Report
State Wildlife Grants
T-1-2

Endangered, Threatened and Rare Wildlife Conservation Projects

Report for Project Year
September 1, 2004 – August 31, 2005

NJ Department of Environmental Protection

DIVISION OF FISH AND WILDLIFE

ENDANGERED AND NONGAME SPECIES PROGRAM

EXECUTIVE SUMMARY

Project:	**Bird Conservation**
Federal Aid Project:	T-1-2 (State Wildlife Grants)
Segment dates:	September 1, 2004 to August 31, 2005
Total Project Expenditures:	$541,525 ($406,144 Federal, $135,381 State)

JOB 1: Federal and State Listed Bird Species

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 48 eagle project volunteers. Nests were monitored approximately weekly from January through fledging in July.
- In 2005, 53 eagle pairs were monitored, 48 of those were active (with eggs) and five were territorial (maintained a nest area) (Figure 1).
- During the 2005 nesting season 40 nests were successful in producing 64 young, for a productivity rate of 1.33 young per active nest. This productivity rate is higher than that required for population maintenance (0.9-1.1 young/active nest), and very close to the past ten-year average in New Jersey of 1.24 young/active nest. In the last ten years, 75% of active nests on average were successful in producing young. Further analysis showed that 81% of the state's nest attempts have an average productivity $\geq$1.0 young/active nest, determined from nest attempts compiled since 1982 when there was just one nest.
- In 2005 7 active nests failed to produce viable hatchlings. The causes were not known for most. We suspect predation may have caused failures at three sites where nestlings had been present (Merrill Creek, Burlington and Galloway). Two other nests were affected by contaminants (Rancocas and Raccoon Creek), and others may have been subject to human disturbance.
- ENSP biologists visited a sample of nests to band young with federal and color leg bands, and take blood samples. In 2005 we sampled 16 eaglets at 10 nests. All blood samples were stored for future analyses.
- In 2005 most nests (38, or 72%) were located on private land, compared to 28% of nests on public and conservation lands.
- We coordinated the Mid-winter Eagle Survey that took place January 8-9, 2005. A total of 179 bald eagles were counted by volunteers and staff, the highest count in New Jersey since the survey began in 1978 (Figure 2). Most eagles (148) 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.

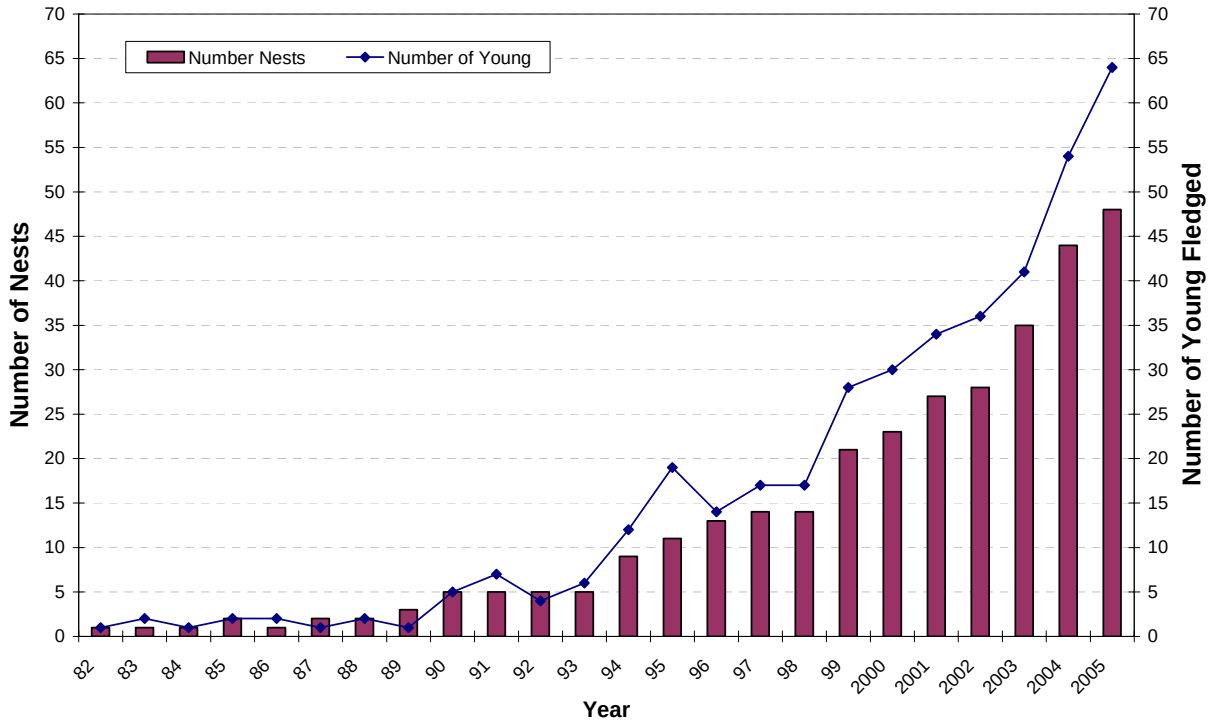

Figure 1. The number of active bald eagle nests and young produced in New Jersey, 1982-2005

Conclusions:

- The New Jersey bald eagle population has increased each year and continues to maintain above-minimum productivity rate. 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 2005 five new eagle nests were discovered, and based on territorial pairs observed, an increase in active nests is expected in 2006.
- While the strength of the current recovery is encouraging, most of the population growth – a doubling – has occurred in just the last five years, and thus must be measured with some caution. Regulatory status, site protection and efforts by observers and landowners are key ingredients in the current 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.
- 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, 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.

JOB 1B: Grassland Birds

OBJECTIVE 1: To develop long-term population monitoring and distribution approaches, as well as the incorporation of incentive programs, for 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).

OBJECTIVE 2: To develop long-term population monitoring and distribution approaches, as well as the incorporation of incentive programs, to benefit grassland-nesting birds of special concern: northern harrier (non-breeding), grasshopper sparrow (non-breeding), and eastern meadowlark (*Sturnella magna*).

OBJECTIVE 3: To develop long-term population monitoring and distribution approaches, as well as the incorporation of incentive programs, to benefit grassland-nesting birds of regional priority, including the field sparrow (*Spizella pusilla*), barn owl (*Tyto alba*), dickcissel (*Spiza americana*), eastern bluebird (*Sialia sialis*), eastern kingbird (*Tyrannus tyrannus*), and horned lark (*Eremophila alpestris*).

Key findings:
- ENSP GIS staff continued to work to develop a habitat analysis of grassland loss and trends in habitat alteration. ENSP staff awaits the availability of the 2002 Land Use/ Land Cover data necessary for this analysis.
- Staff selected the dataset to use for model building, which includes locations where kestrels have been observed (N = 71) during the breeding season between 1994 and 2004. The dataset also includes locations where kestrels have not been observed (N = 71), which were randomly selected from the negative data resulting from the 2004 kestrel survey. We only selected unused points that were at least 2,000m away from used points to assure that there was no overlap.
  - The model building will involve comparing used habitat areas to unused areas. We conducted a literature review and determined that a home range of 1km^2 (500m radius) is a conservative estimate. Therefore, we buffered the used and unused points by 500m and 1000m and will compare the predictive success of each scale.
  - We will use 2002 land use/land cover data to generate the habitat variables to include in the model building. Tested the program Fragstats as a tool to generate various habitat metrics, i.e. edge density, core area, and contiguity.
- Volunteers repeated point count surveys during 2005 breeding season along routes in NJ previously surveyed by the ENSP in the mid-80s and mid-90s.
- Volunteers (approximately 55) were recruited through postings at New Jersey Audubon Society (NJAS) centers and website, Green Gram, through the NJ Division of Fish and Wildlife web site, and various other means.
- Two training workshops were led by NJAS staff members, NJ ENSP biologists and biologists at Duke Farms. A total of 42 citizen scientists participated in these workshops.
  - Participants were trained in bird identification and bird survey methods and gained knowledge of the counting protocols. A grassland bird information packet and CD with photos and project materials were provided to each participant at the end of the workshop.
  - Participants were trained in habitat characterization. A hard copy of each route and maps of all the points in the route were provided for the volunteers to record their habitat observations.

- Forty-six volunteers conducted grassland bird surveys twice during the breeding season (once May 15- May 31, and once June 1-June 15), and conducted habitat surveys twice (once in early May and once in July).
    - Volunteers conducted 5-minute point counts along established routes and recorded all bird observations (visual and audible). Each route consisted of 5 to 20 survey points (or stations). The 5-minute period was divided into 3 and 2 minute periods and observers recorded the distance at which the bird is seen (greater or less than 100 meters).
    - Volunteers mapped the habitat types within a 100m radius around each point location by drawing areas with varying habitat types, identifying the types using codes, and recording the percentages of each habitat type on the map.
- A total of 31 routes (373 points) were surveyed: 23 priority routes (303 points) and 8 secondary routes (70 points).
    - Preliminary data show that target species were observed at about one third of the points. The most commonly seen species were eastern meadowlark and bobolink, seen at about 15% of the points, while grasshopper sparrow was seen at 8% of the points.
    - Final data have been submitted for 19 priority and 8 secondary routes or 88% of the routes. Data from 2 routes are pending. We have not heard from the volunteers at 2 routes, and assume that they were not surveyed.

Conclusions:

- The 1995 Land Use/ Land Cover data currently available will not illustrate the suspected loss of grassland habitat as development and suburban sprawl have significantly increased and agricultural habitat has decreased within NJ during the past decade. The 2002 data, to be available in mid-2006, will be used to conduct this analysis.
- Volunteers, surveying for more than 1500 hours, were able to successfully survey the habitats and count and identify birds as trained.
- Citizen Science, with appropriate training, is an efficient way to collect this type of data; however, we have designed a new census method for grassland bird surveys in 2006.

Recommendations:

- ENSP staff will use the 2002 Land Use/ Land Cover data, when available, to evaluate the trends, loss and alteration of grassland habitat.
- ENSP will build a habitat selection model using statistical and GIS analyses. The model will predict the locations of the most suitable habitat for kestrels in New Jersey, and as such, gives ENSP insight into the amount, distribution and fragmentation of the habitat that is favorable for kestrels.
- ENSP will use data collected during a 2005 grassland bird survey to test and, if necessary, further refine the model.
- Integrate this survey methodology to determine baseline conditions and success of management efforts on private lands that participate in landowner incentive programs and conservation partnerships.

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

OBJECTIVES:

- To improve strategies to protect and recover endangered beach nesting birds by:
    1) An improved assessment of population status, trends and productivity of black skimmers (*Rynchops niger*) and least terns (*Sterna albifrons*).
    2) An assessment of the factors that influence nest site selection, nesting success and productivity.

3) Evaluating and prioritizing a range of management approaches for protection and restoration of nesting and develop and/or modify existing management plans.

- Update mapping of nesting data into GIS/Landscape context.

Key Findings:

- Breeding surveys were conducted at all known least tern and black skimmer nesting sites along the Atlantic Coast by NJDFW-ENSP and other cooperators/landowners. Surveys consisted of ground counts to determine the number of adults present, sitting adults to estimate nesting pairs, and fledged chicks. Surveys were conducted during at least 7 census periods timed every 2-3 weeks throughout the breeding season (May-September).
- Twenty-three (23) active least tern breeding colonies were identified in 2005 for a total of 1569 adults (using the peak counts from each individual colony) or 1089 adults when "adjusted" to reflect the highest statewide count during any one census period. A significant portion of the state's population was concentrated in two areas, including 553 peak adults in the Northern Monmouth County region (Sandy Hook to Seven President's Park) and 428 peak adults clustered near Hereford Inlet (North Wildwood and Stone Harbor Point). Productivity was estimated to be low ($> 0.0 < 0.5$ fledglings per pair). In fact, nearly all the least tern colonies in the state completely failed. The cause of poor reproductive success varied from site to site. However, harassment and predation by red fox was a major factor at most Monmouth County sites, whereas flooding was more predominate in Cape May County. Predation by laughing gulls was also a factor at the colonies in Hereford Inlet. An undetermined predator(s) caused significant losses at South Cape May Meadows, another major nesting site in the state (247 adults, peak).
- Preliminary results from the 2005 black skimmer census surveys indicate 2850 total adults were present (using the peak counts from each individual colony) or ~ 2500 birds when "adjusted" to reflect the highest statewide count during any one census period. Active nesting occurred at 5 colonies with nearly 90% of the state's population being concentrated in two breeding sites (Stone Harbor Point and Mordecai Island) and nearly two-thirds found in just one colony (Stone Harbor Point). Productivity was estimated to be moderate ($\geq 0.5 < 1.00$ fledglings per pair). Flooding was a cause of nest failure at some sites, although predation (eggs and young) by laughing gulls was the most acute problem at the Stone Harbor Point colony.
- In addition to the comprehensive coastal surveys, a one-time black skimmer survey of the coastal marshes and islands from Townsend's Inlet to Little Egg Inlet was conducted by boat between mid-July to mid-August. Thorough surveys of this region have not been possible in the past, although periodic aerial surveys for colonial waterbirds (and other ad hoc observations) suggested that skimmers may have been nesting in this area. Six small black skimmer breeding colonies, ranging in size from 4 to 20 adults (total of 90 adults) were located during the survey.
- Tabulation of the statewide least tern and black skimmer population using the highest census period count method rather than the sum of peak counts from individual sites shows consistent patterns over the last 3 years. As expected, in each year from 2003-2005 the census method resulted in a lower statewide population total. The extent of the difference between methods varied by species, but the relative difference was fairly consistent each year. The census tally for least terns was nearly one-third less than the sum of the peak counts from individual colonies in each year (31%, 33% and 31% less from 2003-2005, respectively). The census tally was also less for black skimmers, although the differences from the sum of peak counts were much smaller (14%, 6%, and 11% less from 2003-2005, respectively, with the 2005 figures being based on preliminary data).
- As efforts to minimize human disturbance are already being implemented (i.e. fencing, signage, patrolling) and little can be done to prevent flooding, predator control was conducted at some targeted sites in 2005 to test its effectiveness for more widespread future implementation (and in order to increase productivity). Of particular significance, an intensive trapping program was conducted at Stone Harbor Point in early April prior to arrival of nesting birds and again later in the season when some evidence of mammalian predators was observed. Productivity for black skimmers increased markedly at the site in 2005 as compared to 2004 when predators (including

raccoon, skunk and free-roaming cats) were thought to have had a major impact at the site. No nest or chick losses for terns or skimmers were directly attributed to mammalian predators at Stone Harbor in 2005 although laughing gulls were still a significant problem. Flooding prevented least terns at the site from successfully producing young.

