deal of commitment to their selected sites, Malibu Beach and North Brigantine. They have been instrumental in helping the ENSP by providing data to support beach restrictions and other recommendations for policies to benefit shorebirds.

Conclusions:
- Citizen Science, with appropriate training, is an efficient way to collect this type of information.
- Citizen scientists working on the shorebird surveys have shown a high level of commitment to their sites and the birds, and have contributed greatly to improving conservation policies at the sites.
- The data on fall shorebird counts will be incorporated into conservation strategies for migratory shorebirds both within New Jersey and along the Atlantic Flyway.

Recommendations:
- Continue this shorebird survey in fall 2006 and spring and fall 2007.
- Develop an online data entry system for shorebird count data.
- Design and implement a broader winter survey to expand on the informal surveys that volunteers are already undertaking for winter 2007-08.
- Continue to evaluate designs that can be used by volunteers to determine the effects of human disturbance on shorebirds, and develop the best approach for addressing questions relating to management as they arise.

Grassland monitoring

OBJECTIVE 1: Assess status and changes in grassland bird populations during the breeding season at sites managed under land incentive programs.
OBJECTIVE 2: Evaluate the success of management in improving and increasing grassland bird habitat.
OBJECTIVE 3: Devise a protocol for monitoring grassland bird populations using volunteer efforts in undertaking surveys.

Key Findings
- The NJAS Citizen Science Grassland Program was initiated April 2005 and volunteers have continued to survey sites established at that time in addition to new sites incorporated in 2006. In 2006, 201 roadside points were repeated and 100 Landowner Incentive Program (LIP) points were added. (see *Job 1B. Grasslands*).

- Additional funding was obtained from the National Fish and Wildlife Foundation to support the initial stages of this program. These funds are used jointly between NJAS for citizen science-based bird monitoring and ENSP's Landowner Incentive Program (LIP) program for enrolling agricultural lands into the LIP and other federal landowner incentive programs.
- Staff from NJAS, ENSP and Rutgers initiated the development of a Before-After-Control-Impact design and methodology for this project during a NJ Habitat Incentive Team (NJHIT) meeting in February 2006, followed up by email and phone conversations among interested parties. This design minimizes the effects of site-specific confounding variables, while distinguishing natural, year-to-year variability from spatial variability and allows us to assess the effects of management.
- Forty-eight volunteers were recruited to conduct the 2006 surveys:
  - 16 volunteers returned from last year's survey.
  - 33 new volunteers were recruited through postings at New Jersey Audubon Society (NJAS) centers and website, and by word of mouth.
  - 2 untrained volunteers (untrained referring to attending the training workshops held by NJAS) accompanied a trained volunteer in 2006 to learn survey data collection and monitoring techniques and are expected to conduct surveys alone in 2007.
- Volunteers were trained at training seminars, in every aspect of the survey protocol. This included visual and auditory identification of target species, data collection and recording, species observation mapping, distance sampling, habitat assessment and web-based data entry.
  - The South Jersey seminar was held on April 1, 2006, at the NJAS Rancocas Nature Center and attracted 14 participants.
  - The North Jersey seminar was held on April 8, 2006, at Duke Farms and included 24 participants.
  - A voluntary field seminar was conducted in May at Duke Farms and was attended by 18 recruits.
  - Volunteers were selected for their bird identification skills, and initially screened by NJAS staff through a presentation and understanding of the survey's requirements. NJAS staff screened volunteers carefully during the trainings and through personal interactions. In addition, volunteers were able to screen/test themselves to make sure that their birding skills are at the appropriate level. Variations in the volunteers' identification skills were not measured quantitatively.
  - A total of 38 people attended workshops. All off them were assigned surveys, and 34 of them completed the surveys and returned their data. In addition, 8 people participated in the survey, but did not attend workshops, and 2 people joined others on their survey routes. Volunteers spent a total 989 hours in this project, and traveled approximately 10,500 miles.
- About 400 hours of staff time were dedicated to recruiting, training, and managing volunteers and reviewing data sheets. This included 150 hours recruiting volunteers, 50 hours training, 150 hours troubleshooting and managing volunteers during the survey period, and 50 hours reviewing data.
- Volunteers were provided materials necessary to complete the surveys. These materials included maps of all survey points, aerial photographs of each survey point, data sheets, bird song CDs, target species identification PowerPoint and access permission letters. The 2006 surveys included the following:
  - Two habitat surveys consisting of visiting each survey point to map the land use/land cover. This provides us with information pertaining to each habitat type existing at each point, any changes in habitat type or condition over the course of the survey period and allows for year-to-year comparison of landscape conditions.
    - Habitat Survey I (April^{15} to May 14th)
    - Habitat Survey II (August 1st to August 15th)
  - Two fixed-radius point counts bird surveys performed at each point and to record numbers of breeding target grassland species. All observations were recorded and mapped so that all sighting locations are compatible with the NJDF&W Biotics species tracking program.
    - Bird Survey I (May 15th to May 31st)
    - Bird Survey II (June 1st to June 15th)

- Volunteers completed most of their surveys within the allotted time and provided the required data (in the appropriate format) requested. A total of 291 points were surveyed out of 301 points assigned.
  - Surveys were conducted at both unmanaged and managed Landowner Incentive Program (LIP) sites as required by our survey methodology (BACI) and included the following
    - 13 sites/32 points at sites that joined LIP in 2005
    - 14 sites/38 points at sites that joined LIP in 2006
    - 14 sites/20 points at Wildlife Habitat Incentive Program (WHIP) sites
    - 28 routes/201 points at control roadside routes.
  - All data was entered on the NJAS grassland data web page that is uploaded directly to Microsoft Access for analysis.
  - Of 48 participants, 44 have entered their data to date. About 75% of the volunteers entered their data themselves through the internet data entry, staff entered the remaining 25%. They have also returned their field datasheets which were checked for accuracy against the entered data. Discrepancies were found in approximately 5% of the data entered.
- A total of 340 individuals of nine target grassland species were recorded. The total number of individuals of each species recorded per point is as follow:
  - American Kestrel (6)
  - Bobolink (124)
  - Eastern Meadowlark (75)
  - Grasshopper Sparrow (73)
  - Horned Lark (16)
  - Northern Bobwhite (13)
  - Northern Harrier (2)
  - Savannah Sparrow (29)
  - Upland Sandpiper (1)
  - Vesper Sparrow (1)

Conclusions:
- Citizen Science, with appropriate training, is an efficient way to collect this type of information.
- It is essential that volunteers understand the data collection and time commitment required by these surveys to ensure active participation and project leaders to obtain the necessary data.
- Review of data submitted electronically by volunteers showed only a small amount of error compared to hard-copy datasheets.
- Data collected from this survey will be used to assess the effectiveness of grassland management programs for increasing population sizes of target bird species
- Data on grassland birds will be incorporated into the NJDF&W Biotics database

Recommendations:
- Continue this grassland survey throughout the 5-year contract for the LIP projects.
- Expand the surveys to include sites as they become accepted into the LIP project.
- Use results for adaptive management of grasslands.

Pinelands monitoring

OBJECTIVE 1: Assess status and changes in grassland bird populations during the breeding season at various habitats in the pinelands.
OBJECTIVE 2: Devise a protocol for monitoring passerine bird populations using volunteer efforts in undertaking surveys.

Key Findings:
- During the 2006 breeding season (May – June), volunteers repeated a subset of point count locations in the Pinelands region previously surveyed in 1995 or 1997.
- Three hundred and fifty-nine (359) points (survey stations) were selected from the original set of

1,411. The ENSP selected the original points based upon where homogeneous habitat existed and were accessible from secondary roads based upon USGS quadrangle topographic maps.

- The subset of 359 points was selected based upon the amount of homogeneous habitat within 100 meters of the point using a combination of GIS layers (95/97 Land Use/ Land Cover and 2002 aerial imagery).
- Points containing >50% homogeneous habitat were assigned a habitat category accordingly and ranked according to the amount of that habitat contained within the 100-m buffer. The number of top-ranking points from each habitat type was selected proportional to the total amount of this habitat within the Pinelands region:
  - 128 coniferous forest points (79 closed-canopy, 30 wetland, 19 open-canopy)
  - 90 mixed forest points (58 closed-canopy, 28 wetland, 4 open-canopy)
  - 62 deciduous forest points (34 closed-canopy, 27 wetland, 1 open-canopy)
  - 38 open field points
  - 13 emergent wetland points
  - 28 shrub/scrub points (15 upland, 13 wetland).

- Twenty two (22) volunteers were recruited through postings at New Jersey Audubon Society (NJAS) centers and website, through the NJ Division of Fish and Wildlife web site, and various other means. Volunteers with some general bird identification skills were selected.
  - NJAS held two training workshops, which were led by staff members, at NJAS Rancocas Nature Preserve on April 9th and April 15th. The classroom training session was followed by a field trip to Batsto Village on May 6th, which was attended by 12 volunteers.
    - A total of 21 people attended the training workshops. All off them were assigned survey points; 19 have completed the surveys and returned their data. In addition, one person who did not attend the workshop participated in the survey and submitted data, for a total of 20 of 22 volunteers submitting hard copies of their data sheets within the allotted time. Volunteers spent a total 434 hours on this project and traveled 5,187 miles.
  - During workshops, participants were trained in bird identification and survey methods and became familiar with the counting protocols. Volunteers were provided with the necessary information and maps to complete their surveys.
  - Participants were also trained in habitat characterization and were asked to collect basic habitat information at each point.
- Approximately 225 hours of staff time were dedicated to recruiting, training, and managing volunteers and reviewing data sheets. Approximately 75 hours were spent recruiting and 25 hours training volunteers and 100 hours were spent managing the volunteer's progress during the surveys and troubleshooting as situations arose. Another 25 hours were spent reaching out to volunteers to collect information and proofing data.
- Surveys took place between May 15th and June 15th.
  - Volunteers were asked to scout their points before May 15th to ensure that they had access or would be able to get access before the start of the survey.
  - Twenty (20) volunteers conducted 5-minute point counts and recorded all the birds heard or seen. Each 5-minute period was divided into a 3 and a 2 minute period and observers recorded the distance at which the bird is seen (as greater or less than 100 meters)
  - Volunteers surveyed a total of 25 quadrats consisting of 252 individual points (out of approximately 300 points assigned).
  - A total of 2,831 individuals of 90 bird species were recorded. The most abundant species were Ovenbird, Pine Warbler, Eastern Towhee, American Robin, Great Crested Flycatcher, and Carolina Chickadee with over a hundred individuals seen. Also abundant were Prairie Warbler, Yellow-billed Cuckoo, Chipping Sparrow, and Common Yellowthroat with over 80 individuals seen during the survey.
  - Most frequently observed species were Ovenbird, Pine Warbler, and Eastern Towhee, recorded at more than 50% of the points, followed by Great Crested Flycatcher, American Robin, Carolina Chickadee, Tufted Titmouse, and Yellow-billed Cuckoo recorded at more than 25% of the points.
  - Approximately 85% of the data was entered by volunteers through the internet data entry system,

staff entered the remaining 15%. Discrepancies were found in less than 5% of the data entered on-line.

- A pilot nightjar survey was undertaken to monitor nightjar abundance and distribution.
  - The program was designed in collaboration with the ENSP and follows protocol established by the Audubon Society of New Hampshire (similar to the USGS Breeding Bird Survey). The purpose of the project is a region-wide assessment of nightjar populations and distribution throughout the Northeast.
  - Twelve volunteers were recruited individually by NJAS staff and selected for their skill level in identifying night birds. No training was provided.
  - Volunteers spent a total 67 hours in this project, and traveled 856 miles. About 20 hours of staff time were dedicated to recruiting, training, and managing these volunteers.
  - Volunteers were provided the necessary information (survey methodology, maps, etc.) needed to complete their surveys.
  - Results of survey are found under *JOB 2B: Scrub-shrub/Open Field Passerines*

Conclusions:

- Citizen Science, with appropriate training, is an efficient way to collect this type of information.
- It is essential that volunteers understand the data collection and time commitment required by these surveys to ensure active participation and project leaders to obtain the necessary data.
- Review of data submitted electronically by volunteers showed only a small amount of error compared to hard-copy datasheets.
- Difficulty accessing and gaining access to some sites requires more careful placement of survey points within the study area to permit more comprehensive survey coverage by volunteers. When sites are located on private property or less easily accessible areas, staff may be required to survey the area(s).
- Nightjar survey results were shared with the NE coordinated bird monitoring group, and the group reached the joint decision that region-wide nighjar monitoring can be undertaken using volunteers instead of dedicating staff to this purpose, but some protocol modifications may be required.

Recommendations:

- Repeat the pinelands survey every 5-10 years.
- Expand the nightjar surveys to include additional routes, and recruit more volunteers to carry this project through.

JOB 2B: Scrub-shrub/Open Field Passerines

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: common nighthawk (*Chordeiles minor*), least flycatcher (*Empidonax minimus*), horned lark (*Eremphila alpestris*), golden-winged warbler (*Vermivora chrysoptera*), yellow-breasted chat (*Icteria virens*), and whip-poor-will (*Caprimulgus vociferus*). Goals include: inventorying and monitoring species populations, specifically to conduct a monitoring program to track population trends not covered by the Breeding Bird Survey, the identification and preservation of critical habitat (important breeding sites), the identification of specific threats at these sites, and the provision of guidance/recommendations to landowners.

Key Findings:

- In 2006, biologists continued surveys along utility rights-of-way (previously surveyed from 2003-2005) in four study areas located in Sparta Mountain and Weldon Brook Wildlife Management Areas and parts of the Pequannock Watershed.