- As use of infrared camera systems and nighttime binoculars purchased during an earlier phase of SWG funding proved ineffective in identifying nocturnal predators, efforts were shifted in 2005 to utilizing human monitoring during nighttime hours at selected sites. Results were spotty, as monitoring was not feasible throughout the entire night and some sites were too large to effectively track predators. However, at one site (Sea Girt – Wreck Pond) where nighttime monitoring was conducted more regularly and the site was limited in size, red fox were identified as the cause of the failure of a least tern colony. Surveys to locate fox dens at or near nesting areas also proved effective in identifying predator threats at several nesting sites.
- Several beach nesting bird management plans have been developed by NJDFW-ENSP and coastal municipalities in recent years as a means to minimize the effects of municipal management and recreational activities on the reproductive success of nesting birds. Although those plans have successfully provided a framework for improved land stewardship and wildlife protection in these cases, none of the current plans have entirely met guidelines set by the USFWS for managing the federally threatened piping plover, and therefore have not gained final USFWS approval. In 2005, as a means to remedy that shortcoming and move the process forward, NJDFW-ENSP, USFWS, and the Borough of Sea Bright (Monmouth County) developed a management plan that was thoroughly reviewed by both agencies and will be used as a template for updating existing plans and developing new ones.
- A pilot study to investigate the impacts of disturbance by watercraft on nesting black skimmers was initiated. The study focused on developing the study methodology including categorizing types of disturbance and determining appropriate metrics for bird response. Methods evaluated for investigating impacts of watercraft on black skimmers included making both direct and tangential approaches at various watercraft speeds. Variables included in the pilot study included colony ID, species, number of nesting birds, approach type (direct or tangential), direction of approach (north, south, east, west) and boat speed. Establishing reasonable endpoints was made difficult by the large number of birds involved, variability in colony size and configuration and the location of nests with respect to the edge of the colony and edge of the island, and watercraft approach paths. It became apparent that the distance birds first became alert, and first flew were reasonably objective and could be measured during each approach. Other variables considered included recording the number of birds that flew at different distances from the colony. The distance of initial response was easier to measure using the distance to the island edge, while noting later the distance from the edge of the island to the first nesting birds. The methodology developed requires at least two field personnel: one to keep the speed of the boat constant and to record some of the distances, and another to record others. A literature review was also completed

Conclusions:

- Although there are typically wide fluctuations in the statewide least tern population from year to year, the total number of adults has trended sharply downward the past three years. Furthermore, productivity has been low for the past four years, especially in 2005 when nearly all least tern colonies in the state failed to successfully produce any fledglings. Although it is not clear if these population swings are abnormal or typical of long-term cycles, the recent drop in population combined with poor reproductive success does raise concerns about the status of least terns in the state.
- Based on preliminary results, the statewide black skimmer population increased sharply in 2005 compared to 2004. Over the past 30 years black skimmers populations have exhibited a generally moderate increasing trend, although levels can vary considerably from year to year. Year to year fluctuations in nesting populations have increased in recent years concomitant with a decrease in the number of active colonies. The long-term trend of a reduction in the number of active colonies and the concentration of most of the state's population into just a few colonies (two in

2005) has continued and remains a concern. The loss of individual colony sites appears to be related to declines in suitability of habitat rather than other factors (i.e. human disturbance, predation). Productivity remains variable from year to year but appears to be sufficient for population sustainability.

- Revised methods in using survey data to calculate statewide populations of least tern and black skimmer appear to have achieved a more accurate measure of population levels. However, the year to year consistency in the differences between the new methodology and previous approach suggests that wide fluctuations in population may be due less to shortcomings in survey tabulation methods than previously surmised.
- Periodic surveys over the past several years of suitable nesting habitats outside the coastal zone or in more remote areas of the coast where surveys are not regularly conducted have resulted in some breeding colonies being discovered and/or additional suitable habitat being found or confirmed. However, the number of breeding birds present on these surveys has not been significant, and when measured against the time and resources necessary to complete these surveys suggest that such surveys may only be needed on a periodic (less than annual) basis.
- Results of mammalian predator control at Stone Harbor Point indicate that trapping programs can effectively increase reproductive success and, when coordinated with local officials are possible without significant public protest. As the effects of predators remain a major limiting factor for colonial beach nesting species in New Jersey, targeted mammalian trapping at additional sites is warranted. Predation by avian species, especially from the large laughing gull breeding colonies located near Hereford Inlet, remain a formidable problem as well, although the effectiveness and feasibility of control techniques need to be studied prior to implementation.
- Nighttime monitoring with existing equipment (i.e. binoculars, cameras) has not proved effective and the expanded monitoring of sites by field assistants during nighttime hours has not yielded significant results (and is difficult to implement effectively). Although the overall adverse effects of predation on beach nesting birds are well-known, clear identification of specific predator species (especially nocturnal ones) would still be useful to develop effective site-specific predator management strategies and build support for and counter opposition to predator control program, by the public, policy makers, and/or land managers. Use of cameras to aid such investigations might still be feasible, although additional techniques and better equipment will be necessary.
- Responses of nesting black skimmers to watercraft can be studied by direct experimentation and observation, including deliberate approach on watercraft to nesting colonies by the investigator. Measurement of the distances at which birds first become alert and then flush provide an appropriate and easily measured variable to assess disturbance impacts, especially in the context of developing appropriate disturbance buffers around nesting sites.

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.
- Continue periodic efforts to locate and monitor nesting sites not captured on regular coastal surveys, including at sand mines, gravel pits and industrial sites for least terns and in coastal marsh habitat for black skimmers. Rely on sightings reports, especially from New Jersey Audubon Society and Biotics, to help direct surveys.
- Continue to track nesting population trends based on new methodologies (i.e. highest census period counts rather than sum of peak counts from individual colonies). Continue to research ways to improve field survey techniques.
- Investigate status and trends of least tern abundance in other Atlantic Coast states to strengthen assessment and interpretation of recent population decline and poor productivity in New Jersey.
- Continue threat assessment with emphasis on effects of predation. Continue to evaluate means to better assess specific predator threats, including nocturnal species. Implement targeted mammalian predator control at sites where needed and feasible. Investigate techniques to control avian predators.

- Incorporate conservation strategies for least terns and black skimmers into new or revised management plans using the Borough of Sea Bright plan as a framework.
- Conduct a full-scale study of black skimmer responses to watercraft. Other variables to consider in a full study are the effect of drifting boats, of stationary boats (such as fishermen), and the recovery response (how soon after the end of a disturbance does the colony resettle).
- Continue to incorporate data into the Landscape Project and Biotics database.

JOB 1D: Osprey Monitoring and Management Planning

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

Key Findings:
- We conducted ground surveys of nesting ospreys in May and June, 2005. Ground surveys were conducted in conjunction with nestling banding activities and covered every major nesting colony on the Atlantic and Delaware Bay coasts. We had planned to conduct aerial survey to census the state population, but funds were insufficient. It was further decided that the population is at a level where we should institute a schedule change to a three-year survey.
- We checked 203 nests statewide, approximately 55% of the 366 pairs documented nesting in 2003. Nests were generally located among eight nesting colonies that have been tracked annually since 1985. Most nests (142, 70%) were in the Atlantic coastal region. Few new nests were found outside the osprey's current range in the state; the few that were found were on cell-phone towers or other man-made structures.
- Productivity averaged 1.54 young per active nest, and was higher (1.53) in the Atlantic coastal region compared to the Delaware Bay region (1.37) (Figure 1). This represents a much higher success rate than the population has had in recent years, and a rate that is higher than necessary to maintain the population. Further, this is the first time in about nine years that Atlantic coastal nests produced at a higher rate than the less-populated Delaware Bayshore; we suspect that prey levels improved in 2005 on the Atlantic shore.
- 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:
- While we do not have a new population count, we conducted ground surveys in all the major nesting areas, documented and recorded new and existing nest locations, and recorded nest success and productivity at all surveyed nests. Productivity was above average in 2005 in both the Atlantic and Delaware Bayshore osprey colonies, thus we suspect that prey resources were more favorable than in recent years.
- 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.
- Human disturbance may pose a threat if it occurs during the most sensitive portions of the nesting season, particularly during egg-laying and incubation.

Recommendations:
- Conduct a population census every three years (next survey due in 2006) to monitor population changes statewide and regionally. Maintain integrated databases on the population and nest locations.
- Continue to measure productivity of ospreys to monitor regional conditions and changes (e.g., Atlantic vs. Delaware Bay regions, and Atlantic subregional comparisons).

- Continue to collect addled and unhatched eggs for archiving for monitoring contaminant levels regionally and statewide.
- Gather information on fisheries trends (particularly menhaden and flounder species) for potential correlation with osprey population parameters.

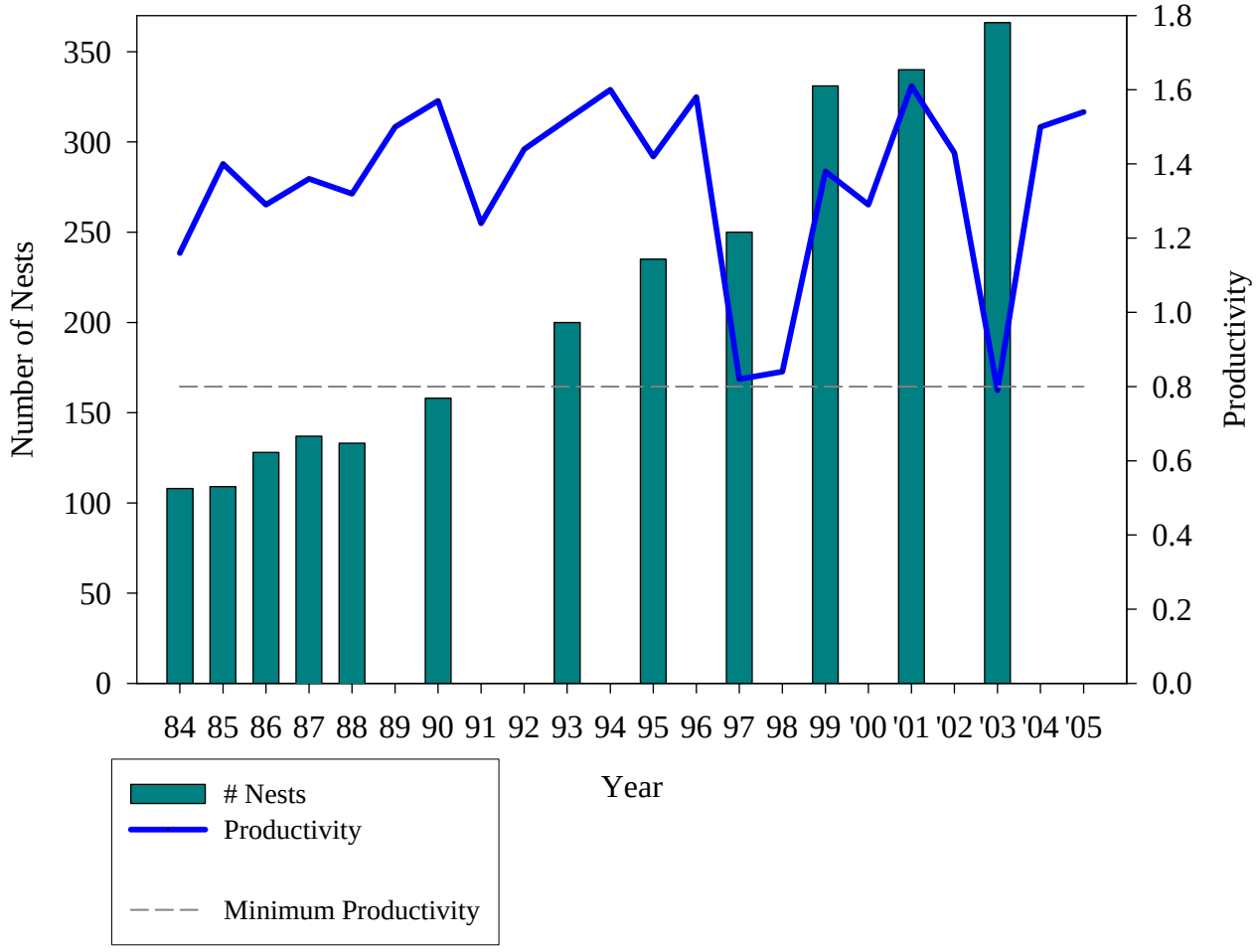

Figure 1. Osprey population and productivity in New Jersey, 1984-2005.

JOB 1E: Colonial Waterbirds

OBJECTIVE: To determine statewide distribution and nesting populations for New Jersey's state listed, special concern, and regional priority colonial nesting waterbirds, including long-legged wading birds, gulls, and terns.

Key Findings:

- An aerial survey of long-legged wading birds was conducted during the last week of May, 2005. Because osprey surveys were not conducted this year, the survey was not conducted in conjunction with the osprey survey as originally planned, but was conducted as a separate survey. The survey was conducted using same methodology as used in past surveys, including the 2004 survey, but due to budgetary constraints, the 2005 survey was limited to the area from Cape May to the Rt. 72 Manahawkin Bridge. This area accounted for about 92% of the total nesting birds and 88% of the long-legged wading bird nesting sites counted in 2004. Comparison with the 2004 counts for the same survey area showed a net increase of 1530 birds (all species), representing a 37% increase. Higher counts were obtained for 5 of the 8 species surveyed with most of the increase due to greater counts of great egrets, snowy egrets and black-crowned night herons. Lower counts were obtained for cattle egret, tri-colored heron and glossy ibis. Birds were counted at 7 fewer colonies in 2005 than in 2004.
- We began retrospective analysis of colonial waterbird data using data from 1985 to present. This was the first time a long-term analysis was attempted and inconsistencies in the data were revealed. We have taken on the task of standardizing data for the 260+ colonies over the 30-year survey period and expect to complete the analysis once the information is quality-checked and in uniform format. We collected habitat data on all sites surveyed in the aerial survey, and this will be included in our analysis.
- Flight line counts were conducted at four long-legged wading bird colonies. Each colony was surveyed three times across sunrise, sunset and tide cycles. The counts were conducted within 3-5 days of the aerial survey to allow as much direct comparison as possible. Results revealed the presence of dark colored wading birds at colonies that were missed on the aerial survey. The survey was conducted after nests began to hatch, so double counting was a concern as adults repeatedly entered and exited the colony as they fed their young. No differences were seen at different tide levels, but time of day was correlated to the numbers of birds entering or exiting (most of the species had larger exoduses in the morning, and returns in the evening).
- Post season nest counts were conducted at each of the four colonies that were included in the flight line survey. Now in their second year, these counts continued to reflect undercounting in the aerial survey. An additional finding this year was that the nests do not seem to persist one season to the next, as total nest counts and nest locations this year varied greatly from last year. This helped to alleviate concerns that we were counting nests from past seasons, and suggested that nest counts may have accurately reflected the number of nesting adults. Nest counts revealed unexpectedly high use of common reed (*Phragmites australis*) as a nesting habitat. We were unable to differentiate the nests by species, and made one "total" count that was adjusted by a mark-recount method.
- We applied the species ratios of the flight line counts to the nest count data to estimate the number of nests attributed to each species in the colonies. Because the aerial survey appeared to underestimate species totals, especially of dark birds, we did not see the same species composition ratios from each method. However, the same basic species relative importance emerged from the aerial and the flight line/nest count methods, allowing us to determine the species that dominated the colonies.
- The great blue heron survey was completed separately from the coastal waterbird survey, since most of the colonies were located inland. The survey took place over three periods- (incubation, brooding and post nesting) to allow surveyors to obtain counts of adults, nestlings, fledges and nests. The majority of colonies (61%) were located in the northern portion of the state. Preliminary results showed that of the 66 known colonies, at least 29 were active. The population count was approximately 479 adults producing at least 89 fledges. Final numbers will not be available until all data has been submitted from observers, but active colonies, total adults are expected to rise in comparison to the last survey conducted in 2000-01.
- Appeals for great blue heron nesting data in southern New Jersey yielded no new colonies, although there continues to be a conspicuous gap in the number of nests/colonies in Cape May and Cumberland counties (both at zero).

Conclusions

- The higher counts obtained for most long-legged wading bird species during the 2005 aerial survey suggests that the timing of the 2005 (last week of May vs. 2nd week in June) was probably a more suitable survey period.
- The disparity in the population estimates for the sampled colonies among the different methods continued to be significant, and therefore we were still unable to find a method that united all the data into one population estimate. This conclusion reinforces the complexity of estimating colonial waterbird populations. Unlike other species based surveys, we cannot easily view the subjects, or keep detailed observational notes on a daily or weekly basis. Therefore, although the "snapshot in time" aerial method prevents us from collecting the most accurate data, it remains our best method as time, logistical and monetary constraints prevent us utilizing any other method.
- Great blue heron surveys are performed every five years. Final conclusions cannot be made until all data is returned, but preliminary data suggested that the number of active great blue heron colonies remains steady (compared to 18 in 1996 and 34 in 2001).