- From April – July 2006, nine individual male golden-winged warblers were identified: two individuals had been banded in 2003, one in 2004, two in 2005, three were newly banded in 2006, and one was not banded.
- Four known golden-winged warbler breeding pairs (both parents golden-winged warblers) were observed while five males seemed unmated. Five nests from three pairs were located and all four pairs were confirmed fledging young. Two pairs fledged 10 young total while the other two pairs fledged an unknown number of young (probably 8 total based upon average clutch sizes). None of the nests were parasitized by cowbirds.
- Two mixed breeding pairs (male blue-winged warbler mated to female golden-winged warbler) were observed with one nest located. The one nest was depredated and the other pair showed no sign of fledging.
- Forty-five blue-winged warbler males were observed within the study sites in 2006.
  - Four blue-winged warbler breeding pairs (both parents blue-winged warbler) were observed with one nest located. The one nest fledged six young and one other pair fledged an unknown number of young. The other two pairs showed no sign of fledging young.
- Eighteen nests of seven species (other than golden-winged and blue-winged warblers) were located and monitored in 2006.
  - Four (22%) of the 18 nests fledged young.
  - Six (33%) nests were depredated.
  - Five (28%) nests were abandoned.
  - Three (17%) had unknown outcomes.
  - Three (30%) of the 18 nests were parasitized (field sparrow, veery, unknown species).
  - Clutch sizes for the 18 nests ranged from one to six with an average of 3.5. The productivity rate was 0.83 (15 fledged).
- Golden-winged warbler territories in 2006 tended to be in wet areas (χ^2=31.18, P<0.001) with less herbaceous cover (χ^2=8.65, P=0.003) and dead vegetation (χ^2=26.99, P<0.001), but greater shrub cover (χ^2=66.64, P<0.001), tree cover (χ^2=10.36, P=0.001) and vegetation height (χ^2=33.40, P<0.001) than unoccupied areas.
  - Blue-winged warblers tended to occupy more upland areas (χ^2=16.85, P<0.001) with less herbaceous cover (χ^2=4.74, P=0.029) but greater shrub cover (χ^2=20.75, P<0.001), tree cover (χ^2=7.07, P<0.008) and vegetation height (χ^2=22.04, P<0.001) than unoccupied areas.
  - Logistic regression analyses were done for the 2003 – 2006 golden-winged warbler habitat data. Herbaceous, shrub, and tree cover along with vegetation height, wetland, blue-winged warbler presence, year, and site all contributed towards a model that explained 85.4% of golden-winged warbler occurrence.
- Blue winged warblers have an increasing trend from 2004 to 2006 (slope = 8.5; R^2 = 0.972).
- Golden-winged warblers have no significant trend from 2004 to 2006 (slope = -1; R^2 = 0.429)

- Fifteen roadside point count routes (similar to the USGS Breeding Bird Survey) were created throughout NJ with ten routes surveyed in 2006 for nightjars as part of a northeast region-wide pilot study.
  - The 2006 surveys were conducted during the period from June 4th through June 19th as this time period was consistent with moon phase requirements established by the survey protocol.
  - Observers were required to record all nightjars heard during a 5-minute point count. Three species of nightjars were recorded: Chuck-will's-widow, Common Nighthawk and Whip-poor-will.
  - A total of 15 routes were created, including previously established survey routes for American woodcock in addition to routes created randomly in suitable habitat in New Jersey, some of which were created from previous whip-poor-will sightings. Each route was made up of 10 points for a total of 150 survey points. Six (40%) routes were in the Pinelands, six (40%) were in the Highlands, and three (20%) in Delaware Bay region.
    - Twelve of the 15 routes were assigned. Ten routes (93 points) of the original 12 assigned routes (120 points) were surveyed: one route was not run due to inaccessibility and one was

not run for an unknown reason. Several points on two routes were unable to be surveyed due to inaccessibility.
    - Of the ten routes surveyed, six (60%) were in the Highlands, four (40%) were in the Pinelands, and 1 (10%) in the Delaware Bay Region.
- A total of 107 individuals of three target nightjar species were recorded (Table 1).
    - A total of 83 whip-poor-wills were detected at six of the ten routes. The number of whip-poor-wills detected per route ranged from 0 to 39 with an average of 8.3 individuals.
    - A total of 21 common nighthawks were observed on four of the ten routes. The number of nighthawks detected per route ranged from 0 to 12 with an average of 2.1 individuals.
    - A total of 3 chuck-will's-widows were observed on two of the ten routes. The number of chuck-will's-widows detected per route ranged from 0 to 2 with an average of 0.3 individuals.
        - Maximum numbers of individuals by target species were recorded at the following routes: Chuck-will's-widow (2) along route 8 in the Pinelands region; common nighthawk (12) along route 1 in the Highlands region; whip-poor-will (39) along route 13 in the Pinelands region.

Table 1. Number of individuals observed and observed per point surveyed by region in New Jersey

Region		Whip-poor-will	Common Nighthawk	Chuck-will's-widow
Highlands	# individuals (%)	3 (4%)	12 (57%)	0 (0%)
	# individuals/ pt	0.06	0.23	0.00
Pinelands	# individuals (%)	69 (83%)	9 (43%)	2 (67%)
	# individuals/ pt	1.73	0.23	0.05
Delaware Bay	# individuals (%)	11 (13%)	0 (0%)	1 (33%)
	# individuals/ pt	1.10	0.00	0.10

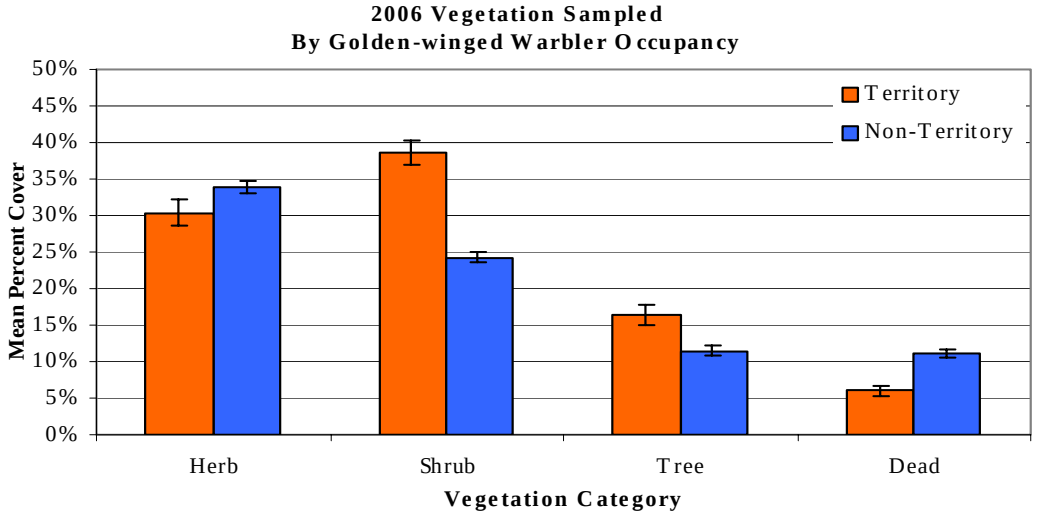
Conclusions:

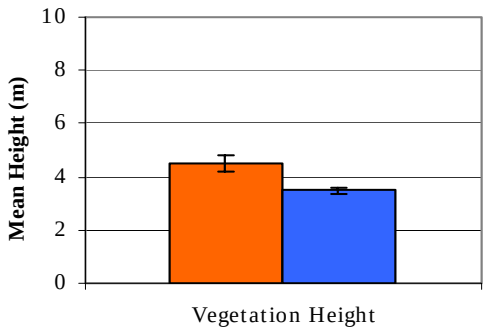
- Although there has been little recovery in the population of golden-winged warblers using the Sparta Mountain area since the population decline in 2003, these data continue to show that the utility rights-of-way are not population sinks in terms of golden-winged warbler productivity.
- Site fidelity in golden-winged warblers is high regardless of blue-winged warbler presence, provided the habitat is not drastically altered.
- The lack of golden-winged warblers immigrating into this area could be a result of an overall population decline, a shift in the species range, subtle changes in the habitat composition of the study sites, increased numbers of blue-winged warblers, or a combination of these factors.
- Site fidelity has as much, if not more influence on golden-winged warbler presence than vegetation cover.

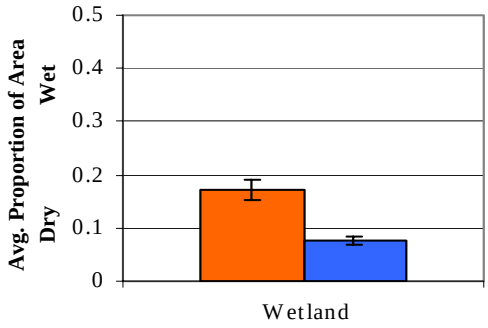
Recommendations:

- Continue to monitor reproductive success and site fidelity of golden-winged warblers and other scrub-shrub birds on utility rights-of-way to determine causes for a lack of immigration in suitable habitat.
- Determine current distribution of golden-winged warblers in New Jersey and assess habitats used.
- Work with utility companies and 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.
- Collaborate with the golden-winged warbler working group to create Best Management Practices for utility companies and land managers to improve existing habitat for golden-winged warblers and discourage blue-winged warblers.

- Begin looking at golden-winged warbler habitat use in scrub-shrub wetlands, particularly in areas where bog turtle management will be implemented, to determine any affects management may have on golden-winged warbler populations.
- Continue to collaborate with the northeast region to survey for nightjars.







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

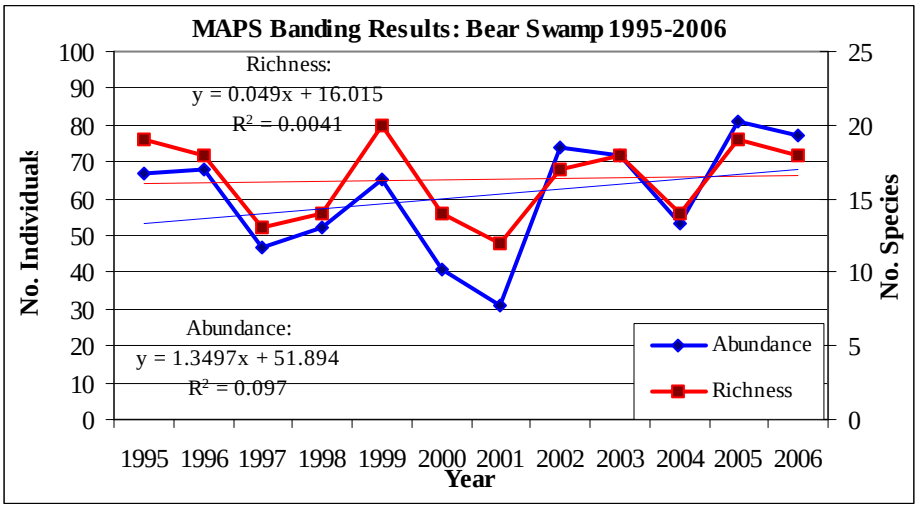
OBJECTIVE: To provide data to the Institute for Bird Populations that will help describe temporal and spatial patterns in the vital rates of target species. Identify the causes of population declines, formulate strategies to reverse declines and maintain healthy populations, and evaluate the effectiveness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

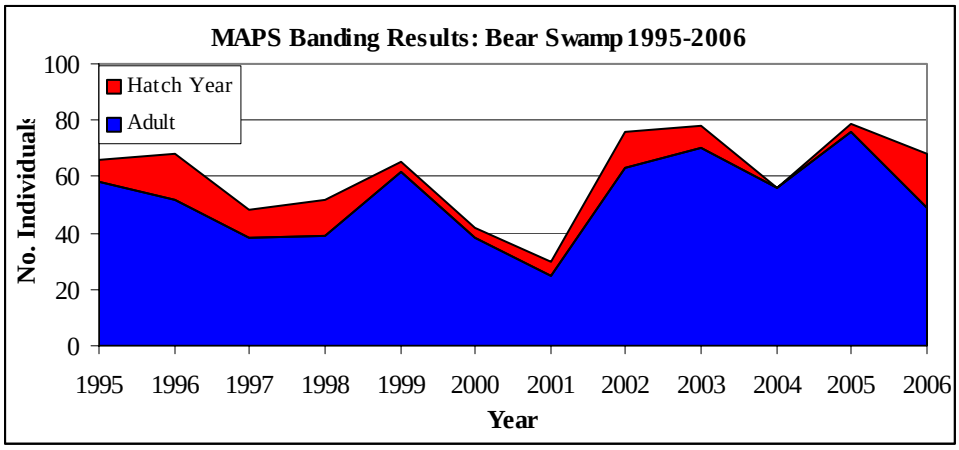
Key Findings:

- In 2006, biologists mist-netted for the 13th consecutive year in Bear Swamp, Cumberland County for approximately 500 net hours on eight different days from May through August.
  - 77 individual birds of 18 different species were mist-netted, seventy-two of these were new captures (68 banded) and five were recaptures from previous years. Nineteen (28%) of the 68 aged individuals were hatch year birds.

- The majority of the birds netted were wood thrushes (17), followed by ovenbirds (16), tufted titmice (8), worm-eating warblers (6), Acadian flycatchers (4), Carolina chickadees (4), and northern cardinals (4).
- The mean species abundance in Bear Swamp from 1995 – 2006 is 67.54 (± 8.72); mean species richness is 17.31 (± 1.32)

- The species abundance in 2006 was the 2nd highest and richness the 4th highest since 1995 (1994 banding results were omitted due to inconsistencies/bias of being the first year)
- Two volunteers were trained to take over mist-netting at this MAPS banding station in 2007.





Conclusions:

- Bear Swamp appears to be a stable community for forest birds. Although there are fluctuations within populations from year to year for the past 12 years, the numbers of birds are neither increasing nor decreasing overall.

Recommendations:

- Continue the long-term monitoring project and supplement the Institute for Bird Populations with data.

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

OBJECTIVES: Determine statewide distribution of wintering and nesting populations of American oystercatcher (*Haematopus palliates*), threats and protection strategies.

Key Findings:

- American oystercatcher breeding surveys were conducted at all Atlantic coast barrier island beach strand sites, with the exception of Little Beach Island, an undeveloped barrier island that is part of the Edwin B. Forsythe NWR. Surveys were primarily completed in conjunction with piping plover breeding surveys (conducted at least 3 times weekly).
  - 59 nesting pairs were identified at 19 beach nesting sites.
    - The vast majority (86%) of beach nesting pairs were located south of Barnegat Inlet.
    - A quarter (25%) of the beach nesting pairs hatched young.
    - Productivity was 0.25 chicks fledged per beach nesting pair.
    - Two-thirds (67%) of the chicks fledged from beach nesting habitat came from one site (Champagne Island).
    - Predation and flooding were the primary causes of nest failure, although the exact circumstances varied by site.
- A statewide survey of marsh nesting oystercatchers was not conducted as it was not proposed as part of the 2005-2006 SWG grant. However, a comparison of breeding success of beach vs. marsh nesting pairs was completed at selected sites within three large study areas as part of a graduate level research project being conducted through Rutgers University.
  - Selected study areas include: Hereford Inlet, including Stone Harbor Point, Champagne and Nummy Islands (Stone Harbor), the Holgate Division of the Edwin B. Forsythe NWR (Holgate), and the southern end of Island Beach State Park including the Sedge Island Marine Conservation Zone and two dredge spoil islands referred to as Gull Island and Pelican Island (Island Beach). Territorial pairs at each site were monitored by ground or boat throughout the entire breeding season (every 3-4 days from April through late July).
  - One hundred and six (106) pairs of oystercatchers defending territories were identified at the research sites.
    - The distribution of oystercatchers across the study areas were as follows:
      - Stone Harbor – 38 pairs.
      - Holgate – 27 pairs.
      - Island Beach – 41 pairs.
    - The distribution of oystercatchers across habitat types was as follows:
      - Barrier beach habitat – 47 pairs.
      - Salt marsh habitat – 25 pairs.
      - Isolated islands (Champagne, Gull and Pelican Islands) – 34 pairs.
    - Productivity was 0.30 fledglings per pair when data from all study areas were pooled.
      - Productivity was highest for oystercatchers breeding on isolated islands (0.62 fledglings per pair).
      - Oystercatchers breeding in salt marsh habitat had lower productivity (0.40 fledglings per pair).
      - Productivity was lowest for oystercatchers breeding in barrier beach habitat (0.02 fledglings per pair).

- Productivity varied between study areas as well. Productivity was highest at Stone Harbor (0.50 fledglings per pair), the next highest productivity was at Island Beach (0.32 fledglings per pair), and the lowest productivity was at Holgate (0.00 fledglings per pair).

- Forty-one oystercatchers, including 9 adults and 32 juveniles, from nine sites were marked with color bands during the breeding season following protocol established by the American Oystercatcher Working Group and consistent with other states along the Atlantic coast. Adults were captured using decoys and noose-carpets (McGowan et al, 2005) placed near nest scrapes on breeding territories. Juveniles were captured with a dip net or by hand just prior to fledging. In addition, 16 wintering oystercatchers, including 13 adults and 3 hatch-year juveniles, were captured with a cannon net and marked with color bands.
- A survey of wintering oystercatchers, targeting known high tide roost locations from Barnegat Inlet to Cape May (Canal) Inlet, was conducted December 7-19, 2005. 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 similar ground survey was conducted in December 2004 and aerial surveys of the coast were conducted during the same general time period in 2002 and 2004.
  - A total of 493 birds were counted during the 2005 ground survey, considerably fewer birds than were counted during the 2004 ground survey (807 birds) or the 2002 and 2004 aerial surveys (973 and 840 birds, respectively).
  - A total of 8 high tide roost flocks were identified during the 2005 ground survey, ranging in size from 11 to 235 individuals, the largest flock being recorded at Absecon Inlet.
    - The Absecon Inlet flock has consistently been one of the largest flocks during every survey year and period, ranging in size from 196 to 260 birds.
    - The Hereford Inlet flock was notably smaller during the 2005 ground survey with only 95 birds compared to as many as 370 and no fewer than 193 birds in other years.
  - For the first time in 2005, additional ground surveys were conducted later in the season (January and February). Less than half as many birds were found during the January and February surveys (223 and 232, respectively) compared to the December survey (493 birds). Furthermore, nearly all the later season birds were located in one roost flock at the Absecon Inlet.

Conclusions:

- The number of breeding pairs of oystercatcher on barrier/ beach strand (beach nesting portion of the population) was the same as in 2005 (59 pairs). However, because the beach nesting portion only represents a part of the overall population and the other segments were only surveyed at selective sites, it is difficult to draw any conclusion from this change.
- Productivity for beach nesting oystercatchers was the same as compared to 2005, and fairly consistent since monitoring of the beach nesting population was begun (0.28, 0.31, 0.25 and 0.25 fledglings per pair from 2003 to 2006, respectively).
- Although statewide surveys of breeding oystercatchers are not conducted in habitat outside of the barrier beach strand, several years of research at selected study areas indicate a significant portion of the breeding population utilize other habitats, in particular marsh islands. An accurate assessment of the state's breeding population and reproductive success is not possible without more comprehensive surveys across all suitable habitats.
- Oystercatchers that nest on Atlantic coast barrier beaches for the most part already receive a high level of protection from human disturbance as a result of fencing and signage that is erected for other beach nesting bird species (e.g. piping plover, least tern, black skimmer).
- Results of the statewide beach surveys and research at selected study areas identified flooding and predation as the major causes of nest failure. Results of the research at selected sites, indicate that productivity was highest in areas where mammalian predation was lowest – particularly on isolated islands where there was an absence of red foxes. There was strong evidence of heavy predation by red foxes on oystercatcher eggs in the barrier beach habitat at Island Beach and Holgate, where productivity was lowest. Additionally, productivity was lower in salt marsh habitat than on isolated islands where both predation and flooding appear to be principal factors influencing these nest sites.

- Results of the research at selected study areas show that distribution of oystercatchers across habitat types was not consistent across study sites. At Holgate there were more beach nesting pairs than marsh nesting pairs (23 pairs and 3 pairs, respectively). At Stone Harbor beach-nesting and marsh-nesting pairs were more evenly distributed (19 pairs and 11 pairs, respectively). However, at Island Beach the distribution between beach nesting and marsh nesting pairs was quite different (5 pairs and 11 pairs, respectively). Additionally, there were 20 pairs of oystercatchers breeding on a single dredge spoil island (Gull Island) at Island Beach. The lack of any protected area on the Atlantic beach at the southern end of Island Beach State Park and high recreational usage (especially intensive 4WD-vehicle usage) likely contributed to the low number of oystercatchers breeding in barrier beach habitat at that site.
- The state's wintering population appeared to be considerably lower in 2005 compared to previous years when surveys were conducted (2002 and 2004). The causes for the decline in the number of wintering birds are not known, although weather and prey availability might have been factors. Human disturbance was not believed to be a factor. Birds were found at nearly all the same winter survey sites as last year, indicating, as suspected, that there is strong fidelity to high tide roost locations. Additional surveys conducted later in the winter showed a sharp decline in the number of birds present compared to earlier in the winter, with the exception of one site (Absecon Inlet) where nearly the same number of birds remained throughout the entire winter season. Weather may have been a factor in the decline of birds observed later in the winter, but because this was the first time late season surveys were conducted it is not clear to what degree fluctuations normally occur. Birds may have moved to locations where they were not easily detected, although this is not believed to be the case as some scouting of the inlet systems was done to address this possibility. If late season surveys are continued in future years, we may be able to gain a better understanding of winter movement or dispersal.

Recommendations:

- Continue to monitor breeding population and productivity of beach nesting oystercatchers on an annual basis.
- Conduct a statewide breeding survey across all habitat types along the Atlantic Coast and Delaware and Raritan Bays sometime in the next several years, if funding and resources are available.
- Develop and test a predictive model using data from the Rutgers University research study of beach nesting versus marsh nesting oystercatchers (conducted from 2004-2006) in order to produce a breeding population viability analysis and help identify additional breeding locations.
- Continue threat assessment with emphasis on effects of predators on breeding success. Predator control, especially removal of red foxes, is warranted at key nesting areas such as Holgate, Stone Harbor Point, and Island Beach, if productivity is to be increased.
- Continue to annually track wintering population and distribution by completing at least one statewide ground survey each winter (December). Repeat winter surveys in January and February, if resources are available.
- Continue to mark (band) breeding and wintering oystercatcher as part of an Atlantic coast initiative to track and study movements of birds and gather other key data.
- Incorporate oystercatchers in management efforts (i.e. fencing projects, predator management, etc.) that are already being implemented for other beach nesting bird species, including as part of beach management plans.
- Assess whether protection strategies are necessary at any of the key winter high tide roost locations. Include consideration of wintering roost locations as part of regulatory reviews and other environmental assessments.
- Continue to incorporate breeding and wintering data into Biotics and Landscape Project databases.
- Refer to the American Oystercatcher Conservation Plan for the Atlantic and Gulf Coasts of the U.S. (June 2006) to help direct monitoring, management, and research efforts within the state.

JOB 3B: Regional & National Bird Coordination

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

Key Findings:

- In 2006, 24 out of 28 of the USGS Breeding Bird Survey (BBS) routes in New Jersey were run.
  - One of the 28 routes was not assigned.
  - Three observers did not run their assigned routes.
- Biologists from NJ DFW and NJAS attended the Northeast Coordinated Bird Monitoring Workshop held September 12 – 14, 2006 in Ithaca, NY.
  - Biologists from NJ DFW and NJAS have volunteered to participate in the 5+ working groups created at the workshop to review, create, and/or revise survey protocols for a regional coordinated bird monitoring.
- Biologists from NJ DFW and NJAS attended the Northeast Partners in Flight meeting on September 11, 2006.

Conclusions:

- The New Jersey Coordinated Bird Monitoring Plan needs to be revised based upon the results of the Northeast Coordinated Bird Monitoring Workshop.
- 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.
- Incentives may be needed to ensure observers run their assigned routes each year.

Recommendations:

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

JOB 4: Migratory Stopover Research and Planning

OBJECTIVE: To identify, monitor, conserve and improve key migratory corridors and stopover locations for migrant land birds that each spring and fall stop in New Jersey seeking food, cover and water.

JOB 4A: Oases Along the Flyway: Critical Stopover Habitat for Migrating Songbirds in the Northeast

OBJECTIVE: The goal of this project is to refine management strategies that help conserve stopover habitats used by songbirds as they travel through New Jersey during north and southbound migrations using migration data. Specifically, our objectives are to: (1) identify specific areas that support high concentrations of migratory songbirds during stopovers in New Jersey, (2) link areas identified as important stopover sites with specific habitat types, and (3) assess how landscape features (e.g., size of habitat, distance to similar habitat, fragmentation) affect which areas are used by migrants.

Key findings:

- Collected 124 nights of National Weather Service Doppler radar data during fall 2005 from Dover Air Force Base, DE (DOX) and Philadelphia, PA (DIX) radar stations to monitor bird migration events in southern and central New Jersey respectively.

- Initially, 35% of all data reviewed were classified as migration events (MIG), however a more stringent review resulted in approximately 15% of the data being used in analyses of stopover abundance and occupancy. Precipitation and uncertainty about the nature of the entities detected by the radar (e.g., insects) during migration departure were reasons for not including data in analyses of stopover abundance and occupancy.
- Results of station-specific occupancy models generated from migration departure data using ArcView Spatial Analyst© 2.0 by creating two composite outputs suggest:
  - Stopover occupancy (SO) models and non stopover (NSO) model areas differ most significantly with respect to forested wetlands and conifer-dominated forest. SO areas for both sites on average contained significantly more forested wetland habitats than NSO areas. Additionally, forested wetland patches were generally larger, more complex in shape, and more traversable in SO compared to NSO areas.
  - Conifer-dominated forest area was greater in NSO compared with SO areas for both central and southern NJ regions examined. Conifer forest patches were larger and more traversable in NSO than SO areas.
  - The abundance and occupancy rates of songbirds during migration stopover are affected by the matrix of development and agricultural lands. Generally, moderate and high density development was greater in NSO compared to SO models in spring. However, this difference was not apparent in fall. Similarly, differences between SO and NSO areas for several agricultural landscape metrics in both "row crop" and "pasture/hayfield" land cover types were variable depending on season.
  - Models developed for spring and fall 2005, were spatially correlated with models developed for the same areas using 2003 and 2004 data. Generally, seasonal models, depending on threshold, showed between 60-80 percent spatial correspondence.

Conclusions:

- Radar data collected during the period when landbirds are departing on nocturnal migration appear useful for delineating areas that are important during stopover periods.
- These analyses suggest several key relationships between stopover site use and habitat and landscape features. Importantly, many of these relationships were consistent across central and southern New Jersey. This finding will be useful in determining other important stopover areas in the state that are not covered by National Weather Service Doppler radar.
- Areas identified by this study suggest persistent use by migrants during northbound and southbound passage through New Jersey. This finding is critically important to the protection and management of stopover habitat for migrating birds, especially for species that migrate long distances between Neotropical wintering areas and breeding areas at northern latitudes.

Recommendations:

- Continue to collect and analyze National Weather Service Doppler radar data to develop more robust abundance and occupancy models and to better quantify persistent use of stopover areas by nocturnally migrating landbirds.
- Propose and test *a priori* models to determine factors that are probabilistic determinants of stopover abundance and occupancy.
- Validate SO and NSO threshold models by using data collected in the field about the relative abundance and occupancy of birds in these areas. Investigate microhabitat variables that are determinates of differential abundance and occupancy patterns. Investigate physiological differences between birds using SO and NSO areas to determine potential effects on fitness (e.g., survival).

JOB 5: New Jersey's Important Bird Areas

OBJECTIVE: Important Bird Areas seek to conserve sites critical to migratory, wintering and breeding birds internationally, under the direction of National Audubon Society and New Jersey Audubon Society (NJAS). The objectives of the NJ Important Bird Areas are to 1) identify a network of key places (Important Bird Areas, or IBAs) that will help sustain naturally occurring populations of birds and birding sites in NJ, 2) ensure the continued viability of these sites, and 3) to raise public awareness about the value of habitat for birds and other wildlife.

Key findings:

- The Important Bird and Birding Areas (IBBA) website is updated regularly to reflect recently approved IBAs and up-to-date site information. The website is also used to invite volunteers to contribute to the IBBA Program by nominating additional important bird and birding areas, provide updated site information and participate in restoration activities at IBAs.
- With the exception of a 5 sites awaiting the submission of additional supporting data, the IBBA Program has completed its initial nomination phase with 117 IBAs. Most (approximately 80%) approved IBAs were nominated through the online nomination process. Approximately 10 sites were suggested by technical committee members or through discussion with citizen scientists. This progress was made possible following two additional IBA technical committee meetings and the establishment of an online IBA review and voting process. IBBA staff continues to collect and compile new information addressing habitat changes, threats, and bird data to update existing IBAs.
- Important Bird Areas have been prioritized based on species and habitat criteria and threat assessments. Based on this prioritization model, two conservation plans have been developed and are in the implementation phase (Mannington Meadows IBA and a demonstration site within the Cape Island IBA). Workshops were held within the Mannington Meadows IBA and the Southern Pinelands IBA. Results of these workshops have yielded:
  - Over 100 acres offered by private landowners for grassland restoration.
  - 50 acres offered for riparian restoration.
  - 25 acres offered for wetland restoration.
  - Information about managing forested land for declining species has been delivered to landowners whose acreage totals over 7,000 ac within the NJ Pinelands IBA.
- Methods for delineating IBA boundaries using the Landscape Project were outlined and approved by the IBA technical committee and GIS specialists within NJ Division of Fish and Wildlife's Endangered and Nongame Species (ENSP). Six IBAs have been delineated using this methodology. These site boundaries were also approved by the IBA technical committee and have been used to guide land-use planning within all priority IBAs. Methods of delineating IBAs using Version 3 of the Landscape Project are being developed and will be used once finalized. The process of integrating IBAs into Version 3 of the Landscape Project and iMap are also being developed.
- The IBBA Program has prepared and distributed IBA summary reports, detailed site boundary maps and site recommendations to 5 local governments, 7 citizens groups, and 3 professional planning organizations to help guide land-use decisions (i.e. TDR and Open Space Plans). IBBA staff has also joined partner organizations to advocate for the protection of habitat within priority IBAs at local planning board meetings where the proposed actions clearly have the potential to impact important bird habitat and reduce biodiversity. Partnerships continue to build and strengthen as conservation plans are developed.

Conclusions:

- The IBBA Website provides viewers with a comprehensive look into the IBBA Program, its progress to date, as well as volunteer activities and opportunities. Users can attain information about nominated and identified IBAs and preliminary site information through user-friendly interactive maps.

- Community involvement in the form of volunteer birders, stewards and nominators continues to contribute to the successful identification of IBAs and stewardship of IBAs.
- The response of the local community, state and local governments, and partner conservation organizations to conservation efforts at priority IBAs has been positive and warrants continued implementation.
- NJAS is impressed with the progress and current status of the IBBA Program. Continuation of the IBBA Program and investment into its perpetuation will greatly assist with the identification and conservation of NJ's important bird habitats.