Recommendations

- Conduct biennial or triennial aerial surveys of long-legged wading birds timed to coincide with the peak incubation period for these species.
- To reduce the probability of double/multiple counting of adults feeding young during flight line surveys, counts should be undertaken during peak incubation periods.
- Continue to investigate methods to synthesize and bias-correct the data from these multiple survey methods and determine the most efficient and effective method(s) to estimate colonial waterbird populations in coastal New Jersey.
- The discovery of new great blue heron colonies should be made a priority especially in Cape May and Cumberland Counties where suitable nesting habitat exists in close proximity to suitable foraging habitat. The lack of known colonies may reflect an observer bias, and dedicated survey efforts should be concentrated in these areas. If there are no colonies found in these areas, investigations to determine factors involved in their absence should be considered.

Job 1F: Shorebirds - Conservation of Red Knot; Delaware Bay

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 of coastal habitats, and monitoring abundance and condition of priority shorebird species.

Key Findings:

- Aerial bay-wide surveys showed the number of shorebirds stopping over on Delaware Bay in May 2005 increased slightly, from 13,315 in 2004 to 15,345 in 2005. However, over the long-term, the red knot population on the Delaware Bay migratory stopover has declined 84 percent, from 95,000 individuals in the late 1980's to 15,345 individuals in 2005. The greatest declines have been observed more recently -- the red knot population declined by 70 percent between 1998 and 2005, from 50,360 to 15,345 individuals, respectively.
- Shorebird weight gains in 2005 were well below the average for the period 1997 to 2004. In 2004, the combination of warm water, calm weather and restriction of all harvest during the spawning period produced good crab spawning activity during May. We estimate that 66% (8,844) of the 13,315 red knots that came to Delaware Bay made threshold departure weight of 185 g – the minimum necessary to continue migration and arrive in the Arctic in good breeding condition. In 2005, there were not sufficient eggs available to shorebirds although crab spawn and shorebird migration occurred simultaneously and crab harvest restrictions remained in place. We estimate only

14% (2,148) of the total 15,345 red knots that came to the bay made threshold departure weight of 185 g.

- Horseshoe crab eggs densities on Delaware Bay beaches decreased in 2005. While spawning events in 2004 and 2005 were well-timed with shorebird migration, the density of eggs available to shorebird declined from 2,989/m^2 in 2004 to 1,548/m^2 in 2005. The mean egg density in 2005 is consistent with the lower egg densities recorded in New Jersey throughout the period 2000 to 2005.

Conclusions:

- In 2003 through 2005, we witnessed a shift of migrating red knots and other shorebirds away from Delaware Bay because of the decline of the horseshoe crab egg resource. Evidence of this shift came from two sources: counts of red knots in migration through Delaware Bay in May fell to 16,255 and 13,315 in 2003 and 2004, respectively, while counts on wintering grounds in Tierra del Fuego remained stable at approximately 30,000 individuals during the same period. However, in February 2005, the wintering red knot population declined by 43% mirroring decline observed on Delaware Bay two years prior. We believe the decline in the red knot wintering population was caused by increased mortality in red knots that bypassed the Delaware Bay. Individuals that bypassed the Bay had little probability of achieving sufficient weight gains (≥ 185 g) in a short period of time on other available food resources (mussel spat and small clams). Knots that leave the bay at lower weights experience reduced survival (Baker et al. 2004).
- The loss of the horseshoe crab population, and abundant food resources for shorebirds in the form of crab eggs, has lead to an overall decline of shorebirds stopping over on the Delaware Bay. Peak numbers of red knots, ruddy turnstones and sanderlings have declined from just over 233,000 individuals in 1982 to 71,000 birds in 2005.
- In 2005, we estimate that only 14 % of the red knots leaving Delaware Bay were adequately prepared for migration to Arctic breeding grounds.
- The unstable and declining conditions on the Delaware Bay stopover, coupled with the vagaries of Arctic breeding, have removed much of the flexibility this migration/breeding system once had to absorb extreme events such as those witnessed in 2003 (complete spawning failure) and 2004 (total reproductive failure because of severe Arctic conditions). In 2005, conditions for spawning were favorable and spawning was well-timed with shorebird migration, however, the majority of red knots failed to gain sufficient threshold departure weights because of low egg densities. This indicates the stopover is continuing to deteriorate and is incapable of supporting even a reduced migratory shorebird population.
- Finally, preliminary results of horseshoe crab population studies have indicated the population is depleted and continuing to decline. We suggest heavy harvests of adult horseshoe crabs that occurred from 1995 through 2000 are now being expressed in reduced spawning and severely reduced egg densities on Delaware Bay beaches. We do not anticipate increases in egg densities for several years unless dramatic action is taken to increase the horseshoe crab population.
- Recent horseshoe crab harvest regulations are not adequate to halt the decline of the spawning horseshoe crab population.

Recommendations:

- We 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.
- Further harvest reductions, or optimally, a moratorium, will be required to increase crab egg densities to a level that will halt the decline of red knots and other migratory shorebird populations. If a harvest reduction or moratorium is formed, the ENSP must continue to monitor the weights and migrations of the knots to evaluate improvement or continued decline in the population.
- Control of recreational use via beach closures have been appropriate and should be expanded and continued well into the future.

- Habitat improvement, particularly bay beaches, is being incorporated into environmental planning. Plans are currently in review to restore Reeds Beach to produce better spawning habitat for horseshoe crabs and increase foraging/roosting areas for shorebirds. This work will require careful monitoring to document the effects of restoration on crabs, birds and invertebrate communities and must be underpinned by the data collected through this project.

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

OBJECTIVE: Monitor nesting density of red knots (*Calidris canutus rufa*) and other shorebird species on Arctic study site to assess factors affecting breeding. Nest density for Delaware Bay migrants (red knots) and non-Delaware Bay migrants (e.g., American golden plover and others) will be compared to assess *in situ* and external factors affecting breeding density.

The population decline of red knot resulted in steadily declining breeding densities of red knot. Based on this trend and the fact that intensive field effort in 2004 yielded few nests, we devoted study effort in 2005 to completion of predictive model of red knot breeding habitat and analysis of field data gathered between 2000 to 2004 including nest site and landscape-level habitat data.

Key Findings:

- Breeding densities of red knot on our study site on Southampton Island declined by 53 percent during the period 2000 to 2004 while breeding density of American golden plover remained relatively from 2001 to 2004.
- In 2005, the potential breeding habitat model for red knot was refined by New Jersey ENSP and Rutgers University using remotely-sensed land-cover characteristics, ground data and aerial telemetry data from 1999 through 2003. The model showed that red knot breeding habitat is generally found at elevations <150 m above sea level, <50 km from the coast and where vegetation cover is <5%, (Figure 1).
- Twenty-one red knot nests on Southampton Island were found on average to be within 360 m of a glacial ridge/esker and within 200 m of a wetland (Niles *et al.* in prep.). Red knot nests also tend to be widely separated, located between 0.75 km and 1.5 – 15 km apart.
- On Southampton Island, nests were most often found on small patches (~0.5 m diameter) of mountain avens. Nests were located in exposed areas of glacial/shattered rocks and mudboils. The amount of vegetative cover averaged 33% within 1 m of the nest and 25% within 10 m of the nest (Niles *et al.* in prep).
- In 2005, isotope analyses of red knots captured on Delaware Bay and subsequently relocated via radio telemetry in the Arctic indicate that at least two individuals were likely to have wintered in Florida or northern Brazil. This has important implications for our understanding of distinct wintering populations, distinct breeding locations of these populations, and potentially the genetic distinction, if any, of these populations (*rufa* vs. *roselaari*). Up to this time, it was believed (anecdotally) that the wintering population of red knot in Florida were comprised of the *roselaari* subspecies and these birds bred in Alaska mainly on the evidence that few knots color marked in Florida/George were ever resighted in migration on Delaware Bay. Second, knots breeding on Southampton Island were, up to know, believed to be Tierra del Fuego knots. The results of this recent isotope analysis, at the least, suggest some Florida knots may be nesting in the eastern Arctic. This leaves open several questions: 1) do breeding areas of Florida/northern Brazil knots overlap with Tierra del Fuego knots?, 2) are Tierra del Fuego knots breeding in the western Arctic? 3) are these populations geographically distinct (wintering/breeding) and genetically distinct (i.e., *rufa* and *roselaari*)?

Conclusions:

- The stability in the density of American golden plover nests indicates that conditions on arctic breeding grounds are not responsible for the decline in the density of knot nests. It is highly

likely that decline in breeding density is resultant from adult mortality and reduced reproductive success, and this trend mirrors the overall population decline observed on the winter population (see Job 1H Conclusions) and on the Delaware Bay migratory stopover.

- The potential habitat model has been validated and will be applied to the entire Arctic to delineate the areas with highest probability of breeding. For the first time, researchers have a tool to greatly narrow the search for red knots breeding areas. Coupled with isotope and genetic analyses, we can identify breeding areas for of Florida/northern Brazil and Tierra del Fuego wintering populations and, whether these differences represent distinct breeding/wintering populations and/or distinct subspecies.

Recommendations:

- Continue to monitor red knot and Am. Golden plover breeding densities on Southampton Island every other year. Collect feather samples for isotope and genetic analyses to determine wintering areas (isotopes) and potentially differentiate C.c. *rufa* and *C. c. roselaari* subspecies (genetics).
- Establish a study site on King William Island to develop baseline data as above.
- 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 (*Calidris canutus rufa*) and Hudsonian godwits (*Limosa haemastica*) on wintering grounds in Bahia Lomas, Chile, and Argentina; monitor recruitment of immatures into the population, assist Chilean, Argentine and Brazilian biologists to 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, and increase local awareness of important shorebird habitats.

Key Findings:

- The primary wintering area of the *rufa* subspecies of the red knot is now restricted to three sites on the main island of Tierra del Fuego. In recent years, about 70% of the population has been found in just one bay, Bahía Lomas in Chilean part of the island, with the most of the remainder at Río Grande in the Argentinian half of the island with smaller numbers at Bahía San Sebastián. In the mid 1980s, the population numbered 67,000 and the wintering area extended northwards along the Argentinian coast from Tierra del Fuego to Río Negro province. Now, the population is not only confined to Tierra del Fuego and has decreased to only 17,653 in 2005. Alarmingly, the population in Tierra del Fuego declined by 43 percent between 2004 and 2005, from 30,778 to 17653.
- In 2005 84 red knots were individually marked for survival analyses. There were no juvenile red knots captured. This is the first year where the ratio of juveniles to adults fell below 5%.

Conclusions:

- The southern South America population of red knot is declining precipitously and has disappeared from all wintering areas in Argentine Patagonia. The population is now confined mainly to three proximate sites. While there appears to be no danger from development or human disturbance, oil spills are an ongoing threat and have the potential to be catastrophic. Bahia Lomas received RAMSAR designation in 2005 is also designated as WHSRN site, however, greater support for protection of these wintering areas must be achieved to recover the red knot population.

Recommendations:

- Continue yearly aerial census of wintering population to monitor change.

- Continue to individually mark birds for ongoing survival analyses and to monitor recruitment into the adult population.
- Continue efforts to establish the research and education center on Bahia Lomas, which is in final negotiation.
- Continue collaboration with Chilean biologists both in academia and the federal government to 1) elevate the conservation importance of Bahia Lomas, and 2) establish a Chilean banding team to take over work on red knot and other shorebirds in Bahia Lomas.

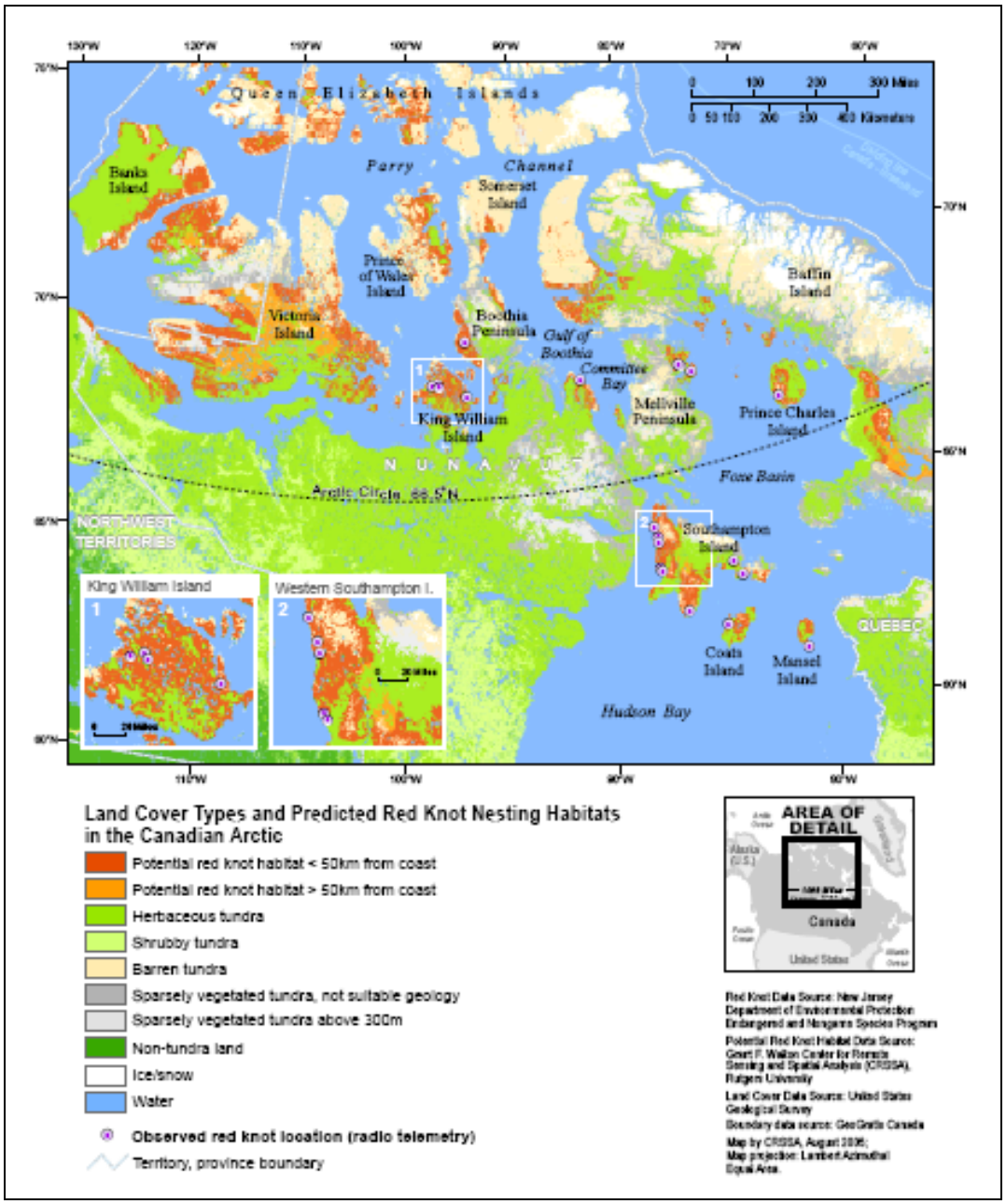

Figure 1. Predicted red knot nesting habitats based on land cover types in the Canadian Arctic and point locations of red knots obtained by radio telemetry.