Recommendations:

- Continue to receive new IBA nominations and additional site information to update existing IBAs.
- Continue to refine the IBBA database to allow convenient data entry, site information updates, production of site summaries and integration of bird observations into the Natural Heritage Database.
- Continue to delineate boundaries of accepted IBAs using Version 3 of the Landscape Project.
- Ensure the continued implementation of conservation plans already developed for priority IBAs.
- Develop and implement conservation plans for additional priority IBAs.
- Develop and implement a monitoring program for evaluation of restoration activities at IBAs.
- Using demonstration sites, continue to educate the public about the goals of the IBA Program and the importance of habitat conservation .
- Continue to work with local governments, citizens groups, and professional planning organizations on identifying and protecting important bird habitat within their communities.

EXECUTIVE SUMMARY

Project:	**Mammal Conservation**
Federal Aid Project:	T-1-3 (State Wildlife Grants)
Segment dates:	September 1, 2005 to August 31, 2006
Total Project Expenditures:	$126,500 ($94,875 Federal, $31,625 State)

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

OBJECTIVE: Determine the distribution, size 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:

- We tested the bobcat predictive model by overlaying bobcat point locations not used to build the model (N = 38). We evaluated how well the model correctly classified these points. Approximately 79% of the points fell within probability areas > 0.50 and 61% of the points fell within probability areas > 0.75.
- The model informed the choices of habitat types and rules used in the development of bobcat habitat patches for the new species based patch methodology of the Landscape Project.
- Detection rate trials were run to quantify the detection rate of a dog-handler team to find bobcat scat under varying environmental conditions. The results will enable ENSP biologists to incorporate detection probability into data analyses, and also test the efficacy of this new tool and conduct pilot work to evaluate how best to use the tool.
    - ENSP is testing the detection dog's ability to detect bobcat scat under combinations of eight different environmental variables: low air temperature (10-40˚F), moderate air temperature (40-75˚F), low humidity (0-50%), high humidity (50-100%), open vegetative structure (<1 m high), closed vegetative structure (>1 m high), sparse snow ground cover (<70%), heavy snow ground cover (≥70%). Trials were run when the average wind speed was ≤10mph. Field trials involved the placement of 3 – 6 bobcat scats within a 150 m x 150 m area in areas where bobcats do not occur. A single dog-handler team was tested. Twenty trials were run related to 4 combinations of environmental variables:
        - Moderate air temp, low humidity, open vegetation, no snow cover (n = 7)
        - Moderate air temp, high humidity, open vegetation, no snow cover (n = 3)
        - Moderate air temp, low humidity, closed vegetation, no snow cover (n = 7)
        - Moderate air temp, high humidity, closed vegetation, no snow cover (n = 3)
- A dog-handler team worked in two locations where bobcats are known to occur to test the method in a real field situation and to determine what information could be retrieved from DNA extracted from bobcat scat. The dog responded to 4 scat piles in unique locations at the 2 sites. All of these scats were confirmed as bobcat by DNA analysis. The analysis was also successful at identifying the sex and individual identity of the bobcats that deposited the scats. The dog had a weak response to another scat that was confirmed to be coyote.
- Bobcat tissue samples from New Jersey (N = 14) and New York (N = 29) were collected and sent to a lab for DNA analysis to help understand the genetic structure of the New Jersey population that will inform the development and implementation of a recovery plan for the state. All tissue samples were

taken from dead specimens that we have collected over the years, using a small piece of tissue from the tongue.

- Bobcat trapping was conducted from February 25, 2006 through March 10, 2006 (56 trap/days) at sites in Sussex and Warren counties in an effort to re-capture two male bobcats that were trapped and collared in 2004. These males were fitted with Televilt, GPS-Posrec™ Model 200 store-on-board collars on 3/5/04 and 3/10/04, respectively.
- It was suspected that the collars failed after the VHF signals were lost after tracking the cats bi-monthly for 13 months. The collars were scheduled to drop off of the animals on approximately 4/26/05 and 5/1/05, respectively. Ground and aerial searches failed to locate the animals, but were continued until 7/15/05.
- On 1/6/06, two hikers reported finding a dead bobcat with a collar on the Copper Mine Trail in the Delaware Water Gap National Recreation Area. The animal was recovered by National Park Service Ranger, Michael Fernalld and taken to his office. The bobcat was the male that was collared on 3/5/04. The collar had failed to drop off as programmed.
- Division Pathologist, Doug Roscoe to determine the cause of death, performed a necropsy. His conclusion was that the animal died of exposure, shock and heart failure that resulted from wounds suffered in a fight with another bobcat.
- To date, three of the four Televilt GPS-Posrec, Model 200 programmable collars have failed to perform as specified. A second collar was recovered on 12/28/05 when the animal died from an automobile collision. The collar was not emitting a VHF signal nor was the GPS unit operating.
- The female bobcat trapped and collared on 2/24/05 was tracked via the VHF signal twice monthly. The collar was scheduled to drop off on approximately 4/18/06. The collar was still emitting a VHF signal up until late July when it converted to a mortality signal. On 7/31/06 biologists observed the animal when trying to locate the source of the mortality signal. The bobcat was alive and the collar was still attached to the animal more than 3 months after it was scheduled to drop off. Two days later the signal could not be located. Searches continued for 30 days without success. This is an animal that had a small activity area and was easily found each time that we attempted to locate her. It is suspected this collar also failed.

Conclusions:

- Due to the poor performance of the Televilt GPS-Posrec collars they will no longer be used in this project.
- Preliminary testing suggests that the predictive model performs well.
- ENSP is halfway finished with detection rate trials quantifying the detection rate of a dog-handler team to find bobcat scat under varying environmental conditions. The overall detection rate from these 20 trials is 81%. For combination A it is 72%, B = 83%, C = 80%, and D = 100%. The dog's average detection distance is 15.5 $\pm$ 10m, with a minimum of 1.2m and maximum of 47.2m. No single variable has shown a significant influence on the dog's detection rate and he seems to do well in all combinations of conditions. His detection rates have been higher (but not significantly) when the humidity and wind speed are higher and in closed vegetative structure. The distance from which he detects scat is higher when the wind speed is higher (though again, not significantly so). Lastly, the age of the scats used in the trials ranged from about 2 days to 37 days old, and there did not seem to be a relationship between age of scat and detectability.
- Preliminary testing suggests that ENSP's detection dog performed well in real field situations and is a promising method of surveying to obtain information on. In recent years, detection dogs have been proving invaluable in conservation applications because they can effectively and rapidly cover large areas of ground, even over difficult terrain, and can work in habitats as diverse as thick forest, riparian areas, open savannas, and mountain ranges. The survey approach is more cost-effective and time-efficient than trapping or radio collaring and avoids risk of injury to the animals. Also, a wealth of information can be obtained by analyzing DNA extracted from scat.

Recommendations:

- Due to the failure of the Televilt GPS-Posrec Model 200 collars, future efforts will utilize satellite collars that do not require the recovery of the collar. Data is transmitted directly from the collar to the data collection center and sent biweekly to the client.
- Trapping will be conducted from January 2007 through March 2007 in an attempt to recapture the female and recover the collar and GPS data.
- ENSP will continue work using a detection dog to gather bobcat location and genetic data throughout northern NJ. This will allow biologists to estimate the distribution of bobcats, along with the minimum population size and sex ratio. Biologists will first finish detection trials to quantify the dog's probability of detection of scat in varying environmental conditions. This first phase of the project will allow biologists to first test the efficacy of the new survey method and enable them to account for detectability biases in data analyses.
- A dog/handler team will then be used to systematically survey northern New Jersey to obtain presence/absence data. The data will be used to test and possibly refine the bobcat predictive habitat model, gather distribution data, and build a database of unique bobcat individuals. Simultaneously, biologists will survey known bobcat areas to further build up the database of unique individuals in order to achieve a best estimate of minimum population size and sex ratio of the New Jersey bobcat population. The sightings information obtained during this project will also be used to update the Biotics database and the NJDEP's Landscape Project.
- ENSP will continue to collect bobcat tissue samples from New Jersey and work with biologists in New York, Pennsylvania, and Maine (the source population of bobcats translocated to New Jersey in the early 1980's) to collect samples from their respective populations. The genetic composition of the populations will be compared in an effort to understand the genetic structure of the New Jersey population.

JOB 1B: Indiana Bat Conservation and Management

OBJECTIVE: To identify and characterize important summer and winter habitats of the federally endangered Indiana bat *(Myotis sodalis)*, protect known habitat, and develop a statewide recovery plan.

Key Findings:

- Population counts at Indiana bat hibernacula were not conducted in the winter of 2005-2006. Counts of Indiana bat hibernacula are conducted every other year in coordination with US Fish and Wildlife Service surveys and this past winter was a non-survey year.
- A cumulative total of 91 abandoned mines have been field surveyed and assessed as habitat for wintering Indiana bats. No Indiana bat hibernaculum were found this year.
- ENSP biologists assisted with a radio-telemetry project funded by the US Army, Picatinny Arsenal and conducted by Bat Conservation and Management, Inc (BCM). On April 13, 2006, over 25 Indiana bats were trapped emerging from a vertical mine shaft of Mount Hope Mine. Three female Indiana bats of sufficient weight were outfitted with a radio-transmitter and tracked throughout the night as they dispersed towards their summer grounds. On April 14th, 2006, an additional 12 Indiana bats were trapped at the same mine shaft and two more females were affixed with a radio transmitter. On April 15th, 2006, five female Indiana bats from Hibernia Mine were captured and outfitted with a radio transmitter. All 10 female Indiana bats were tracked at night to locate travel corridors, foraging areas, maternity colonies, and roost trees. Seven of the ten Indiana bats ended up approximately 15-20 miles south of their capture site; one Indiana bat traveled approximately 11 miles northwest of its capture site; and two were lost soon after release.
- The Picatinny Arsenal/BCM telemetry project identified a total of 30 Indiana bat roosts: 15 shagbark hickory trees, 5 elm trees, 4 snags, 2 ash trees, 1 maple tree, 1 tulip poplar tree, 1 occupied house (using the siding), and 1 unidentified tree. Counts of bats exiting the roosts at dusk ranged from 1 to over 150.

- ENSP assisted with a radio-telemetry project conducted at the Great Swamp National Wildlife Refuge to locate Indiana bat maternity colonies. Indiana bats were captured using mist nets placed along stream corridors and foraging habitat. The study identified a total of 39 roost trees: 27 snags, 8 shagbark hickories, 3 maples, and 1 ash.
- Two nights of harp-trapping for Indiana bats was conducted at Hibernia Mine in the fall of 2005. Trapping methods follow those described by Kunz and Kurta, 1988.
  - On September 9, 2005, a total of 360 bats were captured at the entrance to Hibernia Mine (352 little brown bats, 6 northern long-eared bats, 1 eastern pipistrelle, and 1 Indiana bat). One male Indiana bat was banded with a metal wing band a red plastic wing band.
  - On September 28, 2005, a total of 318 bats were captured at the entrance to Hibernia Mine (312 little brown bats, 4 Indiana bats, and 2 northern long-eared bats). Two male and two female Indiana bats were banded with a metal wing band and red plastic wing band.
- Indiana bat trapping was not conducted during the fall swarm due to time constraints.
- In mid-April, ENSP biologists discovered that the bat conservation gate at Hibernia Mine had been cut through and unauthorized people had entered the mine. This marked the fourth time that the gate had been breached since its installation in 1994.

Conclusions:
- Telemetry studies in 2006 documented Indiana bat summer roosts in 4 counties of northern New Jersey (Morris, Sussex, Somerset, and Union). Prior to the studies, Indiana bats had been documented in only one municipality of Morris County.
- There are hundreds of abandoned mines in northern New Jersey that have not yet been field surveyed and may provide wintering habitat for Indiana bats.
- The harp-trapping at Hibernia Mine on 9/9/05 resulted in the capture of 1 Indiana bat out of 360 bats, for a capture rate of 0.28%. The 9/28/05 trapping resulted in the capture of 4 Indiana bats out of 318 bats, for a capture rate of 1.26%. The most recent hibernation count documented 115 Indiana bats out of 34,174 total bats. Using those figures, capture rates should have been 0.34%.
- The bat conservation gate at Hibernia Mine is not effectively constructed to thwart vandalism attempts.

Recommendations:
- Continue field surveys of abandoned mines and caves in northern New Jersey to assess their suitability for wintering bat populations.
- Replace the Hibernia Mine bat conservation gate with one designed to be more resistant to vandalism attempts while still providing access for official surveys.
- Continue to assist with or conduct radio-telemetry surveys on Indiana bats to document migration corridors, roost trees, and foraging areas.

JOB 1C: Allegheny Woodrat Conservation

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 woodrat population through the use of medicated raccoon baits.

Key Findings:
- Allegheny woodrat trapping was conducted at six separate talus slope sites at the base of the Palisades Interstate Park on November 4, 2005. Tomahawk™ Model 201 (5"x5"x16") Collapsible Single-door Live Traps were used for sampling. The traps were baited with apple slices and peanut butter.
- Thirty-six traps were set for one evening for a total of 36 trap nights of sampling effort.

- A total of 18 woodrats were captured for a capture index (# of individuals trapped/10 trap nights) of 5.0.
- Captured animals consisted of six adult males, nine adult females, three sub-adult females and 0 sub-adult males.
- One adult male and one adult female were recaptures from the fall of 2003. Three adult females and one adult male were recaptures from the fall of 2004.
- All captured animals were observed for several minutes while in the traps to determine if they exhibited symptoms of infection with *B. procyonis*. All animals were released at the site of capture.

Conclusions:
- A linear regression was performed on the data (year and capture index) collected from 1987 through 2005. Only data from years where 60 or more trap nights of effort were expended were included in the regression analysis. The r^2 value for the regression is 0.8334 indicating that the equation represents a good description of the relation between the year and the capture index. The t statistic is >7 and the P value is <0.0001. These results suggest that the Allegheny woodrat population at the Palisades may be increasing.
- Six of the 18 animals captured in 2005 were recaptures from previous years (2003 and 2004). This suggests that adult animals within the population are surviving for several years and not succumbing to *B. procyonis* infection.
- All captured animals appeared healthy and none exhibited any symptoms of infection by *B. procyonis*.

Recommendations:
- Recent research (LoGuidice 2000 and McGowan 1993) suggests that *B. procyonis* contamination of Allegheny woodrat habitat is a serious mortality factor for woodrat populations in the affected areas. Population declines resulting from *B. procyonis* infection can occur rapidly. Therefore, woodrat population monitoring should continue at the Palisades site and should include the monitoring of raccoon populations and parasite prevalence.

JOB 2: Bat Conservation and Management

OBJECTIVE: To identify and characterize important summer and winter bat habitats, determine the distribution of New Jersey's bat populations, protect important bat hibernacula, and maintain viable populations throughout the state.

Key Findings:
- Winter population counts were not conducted at known bat hibernacula in the winter of 2005-2006. In coordination with US Fish and Wildlife Service recommendations, surveys of bat hibernacula are conducted every other year and this past winter was a non-survey year.
- ENSP biologists continued to conduct field surveys of abandoned mines and caves in northern New Jersey to assess their suitability as wintering bat habitat. Most surveys documented flooded shafts, open fissures, shallow caves with too much airflow, or no remaining evidence of previous mining activity. However, a few mines/caves did contain small populations of wintering bats that had not been previously documented by ENSP:
  - Francisco's Cave in Sussex County contained 8 eastern pipistrelles, 1 little brown bat, and 1 long-eared bat on 12/23/05.
  - Faery Hole in Warren County contained 1 eastern pipistrelle on 1/5/06.
  - Mud Pond Cave in Warren County contained 7 eastern pipistrelles on 1/27/06.
- Field surveys of abandoned mines are based on a GIS layer produced by the NJ DEP. An updated mine layer was released in June 2006 that added an additional 132 mines to the existing coverage.

- The volunteer-based "Summer Bat Count" program was conducted in 2006. Volunteers identified summer bat roosts in 5 counties with average colony sizes ranging from 2 to 509 bats. Bat colonies were located in house and church attics, under siding of houses, and in bat boxes.
- Surveys were not conducted to specifically determine the distribution of New Jersey's summer bat populations. ENSP biologists instead focused time and resources on assisting various radio-telemetry and mist-net surveys of Indiana bats. However, the Indiana bat surveys resulted in captures of other bat species and will therefore help to determine distribution of all of New Jersey's bats. ENSP is awaiting final reports of these studies and will use the data to help create a distribution map of New Jersey's nine species of bats.
- The capped shaft of Beach Glen Mine located in Rockaway Township, Morris County, was lifted and replaced with a removable lid. An internal reconnaissance of the shaft was conducted in April of 2006 but passage was blocked by a large plug within the mine shaft. Surveyors documented evidence of bats using the mine but an official hibernation count could not be conducted at the time.
- ENSP distributed educational bat brochures to NJ Audubon centers, state parks, environmental education centers, and at various environmental fairs, educational talks, and public programs.
- ENSP finalized the creation of a bat capture database for the Northeast Bat Working Group (NEBWG). In addition, ENSP collaborated with the Southeast Bat Diversity Network to combine databases and launch a regional database to compile all bat capture and banding data for the entire eastern US.

Conclusions:

- No significant bat hibernacula were discovered in 2006. Although several small populations of wintering bats were documented, the sites do not contain sufficient habitat to support large populations of hibernating bats.
- The updated GIS mine coverage identifies additional mine sites that will need to be field surveyed and assessed as wintering bat habitat.
- The majority of abandoned iron mines and caves located during field searches do not provide adequate habitat to sustain populations of wintering bats. It is therefore critical to protect current hibernacula from human disturbance and further investigate mines with potential bat habitat.
- Beach Glen Mine, located approximately 1 mile from Hibernia Mine, was structurally similar to Hibernia Mine and contained multiple underground levels and a horizontal tunnel. Since evidence of bats was documented in the inclined shaft, Beach Glen Mine seems capable of supporting a wintering bat population.
- The Summer Bat Count is an effective program to involve the general public in bat research and to help foster appreciation for New Jersey's bats.

Recommendations:

- Continue field surveys of abandoned mines and caves in northern New Jersey to assess their suitability for wintering bat populations.
- Continue biennial counts of wintering bats at known hibernacula to compile population and trend data.
- Continue to conduct the volunteer-based Summer Bat Count to identify new bat roosts and establish long-term counts of summer colonies.
- Create a distribution map for the nine species of bats in New Jersey based upon summer capture data and winter hibernation surveys conducted by ENSP and other bat researches in the state.
- Restore wintering bat habitat at Beach Glen Mine by opening entranceways and installing bat conservation gates.

JOB 3: Pinniped Research and Conservation

OBJECTIVE: Develop a pinniped conservation plan to identify and protect overwintering colonies or haul-out areas and other transient occurrences of harbor seals and other pinnipeds.

Key Findings:

- ENSP biologists conducted a detailed literature and information search on pinniped occurrences offshore and along the NJ coast. Searches for pinniped occurrences included published and "gray" literature, along with information from other organizations conducting pinniped research in the state.
- ENSP established a Memorandum of Understanding (MOU) with a researcher at Richard Stockton College of NJ who studies a seal colony in Atlantic County. The agreement allows for information sharing subject to particular conditions, including protection of site specific location data.
- ENSP biologists met with staff at the Marine Mammal Stranding Center (MMSC) in Brigantine, who agreed to share their data on NJ pinniped occurrences with us for inclusion into the Biotics database. The MMSC information, however, was not made available during the project period due to understaffing at the Center..
- Based on the literature and information search, we have identified and mapped ten haul-out sites with the following breakdown by county: Atlantic (1); Burlington (2); Monmouth (4), Ocean (3). In addition, two areas of seal sightings have also been identified (non haul-out areas): Monmouth (1) and Ocean (1) counties.
- ENSP conducted field visits to two reported haul-out sites and identified threats to those areas. In addition, aerial maps of remaining haul-out sites were examined to delineate apparent threats.
- During an ENSP-sponsored Marine Mammal and Sea Turtle Conservation Workshop, ENSP outlined (with the assistance of experts) current status and threats of NJ seal populations. Recommendations for future actions, timelines, lead agencies, approximate costs, and project priorities were also determined at the workshop.
- ENSP established Level III Landuse/Landcover categories that may be valued for seal haul-out sites in the next version of the Landscape Project (Version 3.0) and began developing a Landscape model for pinnipeds based on Species Area Occurrence.

Conclusions:

- Harbor seals represent, by far, the species most often observed and in the greatest number, followed by Gray seals, and then Harp seals. Hooded seals, although the least frequently observed pinniped species in NJ, have been observed but haul-out locations have not been identified.
- The number of individuals observed at the haul-out locations varies from one individual seen only occasionally (usually during extreme winter weather) to approximately 100 individuals observed regularly between late October and mid-May. All known haul-out sites occur within sheltered back-bay areas.
- Based upon the marine mammal and sea turtle conservation workshop, threats to NJ itinerant seal populations include (but are not limited to) human disturbance/interaction, repetitive disturbance such as military flyovers, influence of contaminants, climate change, inadequate understanding, intentional killing, artificial lighting, wind turbines, lack of outreach, and lack of protection at haul-out sites.
- Based on field visits, probable threats to haul-out sites include 1) human disturbance due to proximity to navigation channels (boat traffic), along with proximity to public beaches and boardwalks and 2) domestic pets (i.e. dogs), which are known to frequent the locations visited. Dogs could possibly harass, directly harm and/or spread disease to seals at haul-out sites.
- The following Level III Landuse/Landcover categories may be valued for seal haul-out sites in the Landscape Project Version 3.0, but are subject to change based upon ongoing literature review, new sightings and expert opinion: 5410 (Tidal Rivers, Inland Bays and other Tributaries), 5411 (Open Tidal Bays), 5420 (Dredged Lagoon, Artificial), 5430 (Atlantic Ocean), 7110 (Open Beach), 7120

(Unvegetated Dune Communities), 7130 (Other Sandy Areas), 7420 (Dredge Material Disposal Sites).

- Formulating a Species Occurrence Area for use to value habitat patches within the Landscape Project Version 3.0 is ongoing and based upon literature reviews and personal communication with experts. Suggested buffer distances have ranged from 300 meters to 10 kilometers.

Recommendations:

- Conduct systematic census to locate additional pinniped haul-out sites via coastwide aerial surveys, enter all new occurrences into the Biotics database, and perform a threats assessment for each location.
- Obtain sightings information from MMSC staff, prepare maps and incorporate into Biotics.
- Implement high priority actions recommended by experts at the marine mammal and sea turtle conservation workshop, including 1) protection of haul-out sites through outreach and law enforcement 2) establishment of a sightings report system and a method for processing information.
- Refine Species Occurrence Area to be used in the Landscape Project Version 3.0 based on additional sightings information from literature searches, MMSC data, and aerial surveys.
- Conduct outreach program that focuses on protecting pinnipeds from human disturbance and develop NJ pinniped conservation plan.

EXECUTIVE SUMMARY

Project:	**Reptile and Amphibian Conservation**
Federal Aid Project:	T-1-3 (State Wildlife Grants)
Segment dates:	September 1, 2005 to August 31, 2006
Total Project Expenditures:	$211,365 ($158,524 Federal, $52,841 State)

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

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

Key Findings:

- One site in Sussex County was surveyed visually this season to gather additional population data and three turtles were tracked using radio-telemetry prior to initiating management for the habitat. A total of eight additional turtles were found visually at the site bringing the total to over 70 individuals; the highest number of documented occurrences at a site in the state. An additional patch of habitat was identified as suitable and later confirmed as occupied through visual surveys (nesting female) and later when a telemetered turtle moved there.
  - The landowner was propositioned to develop a management regime which would include woody vegetation management and grazing. US Fish and Wildlife Service (USFWS)-NJ Field Office (NJFO) funding will provide the fencing and the Landowner Incentive Program (LIP) will provide payment for the livestock.
- A total of four potential habitats were surveyed visually for bog turtle. No bog turtles were found.
- Trapping was conducted at one site this season to assess population status. Only five turtles were known from the site. Trapping yielded three recaptures (one turtle was captured twice).
- Survey and management work (funded by the NJFO) was conducted at four sites. Survey work was to re-confirm presence at sites that had not been visited in at least four years. At each of the four sites at least one recapture was made.
- A meeting was held at the NJ Division of Fish and Wildlife (NJDFW) Southern Region Office on March 1 with representatives from ENSP, USFWS-NJFO, USFWS Law Enforcement, and DEP Conservation Officers to prioritize key sites for monitoring and surveillance of illegal activities (collection, site destruction).
  - State and Federal Law Enforcement agents are currently following up on a tip provided to ENSP.
- Met with a biologist from Delaware Water Gap National Recreation Area (NRA) to discuss the possibility of management and possible reintroduction onto federally managed lands.
- A total of 12 new or updated sightings will be integrated into ENSP's Biotics Database.
- No genetic samples were collected this season. No turtles were found outside of areas where samples had previously been collected.

Conclusions:

- Little new suitable bog turtle habitat was found in New Jersey. Decades of work in the state have identified the majority of suitable habitat. New habitat found demands restoration both for vegetation and hydrology before becoming suitable for colonization.
- Cooperation with private landowners is crucial to the success of NJ bog turtle populations. The strongest documented populations exist on private lands.
- Trapping efforts demonstrate ability to assess populations of bog turtle even in low densities.

- Poaching continues to be a potential problem in NJ.

Recommendations:
- Restore potential habitat for vegetation and hydrology in an effort to make suitable habitat for colonization. Monitor success of restoration efforts.
- Continue to monitor known populations for population trend development and analysis of current habitat management strategies.
- Survey suitable habitats for currently unknown populations.
- Continue to rely on state and federal law enforcement agents to investigate poaching in NJ.
- Minimally, trap at two of the four potential habitats that were visually surveyed for bog turtles in 2006, but no observations were made.

JOB 1B: Wood Turtles

OBJECTIVE: To determine wood turtle (Glypt*emys 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:

Wood Turtle Habitat Use by Level III Land-Use Type

Level III Land-Use	COUNT	PERCENT
DECIDUOUS WOODED WETLANDS*	96	31.48
DECIDUOUS FOREST (>50% CROWN CLOSURE)*	56	18.36
UPLAND RIGHTS-OF-WAY UNDEVELOPED	53	17.38
CONIFEROUS BRUSH/SHRUBLAND	21	6.89
WETLAND RIGHTS-OF-WAY	15	4.92
DECIDUOUS FOREST (10-50% CROWN CLOSURE)*	14	4.59
RESIDENTIAL, SINGLE UNIT, MEDIUM DENSITY	14	4.59
MIXED DECIDUOUS/CONIFEROUS BRUSH/SHRUBLAND*	11	3.61
DECIDUOUS SCRUB/SHRUB WETLANDS*	7	2.3
AGRICULTURAL WETLANDS (MODIFIED)	4	1.31
RESIDENTIAL, RURAL, SINGLE UNIT	4	1.31
HERBACEOUS WETLANDS*	3	0.98
MIXED SCRUB/SHRUB WETLANDS (DECIDUOUS DOM.)*	3	0.98
CROPLAND AND PASTURELAND	2	0.66
MIXED SCRUB/SHRUB WETLANDS (CONIFEROUS DOM.)	2	0.66
TOTAL	305	100

*Habitat types in Bold are Level III land-use categories selected by ENSP biologists prior to the research being conducted as being critical to the wood turtle.
**The Count field refers to how many relocations took place in the Level III habitat type.

- A total of 15 wood turtles were radio tracked at 3 sites within the Highlands Region.
  - The average home range size for the turtles across all sites was 2.79 ha using the minimum convex polygon model.
  - Nesting areas were found for 5 of the females in the study. Nest predation appeared high with many shell fragments found shortly after the nesting period.
- Movements:
  - The farthest straight line distance a turtle traveled from a stream across the study sites was 317 meters, by a juvenile turtle.
  - The farthest straight line distance a turtle traveled up and down a major stream corridor was 600 meters, by an adult male turtle that later died of apparent natural causes.
  - Males remained closer to the streams season-long compared to females. This is consistent with existing data

Conclusions:
- Habitat selections made by ENSP biologists to value critical habitat for wood turtles is generally supported through the results of this radio-telemetry study.
- Wood turtle habitat use and movements in New Jersey are comparable to data in other states within the species range.
- Nest predation is an issue at each of the study sites. Additionally, at least 3 of the turtles moved outside their normal ranges to nest in yards, although suitable nesting habitat appeared to exist in more natural settings.

Recommendations:
- Additional telemetry may be necessary to determine habitat preferences and habitat selection.
- Work to combat nest predation through predator-exclusion fencing at known nesting areas.
- Educate private landowners who have wood turtles nesting on their properties.

JOB 1C: Timber Rattlesnakes

OBJECTIVE: To conserve NJ's timber rattlesnake *(Crotalus horridus horridus)* populations through a coordinated approach of population and habitat monitoring, threat assessment, habitat protection and acquisition, management, research, education and environmental review.

Key Findings:
Statewide
- ENSP revised and republished the *Timber rattlesnake* educational pamphlet to include northern region contact information.

Pinelands region
- Two female rattlesnakes outfitted with external transmitters during the late summer 2005 were tracked by ENSP partners, the NJ Conservation Foundation (NJCF) to two previously unknown dens during the fall 2005.
- One gravid female was captured in July 2006 and fitted with an external transmitter. She was tracked by NJCF to a previously unknown gestation site, but shed shortly before birthing, was not seen after giving birth, and therefore, could not be refitted with an external transmitter.
- Two additional gestation sites were located; researchers observed 10 neonates at one location and 11 at the second location.
- One female was captured at the second gestation site, fitted with an external transmitter, and is being tracked by NJCF to determine her den location.
- ENSP staff responded to three timber rattlesnake calls, one of which was for a dead timber rattlesnake that was needlessly killed by a resident.