JOB 2: Species of Special Concern

JOB 2A: Techniques for Bird Population Monitoring

The goals of this project, also called the Citizen Science Program, are to protect New Jersey's birds, mammals, other animals, and plants, especially endangered and threatened species, to assess various methodologies of population monitoring and survey techniques, and to foster environmental awareness among New Jersey's citizens through active participation of population monitoring. These goals are accomplished through the collection of species abundance and distribution data by interested New Jersey citizens, under the direction of professional biologists. These data can provide insight into population trends, breeding ecology, and migration patterns, and be used to promote habitat preservation and develop management strategies by improving our knowledge of the ecology of New Jersey's wildlife. The project consists of two survey strategies including migratory shorebird surveys and bird-banding initiatives.

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 May- early June 2005 (spring migration) and mid-July to November of 2005 (fall migration).
- Surveys were conducted by seventeen returning volunteers and eight new volunteers recruited through postings at New Jersey Audubon Society (NJAS) centers and website, and word of mouth.
- Four training workshops were held, two in both April and July at various locations (NJAS's Plainsboro Preserve, the Center for Research and Education in Cape May, and Stockton College). A total of 17 citizen scientists, a biologist with the NJ ENSP, and two biologists with the USFWS participated in these workshops. In addition, students in the NJ Governors School for the Environment participated in the fall training and undertook shorebird counts during the months of July and August.
    - New participants were trained in shorebird identification, bird survey methods, and the counting protocols. Returning participants reviewed the information and shared their experiences. An information packet and CD with shorebird photos and project materials were provided to each participant at the end of the workshop.
- Volunteers conducted surveys during the 2005 spring and fall shorebird migration.
    - 22 volunteers, conducted spring shorebird migration surveys, 1 count per week for a total of 4 weekly surveys between May 7 and June 7, 2005, 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.
    - 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 spring migration survey.
    - Volunteers submitted regular reports to the Citizen Science program and maintained contact with the NJAS through e-mail, telephone, listserve and facsimile.
- During the spring 2005 counts, a total of 36,418 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, and Avalon.

- Maximum numbers of shorebirds seen during a single count were 2500 at Gandy's Beach; 1309 birds at Avalon; 1300 at Bivalve; 1032 at Strathmere-Sea Isle; 984 at Holgate; 750 at Thompson's Beach; 507 at Two-mile Beach (Cape May); and 404 at North Brigantine.
- Maximum numbers of Red Knots were seen at Holgate (196), North Brigantine (150), and Gandy's Beach (150).
- Data from the fall migration survey are still being collected. Based on preliminary data, a total of 48,103 birds were seen. Of these, 23,423 were seen at Stone Harbor; 9,324 at Malibu Beach; 8,965 at Two-mile Beach; and 5,346 at Bivalve.
- Based on preliminary data, the maximum number of birds of a species seen per site were 2,150 (Red Knot) at Stone Harbor; 3,000 (Sanderling) at Malibu Beach; 2,447 (Sanderling) at Two-mile Beach; and 2,050 (Semipalmated Sandpipers) at Bivalve.

Conclusions:
- Citizen Science, with appropriate training, is an efficient way to collect this type of information.
- 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 spring and fall 2006.
- Expand the surveys to include behavioral observation of shorebirds to determine the effects of human disturbance on these birds.

Coordinated banding of birds in New Jersey

OBJECTIVE: Develop a plan with the USGS-Bird Banding Lab for monitoring bird populations using bird banding on a broad scale in NJ.

Key findings:
- NJAS and ENSP organized a meeting with master banders in the State of New Jersey on August 2, 2005 at Plainsboro Preserve. The majority of the experienced Master banders that attended the meeting are unable to handle more volunteers at this time. Several issues were addressed during this meeting.
    - Discussion regarding how to address the need for an increase in the number of banders in New Jersey continued with no resolution at this time.
    - Discussion regarding training new banders through the use of current experts and existing banding stations continued. This remains a potential hindrance as there are a limited number of experienced banders who have mentoring openings available.
        - American Banding Council certification is not necessary for somebody to obtain a master banding permit, however, in order to receive a banding permit one must mentor under an experienced master bander.
    - Banders are interested in increased coordination and networking with other banding efforts in New Jersey

Conclusions:
- It will take several years for this program to come to fruition as the NJAS and the ENSP envision it due to the extensive training/ mentoring process (a minimum of 1-2 years) to become a master bander.

Recommendations:
- Assess what is feasible in a volunteer banding project with a limited number of banders.
- Recruit master banders who can assist with this project

JOB 2B: Scrub-shrub/Open Field Passerines

OBJECTIVE 1: 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. Initial work focused on the golden-winged warbler (*Vermivora chrysoptera*) as a species of state and regional concern. We propose to incorporate for this year the following species: common nighthawk (*Chordeiles minor*), least flycatcher (*Empidonax minimus*), horned lark (*Eremphila alpestris*), yellow-breasted chat (*Icteria virens*), blue-winged warbler (*Vermivora pinus*), eastern towhee (*Pipilo erythrophthalmus*), prairie warbler (*Dendroica discolor*), field sparrow (*Spizella pusilla*), indigo bunting (*Passerina cyanea*), brown thrasher (*Toxostoma rufum*), gray catbird (*Dumetella carolinensis*), whip-poor-will (*Caprimulgus vociferus*), and chuck-will's-widow (*Caprimulgus carolinensis*). Goals include: inventorying and monitoring populations, specifically to conduct a monitoring program to track population trends not covered adequately by the Breeding Bird Survey, the identification and preservation of critical habitat, identification of specific threats at these sites, and the development of best management practices.

Key Findings:

- In 2005, biologists continued surveys from 2003-2004 in three study areas located in Sparta Mountain and Weldon Brook Wildlife Management Areas and expanded the study area to include parts of the Pequannock Watershed.
- From April – July 2005, nine individual male golden-winged warblers were identified: two individuals had been banded in 2003, one in 2004, and five were banded in 2005.
- Twelve golden-winged warbler nests (at least one parent golden-winged warbler) were monitored with 8.5 breeding pairs total (one male mated with 2 females).
  - Five (41.7%) of the twelve golden-winged warbler nests fledged 23 chicks total for a productivity rate of 2.70. All of the nests that failed had been depredated. The average clutch size for the twelve nests was 4.9. One nest contained two cowbird eggs and four golden-winged warbler eggs.
  - Eight nests of six pairs (both parents golden-winged warblers) were observed. Four of the eight nests (50%) fledged 19 chicks for a productivity of 3.17.
- No hybrids were observed in 2005. However, three mixed pairs (4 nests) were observed breeding (one parent golden-winged warbler, the other parent blue-winged warbler).
  - One of the four mixed pair nests (25%) fledged 4 chicks for a productivity of 1.33.
- Golden-winged warbler territories in 2005 tended to be in wet areas (χ^2=13.98, P<0.001) with less herbaceous cover (χ^2=5.24, P=0.022) and more shrub cover (χ^2=3.97, P=0.046) and overall vegetation height (χ^2=5.29, P=0.021).
  - Combining vegetation characteristics for all years in analyses show golden-winged warblers again to occupy wet areas (χ^2=14.39, P<0.001) with less herbaceous cover (χ^2=12.66, P<0.001) and greater overall vegetation height (χ^2=19.47, P<0.001), but with and less canopy cover (χ^2=6.20, P=0.013) and more dead vegetation cover (χ^2=4.21, P=0.040).
  - Kruskal-Wallis analyses of 2003 – 2005 vegetation data show that all the vegetation characteristics except percent dead cover differed between years: 2005 contained a higher percentage of herbaceous cover but was intermediary to 2003 and 2004 with percent shrub and canopy cover, vegetation height, and number of wet areas.
- Thirty-one blue-winged warbler males were observed within the study sites in 2005.
  - Six blue-winged warbler nests (both parents blue-winged warbler) from six pairs were located and monitored in 2005
  - Four nests (66.7%) fledged 19 chicks for a productivity of 3.17. The average clutch size was 4.8.
  - Blue-winged warblers tended to occupy areas with greater shrub cover (χ^2=26.09, P<0.001).
  - Twenty-two nests of ten species (other than golden-winged warblers) were located and monitored in 2005.

- Eleven (50%) of the 22 nests located and monitored fledged, ten (27%) were depredated, and one (4.5%) abandoned. Clutch sizes for the 22 nests ranged from one to six with an average of 4.33. The productivity rate was 2.13 (47 fledged).
- Two (9%) of the 22 nests contained a cowbird egg or chick (both field sparrows).

Conclusions:

- Although there has been little recovery in the population of golden-winged warblers using the Sparta Mountain area since the drop-off after 2003, these data show that the utility rights-of-way are not population sinks in terms of golden-winged warbler productivity.
- 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, or a combination of these factors.

Recommendations:

- Continue to monitor reproductive success and site fidelity of golden-winged warblers and other scrub-shrub birds on utility rights-of-way.
- Work with utility companies and land managers to conduct experimental studies to determine characteristics of source habitats and the best methods for maintaining them.
- Use results of experimental work to recommend Best Management Practices by utility companies and land managers, to improve existing habitat for golden-winged warblers and discourage blue-winged warblers.
- Collaborate with utility companies, researchers, and land managers to identify priority areas where best management practices for scrub-shrub species are needed.
- Develop survey methods that better assess productivity.
- Continue to assess threats to scrub-shrub birds, including habitat loss/conversion, succession, edge-effects and predation.

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 2005, biologists mist-netted for the 12th year in Bear Swamp, Cumberland County for approximately 410 net hours on seven different days from May through August.
  - 81 different birds of 19 different species were mist-netted, seventy-six of these were new captures (65 banded) and 20 were recaptures from previous years.
  - The majority of the birds netted were wood thrushes (17), followed by worm-eating warblers (12), common grackles (8), ovenbirds (7), black-and-white warblers (6) and Acadian flycatchers (6), red-eyed vireos (5), and Kentucky warblers (4).
- The mean species abundance in Bear Swamp is 66.75 (± 9.07); mean species richness is 17.25 (± 1.38)
- The species abundance in 2005 was the highest and richness the 2nd highest since the first year of mist-netting in 1994.
- Species composition has not changed significantly.
- The trend in species abundance and richness has a slight negative tendency but is not significant.

Conclusions:

- Bear Swamp appears to be a stable community for forest birds.

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.

NEED: A number of bird species presently have Regional Priority status according to national plans (e.g., U.S. Shorebird plan, Partners In Flight, etc.). The populations of these species are threatened by habitat loss and human encroachment. Additional research must be conducted to determine their population status, develop management strategies to promote stability and prevent further population declines, and reduce the possibility of them being listed.

JOB 3A: American Oystercatcher

OBJECTIVES: Determine statewide distribution of wintering and nesting populations of American oystercatcher (*Haematopus palliates*), threats, and protection strategies. Collect macro-habitat information for use in future predictive modeling.

Key Findings:

- American oystercatcher breeding surveys were conducted at all barrier/bay island beach strand sites, primarily in conjunction with piping plover breeding surveys (conducted at least 3 times weekly). A total of 64 nesting pairs were identified at 21 beach nesting sites. Data was not collected/reported for Little Beach Island, an undeveloped barrier island that is part of the Edwin B. Forsythe NWR, although nesting likely occurred at this site. Nearly all the beach sites where oystercatchers were present as breeders also had other beach nesting bird species present. A quarter (25%) of the nesting pairs hatched young. Productivity was 0.23 chicks fledged per pair. Predation and flooding appear to be the primary limiting factors influencing productivity.
- Although a comprehensive statewide survey of marsh nesting oystercatchers was not conducted, a comparison of breeding success of beach vs. marsh nesting pairs was completed at selected sites as part of a graduate level research project being conducted at Rutgers University (which was funded through 2005 SWG). The sites selected for the study were 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 Barnegat Dredge (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 eleven (111) pairs of oystercatchers defending territories were identified at the research sites. The distribution of oystercatchers across the sites was as follows: Stone Harbor – 34 pairs, Holgate – 28 pairs, and Island Beach – 49 pairs. The distribution of oystercatchers across habitat types was as follows: barrier beach habitat – 34 pairs, salt marsh habitat – 53 pairs, and isolated islands (Champagne and Gull Islands) – 24 pairs. Productivity was 0.18 fledglings per pair when data from all sites were

pooled. Productivity was highest for oystercatchers breeding on isolated islands (0.33 fledglings per pair). Oystercatchers breeding in barrier beach habitat had lower productivity (0.24 fledglings per pair). Productivity was lowest for oystercatchers breeding in salt marsh habitat (0.08 fledglings per pair). Productivity varied between study sites as well. Productivity was highest at Stone Harbor (0.38 fledglings per pair), the next highest productivity was at Island Beach (0.12 fledglings per pair), and the lowest productivity was at Holgate (0.04 fledglings per pair).

- Eleven (11) adult and 12 juvenile oystercatchers were marked with color bands during the breeding season following protocol consistent with other states along the Atlantic Coast and as established by the American Oystercatcher Working Group. Adults were captured using decoys and noose-carpets placed near nest scrapes on breeding territories. Juveniles were captured with a dip net just prior to fledging.
- Two separate surveys of wintering oystercatchers were conducted: 1) a one-day (December 3, 2004) aerial survey of the back bay and outer coast within an hour of high tide to determine overall population and distribution 2) follow-up ground surveys (conducted December 6-16, 2004) that attempted to determine the total number of birds present, the ratio of adults and juveniles, and the presence of banded individuals. The aerial survey was conducted, in part, to replicate a first-ever wintering survey conducted along the entire Atlantic coast in 2002 (November 24, 2002 in New Jersey). A total of 840 birds were counted at 8 wintering flocks on the 2004 aerial survey. Flock size ranged from 10 to 350 individuals, the largest being recorded in Hereford Inlet. This compares to 973 birds (7 flocks) during the 2002 aerial survey. The location of birds, clustered on sandbars or sandy beaches in or near coastal inlets/bays, was similar on both aerial surveys, although population distribution varied somewhat. Counts conducted during the follow-up ground surveys in 2004 were consistent with the aerial surveys, although some flocks could not be relocated during the ground surveys. Age was determined by bill color (full orange bills for adults and dark coloration in bill for immature birds). A large percentage of the two largest flocks could not be aged using this method as bills were not always visible (tucked, obscured by tightness of flock, or too distant to determine accurately). Of the 807 birds counted on the ground, only 292 (36%) could be aged. Of the total birds aged, 79% were adults and 21% were sub-adults, although percentages varied from site to site (ranging from 67% to 90% adults in some flocks).

Conclusions:

- The number of breeding pairs of oystercatcher on barrier/bay island beach strand (beach nesting portion of the population) increased in 2005 (64 pairs compared with 53 and 55 pairs, respectively, in 2003 and 2004). However, a greater intensity of survey efforts in 2005, particularly at Holgate, probably accounted much of the observed increase.
- Productivity for beach nesting oystercatchers has been fairly consistent over the past 3 years (0.28, 0.31 and 0.23 fledglings per pair from 2003 to 2005). These fledge rates appear low, but oystercatchers are a long-lived species and the productivity necessary to sustain populations is unknown.
- Beach nesting oystercatchers are primarily located where other beach nesting bird species (e.g. piping plover, least tern, black skimmer) are also present, therefore, they already receive a high level of protection from human disturbance by means of fencing and signage erected for those species.

- Although statewide surveys of breeding oystercatchers are not conducted in habitat outside of the barrier beach strand, results of research at selected sites (as well as anecdotal observations) suggest a significant portion of the breeding population may utilize other habitats, in particular marsh islands.
- Results of the statewide beach surveys identified predation as a major cause of nest failure. Furthermore, results of the research at selected sites, indicate that productivity was highest in areas where mammalian predation was lowest – particularly at Stone Harbor and 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 where both predation and flooding appear to be principal factors influencing these nest sites.
- Results of the research at selected sites 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 (18 pairs and 10 pairs, respectively). At Stone Harbor beach-nesting and marsh-nesting pairs were more evenly distributed (11 pairs and 13 pairs, respectively). However, at Island Beach the distribution between beach-nesting and marsh-nesting pairs was quite different (5 pairs and 30 pairs, respectively). The lack of any protected area on the Atlantic beach at the southern end of Island Beach State Park likely contributed to the low number of oystercatchers breeding in barrier beach habitat there.