Highlands region

- Due to proposed legislation in 2004 that was introduced to protect areas within the Highlands region, the *Highlands Bill*, timber rattlesnakes within the region remain a priority for research to identify critical habitats (dens, gestation areas, basking areas, foraging grounds).
- During the September 1, 2005 – August 31, 2006, field seasons, ENSP did not use radio-telemetry to track timber rattlesnakes to locate new dens, gather critical habitat data, nor identify home range territories.
- A partnership with a non-government researcher along the NJ-NY border has continued. K. Michell and her team have been tracking twelve NJ rattlesnakes, observed sixteen non-study snakes during the foraging period and an additional five juveniles at one of the den sites, and have located two critical basking areas and one gestation site previously undocumented.
    - Northern edge of Highlands shows promise as an area for genetic exchange between NJ and NY populations; theory supported by information discovered during the summer of 2005 and 2006. During this research period:
        - One NJ female traveled into NY during the foraging and breeding seasons.
        - Three NJ males traveled to NY during the breeding season.
        - One NY female traveled into NJ during foraging and breeding season and was observed with one NJ study male and two NJ non-study males.
- Two new volunteers were trained as members of the Endangered and Nongame Species Program's Venomous Snake Response Team within the Highlands.
- Experienced volunteer conducted educational programs at one state park regarding living in venomous snake areas in an attempt to educate citizens about rattlesnake behavior and to recruit citizen assistance to help locate/ report rattlesnakes to be included in the study and the ENSP Biotic's database.
- Venomous Snake Response Team responded to twelve complaints on private lands during the 2006 field season. Ten of the twelve incidents occurred in the Ringwood area. (Staff responded to an additional seven complaints in the northern region.)
- Using the den model ENSP developed in the spring of 2005, ENSP volunteers and staff surveyed for rattlesnake presence at potential dens during the emergence period. No observations were made.
    - Approximately 13.9 kilometers of ridgeline and three isolated outcrops/ mountains were surveyed. Volunteers attempted to survey during optimal weather conditions, however, unseasonably low night temperatures followed by unseasonably high day temperatures made it difficult to schedule survey periods that fit the volunteers' work schedules.
        - Snakes at a known den emerged at varying times of day, including four males emerging in early evening hours on four days.
    - During the spring of 2006, no timber rattlesnake observations were made at the potential den locations.
- Using micro-habitat data collected (2003-2005) and known snake territories (2003-2005), ENSP identified random habitat points to be surveyed to analyze habitat use characteristics.
    - Random point locations were selected using a 95% CI, using ESRI's ArcView 3.2 © software's Animal Movement Extension.
    - With an allowable error (AE) of 20%, 78 random habitat sites were selected, AE of 15%, 138 sites were selected, and an AE of 10%, 312 sites were selected.
    - Seventy-two out of a potential 312 sites were surveyed during the 2006 field season (post leaf-out, pre-leaf drop); a minimum of 38 sites must be surveyed in 2007 to complete the random set at 20% AE.
- Females were removed from habitat analysis due to:
    - Very few females existing in the study and one female was gravid and two were post-partum.
    - Females generally have a smaller territory, and gravid females use significantly different habitat which could bias the analysis to determine critical summer habitats.

- Kruskal-wallis analyses of the of critical habitat used by the rattlesnakes [as identified per NJ DEP, 1995 Land Use/ Land Cover (LULC95)] showed:
  - No significant difference between Highlands Region's study snakes' (males) observed locations (n=779) and non-study snakes' (sex undetermined) observed locations (n=60), (χ^2=2.99, P=.08).
  - No significant difference between Highlands Region's male study snakes' observed locations (n=707) and Kittatinny Ridge male study snakes' observed locations (n=230), (χ^2=2.15, P=.14).
  - Highlands Region's male study snakes:
    - 81% of observations were within the LULC95 identified as # 4120 (deciduous forest with >50% crown closure).
    - 5.1% of the observations were within LULC95 identified as # 4110 (deciduous forest with 10-50% crown closure).

Conclusions:

Pinelands region

- Undocumented rattlesnake dens still exist within the Pinelands Landscape Region and the use of radio-telemetry is the most efficient means of locating them.
- Dirt and paved roads in the Pinelands fragment critical timber rattlesnake habitats and pose a major threat to this species.

Highlands region

- The ENSP's northern region's Venomous Snake Response Team continues to be effective at rapidly responding to rattlesnake reports made by the general public.
- Additional surveys are needed to validate and refine the den model.
- Unknown den locations and gestation and basking areas persist throughout the Highlands region.
- Basking areas and foraging grounds exist on both public and private lands within the Highlands region.
- Increasing development and roads continues to impede travel between habitats, isolate populations, and limit habitat use.

Recommendations:

Pinelands region

- Continue to recruit and train volunteers to serve on the Pinelands Venomous Snake Response Team to remove snakes from human-inhabited areas for the safety of the snakes and NJ citizens.
- Conduct research focused on assessing the overall effects of roads on timber rattlesnakes in the Pinelands. Identify stretches of roads where high mortality of this species occurs and develop a strategy for reducing snake mortality in these areas.
- Continue the ongoing effort to identify new den locations by radio-tracking rattlesnakes and working with non-government agencies to collect and share data of rattlesnake occurrences.

Highlands region

- Continue to develop educational methods to involve NJ citizens in the recruitment of rattlesnakes. Create a sense of ownership and partnership for the rattlesnakes' protection and protection of their habitats.
- Continue radio-telemetric research to identify additional critical habitats in areas where data gaps exist. Focus on areas that potentially will identify 1) a link connecting populations throughout the northern edge of the Highlands region, 2) populations at risk of human encroachment and increased human-rattlesnake interaction, and 3) populations using intrastate habitat (NY-NJ) for their summer ranges.
- Continue to collect habitat data for future development of a critical habitat model for integration into NJ's Landscape Project map.
- Continue to recruit and train volunteers for the Venomous Snake Response Team in an effort to capture rattlesnakes from currently unknown populations or from areas where populations are known

to exist, but critical habitats are undetermined, and to safely remove snakes from human-inhabited areas for the safety of the snakes and NJ citizens.
- Recruit dedicated volunteers to conduct den model validation searches. Isolate volunteers to thoroughly survey smaller, more localized areas regularly rather than surveying larger areas sporadically.
- Habitat use analysis should be conducted using NJ DEP 2002 Land Use/ Land Cover data when available (tentatively scheduled for completion December 2006).
- Complete random habitat surveys on 312 locations for AE of 10%; greater accuracy.

JOB 1D: Northern Pine Snake

OBJECTIVE: To conserve populations of state-threatened Northern pine snakes *(Pituophis melanoleucus melanoleucus)* by identifying critical habitats, monitoring trends in populations, productivity and habitat, evaluating meta-population and genetic diversity issues, and implementing innovative habitat management practices.

Key Findings:
- We evaluated ENSP's existing Northern pine snake habitat model with documented sightings data from the Biotics database. There were a total of 174 pine snake point locations (documented sightings) contained within the Biotics database. In order to test the accuracy of our pine snake habitat models we used GIS software to determine the percentage of pine snake sightings that occurred in habitats predicted to be "pine snake habitat" by our model. Direct overlap of sightings (points) and predicted habitat occurred for only 35% of the documented sightings (48/174). However, 65% (113/178) of all sightings occurred within 100 meters of predicted habitat and 78% (135/174) were within 200 meters of predicted habitat.
- As a continuation of a project initiated last year, we surveyed multiple sites with a dog trained to scent-track pine snakes. The dog assisted in the detection of pine snakes in the field and lead our pine snake biologist to 5 adult pine snakes, 1 pine snake nest (with 15 hatchlings), and multiple pine snake sheds; each of these would have likely gone undetected if the dog had not signaled of their presence.

Conclusions:
- Based on the high percentage (65%) of the pine snake sightings that fell outside of predicted pine snake habitats, it appears that our current models are not extremely robust and refinements should be made in 2007.
- Our fieldwork from 2006 suggests that scent-tracking dogs can aid in the detection of adult pine snakes, pine snake nests, and shed skins of pine snakes.

Recommendations:
- Refine existing pine snake models to increase their predictive power. Use these models to develop maps that identify important pine snake habitats and can aid in the prioritization of areas important for protection or acquisition.
- Conduct detection rate studies to determine what percentage of samples (pine snakes, sheds, or eggs) ENSP's scent-tracking dog is likely to miss in a given area. These should be blind trials where samples are laid out ahead of time and where neither the handler nor dog is aware of sample locations.

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: Eastern Tiger Salamander and Southern (Cope's) Gray Treefrog

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

Key Findings:

- ENSP developed a list of 27 sites with ponds that should be surveyed for tiger salamanders. Each of these ponds has either documented tiger salamander sightings or contains appropriate habitat for this species. Between January and March 2006, ENSP staff surveyed ponds at 13 of the identified sites and documented tiger salamander presence at 7 of the sites; all but 2 documented or historic sites were surveyed. Of the 13 sites surveyed, tiger salamanders were absent from 3 historic sites.
- ENSP developed a small list of names and landowner information that was given to the NJ Green Acres Program in an effort to permanently preserve a documented eastern tiger salamander breeding ponds. While this list is not totally complete, it provides a starting point for Green Acres to consider land acquisition opportunities that will have a direct benefit to tiger salamanders.
- For the third consecutive year we evaluated the effectiveness of using PVC piping to survey for Southern gray treefrogs. Our results from previous years suggest that neither pipe color nor the presence of water in the pipe influenced the tendencies of treefrogs to use PVC pipes as artificial refugia. This method was tested for the first time by our staff in an area where treefrogs were assumed to be present, but where no documented sightings existed. A total of six PVC pipes were put up into the wetland buffer and after 9 days two treefrogs took up residence in different pipes. This colonization rate is consistent with our findings from 2005.

Conclusions:

- Based our survey results from 2006, the distribution/presence of tiger salamanders may be limited to as few as 7 sites statewide. If this number is accurate immediate measures should be taken to protect and enhance these sites for this species.
- The use of PVC pipes is an effective method of surveying for southern gray treefrogs, even outside of the breeding season and could be used as a method of site assessment for NJDEP permit evaluations.

Recommendations:

- Continue to work with NJDEP's Green Acres Program to acquire land within the NJ range of eastern tiger salamanders, especially around documented breeding pools. Map important habitat corridors that connect occupied pond with other occupies or suitable ponds. Use this "corridor map" to direct Green Acres' acquisitions.
- On state-owned lands within the range of tiger salamanders experiment with the creation of tiger salamander-breeding ponds to increase the availability of breeding habitat for this species.
- Revise the NJDEP's Land Use Regulations Program's document entitled, "Protocols for the Establishment of Exceptional Resource Value Wetlands Pursuant to the Freshwater Wetlands Protection Act", to include the use of PVC pipes as an acceptable method of surveying for southern gray treefrogs.

JOB 2B: Long-Tailed Salamanders

OBJECTIVE: To identify viable populations of long-tailed salamanders *(Eurycea longicauda)*, assess threats, and implement actions to protect the riparian and lacustrine habitats they inhabit.

Key Findings:

- A total of 83 long-tailed salamander sites were visually surveyed from June until early October. The 83 sites are locales where the species had been previously documented and where the location data was considered accurate within 20 meters.
- Long-tailed salamanders were documented at 32 of the 83 sites, or 38.55%.
  - All sites previously had records dated 1970 to current.
  - The average number of visits needed to find a long-tailed salamander was 1.27.
  - The average amount of time needed to find a long-tailed salamander during a single visit was 15.27 minutes. When it took more than one visit to document a long-tailed salamander, an average of 27.96 minutes was needed.
  - County breakdown of the 32 positive sites:
    - Hunterdon - 7
    - Sussex - 11
    - Warren – 14
- A total of 51 of the 83, or 61.45%, sites that were surveyed did not yield long-tailed salamanders.
  - On a subjective rating scale based on current land-use and hydrology, 21 of 51 sites where long-tailed salamanders were not found during this survey have a high potential for presence and should be examined again.
  - 17 of 51 sites were considered to have moderate potential for presence.
  - 13 of 51 sites have undergone significant changes in land-use and/or hydrology making presence of long-tailed salamanders at the site unlikely.

Conclusions:

- Since the last major survey for the species in 1990-1991 only 39 records have been added to the database. A 4-month survey period conducted this year yielded 82% as many records.
- The species appears to be locally abundant and, when found, were not often far from where they had previously been recorded and could often be found fairly quickly.
- A decline in the number of observations in the early part of October seemed to coincide with nighttime air temperatures below 45 degrees Fahrenheit.

Recommendations:

- The 38 sites that rated as moderate potential or higher where long-tailed salamanders were not found should be re-surveyed next season.
- Using this base layer of current, accurate sightings a predictive model can be created to guide future surveys. Since only known sites were surveyed, a potential exists that many other locales for the species are not yet recorded.
- Once a species range is established, determine what the limiting factors are to the species success, especially in areas where the habitat is ranked highly.

JOB 4: NJ Herp Atlas Project

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. A web-base method of data collection and distribution will be used for conservation, planning, and education purposes.

Key Findings:

- ENSP conducted two bio-blitzes in 2006 in an effort to conduct a rapid inventory of reptiles and amphibian species on two Wildlife Management Areas. While the initial intention of each bio-blitz was primarily to survey for reptiles and amphibians, volunteers recorded sightings of species they could identify from any taxonomic group.
    - The northern bio-blitz was held at Sparta Mountain Wildlife Management area on June 3rd, 2006. During this 24-hour period, fourteen volunteers recorded:
        - 35 species of amphibians, reptiles, birds and mammals, including 11 species of amphibians and one snake.
    - The southern bio-blitz was held on June 9-10th at the Lizard Tail Swamp WMA. During this 24-hour period, thirteen volunteers and staff recorded:
        - 396 species including the following number of species:
            - Birds - 68
            - Reptiles - 7
            - Amphibians - 6
            - Butterflies - 29
            - Dragonflies - 19
            - Moths - 165
            - Tiger beetles - 2
            - Plants - 100
- During 2006, Herp Atlas volunteers conducted general surveys throughout the state of New Jersey and logged over 400 hours of volunteer time for this project alone. Deadline for data submission for the 2006 session is November 15th so data have yet been entered into the Herp Atlas Database for this year.
- Our Calling Amphibian Monitoring Program (CAMP) is part of the US Geological Survey's North American Amphibian Monitoring Program (NAAMP), which is national project that is administered within each state. In 2006, 26 volunteers surveyed at total of 26 driving routes for calling amphibian. Volunteers surveyed each 10-mile survey route a maximum of 3 times throughout the year and collectively conducted a total of 70 surveys and surveyed at 700 stops. The northern spring peeper was the most commonly heard species and was present at 229 stops. The eastern spadefoot was the only calling amphibian species not detected during the 2006 survey.

Conclusions:

- With the data submitted from our volunteers, ENSP has developed a better understanding of the distribution and abundance of reptiles and amphibians in New Jersey.
- The use of bio-blitzes on state lands is an effective way to collect large amounts of data in a single day and consideration should be given to phasing out the Herp Atlas project and replacing it with periodic bio-blitz events.
- Calling amphibian data collected in 2006 represents the sixth year that NJ has participated in the NAAMP. Although fewer surveys were conducted in 2006 than 2005, volunteers logged over 140 hours.

Recommendations:

- Continue to recruit volunteers to pick up unassigned routes (lacking active volunteers) for the Calling Amphibian Monitoring Program.
- Plan for additional bio-blitz activities for 2007. New locations on state lands should be chosen for future events.
- Work with biologists of the USGS to analyze the CAMP data according to their recommended statistical methods.

EXECUTIVE SUMMARY

Project:	**Invertebrate Conservation**
Federal Aid Project:	T-1-3 (State Wildlife Grants)
Segment dates:	September 1, 2005 to August 31, 2006
Total Project Expenditures:	$85,000 ($63,750 Federal, $21,250 State)

JOB 1: State Listed Mollusks

OBJECTIVE: To monitor populations and create conservation plans and strategies to aid in the recovery of listed species found throughout New Jersey, including the dwarf wedgemussel, brook floater, green floater, yellow lampmussel, eastern lampmussel, eastern pondmussel, tidewater mucket, and triangle floater.

Key Findings:

- We surveyed 12 stream sites in six counties for listed freshwater mussels during the study period. Timed searches were conducted in historic locations and/or previously unsurveyed suitable habitats.
- Two Dwarf wedgemussels (federal and state endangered), one live, one very fresh shell, were found several miles downstream of the Pequest River hatchery occurrence in Warren County. In addition, we located one Dwarf wedgemussel shell in an area where the species is known to occur.
- We documented the state threatened Tidewater mucket (one fresh shell) in Menantico Creek, Cumberland County, in a previously unreported location. In addition, we found an unidentified shell of the genus Elliptio in the same stream segment. The shell is being sent to the NC Natural History Museum for species confirmation.
- We found the state threatened Triangle floater at three sites; Stony Brook, Mercer County, Princeton Pike (1 shell), Salem Creek, Salem County (16 shells), South Branch Raritan River, Hunterdon County (1 live specimen). The Creeper, a state Special Concern species, was documented at the two Stony Brook locations. All listed and Special Concern species occurrences will be entered into the ENSP's Biotics database.
- We collected water quality and habitat information at each site surveyed. Water quality and habitat parameters measured included temperature, dissolved oxygen, pH, current speed and depth. In addition, we completed EPA Habitat Assessment Field Data Sheets for each survey site, which score individual habitat characteristics (e.g. vegetative protection, bank stability, riparian zone width) on a scale of 0-20 for high and low gradient streams. These scores are then added together to provide a total habitat score for a given stream segment.
    - EPA Habitat Assessment Field Data Sheet scores ranged from 139 (Pequest River, Warren County) to 170 (Capoolong Creek, Hunterdon County), out of a possible 200. Previous ENSP studies have shown that mussels occur in a range of 68-173, occurring most frequently at an average score of 121. All sites surveyed scored within the preferred habitat range.
- An analysis is underway to determine the relationships between freshwater mussel abundance and specific habitat characteristics that are ranked on the habitat assessment data sheet. Preliminary analyses suggest a relationship between freshwater mussel abundance and bank stability, vegetative cover, riparian zone width, and flow status.
- Species richness was highest in two locations, with four species present: 1) Salem Creek, Salem Co.(Alewife floater, Eastern elliptio, Eastern floater, and Triangle floater) and 2) Stony Brook, Mercer County, Princeton Pike (Alewife floater, Creeper, Easter elliptio, and Triangle floater. Menantico Creek, Cumberland County, had three species (and one unidentified species) present.
- Freshwater mussels were most abundant in the Stony Brook, Mercer County, Rosedale Park site, with a catch per unit effort (CPUE) for live mussels of 1.73 mussels/ minute.

- No live mussels or shells were found in Capoolong Creek, an area which had the highest habitat score of the season (170). After conducting surveys, we learned from a local couple that we had been searching immediately downstream of a superfund site, where pesticides had once been manufactured. The couple mentioned that the creek had been loaded with mussels 20-25 years ago.
- We completed a draft "Field Guide to Freshwater Mussels" to be used as a training tool for next season's freshwater mussel atlas volunteers. The guide includes range maps for each species, species profiles and color plates of shells, key to NJ species, and sections on habitat, threats, protection and survey methods. The guide is scheduled to be published in Spring 2007.
- An effort to enlist volunteers to assist with the upcoming freshwater mussel atlas is now underway. To date, eight people have expressed interest in working on the project.

Conclusions:
- The new Dwarf wedgemussel sighting in the Pequest River expands the lower boundary of the population by several miles.
- Discovery of Dwarf wedgemussels in a new area of the Pequest River underscores the need for more surveys in New Jersey. It is possible that other populations occur in previously unsurveyed streams with suitable habitat and appropriate host fishes present.
- Although several Brook floaters have been found in the Stony Brook within the past ten years by ENSP and Natural Heritage Program (NHP) staff, failure to find juveniles or younger mussels may indicate a functionally extinct population.
- There is only one recent occurrence of Green floaters in New Jersey. One live Green floater was reported from the Stony Brook, Mercer County in 1996. We have revisited this site numerous times, including once during the survey period, and were unable to relocate the individual.
- Although surveys to locate Green floater populations should continue, it is possible that the species is extirpated in New Jersey.
- Although Eastern lampmussels and Eastern pondmussels occur in several stream and river habitats within the state, they are also found in lakes and ponds. Surveying these areas adequately requires SCUBA divers. It is possible that these species are more common than previously thought, since lake habitats have not been the focus of past survey efforts.
- New Jersey's Yellow lampmussel population appears to be confined to the Delaware River.

Recommendations:
- Continue surveys for listed species in previously unsurveyed habitats to document distribution.
- Monitor Dwarf wedgemussels in the Paulins Kill and Pequest River to estimate population size, determine age classes and refine boundaries.
- Continue surveys in the Stony Brook to determine if juvenile or young Brook floaters are present.
- Use SCUBA in lake and other deep-water habitats to document Eastern lampmussel and Eastern pondmussel occurrences.
- Continue analysis to determine the relationship between freshwater mussel abundance and specific habitat characteristics.
- Develop site management plans for critical high quality areas where Dwarf wedgemussels, Brook floaters, Green floaters and Eastern lampmussels occur.
- Perform a status assessment using the Delphi process for all native freshwater mussels within the next year.
- Work with the DEP's Bureau of Water Monitoring and Standards to upgrade stream classifications in areas where endangered and threatened mussels occur.
- Publish freshwater mussel field guide and train volunteers to assist with surveys as part of the freshwater mussel atlas.

JOB 2: Federal and State-Listed Lepidoptera

OBJECTIVE: To identify, survey, protect, and manage for listed Lepidoptera populations and habitats in New Jersey. Listed species include arogos skipper, Mitchell's saytr, bronze copper, Appalachian grizzled skipper, checkered white, silver-bordered fritillary, and frosted elfin. For the 2006 field season, surveys will focus on identifying new colonies of arogos skipper, and frosted elfin.

Key Findings:

- Three of the seven known frosted elfin sites were surveyed this year. Frosted elfins were determined to be present at each of the three sites.
- Additional habitats that would be considered suitable for frosted elfin (based on the presence of wild indigo) were identified and mapped using GIS software during 2006. This habitat will be surveyed for the presence of frosted elfin in 2007.
- Planning sessions to discuss the experimental reintroduction of frosted elfin were carried out over the 2006 project year. The primary reintroduction site selected is to be within Millville Wildlife Management Area. Frosted elfins from the Atlantic City Airport will be used as the source population for this reintroduction.
- ENSP staff worked with Atlantic City Electric to help direct right-of-way maintenance efforts along two rights-of-way where frosted elfin colonies are present.
- The Biotics Database was updated with sighting information from the 2006 surveys for both arogos skipper and frosted elfin.

Conclusions:

- There is a considerable amount of suitable habitat in Southern New Jersey that has not yet been surveyed for frosted elfin.
- Plans are in place for the experimental reintroduction of frosted elfin into the restored habitat on Millville Wildlife Management Area. Conditions of the reintroduction area have been improved over the past 2 years for this species to the point where the habitat may currently be in better condition then it was when frosted elfin historically existed on the site.
- Our understanding of the distribution of arogos skipper and frosted elfin continues to expand with annual submissions of sightings into the Biotics Database.

Recommendations:

- In spring 2007, surveys for frosted elfin should be conducted in the newly mapped wild indigo patches in southern New Jersey.
- Carry out with the experimental reintroduction of frosted elfin into the species' historic location on Millville Wildlife Management Area.
- Where appropriate, the Green Acres Program should attempt to acquire private lands containing frosted elfin habitat.
- Work with private land owners, such as utility companies and airports, to develop frosted elfin management plans in appropriate areas.
- Develop a management plan for maintaining the Pine Barrens reedgrass communities needed to support known colonies of arogos skippers. Specifically, woody growth in the habitat of the Penn State Forest colony should be removed, either manually or with the use of fire.

JOB 3: Rare Odonata Conservation

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

Key Findings:

- We surveyed 32 sites statewide (via contractor) for the presence or absence of soon-to-be listed Endangered and Threatened Odonata. An emphasis was placed on identifying appropriate habitat that had not been previously surveyed. Surveys were conducted through collection of larvae, exuviae and the capture and release of adults. When present, Special Concern and other state-tracked species were also documented. Details of all significant findings will be submitted for inclusion in the ENSP's Biotics database.
    - We confirmed two new breeding populations of the Brook Snaketail (*Ophiogomphus aspersus* – state threatened). These populations are located in Sussex County. A critical foraging/sheltering site utilized by one population was discovered adjacent to property newly acquired by the NJ Division of Fish and Wildlife. Also found within this property was a new population of the Beaverpond Clubtail (*Gomphus borealis* – Special Concern).
    - A breeding population of the Banner Clubtail (*Gomphus apomyius* – Threatened) was discovered in Ocean County near Greenwood Forest Wildlife Management Area.
    - Attempts were made to re-confirm a historical population on Albertson's Brook in Atlantic County. Unfortunately no evidence of larvae, exuviae or adults was found.
    - Eleven sites were identified as potential breeding habitat for the state Endangered Gray Petaltail (*Tachopteryx thoreyi*). These 11 sites were carefully surveyed but no evidence of this species was found. The surveys did result in the discovery of two new populations of Tiger Spiketail (*Cordulegaster erronea* – Special Concern) and three populations of Arrowhead Spiketail (*Cordulegaster obliqua* – Special Concern). The new populations are location in Morris and Sussex counties.
    - A second breeding population of Kennedy's Emerald (*Somatochlora kennedyi* – Threatened) was confirmed near Monroe in Sussex County. Both mating and oviposition was clearly observed during the survey.
- Additional sites in Sussex County were successfully surveyed for the presence of Superb Jewelwing (*Calopteryx amata* – Threatened), Harpoon Clubtail (*Gomphus descriptus* – Threatened) and Brook Snaketail (*Ophiogomphus aspersus* – Threatened). Breeding and oviposition were observed at these new sites. Exuviae of Harpoon Clubtail and Brook Snaketail were abundant at most sites along a segment of stream approximately a quarter of a mile long. Also abundant throughout this segment was the Maine Snaketail (*Ophiogomphus mainensis* – Special Concern).

Conclusions:

- Despite attempts during the field season, we could not find evidence of the Banner Clubtail at Albertson's Brook in Atlantic County. It may be that the population once reported there is now extirpated.
- Despite attempts through this survey and others, there has been no evidence to suggest that the Gray Petaltail still occurs in NJ.
- A 2005 record of a possible Kennedy's Emerald in Sussex County should be considered accurate given this year's confirmation of the species at the site.

Recommendations:

- Continue surveys for soon-to-be listed species in previously unsurveyed suitable habitats throughout the state.
- Inform appropriate land managers of the importance of the fields adjacent to the area identified as a foraging site in Sussex County for rare Odonata. Mowing should be discouraged during the months of May and June. Ideally any mowing should be postponed until late autumn.
- Steps should be taken to protect the newly found population of Banner Clubtail in Ocean County. The presence of this species indicates a high level of water quality. Further, any degradation of this stream will ultimately impact other nearby habitat, where Banner Clubtail also breeds in addition to two special concern species.
- The newly discovered population of Kennedy's Emerald in Sussex County needs further study to ascertain its size and population utilization. Also, other limestone fens in the regions should be carefully surveyed during May and June for the presence of this species.
- Investigate all potential forage/shelter sites in the Walpack Valley for suitable habitat and evidence of listed species.
- Proceed with plan to reintroduce the Gray Petaltail into permanently protected forested lands with spring-fed seepages in northern New Jersey and monitor breeding success.

JOB 4: Coleoptera

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

Key Findings:

- We consulted with tiger beetle expert, Dr. Dan Duran, who is completing his research in New Jersey. Dr. Duran provided new information on four species: *Cicindela dorsalis dorsalis* (federally and state endangered), *C. patruela*, *C. lepida* and *C. hirticollis*. The identification of two extant, native populations of *C. d. dorsalis* was particularly significant for the state.
- In addition to Dr. Duran's data, one new species occurrence record was received and verified for the Biotics database.
- Tiger beetles of NJ, from USGS website. Names in bold may be eligible for state listing.
  Cicindela abdominalis
  Cicindela dorsalis dorsalis
  Cicindela duodecimguttata
  Cicindela formosa
  Cicindela hirticollis
  Cicindela lepida
  Cicindela limbalis
  Cicindela marginata
  Cicindela marginipennis
  Cicindela patruela **(**also *C. patruela consentanea***)**
  Cicindela punctulata
  Cicindela purpurea
  Cicindela repanda
  Cicindela rufiventris
  Cicindela scutellaris

Cicindela sexguttata
Cicindela tranquebarica
Cicindela trifasciata
Cicindela unipunctata
Tetracha virginica

Conclusions:

- The tiger beetles may be one of the easier families of Coleoptera to identify and obtain status information. There remains much more work in this field, and ENSP needs to build up species information using outside professionals and developing in-house expertise.

Recommendations:

- Process all new data in Biotics database.
- Review historic and current locations and compile natural history background.
- Define habitat parameters that can be used to identify potential habitat in Landscape Project mapping.
- Conduct surveys in known and potential habitats, prioritizing by the probable rarity of species.
- Convene experts to review status. In addition to *C. d. dorsalis*, which is state-listed by definition due to its federal endangered status, six species and one subspecies may be appropriate for state listing.

EXECUTIVE SUMMARY

Project:	**Species Status Review**
Federal Aid Project:	T-1-3 (State Wildlife Grants)
Segment dates:	September 1, 2005 to August 31, 2006
Total Project Expenditures:	$12,000 ($9,000 Federal, $3,000 State)

JOB 1: Species Status Review and Listing

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

Key Findings:

- BIRDS: In the previous segment, 97 bird species were reviewed to determine their current status in New Jersey in breeding and non-breeding season. Nineteen invited experts participated in the Delphi review process (Clark et al. 2006[1]), including representatives from the NJ Division of Fish and Wildlife, state colleges and universities, NJ Audubon, NJ Conservation Foundation, ornithology consultants, and unaffiliated experts. The compiled results were presented to the Endangered and Nongame Species Advisory Committee in November 2005. The Committee recommended species status changes be made in the state regulations. Staff prepared the documentation necessary to make status changes under the NJ Endangered and Nongame Species Conservation Act, as well as to create the regulatory definition of "special concern."
- MARINE AND ANADROMOUS FISH: Division staff selected 14 recognized experts to participate in status review using the Delphi process. Bureau of Marine Fisheries staff selected for review 58 marine fish species out of 336 species in 116 families. The list included NJ species thought to be declining, of conservation concern, or already considered federal species of concern.
  - The first round questionnaire was sent electronically to each panelist. Included in the package were detailed instructions and available information on the species (e.g. National Marine Fisheries Service stock assessments). The facilitator compiled results and comments from the first round. Consensus on a species status was achieved when 85% of the participants agreed on a particular status. The second round questionnaire was comprised of status results from Round 1, including comments, and only included those species for which consensus was not achieved. Subsequent rounds were performed in the same fashion.
  - Over the course of three rounds, reviewers reached consensus on the status of 37 species, of which two were deemed special concern and none as endangered or threatened. As of October 2006, Round 4 was still being compiled. Results on the remaining 21 species will be completed and reported in the next segment.