Recommendations:

- Continue to annually monitor breeding population and productivity of beach nesting oystercatchers.
- Continue research of beach vs. marsh nesting oystercatchers at selected sites, including more thorough analysis of results.
- Although an intensive statewide breeding survey of oystercatchers across all habitats and regions is not feasible at this time, a reliable assessment of the status of the species in the state is not possible without a better understanding of overall distribution. Consideration should be given to implementing a statewide survey, including previously unsurveyed habitats associated with Delaware and Raritan Bays, over the next several years, at least on a periodic basis, possibly as part of other aerial breeding surveys (i.e. colonial waterbirds, osprey).
- Continue threat assessment with emphasis on effects of predators. Predator control, especially removal of red foxes, should be continued or may be warranted at key nesting areas such as Holgate, Stone Harbor Point, and Island Beach, if productivity is to be increased.
- In addition to predator control at Island Beach, consideration should be given to protecting the southern end of the Southern Natural Area by fencing suitable habitat. This may encourage some oystercatcher pairs to move from salt marsh habitat (where productivity is low due in part to flooding) to beach habitat to breed and could lead to a small increase in productivity at Island Beach if coupled with management of off road vehicle use to protect unfledged chicks.
- Continue to track wintering population and distribution on an annual basis through ground surveys. Ground surveys should supplant annual aerial surveys as a means of tracking winter populations, although periodic aerial surveys may be needed on a periodic basis to detect shifts in distribution.

- 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.
- Include considerations for oystercatchers in management efforts (i.e. fencing projects, predator control, etc.) that are already being implemented for other beach nesting bird species.
- Incorporate breeding and wintering data into Biotics and Landscape Project databases.

JOB 4: Migratory Stopovers

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

OBJECTIVE: The goal of this project is to develop land acquisition and management strategies that help conserve stopover habitats used by songbirds as they travel through NJ during north and southbound migrations. A stopover habitat can be defined as "an area with the combination of resources (e.g., food, shelter, water) and environmental conditions (e.g., temperature, precipitation, predators, competitors) that promotes occupancy by individuals of a given species (or population), and allows those individuals to survive" during migration. Specifically, our objectives are to: 1) identify specific areas that support high concentrations of migratory songbirds during stopovers in NJ, 2) identify habitat types in areas identified as important stopover sites, 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:
- Radar data was available and collected on 67 nights during spring 2004 and 107 nights during fall 2004 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.
- Initial data review suggested that migration events (MIG) may have occurred on 31 nights in spring and 39 nights in fall. Final review resulted in a reduced set of data (i.e., Spring: DOX, 15 nights, DIX, 11 nights; Fall: DOX, 14 nights, DIX, 18 nights) used in analyses of stopover site use.
- Image data were imported and georeferenced in ArcView 3.2©, then converted to GRID for analyses.
- ArcView Spatial Analyst© 2.0 was used to build station-specific stopover occupancy models from migration departure data by creating two composite outputs: (1) total target (e.g., birds) density during departure across all migration nights for each 1 x 1 km cell (spatial resolution of NEXRAD data) and (2) number of nights targets were detected during departure in each 1 x 1 km cell (i.e., frequency of bird occupancy).
- These two outputs were queried to generate stopover occupancy models (SOM) and overlaid onto 2001 National Land Cover Data (NLCD) to begin preliminary investigations of relationships between stopover site occupancy and habitat and landscape features.
- 30 points within the 85th percentile stopover occupancy model (SOM) area, and 30 points outside the SOM area (NSOM) , but within 30 nautical miles (nm, ~55km) of DIX and 45 nm (~73 km) of DOX were randomly selected. These were used to male comparisons of habitat (e.g., forest, agriculture, development) and landscape characteristics (e.g., habitat size, amount of edge, distance to similar habitat) in SOM and NSOM areas. The 30nm limit was used because this was the approximate spatial extent of the 85th percentile SOM for each site in each season.
- Aspects of scale that might influence stopover area use were investigated by creating 1, 3, and 5 km buffers around each point to extract data from the NLCD grids and derive "class metrics" using Fragstats 3.3.

Conclusions:
- Data from 2004 suggests that SOM and NSOM areas differ most noticeably with respect to forested wetlands, regardless of season or the investigated buffer size. SOM areas for both DIX and DOX coverage areas on average contained significantly more forested wetland habitats than NSOM areas.

Additionally, forested wetland patches were generally larger, had greater traversability, and were closer to each other in SOM compared to NSOM areas.
    - These relationships were detected in both regions, however, they appeared more pronounced in central NJ, and during the spring migration compared with fall migration.
- Large upland forest patches and agricultural patches in pasture and hay contributed to songbird occupancy at the 3 and 5 km buffers. DIX, which covers much of the Pinelands, also showed that birds appear to avoid coniferous forest habitats. Coniferous forest area and mean patch size was significantly greater and nearest patch neighbor distances significantly smaller for SOM versus NSOM buffers.
- DIX, SOM buffers had significantly less moderate and intense development, although this was less apparent in the fall. Avoidance of development was also evident in SOMs for southern New Jersey, although this was not statistically significant.
- Models developed for spring and fall 2004, were spatially congruent with models developed for the same areas using 2003 data. Generally, seasonal models, depending on threshold, showed between 60-80 percent spatial correspondence.

Recommendations:
- Continue to build and refine models exploring all threshold models to establish optimum variables.
- Explore a more detailed and robust relationship of (1) differences in habitat and landscape features between areas described by SOMs and areas outside the models (NSOM), and (2) similarities in spring and fall stopover site occupancy based on the models generated for each season.

JOB 4B: Migratory Raptors (Cape May and Ridge & Valley/Highlands)

OBJECTIVE: To monitor migrating raptor populations and their habitat use during fall migration through NJ, and to develop habitat management guidelines and informational vehicles necessary to sustain the migration.

Key Findings:
- We conducted a detailed analysis of habitat availability and trends between 1984 and 2000 using Level I Land Use/Land Cover Classification Maps prepared by Rutgers University's Center for Remote Sensing and Spatial Analysis. We calculated the loss/gain of major habitat types that occurred within the study area between the two survey periods. As was previously reported from preliminary analyses, this more extensive landscape analysis confirmed that the greatest habitat losses occurred within the lower 10 km of Cape May Peninsula, also the area of the highest concentration of migratory raptors, and within grassland habitat. Throughout the study area, habitat loss occurred in grassland (-2,046 ha), upland forest (-367 ha), palustrine wetland (-337 ha) and estuarine emergent wetland (-311 ha) habitats. Total habitat loss amounted to approximately 4.0% (-3,061 ha) of the study area.
- All observer data (species, behavior, bird altitude, bird distance, flight direction and habitat characteristics) collected from all previous surveys was quality controlled, prepared for analysis and summarized in cooperation with Rutgers University's Ecology and Evolution Graduate Program.
- Bird abundance, altitude and distance data was prepared for and analyzed by Distance, a program designed to analyze distance sampling surveys of wildlife populations. This program produced bird densities that accounted for several observer and site biases to be used in ongoing analyses.
- Analysis of overall abundance showed no significant change in the number of birds per survey observed between the two survey periods. We observed a significant increase in the number of turkey vultures (*Cathartes aura)* and black vultures (*Coragyps atratus)* and a significant decrease in the number of American kestrels (*Falco sparverius)* throughout the study area. There was a significant decrease in the number of sharp-shinned hawks (*Accipiter striatus*) observed within the lower 10km of the study area.

- A detailed analysis of distribution of migratory raptors throughout Cape May Peninsula confirmed our preliminary assumptions. Birds still concentrated near their crossing point at the southern most tip of Cape May but were concentrating in significantly greater numbers in areas further north. More birds flew at lower altitudes and were observed using habitat (hunting, perching and/or roosting) within the area of the peninsula 10-20km from the crossing point. These findings have indicated changes in distribution and habitat use by migratory raptors at the Cape May stopover that warrant further analysis of the data.
- We presented this study and key findings at several conferences in 2005 (The Wildlife Society, Ecological Society of America, Society for Conservation Biology). We discussed methodology, landscape changes and our conclusions thus far. Recommendations for future analysis were considered and will be implemented.

Conclusions:
- Analysis of landscape data obtained in 1984 and 2002 revealed a significant loss of available habitat throughout Cape May peninsula, a nationally important migratory bird stopover site. There appears to be a relationship between the areas of greatest habitat loss and the abundance, distribution and behavior of migrating raptors. This study shows that existing and future landscape changes may continue to have implications for the viability of Cape May as a stopover that supports several raptor populations in the Eastern U. S.

Recommendations:
- Complete analysis of data from this study to draw further conclusions from correlations between habitat loss and changes in raptor distribution, abundance, species richness and behavior.
- Continue to identify habitats that can be protected and enhanced to meet the stopover needs of migratory bird populations. Focus efforts on habitats that have experienced the greatest losses, such as grassland and early successional habitats.
- Based on this study's conclusions, make recommendations to land use planning agencies and state regulatory agencies to preserve and enhance habitat. Possible recommendations thus far may include the strengthening of current land use regulations within the lower 10km of Cape May Peninsula as well as the expansion of similar regulations further north along the peninsula where raptors appear to be occurring in greater densities during their migratory stopover.

JOB 5: New Jersey's Important Bird Areas

OBJECTIVE: 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 populations of birds and birding sites in New Jersey, 2) ensure the continued viability of these habitats and ecotourism sites, and 3) to raise public awareness about the value of habitat for birds and other wildlife. Important Bird Areas seek to identify and conserve sites critical to migratory, wintering and breeding birds internationally. The program was initiated by Bird Life International, and continued by National Audubon Society. New Jersey Audubon Society has been asked by National Audubon to oversee this innovative project in New Jersey.

Key findings:
- Public awareness and educational outreach encouraged public nominations of IBAs throughout NJ.
    - NJAS received 120 site nominations through the online submission website.
    - NJAS spent over 30 hours checking online database for errors and omissions to improve upon and finish incomplete nominations.
    - NJAS began reviewing and collecting additional information on all 120 site nominations.
    - Online site nomination database was reviewed and updated to reflect finalized list of 120 nomination sites.

    - An interactive map of nominated IBA sites was created and updated regularly. The map was accessible through the IBA Program website. This website continues to distribute information on the IBA Program, reaching thousands of people, stakeholders and conservation partners.
- NJAS conducted outreach programs to thousands of NJ citizens to engage and educate them about IBAs.
    - Coordinator conducted more than 20 talks reaching over 200 individuals throughout NJ to conservation organizations, birding organizations, citizen groups and at NJAS nature centers to continue education about the Important Bird Area (IBA) program.
    - Quarterly NJAS Magazine articles continued to educate and engage more than 21,000 NJAS members in the Important Bird and Birding Areas (IBBA) Program effort.
    - Feature newspaper and magazine articles were used to continue educating thousands of people about the importance of protecting habitat for birds.
    - The IBA program hosted a media event at Island Beach State Park to highlight its acceptance as an IBA. The media event was attended by individuals from partner organizations including the NJ Division of Parks and Forestry. An award was given to a local activist and wildlife biologist who has greatly contributed to conservation in NJ.
- Two IBA technical committee meetings, composed of ornithologists, state agency personnel and conservation organization personnel, were held to begin the review of 120 site nominations to determine if they meet the state-level criteria for Important Bird Areas. Twenty sites have been reviewed and accepted into the IBA program, representing the first list of approved IBAs in NJ. The remaining nominated sites are pending review.
    - NJAS is developing and implementing conservation plans on selected priority sites as we continue with the nomination process.
- A GIS committee composed of ornithologists, state agency personnel and GIS professionals was formed to develop a protocol for a state-wide IBA Habitat Analysis that will further assist with the identification and approval of IBAs.
- IBBA staff, including the IBBA GIS specialist and the IBBA Coordinator met with the GIS committee to finalize the protocol for the IBA Habitat Analysis.
- The GIS committee completed the IBA Habitat Analysis and the analysis was forwarded to Pete Winkler, ENSP GIS specialist, for review. P. Winkler will evaluate analysis to consider incorporation into Landscape Project database.
- IBBA staff, including the former IBBA Coordinator, the newly hired IBBA Coordinator, and the IBBA Conservation Planner met with partner organizations to discuss conservation objectives and identify priority IBA sites for conservation planning. We selected two IBA demonstration sites; one in the Pinelands Region and one within the lower 10km of Cape May Peninsula (Rea Farm).

Conclusions:
- Public awareness has increased over the past year with regards to IBAs and their value to migratory birds through NJAS's intense outreach effort.
- Public nominations of IBAs have assisted in quickly identifying important areas of conservation.
- NJAS is satisfied with the current accomplishments of the IBBA Program and encourages continued efforts.
- Continuation of the IBBA Program will ensure the identification of important bird habitat.

Recommendations:
- Complete the process of accepting IBAs through the technical committee.
- Delineate boundaries of accepted IBAs.
- Convene the conservation planning committee.
- Develop and implement conservation plans for priority IBAs.
- Continue to educate the public about the goals of the IBA Program and the importance of habitat conservation.

EXECUTIVE SUMMARY

Project:	**Mammal Conservation**
Federal Aid Project:	T-1-2 (State Wildlife Grants)
Segment dates:	September 1, 2004 to August 31, 2005
Total Project Expenditures:	$89,000 ($66,750 Federal, $22,250 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.

NEED: All listed species in NJ have special conservation needs due to the unique threats that are impacting their respective populations. These threats include habitat loss or alteration, contaminants, competition, predation and human disturbance. Population monitoring and threat assessments provide the basis for developing conservation strategies and recovery plans for federal and state-listed species.

JOB 1A: Bobcat Conservation

OBJECTIVE: Determine the distribution, size and habitat needs of New Jersey's bobcat population. Map suitable bobcat habitat within the state through the Landscape Project.

Key Findings:

- Bobcat trapping was conducted during February and March of 2005 in selected areas of known bobcat habitat throughout Warren and Sussex counties in northern New Jersey. The Sussex County sites included Trout Brook Wildlife Management Area and Fairview Lake YMCA Camp. The Warren County sites were located on property owned by Camp Mason in Hardwick Township and in Blairstown Township where Yards Creek flows into the lower Yards Creek Reservoir. Trapping was conducted using 19" x 19" x 48" wire mesh live traps baited with beaver meat.
- A total of 188 trap-nights of effort produced three captures at the Sussex County sites. A total of 88 trap/nights of effort at the Warren County sites produced 0 captures. Although no captures were made at the Warren county sites bobcats visited the trap at the Hardwick Township/Camp Mason location but failed to enter the trap.
- An adult female bobcat was captured at the Sussex County site on February 24, 2005. The animal weighed 17.5 lbs. and was anesthetized with .55cc of a 5:1 solution of Ketamine and Xylazine. A second dose of .5cc was administered 25 minutes after the initial dose when the animal failed to respond to the initial dose. The drug was administered to the animal while in the trap using a Dan-Inject automatic Jabstick. The animal responded to the second dose and was immobilized 19 minutes from the time of the second injection. The animal's vital signs were monitored during the entire procedure.
- The first (female) bobcat was fitted with a 295 gram Televilt GPS-Porsec™ Model 200 store-on-board collar with an internal antenna. The collar was programmed to attempt 2 GPS positions at 05:00 and 22:00 three times per week (Mon., Weds. and Fri.). The collar emits a VHF signal four times each week (Mon., Weds., Thurs. and Fri.) from 10:00 to 14:00 EST. The estimated life of the battery is 418 days (as programmed). The collars have both an activity and mortality sensor and they have an internal drop-off mechanism that is activated by a low battery. Once the collar drops off it continues to emit a double pulse at 48 ppm for 45 days, allowing recovery of the collar.
- A second female bobcat was captured at the same site on March 9, 2005. The animal weighed 11.5 lbs. and was anesthetized with .4cc of a 5:1 solution of Ketamine and Xylazine. The animal

responded to the drug and was immobilized 11 minutes from the time of injection. No collar was affixed to the animal due to its small size. The animal's vital signs were monitored during the entire procedure.

- A male bobcat was captured on March 11, 2005 at the Fairview Lake site. The animal weighed 16.5 lbs. and was anesthetized with an initial dose of .6cc of a 5:1 solution of Ketamine and Xylazine. A follow-up dose of .4cc was administered to the cat 32 minutes after the initial dose when the cat failed to respond to the initial dose. Wildlife Veterinarian, Scott Newman administered the drugs. The animal's vital signs were monitored during the entire procedure. A GPS collar was attached to the animal prior to release.
- Each cat was located using standard radio telemetry equipment and techniques at least one time per month to keep track of their location and to assure that the collar did not entered the mortality mode or dropped off of the animal. The collars were scheduled to drop off on April 18, 2006 and May 3, 2006 respectively.
- Biologists selected several habitat variables for analysis and compared habitat characteristics of areas where bobcats occurred to randomly selected areas to build a habitat selection model using statistical and GIS analyses.
- During the 2005 field season we attempted to validate the model using volunteers to set up, maintain and monitor scent station surveys with motion sensitive cameras. The environmental space was broken down into 7 habitat types: Emergent wetlands, emergent wetlands and stony soil, forested, forested and stony soil, shrub, shrub and stony soil, stony soil. Only areas that are part of public open space and a minimum of 0.25 acres in size were used. Random points at least 1 km apart were generated within each strata.
    - The study area (northern New Jersey) was divided into 10 grid cells (13 miles x 17 miles).
    - All 10 grid cells (70 sites) were surveyed in a total of 4 rounds of sampling between 3/5/05 and 7/5/05. Each round involved randomly selecting 3 grid cells (1 grid cell for the 4th round) within which to survey. Within the selected grid cells, one point from each strata was randomly selected so that 7 points from the 7 strata were surveyed within each grid cell. The cameras were set up as close as possible to these computer generated points by volunteers, who also maintained and took down the cameras at the end of the 3 week survey period.
    - Each sampling point consisted of a scent attractant (bobcat urine), a visual attractant (6" x 8" piece of aluminum flashing) hung from a nearby branch and a motion-sensitive camera.
    - Volunteers recorded habitat characteristics of the camera site and visited each site a minimum of three times during the 2 week sampling period to maintain the scent stations.
    - Pictures from the cameras were developed and the number of individuals, species, and date were entered into an Access database. Of the 70 sites surveyed, only two sites had recorded visits of bobcats.

Conclusions:

- The variables that best predicted the presence of bobcats were residential areas (negative relationship) and stony soil (positive relationship).
- The predictive model provides ENSP biologists with an insight into the amount of habitat, distribution of habitat and degree of fragmentation that is characteristic of bobcat habitat in northern NJ.
- Due to the training they received, the use of volunteers to monitor the scent post stations was a success. However, many lacked the field experience to select a suitable location to set up the scent stations. This ability varied greatly among the volunteers that participated in the study.
- It is uncertain if the low number of bobcats captured by the motion sensing cameras is due to a low population density, reluctance of the cats to approach the sets, or failure of the predictive model to accurately identify suitable habitat. .

Recommendations:

- ENSP will continue to trap, collar and track bobcats throughout northern NJ in an effort to further refine the predictive GIS model. The goal is to trap, collar and collect movement and habitat use data from 10-12 bobcats.
- ENSP is currently developing a standardized sampling regime for conducting bobcat presence/absence surveys using a trained working dog to detect bobcat scat. The data collected will be used to test and further refine the predictive model. Data from this survey will provide a better understanding of bobcat distribution within northern NJ.
- The survey method will be tested to determine whether or not individual bobcats can be identified using DNA analysis. If individuals can be identified from scat samples we will use the data to obtain abundance/density indices using mark/recapture techniques.

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)*. To protect known habitat and develop a statewide recovery plan.

Key Findings:

- Biologists attempted to conduct an internal survey of the eastern vertical shaft of Mount Hope Mine in Morris County. The western vertical shaft was internally surveyed in winter of 2004 and we confirmed the presence of wintering Indiana bats. Although Indiana bats had previously been netted emerging from the eastern vertical shaft, an internal survey had never been conducted. Several attempts in 2005 to rappel into the eastern vertical shaft and an adjacent subsidence were thwarted due to heavy ice formations and dangerous rocks and debris along the entrance to the shaft.
- With the aid of technical rope experts, biologists descended into the western vertical shaft of Mount Hope Mine in Morris County to explore previously unaccessed areas. A safety rope was set along a dangerous traverse and bolts were drilled to attach a rope for a second drop within the mine. The second rappel was approximately 40' to a short tunnel leading beneath a large pillar. This exploration, which ended at a water body of undetermined length, doubled the underground area that was accessible in the winter of 2004.
- In August of 2005, data loggers were installed in Hibernia Mine in Morris County to monitor temperature and relative humidity at Indiana bat winter roosts. Three Hobo data loggers inside the mine and one outside of the mine entrance were installed according to "Protocols for Hibernacula Temperature Monitoring" compiled by Jim Kennedy of Bat Conservation International, 2002. Data will be retrieved in the spring/summer of 2006 and monitored yearly thereafter.
- On February 23, 2005, an internal survey of Hibernia Mine in Morris County was conducted to assess populations of hibernating bats. Six species of bats were recorded wintering in the mine: 1 *Eptesicus fuscus*, 1 *Lasionycteris noctivagans*, 34,1016 *Myotis lucifugus*, 39 *Myotis septentrionalis*, 115 *Myotis sodalis*, and 2 *Pipistrellus subflavus*.

Conclusions:

- The eastern vertical shaft of Mount Hope Mine remains a verified Indiana bat hibernaculum but has yet to be internally surveyed during the winter months. The descent into the eastern vertical shaft surpasses the 135' rappel of the western vertical shaft, and likely approaches 300' before reaching the bottom of the shaft.
- Due to newly accessible underground passageways, future counts of hibernating bats (including Indiana bats) in the western vertical shaft of Mount Hope Mine could be significantly larger than populations recorded in winter of 2004.
- Hibernia Mine remains the largest bat hibernaculum and the second largest Indiana bat hibernaculum in New Jersey.

Recommendations:

- Rock and debris should be cleared from the slope leading into the eastern vertical shaft of Mount Hope Mine to allow safe access. Internal surveys should be conducted in late fall before ice forms within the shaft but after bats have entered hibernation.
- Winter surveys of the western vertical shaft of Mount Hope Mine should include the newly accessible passageways. Further exploration of the underground passageways should be attempted to assess if viable wintering bat habitat lies beyond the water body encountered in 2005.
- Continue efforts to protect the eastern and western vertical shafts of Mount Hope mines from human disturbance.
- Continue biennial counts of wintering Indiana bats at Hibernia Mine and the two vertical shafts of Mount Hope Mine.

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:

- An internal survey of Asbury Mine in Hunterdon County attempted in winter of 2005 was unsuccessful due to wood debris and rock freezing around the portal and making it inaccessible to biologists.
- On January 20, 2005, an internal survey of Roomy Mine in Passaic County documented 24 wintering bats: 3 *Eptesicus fuscus*, 13 *Myotis lucifugus*, 1 *Myotis septentrionalis*, and 7 *Pipistrellus subflavus*.
- On January 28, 2005, an internal survey of the Army Corps of Engineer tunnel located in Worthington State Forest recorded a total of 161 hibernating bats: 133 *Myotis lucifugus*, 6 *Myotis septentrionalis*, and 22 *Pipistrellus subflavus*.
- On January 28, 2005, an internal survey of the Upper and Lower Copper Mines located in Delaware Water Gap National Recreation Area was conducted. The Lower Copper Mine recorded a total of 81 wintering bats: 64 *Myotis lucifugus*, 3 *Myotis septentrionalis*, and 14 *Pipistrellus subflavus*. The Upper Copper Mine recorded a total of 182 wintering bats: 4 *Eptesicus fuscus*, 173 *Myotis lucifugus*, and 5 *Pipistrellus subflavus*.
- On January 31, 2005, an internal survey of Leigh Cave in Hunterdon County recorded a total of 377 wintering bats: 333 *Myotis lucifugus*, 15 *Myotis septentrionalis*, and 29 *Pipistrellus subflavus*.
- On February 2, 2005 an internal survey of the upper and lower Coggill Mine was conducted to document hibernating bats. The lower Coggill Mine, comprised of two intersecting tunnels, contained 26 wintering bats: 20 *Myotis lucifugus*, 2 *Myotis septentrionalis*, and 4 *Pipistrellus subflavus*. The upper Coggill Mine offered limited bat habitat and contained 7 unidentified *Myotis spp*.
- On February 7, 2005, an internal survey of Charlotte Mine in Sussex County revealed limited bat habitat due to flooding within the mine. One *Pipistrellus subflavus* was recorded.
- On February 7, 2005, an internal survey of Stirling Hill Mine in Sussex County recorded a total of 47 bats: 13 *Myotis lucifugus*, 4 *Myotis septentrionalis*, 25 *Pipistrellus subflavus*, and 5 unidentified *Myotis spp*.
- On February 9, 2005, an internal survey of the abandoned Musconetcong Railroad Tunnel in Hunterdon County recorded 125 bats of unidentified *Myotis spp*.
- Biologists worked with personnel from Round Valley State Recreation Area in Hunterdon County to develop plans to close Leigh Cave to the general public between September 1 and April 30 to

minimize disturbance to hibernating bats. Recreational cavers would still be allowed to access the cave in the summer months when threats to bats are minimal.

- As of August 31, 2005, 82% of mines classified as "high priority" have been field inspected. High priority mines are those with historical documentation of tunnels, adits, vertical shafts, or other surface openings leading to underground passageways.
- Out of 75 historical mine sites that have been field visited, 21 (28%) are safely accessible and provide some degree of bat habitat; 15 (20%) may provide bat habitat but either have access issues or require further investigation; and 39 (52%) provide no suitable bat habitat.

Conclusions:

- According to counts of hibernating bats conducted over the last two years, Leigh Cave in Hunterdon County is the third largest hibernaculum in the state. It is currently the only natural (as opposed to man-made iron mines and railroad tunnels) hibernaculum surveyed for wintering bats.
- Results of current field surveys have determined that approximately a dozen of New Jersey's abandoned iron mines provide critical habitat for populations of wintering bats. Further searches of iron mines and caves may lead to new discoveries of suitable winter bat habitat.
- The majority of abandoned iron mines 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.

Recommendations:

- Continue biennial counts of wintering bats at all known hibernacula to compile population and trend data.
- Enlarge opening to Asbury Mine in the fall before the ground freezes to ensure access for winter surveys.
- Continue ground/internal surveys of abandoned mines and caves to assess their suitability for wintering bat populations.
- Develop information for modeling of essential habitat for summer bat roosting and foraging sites.
- Pursue closure of important hibernacula to minimize disturbance to hibernating bats by installing protective bat gates.

EXECUTIVE SUMMARY

Project:	**Reptile and Amphibian Conservation**
Federal Aid Project:	T-1-2 (State Wildlife Grants)
Segment dates:	September 1, 2004 to August 31, 2005
Total Project Expenditures:	$218,000 ($163,500 Federal, $54,500 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.

NEED: The majority of New Jersey's listed reptile species have earned their status because of habitat loss (e.g. wood turtle), habitat fragmentation (e.g. northern pine snake), invasive/exotic species (e.g. bog turtle), human persecution (e.g. timber rattlesnake) and illegal collection (e.g. bog turtle). To stem further decline of these species, it is essential that a comprehensive conservation strategy be developed for each species entailing the identification of viable populations, delineating critical habitats, addressing threats through a cooperative effort among Division bureaus and other DEP offices, and establishing a long-term monitoring project for each species.

JOB 1A: Bog Turtle

OBJECTIVE: To preserve and manage populations of the federally threatened and state endangered bog turtle *(Clemmys muhlenbergii)* through establishing cooperative relationships with private landowners, managing and restoring habitats, monitoring long and short-term population trends, coordinating land acquisitions of sites threatened by adjacent land uses, determining the full extent of the species range and distribution through de novo surveys, and encouraging greater surveillance by state and federal law enforcement to help secure populations threatened by collectors.

Key Findings:

- Ongoing Mark/Recapture surveys were conducted at a total of 17 sites. A total of 58 turtles were captured (32 recaptures/26 new)
- Hatchling turtles were discovered in a portion of grazed wetland. Once a dense stand of Phragmites, controlled grazing has transformed this habitat into a low, speciose graminoid wetland. Shell fragments had previously been found in the restored wetland portion, but these were the first live hatchling captures.
- Hatchlings were found at 4 other sites indicating potential nesting in these areas the year prior. Restoration is planned at 2 of these sites and the implications of the hatchling findings will be incorporated into the management plan for these sites.
- ENSP Landscape Project GIS team identified 67 potential habitats for bog turtle without documented occurrences. Data was retrieved for 35 of these sites and integrated into the Biotics database and will be included in the updated version of the Landscape Project. Presence/Absence data will attempt to be retrieved thru existing data or new survey efforts in the next two seasons.
- A total of 23 historic/potential sites were evaluated, and two potential habitats were surveyed. These habitats were found to not be presently suitable for occupancy but potential for restoration may exist. Remaining historic sites were surveyed visually and with trapping when necessary. New or recaptured turtles were discovered at 78% of the sites. Additional survey efforts will be necessary before deeming bog turtles absent from the remaining sites.
- A revision to the current Landscape Project bog turtle model was initiated. Revisions will more fully mask element occurrences in the product and more accurately value bog turtle habitat based on new

findings and research. The revised model will be used in the upcoming release of ENSP's Landscape Project version 3.
- A total of three trustworthy citizens were trained to assist in bog turtle work for ENSP mainly conducting visual surveys. Several other individuals recognized as qualified bog turtle surveyors by the USFWS assisted ENSP with survey work including consultants from various firms.

Conclusions:
- Little new suitable bog turtle habitat is 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.
- Mark/recaptures studies continue to identify a large number of new turtles found in existing sites, including strong age class stratification.
- Future management should continue to focus on known populations but also on suitable habitats within corridors to populated sites.
- Full surveys, including trapping, should be completed at a site before deeming absence.
- Trustworthy project volunteers are indispensable in assisting the completion of project work.

Recommendations:
- Restore new habitat found for vegetation and hydrology in an effort to make suitable habitat for colonization. Monitor success of sites.
- 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 recruit trustworthy citizens to assist in bog turtle surveys.

JOB 1B: Wood Turtles

OBJECTIVE: To determine statewide wood turtle (*Clemmys 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 habitat protection strategy for viable populations, which entails landscape-level protection of riparian corridors and adjacent upland habitats.

Key Findings:
- Funding cuts eliminated the possibility for radio telemetry research this past year. Telemetry work will be completed during the 2005-2006 field season.
- Report on the effects of water quality and land use on wood turtle abundance based on 2003-2004 SWG work in peer review for internal use.
- A total of 16 wood turtle sites with element occurrences over 20 years old were investigated. New occurrences were found at 42% of these sites. Additional surveys may be necessary to determine true absence (extirpation) from the remainder of these sites.
- Site inspections were performed at seven sites for potential use in upcoming radio telemetry study documenting habitat use in differing categories of upland land use designations.
- Investigations were made into studying wood turtle nesting sites in hopes of replicating nesting habitat at impaired sites. Funding for implementation to create nesting habitat may be applied for in 2006-2007.
- New wood turtle records were assessed and entered into Biotics database.
- A total of four trustworthy volunteers were trained in wood turtle survey techniques to assist in presence/absence survey work.