Conclusions:

- The Delphi technique is an appropriate, objective method for determining species status, and should continue to be the method used by the Division.

Recommendations:

- Continue the process of species status review by 1) completing the marine fish species review, 2) initiating a review of nongame mammal species, and 3) initiate a new status review of reptiles and amphibians based on the recommended five-year review period.
- Compile the results of the Delphi process of review and present them to the Endangered and Nongame Species Advisory Committee (and Marine Fisheries Council, as appropriate) for recommendations on new status assignments.
- Proceed with new status assignments through the regulatory (rulemaking) process.

EXECUTIVE SUMMARY

Project:	**The Landscape Project & Natural Heritage Program Database**
Federal Aid Project:	T-1-3 (State Wildlife Grants)
Segment dates:	September 1, 2005 to August 31, 2006
Total Project Expenditures:	$350,000 ($262,500 Federal, $87,500 State)

JOB 1: Critical Habitat Mapping

OBJECTIVE: Design, refine and make available critical habitat designations using the most current data on rare species populations and land cover types.

Key Findings:

- Completely reviewed most (4,259 out of an approximate total of 5,774) existing animal sightings from previous database, Biological Conservation database (BCD), and converted the data to the new Biotics database.
- Updated feature labels for 357 species, that categorize sightings (e.g., nest, den, sighting, foraging, non-breeding season sighting, etc).
- Created Version 3.0 of Landscape Project within the Highlands Region of New Jersey. This version incorporates a more species-specific habitat approach using Level 3 habitat typing. This methodology was developed, documented, and applied to the Highlands region first, with plans to extend it statewide.
- Conducted Landscape Project peer review for Highlands Version 3.0, involving full review of the newer methodology.

Conclusions:

- While reviewing records the following was observed:
  - Older records (1970-1980) should be resurveyed for species presence to retain the sites (as appropriate) in future revisions of Landscape mapping..
  - Data gaps exist in the urban areas of the state.
  - Certain species groups are provided more survey and research resources than others.
- Version 3.0 mapping methodology, according to biologists' review, more accurately represents species habitat needs than previous versions of the Landscape Project.
- The peer review process yielded the following advice and comments:
  - ENSP needs clear and consistent terminology when defining terms.
  - Urban habitats need more attention.
  - There needs to be better documentation for all methodological and biological decisions.

Recommendations:

- Identify older (1970-1980) records and target those areas for species surveys.
- Target urban areas for surveying effort and solicit partners in urban areas for sightings information.
- Apply Version 3.0 methodology to the remainder of the state.
- Continue the peer review process
- Work to incorporate all peer review comments

JOB 3: Landscape Project Stepped-Down Planning

OBJECTIVE: Build knowledge of critical habitat locations to guide land management, habitat conservation and acquisition, and land planning at all levels of government and non-government organizations.

Key Findings:

- Provided 24 training/guidance sessions attended by approximate 335 people.
    - Provided guidance to representatives of 30 municipal agencies including environmental commissions and planning boards; 8 county agencies including Gloucester, Middlesex, and Sussex planning departments. 3 federal agencies (USDA-NRCS, USFWS, NPS); 8 state (DEP) organizations (Land Use Regulation, Dam Safety, Watershed Management, Dredging and Sedimentology, Natural Lands Trust , Office of Environmental Review, Division of Fish and Wildlife, and Parks and Forestry); 10 NGOs including ANJEC, TNC, NJCF, Duke Farms, NJ Audubon; and private consulting firms as well as the general public. Also provided instruction on the creation and use of the Landscape Project through Rutgers University's continuing education courses and the Environmental Stewards Program.
- Worked with DEP's Division of Natural and Historic Resources (NHR) on *Standard Operating Procedures* (SOP) that included development of a GIS screening tool for all activities on Department Lands. The screening tool is used to screen an action and determine if it will have an adverse effect on threatened and endangered species habitat.
- Provided guidance and training on Landscape Project for land managers within the NHR for use as a component of the GIS screening tool to comply with the Division's SOP.
- Partnered with the Association of New Jersey Environmental Commissions (ANJEC) to provide customized training for municipal environmental commissions.

Conclusions:

- Training users is essential to the success of the Landscape Project. Creating and distributing the product (or making the product available) is not enough; the Landscape Project has greater impact when creation and distribution are done in conjunction with promoting and ensuring its correct use and interpretation.
- Targeting municipalities with a large percentage of privately owned endangered and threatened species habitat is an efficient use of ENSP' limited resources and training funds.
- Through the NHR's SOP, Department owned lands are being screened at a more restrictive level than allowed by current regulations.

Recommendations:

- Continue to offer training and guidance sessions to:
    - Target more user groups.
    - Tailor training's to particular users' needs.
    - Develop partnerships with known user groups.
- Continue to provide guidance to state, federal, and municipal agencies and conservation groups.
- Continue to provide assistance to the NHR in support of the screening tool.
- Continue to provide training and guidance to the Department's environmental review groups.

JOB 4: CWCS Stepped-Down Planning (Wildlife Action Plan)
OBJECTIVE: To develop the Wildlife Action Plan (formerly known as the Comprehensive Wildlife Conservation Strategy, CWCS) into a usable format similar to a 5-year Federal Aid Plan that will provide the ENSP with a clear vision of prioritized jobs and actions that need to be accomplished within each conservation zone of each landscape region throughout the state.

Key findings:
- ENSP (in partnership with the Conserve Wildlife Foundation of NJ, Environmental Law Institute, and the Doris Duke Foundation) held two state-level stakeholders' meetings to develop a list of priority conservation goals and strategies (actions) for the state and to refine/revise them to include measurable outcomes and stakeholders' comments and recommendations.
    - Forty-four participants discussed and selected thirteen goals (out of a potential sixty-three goals identified within the Wildlife Action Plan) as priority items at the first meeting.
    - Forty participants discussed and selected seventy-two conservation strategies/actions (out of one hundred six actions identified within the Wildlife Action Plan (Plan) that address the thirteen priority goals) as priority strategies at the second meeting.
- ENSP revised/ refined all state-level conservation strategies/actions to include measurable outcomes and to incorporate recommendations and comments submitted by NJ citizens during the public comment period (September 21, 2005, through January 15, 2006) and conservation partners (stakeholders) through April 6, 2006.
- ENSP resubmitted the NJ Wildlife Action Plan for final approval on July 26, 2006.
- ENSP (in partnership with the Conserve Wildlife Foundation of NJ, Environmental Law Institute, and D&R Greenway Land Trust) prepared for the first regionally-based stakeholders' meeting to prioritize conservation actions identified within the Plan for the Piedmont Plains Regional Landscape.
- ENSP began development of the Wildlife Action Plan state-level brochure. This brochure will be an abbreviated reference identifying the priority goals and actions for the state (as identified during the stakeholders' meetings).
- ENSP's 2006-2007 State Wildlife Grants Proposal only included projects that satisfy the priorities outlined by the stakeholders.

Conclusions:
- ENSP's intention to develop the following was not feasible on the timeline set forth. Prioritization and revising conservation goals and strategies/actions was more time consuming than anticipated.
    - Develop an "issue" list to be addressed by DFW, ENSP and included in the 5-year implementation plan.
    - Develop a list of specific jobs and actions with timelines and necessary budgets and incorporate them into a 5-year plan to guide the work of the ENSP.
        - Identify the most appropriate partner that is best suited to help accomplish each task.
        - Develop priorities for actions that fall outside of the ENSP's jurisdiction/responsibility, and identify a plan of action to move these issues ahead.
- NJ's citizens and organizations (local government agencies, sportsmen groups, watershed associations, etcetera) have not been well informed of the Plan's existence and purpose.

Recommendations:
- Continue to pursue completion of ENSP's 5-year implementation plan as outlined in the 2005-2006 project proposal (SWG proposal 2005) and identified above under *Conclusions*.
- ENSP must work with partners in conservation to publicize the Plan's existence, purpose, and benefits, and encourage partnerships in land management and research at all levels.

- Conduct regionally-based stakeholders' meetings to complete the prioritization of conservation actions within each region and prepare informative pamphlets for distribution about each region's priorities.
- Finalize the NJ Wildlife Action Plan per discussion and action prioritization at stakeholders' meetings and lead in the coordination of implementation statewide.

EXECUTIVE SUMMARY

Project:	**Fish Conservation**
Federal Aid Project:	T-1-3 (State Wildlife Grants)
Segment dates:	September 1, 2005 to August 31, 2006
Total Project Expenditures:	$10,000 ($7,500 Federal, $2,500 State)

JOB 1: Federal and State Listed Fish

OBJECTIVE: To develop conservation planning for listed fish species through identification and protection of critical habitat using the Riparian Landscape Project.

Key Findings:

- The Delphi process to determine the status of nongame freshwater fish was stalled after the third round due to database problems within the Bureau of Freshwater Fisheries (BFF). The process will continue once the BFF's FishTrack database is validated and species' distribution maps can be sent to Delphi process reviewers.
- To date, the only fish species listed in New Jersey is the shortnose sturgeon, which has a status of federal and state endangered.
- Despite the delay in completing the nongame freshwater fish status review, the ENSP, with assistance from Bureau of Marine Fisheries staff, undertook a Delphi process to determine the status of selected marine fishes. After four rounds, final results are being compiled.
- ENSP biologists conducted literature searches:
  - To determine historic and recent occurrences of shortnose sturgeon in NJ and incorporate the information into the ENSP's Biotics database. In addition, we are updating sightings in Biotics to include a report from the National Marine Fisheries Service of 26 shortnose sturgeon larvae entrained at a Delaware River power plant in Spring 2006. The power plant is located approximately 18 miles downstream of the suspected spawning area at Scudder's Falls. This is the first report of shortnose sturgeon larvae captured in the river.
  - On three species of freshwater fish that had achieved "special concern" consensus during early rounds of the nongame freshwater fish Delphi process. Home ranges for each of the species (American brook lamprey, shield darter, and slimy sculpin) were investigated.
  - To determine species occurrence areas for each Biotics feature label assigned to shortnose sturgeon. Feature labels include adult sighting, egg sighting, juvenile sighting, larvae sighting, migration corridor, nursery area, overwintering area, spawning area, and young-of-year sighting.
- Preliminary species occurrence areas for shortnose sturgeon were formulated for use in the Landscape Project based on research in the Connecticut River, which suggests that adult and juvenile summer home ranges are approximately 10 km, whereas winter range is usually less than 2 km.

Conclusions:

- It seems likely, based on early results from the marine fish Delphi process, that Atlantic Sturgeon will have a recommended state status of endangered or threatened. Round four (final) results will be compiled by late November, 2006.
- Preliminary results of a multi-year, acoustic telemetry study of shortnose sturgeon in the Delaware River by ERC, Inc. indicate that species occurrence areas for adults in the summer may be 20-30 km. ERC, Inc. has agreed to send the ENSP raw occurrence data from the study to be entered into Biotics and incorporated into the Landscape Project model.
- Although 26 shortnose sturgeon larvae were reported entrained at a power plant 18 miles downstream of the suspected Delaware River spawning area, available literature indicate that the larvae are known only to travel a maximum of 9 miles from the spawning ground before becoming resident. Possible

explanations include: 1) larval movement in the Delaware River does not conform to movement patterns in other river systems, 2) heavy rains and/or flooding may have swept the larvae farther downstream than normal, and/or 3) there is spawning occurring far below the actual suspected spawning site, although this is unlikely.

- More studies of shortnose sturgeon in the Delaware River are needed to pinpoint the exact location of the spawning area in order determine species area occurrences for early life stages.

Recommendations:

- Continue Delphi process for nongame freshwater fishes once the BFF has validated information in the FishTrack database and are able to produce distribution maps for species being reviewed.
- Once the nongame freshwater fish Delphi process is completed, incorporate sightings information for appropriate species into Biotics, develop species area occurrence models, and include in the Landscape Project. Seek Category 1 stream classification upgrades for areas with listed fish species.
- Complete marine fish Delphi process, present results to the Endangered and Nongame Species Advisory Committee, and move forward with state rule making process to list appropriate species.
- Conduct investigations into early life stage occurrences of shortnose sturgeon in the Delaware River to identify spawning sites and refine species occurrence area models to be included in the Landscape Project.
- Incorporate shortnose sturgeon acoustic tagging results into Biotics, analyze all available movement pattern data, and refine species occurrence area models.
- Conduct literature and data searches for Atlantic sturgeon occurrences, incorporate known sightings information into Biotics, and develop Biotics' feature labels and species occurrence area models.

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.

Erwin, M. 1995. Status and trends 1995. US Department of the Interior, National Biological Service. http://www.biology.usgs.gov

Hernandez, D. 2006. The Richard Stockton College of New Jersey, Pomona, NJ

Kunz, T.H., and A. Kurta. 1988. Capture methods and holding devices. Pages 1-29 in T. Kunz, editor. Ecological and behavioral methods for the study of bats. Smithsonian Institution Press, Washington D.C., USA.

LoGuidice, Kathleen. 2000. *Baylisascaris procyonis* and the decline of the Allegheny woodrat (*Neotoma magister*). Ph.D. dissertation, Rutgers, The State University of New Jersey, 100pp.

McGowan, Conor P. and Simons, Theodore R. 2005. A method for trapping breeding adult American Oystercatchers. Journal of Field Ornithology. 76(1): 46-49.

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

Niles, L.J., H. Sitters, A Dey, A. Baker, D. Hernandez, K. Clark, B. Harrington, M.Peck, P. Gonzalez K. Bennett, K. Kalasz, P. Atkinson, N. Clark and C. Minton. 2006. Status of the Red Knot (*Calidris canutus rufa*) in the Western Hemisphere. Report to the USFWS. 257pp.

NJ Department of Environmental Protection, Division of Fish and Wildlife, Endangered and Nongame Species Program. 2004. Report on State Wildlife Grants Project T-1-1.

NJ Department of Environmental Protection, Division of Fish and Wildlife, Endangered and Nongame Species Program. 2005. Proposal for Funding U. S. Fish and Wildlife Service's State Wildlife Grants project T-1-3.

NJ Department of Environmental Protection, Division of Fish and Wildlife, Endangered and Nongame Species Program. 2005. Report on State Wildlife Grants Project T-1-2.

Smith, D. R. and S. B. Bennett, 2005. Horseshoe Crab Spawning Activity in Delaware Bay: 1999-2004. Report to the ASMFC Horseshoe Crab Management Board.