Conclusions:

- Historic wood turtle sites currently provide little suitable remaining habitat, specifically in the uplands, to provide for long-term survival. Lack of nesting habitat or high egg/hatchling predation may be underlying cause.
- The creation of nesting habitat at impaired wood turtle sites, along with headstarting initiatives, may induce population growth at historic sites.
- Home range size estimates using radio telemetry at various sites of differing upland land use categories will be useful in determining management techniques for the species.
- Trustworthy project volunteers are indispensable in assisting the completion of project work.

Recommendations:
- Continue to train trustworthy volunteers to assist in surveys.
- Continue to research and evaluate nesting habitat needs for future management efforts.

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:
Pinelands region
- Four rattlesnakes were captured from the Pinelands region during the 2005 field season, unable to endure surgical implantation of a transmitter (two gravid females captured in July, and one non-gravid female and male captured late in season). One gravid female, the non-gravid female, and male were outfitted with external transmitters; the male's detached shortly after release, the females' transmitters remain in tact and have revealed two new den locations.
- Two rattlesnakes were collected after being struck by cars, and released to veterinarian for medical assistance. Both rattlesnakes survived and were returned to their capture locations.
- Two new volunteers were trained as members of the Endangered and Nongame Species Program's Venomous Snake Response Team within the Pinelands.

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 remains a priority for research to identify critical habitats (dens, gestation areas, basking areas, foraging grounds).
- During the September 1, 2004 – August 31, 2005 field seasons, nine timber rattlesnakes were tracked using radio-telemetry to locate new dens, gather critical habitat data, and identify home range territories. Two of the study snakes denned at a known den area, two denned at a suspected den site (validating the location), and the remaining five denned at three new sites.
- In spring 2005, two of the snakes' transmitters failed during the first month of emergence, a third snake's transmitter was removed due to time constraints, the remaining six snakes were tracked until early August completing a year of seasonal movement data.
- Seventeen volunteers were trained (nine of which were retrained) as members of the Endangered and Nongame Species Program's Venomous Snake Response Team within the Highlands.
- Two rattlesnakes were reported to the ENSP as killed by landowners, one will be released to H. Reinert for inclusion in DNA analysis and the other remains with ENSP awaiting potential prosecution. Two rattlesnakes were injured by landowners and provided care at a rehabilitation facility. One snake was released in late August, the second has not recovered from his injuries and will be overwintered by the rehabilitator per ENSP instruction. No rattlesnakes were reported as "dead on the road" in 2005 throughout the Highlands.

- Experienced volunteer conducted educational programs within two communities 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 thirty-six complaints on private lands during the 2005 field season.
- ENSP developed a den model to identify potential den locations using landscape characteristics of twenty-six known dens and various habitat combinations of 260 random potential den sites. This variable testing showed 84.6% (22 of 26 dens) of the habitat classification was correct and that 99.2% of the random habitat locations were correctly classified as used or unused habitat.
    - During the spring of 2005, survey of nine sites confirmed two of the locations as timber rattlesnake denning areas.
- A partnership with a non-government researcher has revealed two additional den locations within the Highlands region, one with typical [published] den characteristics, the second with atypical features.

Conclusions:

Pinelands region

- The ENSP's Pinelands Venomous Snake Response Team continues to be effective at rapidly responding to rattlesnake reports made by the general public.
- Undocumented rattlesnake dens still exist within the Pinelands Landscape Region.
- 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 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.
- 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 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.

JOB 1D: Corn Snake and Northern Pine Snake

OBJECTIVE: To conserve populations of state-endangered corn snakes *(Elaphe guttata guttata)* and 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 such as prescribed burns.

Key Findings:
- In 2005, ENSP embarked on an innovative project to survey for northern pine snakes in the New Jersey Pinelands Region. As part of this project, ENSP biologists contracted services to obtain a dog that was professionally trained to scent track pine snakes. The dog will be used to aid in field survey for this species. Dogs have long been recognized for their scent-tracking abilities, but only recently have scientists begun to use dogs to track rare wildlife for research purposes. Even though the dog came to ENSP late in the 2005 field season (after August 31, 2005), it was successful in detecting two undocumented pine snake nesting locations and found a neonate pine snake in another area. It is our goal to obtain important location/sighting information on pine snakes by scent tracking them using this dog. The sightings information obtained during this project will be used to create predictive models for pine snake and to update the Biotics database and the NJDEP's Landscape Project.

Conclusions:
- Scent-tracking dogs have been used to locate various species of wildlife. Preliminary findings suggest that the use of a scent-tracking dog can be effective for documenting new pine snake locations.

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 be used to prioritize areas for protection or acquisition.
- Test the accuracy of the pine snake models using surveys during the 2006 field season.

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

OBJECTIVES: 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:

- Using NJDEP 1995 land-use/land-cover data, a southern gray treefrog habitat model was developed. This model differed from the existing Landscape Project Mapping because it used more detailed/refined habitat classifications as the GIS based map. The predictability of this mapping was tested using 2004 survey data. The model was 73% accuracy in predicting southern gray treefrog presence (when tested against the 2004 data).
- Explorations into the use of PVC traps for surveying southern gray treefrog continued in 2005. Our study from 2004 determined that southern gray treefrogs readily use PVC pipes as daytime refugia and that they do not discriminate between black and white colored pipes. This year we investigated whether humidity or odor influenced the use of PVC pipes by this species. We tested three treatments (pipes with: 1] no water, 2] pond water, 3] fresh water). A total of 27 PVC pipes (9 replicates of 3 treatments) were set out between June 28, 2005 and October 24, 2005 and traps were checked three days each week. A total of 121 frogs were found using the pipes during this period. There was no significant difference in the number of frogs that colonized the pipes from each treatment. However, the mean number of days it took frogs to "find" or colonize pipes did significantly differ among treatments ($P<0.05$). Pipes with no water were colonized more quickly (mean = 7.1 days) than pipes containing pond water (mean = 13.4 days) or freshwater (mean = 13.8 days). These findings were opposite to our expectations.

Conclusions:

- The new southern gray treefrog habitat model appears to do a better job of predicting the presence of southern gray treefrogs.
- The use of PVC pipes is an effective method of surveying for southern gray treefrogs, even outside of the breeding season. Research over the past two years has shown that pipe color and whether or not the pipes contain water does not have an influence on the overall number of southern gray treefrogs that will ultimately colonize the pipes. However, pipes appear to be colonized more quickly if they are set out without any water in the bottom. Based on these findings, we make the following recommendations to optimize capture rates when using PVC pipes to survey for southern gray treefrog: PVC pipes measuring 18" in length, with a 1.5" inner diameter, should be attached to trees using flexible wire at a height of 5'. Pipe color did not influence capture rate so the use of black pipe is recommended since it is less visible to humans and vandalism may therefore be reduced. Pipes should be capped at the bottom, but no water should be added.

Recommendations:

- Conduct surveys to further test the predictability of the new southern gray treefrog habitat model.
- 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.
- Work with NJDEP's Green Acres Program to acquire land within the NJ range of eastern tiger salamanders. Within these acquired lands, experiment with the creation of tiger salamander breeding ponds.

JOB 5: NJ Herp Atlas Project

OBJECTIVES: 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:

- Work on the Herp Atlas Project in 2005 largely consisted of collecting survey data and entering data from 2004 and 2005 (spring surveys) into our database. Because of the bulk of data submitted as part of this project each year, it is typical for data entry to run several months behind data collection. In last year's SWG report (2004) we were only able to summarize the data findings from the previous field season (2003). This year, however, we are slightly ahead in our data entry and all data submissions up to July 2005 entered in our database. Our data entry efforts in 2005 therefore allow us to summarize from the time period of January 1, 2004 through July 29, 2005. During this period, Herp Atlas volunteers conducted general surveys throughout the state of New Jersey. Volunteers from this project submitted datasheets documenting sightings of over 27,350 reptiles and amphibians, and accounting for 59 different species.
- Data for the Herp Atlas Project are collected and compiled within Herp Atlas blocks or "sixthquad" areas (areas comprised of $1/6^{th}$ of a standard USGS quadrangle). There are 1032 Herp Atlas blocks within New Jersey, but only 711 (or 69%) fall entirely within the boundaries of the state. The remaining 321 (31%) blocks are only partially contained within New Jersey. As part of the Herp Atlas Project, ENSP has received data for 81% of the Herp Atlas blocks that are contained completely within New Jersey.
- As part of the US Geological Survey's North American Amphibian Monitoring Program (NAAMP), 50 volunteers from New Jersey surveyed 36 driving routes for calling amphibians. This data was incorporated into a state database as well as into the North American Amphibian Monitoring Program's database.

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.
- Awareness and sensitivity about reptile and amphibian conservation has been elevated through this project.
- Calling amphibian data collected in 2005 represents the fifth year that NJ has participated in the NAAMP and, according to statisticians with USGS, trend analysis with these data can now be conducted.

Recommendations:

- Continue to recruit and train volunteers to participate in the Herp Atlas Project and Calling Amphibian Monitoring Program.
- Focus Herp Atlas volunteers efforts into areas that have not been surveyed in previous years.
- 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-1-2 (State Wildlife Grants)
Segment dates:	September 1, 2004 to August 31, 2005
Total Project Expenditures:	$71,667 ($53,750 Federal, $17,917 State)

JOB 1: Federal and State Listed Invertebrates

OBJECTIVES: To conduct searches for Dwarf wedgemussels (*Alasmidonta heterodon*), Brook floaters (*Alasmidonta varicosa*), Green floaters (*Lasmigona subviridis*), and Eastern lampmussels (*Lampsilis radiata*) in previously unsurveyed suitable habitats throughout the state and to create a geo-referenced database of extant sites. Also, to protect populations through development of site management plans and to work with the Division of Watershed Management to ensure appropriate stream classifications in critical occupied areas.

Key Findings:

- We surveyed 16 stream sites in six counties for Dwarf wedgemussels, Brook floaters, Green floaters and Eastern lampmussels during the study period. Timed searches were conducted in historic locations and/or previously unsurveyed suitable habitats.
- No live Dwarf wedgemussels or Green floaters were found during the survey period. We found the right valve (partial) of a possible Dwarf wedgemussel in the Paulins Kill, Warren County, approximately eight miles downstream from the extant population's lower boundary. We are sending the valve to the NC Natural History Museum for species confirmation.
- We documented Brook floaters at two sites; Stony Brook, Mercer County (1 live specimen) and Whippany River, Morris County (1 shell). The Stony Brook site in Mercer County is upstream from where Brook floaters have been found within ten years. Our report of a Brook floater in the Whippany River constitutes a new occurrence for the species.
- One live Eastern lampmussel and two shells were found in the Whippany River, Morris County, during the survey period. One Brook floater shell (State Threatened) and numerous Eastern elliptio were also documented at the site.
- 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.
- Average EPA Habitat Assessment Field Data Sheet scores ranged from 99.0 (Willoughby Brook, Hunterdon Co.) to 151.3 (Paulins Kill tributary, Sussex Co.), 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 the Paulins Kill, Warren Co., with five freshwater mussel species present (Alewife floater, Creeper, Eastern elliptio, Eastern floater, and Triangle floater). The Paulins Kill, Sussex County and the Stony Brook, Mercer County had four species present.
- Freshwater mussels were most abundant in the Paulins Kill, Warren County, with a catch per unit effort (CPUE) for live mussels of 0.68 mussels/ minute.
- We documented occurrences of the State Threatened Triangle floater at six sites (Paulins Kill, Sussex Co.; Paulins Kill, Warren Co.; Paulins Kill tributary, Sussex Co.; Musconetcong River, Hunterdon Co.; Black River, Morris Co.; and the South Branch Raritan River, Hunterdon Co) and the State Threatened Yellow lampmussel at one site (Delaware River, Hunterdon Co). The Creeper, a State Special Concern species, was present at four sites (Paulins Kill, Sussex Co.; Paulins Kill, Warren Co.;

Wickecheoke Creek, Hunterdon Co.; Stony Brook, Mercer Co.). All listed and Special Concern species occurrences will be entered into the ENSP's Biotics database.

Conclusions:

Dwarf Wedgemussel

- Streams such as the Paulins Kill were subjected to extensive scouring over the past three seasons. It is possible that extant Dwarf wedgemussel populations may have sustained negative impacts due to sediment disruption.
- Discovery of Dwarf wedgemussels the Pequest River several years ago 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.
- If the recovered valve from the Paulins Kill, Warren County, is confirmed to be a Dwarf wedgemussel, there may be other individuals upstream of the 2005 survey site and downstream of the lower population boundary in Balesville.

Brook Floater

- 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.
- The presence of a Brook floater shell in the Whippany River may indicate the presence of an undocumented population upstream from the survey area.

Green Floater

- There is only one recent occurrence for this species 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. A new status assessment for the green floater and all native freshwater mussels should be conducted within the next year.

Eastern Lampmussel

- Although Eastern lampmussels 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 Eastern lampmussels are more common than previously thought, since lake habitats have not been the focus of past survey efforts.

Recommendations:

- Continue surveys for Dwarf wedgemussels, Brook floaters, Green floaters and Eastern lampmussels in suitable, previously unsurveyed habitats to document distribution.
- Conduct additional surveys in the Paulins Kill between Hardwick Township, Warren County and Balesville, Sussex County for Dwarf wedgemussels to determine if lower population boundary has changed.
- Monitor extant Dwarf wedgemussels in the Paulins Kill and Pequest River to determine if recent scouring negatively impacted populations.
- Perform quantitative surveys for Dwarf wedgemussels, Brook floaters, Green floaters and Eastern lampmussels in occupied stream segments with suitable substrate to estimate population abundances and determine age classes.
- Develop site management plans for critical high quality areas where Dwarf wedgemussels, Brook floaters, Green floaters and Eastern lampmussels occur and request stream classification upgrades to protect water quality.
- Perform additional qualitative surveys in the Whippany River to determine if a Brook floater population occurs upstream from the above-mentioned survey area. Also, continue surveys in the Stony Brook to determine if juvenile or young mussels are present.
- Perform a status assessment for all native freshwater mussels within the next year.
- Use SCUBA in Lake Aeroflex and other lake habitats to document Eastern lampmussel occurrences.

Yellow Lampmussel

OBJECTIVES: To conduct searches for Yellow lampmussels (*Lampsilis cariosa*) in previously unsurveyed suitable river habitats and to create a geo-referenced database of extant sites. Also, to protect

populations through development of site management plans and work with landowners to ensure long-term protection of critical Yellow lampmussel areas.

Key Findings:

- We surveyed eleven river and stream sites in six counties for Yellow lampmussels during the study period. Surveys were conducted in historic locations and/or previously unsurveyed suitable habitats.
- We located one live Yellow lampmussel and 13 shells in the Delaware River, Hunterdon Co. Yellow lampmussels had been reported at this location historically.
- 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 at nine of the survey sites, which score individual habitat characteristics (e.g. vegetative protection, bank stability, riparian zone width) on a scale of 0-20. These scores are then added together to provide a total habitat score for a given stream segment. Habitat Assessment Field Data Sheets were not used at the three Delaware River sites, since these sheets are intended to rank wadeable streams and rivers only.
- Average EPA Habitat Assessment Field Data Sheet scores ranged from 116.0 (Assunpink Creek, Mercer Co.) to 165.0 (Maurice River, Salem/Cumberland Co.), 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.
- Species richness was highest in Oldmans Creek (Gloucester/Salem Co.) and Salem Creek (Salem Co.), with five freshwater mussel species present at each site. We found Alewife floater, Creeper, Eastern elliptio Eastern floater and Triangle floater in Oldmans Creek, whereas Salem Creek had Eastern elliptio, Eastern floater, Triangle floater, Paper pondshell, and Lilliput present.
- Freshwater mussels were most abundant in Oldman's Creek (Gloucester/Salem Co.), with a catch per unit effort (CPUE) for all live mussels at 3.48/min.
- We documented occurrences of the State Threatened Eastern pondmussel at one site (Maurice River, Salem/Cumberland Co.), and the State Threatened Triangle floater at four sites (SB Raritan River, Hunterdon Co.; Oldmans Creek, Gloucester/Salem Co.-2 sites; and Salem Creek, Salem Co.). We found the Creeper, a State Special Concern species, at two sites (Oldmans Creek, Gloucester/Salem Co. and Wickecheoke Creek, Hunterdon Co). All listed and Special Concern species occurrences will be entered into the ENSP's Biotics database.

Conclusions:

- New Jersey's Yellow lampmussel population appears to be confined to the Delaware River.

Recommendations:

- Continue surveys for Yellow lampmussels in suitable, previously unsurveyed habitats to document distribution. Use SCUBA for surveys in appropriate areas of the Delaware River.
- Perform quantitative surveys (using SCUBA) in occupied stream segments to estimate population abundances and determine age classes.
- Develop site management plans for high quality areas where Yellow lampmussels occur and request stream classification upgrades to protect water quality.

Eastern Pondmussel

OBJECTIVES: To conduct searches for Eastern pondmussels (*Ligumia nasuta*) in previously unsurveyed suitable habitats and to create a geo-referenced database of extant sites. Also, to protect populations through development of site management plans and work with landowners to ensure long-term protection of critical Eastern pondmussel areas.

Key Findings:

- We surveyed thirteen stream sites in seven counties for Eastern pondmussels during the study period. Surveys were conducted in historic locations and/or previously unsurveyed suitable habitats. We located 11 live Eastern pondmussels and one shell in the Maurice River, Salem/Cumberland Co. The Maurice River is a new location for the species.
- 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. These scores are then added together to provide a total habitat score for a given stream segment.

- Average EPA Habitat Assessment Field Data Sheet scores ranged from 116.0 (Assunpink Creek, Mercer Co.) to 165.0 (Maurice River, Salem/Cumberland Co.), 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.
- Species richness was highest in Oldmans Creek (Gloucester/Salem Co.) and Salem Creek (Salem Co.), with five freshwater mussel species present at each site. We found Alewife floater, Creeper, Eastern elliptio Eastern floater and Triangle floater in Oldmans Creek, whereas Salem Creek had Eastern elliptio, Eastern floater, Triangle floater, Paper pondshell, and Lilliput present.
- Freshwater mussels were most abundant in Oldmans Creek (Gloucester/Salem Co.), with a catch per unit effort (CPUE) for all live mussels at 3.48/min.
- We documented occurrences of the State Endangered Brook floater at one site (Stony Brook, Mercer Co.), the State Threatened Triangle floater at four sites (Raccoon Creek, Gloucester Co.; Oldmans Creek, Gloucester/Salem Co.-2 sites; and Salem Creek, Salem Co.) and the State Threatened Yellow lampmussel at one site (Delaware River, Hunterdon Co.). We found the Creeper, a State Special Concern species, at three sites (Oldmans Creek, Gloucester/Salem Co.; Wickecheoke Creek, Hunterdon Co. and the Stony Brook, Mercer Co). All listed and Special Concern species occurrences will be entered into the ENSP's Biotics database.

Conclusions:

- Although Eastern pondmussels occur in small-to-mid size streams such as the Stony Brook and Raccoon Creek, there are several locations documented in the Delaware River. SCUBA divers may be necessary to adequately survey for the species.

Recommendations:

- Continue surveys for Eastern pondmussels in suitable, previously unsurveyed habitats to document distribution. Use SCUBA divers in appropriate areas of the Delaware River.
- Perform quantitative surveys in occupied stream segments with suitable substrate to estimate population abundances and determine age classes.
- Develop site management plans for high quality areas where Eastern pondmussels occur and request stream classification upgrades to protect water quality.

Tidewater Mucket

OBJECTIVES: To conduct searches for Tidewater muckets (*Leptodea ochracea*) in previously unsurveyed suitable habitats and to create a geo-referenced database of extant sites. Also, to protect populations through development of site management plans and work with landowners to ensure long-term protection of critical Tidewater mucket areas.

Key Findings:

- We surveyed twelve stream sites in six counties for Tidewater muckets during the study period. Surveys were conducted in historic locations and/or previously unsurveyed suitable habitats. No Tidewater muckets were found during the survey period.
- 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. These scores are then added together to provide a total habitat score for a given stream segment.
- Average EPA Habitat Assessment Field Data Sheet scores ranged from 116.0 (Assunpink Creek, Mercer Co.) to 165.0 (Maurice River, Salem/Cumberland Co.), 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.

- Species richness was highest in Oldmans Creek (Gloucester/Salem Co.) and Salem Creek (Salem Co.), with five freshwater mussel species present at each site. We found Alewife floater, Creeper, Eastern elliptio Eastern floater and Triangle floater in Oldmans Creek, whereas Salem Creek had Eastern elliptio, Eastern floater, Triangle floater, Paper pondshell, and Lilliput present.
- Freshwater mussels were most abundant in Oldman's Creek (Gloucester/Salem Co.), with a catch per unit effort (CPUE) for all live mussels at 3.48/min.
- We documented occurrences of the State Threatened Triangle floater at four sites (Raccoon Creek, Gloucester Co.; Oldmans Creek, Gloucester/Salem Co.-2 sites; and Salem Creek, Salem Co.) and the State Threatened Yellow lampmussel at one site (Delaware River, Hunterdon Co.). We found the Creeper, a State Special Concern species, at two sites (Oldmans Creek, Gloucester/Salem Co. and Wickecheoke Creek, Hunterdon Co.). All listed and Special Concern species occurrences will be entered into the ENSP's Biotics database.

Conclusions:
- Recent sightings of the Tidewater Mucket are limited to the Delaware River and tributaries. It is often confused with the Yellow lampmussel and may have been misidentified in the past. SCUBA divers are needed to conduct surveys in deeper sections of the Delaware River.

Recommendations:
- Continue surveys for Tidewater muckets in suitable, previously unsurveyed habitats to document distribution.
- Perform quantitative surveys in occupied stream segments with suitable substrate to estimate population abundances and determine age classes.
- Develop site management plans for high quality areas where Tidewater muckets occur and request stream classification upgrades to protect water quality.

Triangle Floater
OBJECTIVES: To conduct searches for Triangle floaters (*Alasmidonta undulata*) in previously unsurveyed suitable habitats and to create a geo-referenced database of extant sites. Also, to protect populations through development of site management plans and work with landowners to ensure long-term protection of critical Triangle floater areas.

Key Findings:
- We surveyed 25 sites in ten counties for Triangle floaters during the study period. Surveys were conducted in historic locations and/or previously unsurveyed suitable habitats. We documented occurrences of Triangle floaters at ten sites (Paulins Kill and tributary, Sussex Co.- two sites; Paulins Kill, Warren Co.; Musconetcong River, Hunterdon Co.; Black River, Morris Co.; SB Raritan River, Hunterdon Co.; Oldmans Creek, Gloucester/Salem Co. – two sites; Salem Creek, Salem Co.; and Raccoon Creek, Gloucester Co.)
- 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 site, which score individual habitat characteristics (e.g. vegetative protection, bank stability, riparian zone width) on a scale of 0-20. These scores are then added together to provide a total habitat score for a given stream segment.
- Average EPA Habitat Assessment Field Data Sheet scores ranged from 99.0 (Willoughby Brook) to 165.0 (Maurice River), 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.
- Species richness was highest in Oldmans Creek (Gloucester/Salem Co.), Salem Creek (Salem Co.) and the Paulins Kill (Warren Co.), with five freshwater mussel species present. We found Alewife floater, Creeper, Eastern elliptio Eastern floater and Triangle floater in the Paulins Kill and Oldmans Creek, whereas Salem Creek had Eastern elliptio, Eastern floater, Triangle floater, Paper pondshell, and Lilliput present.
- Freshwater mussels were most abundant in Oldman's Creek (Gloucester/Salem Co.), with a catch per unit effort (CPUE) for all live mussels at 3.48/min.

- We documented occurrences of the State Endangered Brook floater at two sites (Whippany River, Morris Co.; Stony Brook, Mercer Co.), State Threatened Eastern lampmussel at one site (Whippany River, Morris Co.), the State Threatened Yellow lampmussel at one site (Delaware River, Hunterdon Co), and the State Threatened Eastern pondmussel at one site (Maurice River, Salem/Cumberland Co.). The Creeper, a State Special Concern species, was present at five sites (Paulins Kill, Sussex Co.; Paulins Kill, Warren Co.; Wickecheoke Creek, Hunterdon Co.; Stony Brook, Mercer Co.; Oldmans Creek, Gloucester/Salem Co.). All listed and Special Concern species occurrences will be entered into the ENSP's Biotics database.

Conclusions:
- Triangle floaters were present at ten out of 25 sites that were surveyed. Although widely distributed, they are not abundant in many areas where they occur. A status change to Special Concern may be warranted in the future as more populations are discovered.

Recommendations:
- Continue surveys for Triangle floaters in suitable, previously unsurveyed habitats to document distribution. Since Triangle floaters are generalists, most stream habitats with good water quality should be the focus of survey work.
- Request stream classification upgrades in high quality areas that support Triangle floater populations.
- Perform a status assessment for the triangle floater and all native freshwater mussels within the next year.

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 2005 field season, surveys will focus on identifying new colonies of arogos skipper, frosted elfin, bronze copper, Appalachian grizzled skipper, and silver-bordered fritillary.

Key Findings:
- Frosted elfin surveys were conducted at 16 different sites in Cape May, Cumberland, and Burlington counties. Frosted elfin were observed at seven (44%) of the 16 sites surveyed. The 2005 surveys led to the identification of two previously undocumented populations of these species. Location information for these sightings were incorporated into NJDEP's rare species database.
- Deer browse on wild indigo (the larval host plant for frosted elfin) was significant within two of the documented frosted elfin habitats in 2005.
- By cruising power line rights-of-way, undocumented locations of wild indigo were identified in southern New Jersey. These areas have never been surveyed for frosted elfins, but may hold undocumented occurrences of this species.
- Surveys for arogos skippers were conducted at five sites in the Pinelands region. Positive survey results were obtained at four of these sites. No sites in northern NJ were surveyed and, due to heightened security, we could not gain access to survey the large population located on Fort Dix Military Installation.

Conclusions:
- Based on the survey results from this year, it now appears that New Jersey holds the two largest known populations of frosted elfin worldwide. The largest occurs at the Atlantic City International Airport and active management for this species has been taking place at the airport for several years. The second largest frosted elfin population was undocumented prior to the 2005 survey and a portion of this population occurs on state-owned land in Cape May County, NJ. The NJ Division of Fish and Wildlife's Endangered and Nongame Species Program is working with landowners to manage the remaining (privately-owned) portion of this site correctly.

- Frosted elfin appear to have been extirpated from a number of historical sites in New Jersey. However, a number of new occurrences where documented in 2005 and now this species is know to exist at a total of seven sites statewide.
- Viable metapopulations of arogos skippers continue to exist in the Pinelands, but population numbers are at critically low numbers. Some critical habitats for this species appear to be under going natural succession and in the absence of active management these habitats may become unsuitable for this species

Recommendations:

- Efforts to restore frosted elfin habitat should be initiated on state lands where habitat for this species has been lost. These efforts should include plantings of wild indigo, construction of deer exclosures, and the reintroduction of frosted elfin. Such efforts should be evaluated for success through habitat and species surveys for several seasons.
- In spring 2006, surveys for frosted elfin should be conducted in the newly identified wild indigo patches along power line rights-of-way in southern New Jersey.
- Where appropriate, the Green Acres Program should attempt to acquire private lands where existing frosted elfin habitat is present. On private lands where Green Acre acquisitions are not possible, ENSP must work with the landowners to ensure proper management of the habitat.
- 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.

EXECUTIVE SUMMARY

Project:	**Species Status Review**
Federal Aid Project:	T-1-2 (State Wildlife Grants)
Segment dates:	September 1, 2004 to August 31, 2005
Total Project Expenditures:	$13,333 ($10,000 Federal, $3,333 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: Two hundred fifty-four bird species had been reviewed for status in the early 1990s in a thorough status assessment of that taxon. In July 2004, 97 bird species were selected for review of breeding and non-breeding season status. Of 21 invited experts, 19 participated in the Delphi review process (Clark et al. 2006), 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 review began in September 2004 and went through four iterative rounds as of August 31, 2005. The results were compiled during this reporting period (October 2005), and will be presented to the Endangered and Nongame Species Advisory Committee in November 2005. The results of the status review will be finalized by the Committee and will be the subject of state rulemaking in the next segment. Results will be made available in the next segment's reporting.

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 nongame fish species review, 2) completing the bird status changes, and 3) initiating a review of nongame mammal species.
- Compile the results of the Delphi process of review and present them to the Endangered and Nongame Species Advisory Committee 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-1-2 (State Wildlife Grants)
Segment dates:	September 1, 2004 to August 31, 2005
Total Project Expenditures:	$240,000 ($180,000 Federal, $60,000 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:

- The Program made the transition from the Natural Heritage Database to a new database structure called Biotics. This new structure incorporates the qualitative textual information of the old system, with a geographic information system (GIS) component that enables it to store spatial data as well. Because Biotics is built on an Oracle data model, it has multi-user capabilities and provides live updates, making it possible for both ENSP and the Natural Heritage Program to house the database. The fact that ENSP now houses the database means that the Program is now completely fulfilling its responsibility of overseeing the rare animal component of the Natural Heritage database. Biotics has dramatically improved data management, enabling ENSP to develop a more seamless process that ends with the Landscape mapping.
- ENSP staff tracked and entered approximately 2,000 new rare species sightings. This was a significant addition to the existing 5,800-record database, and resulted in a better, more accurate valuation of endangered and rare species habitat.
- GIS staff investigated valid sightings not valuing habitat in Version 2 of the Landscape Project Maps, and made changes necessary to include them in site evaluations and in version 3.
- GIS staff updated or created new models for five rare species. These new models will be used to value habitat patches in Landscape version 3.
- Development of Landscape Project version 3 began with revisions to species models, and tests of more species-specific habitat valuation procedures.
- GIS staff created a brochure and poster for ENSP staff to bring to conferences and events in an effort to solicit rare species sightings.

Conclusions:

- Development of selected species-based habitat valuation may result in more accurate identification of critical habitat. We will pursue changes in methodology in the next segment by developing new species-specific habitat models, reviewing them in-house and in an outside peer group, then generating statewide critical habitat mapping.
- Every year the number of sightings the ENSP receives continues to increase as well as the areas where these sightings occur. These sightings form the basis for rare wildlife habitat assessment, thus we need to continue to track and record rare species data, both from the public as well as staff and contracted surveys.
- 173 valid rare species records fell outside of Version 2 methodology, these are records of species falling outside of the habitats we designated for them. We will be reviewing and revising methodologies in the next segment to improve accuracy in habitat mapping.
- Our knowledge of species habitat use and home range size is growing with targeted research, and we need to incorporate this into our mapping by updating species and habitat modeling as new information becomes available.

Recommendations:

- Revise Landscape Project methodology to reflect a species based patch system. A species based patch approach will allow biologists to better refine specific habitats a species should value.
- Continue to refine and improve species models for incorporation into Landscape Project mapping.
- Review species models and base layer to ensure incorporation of all valid rare species records.
- Continue to track and record rare species records.
- Continue to solicit records from other sources and identify new competent sources of data.

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:

- ENSP conducted 18 trainings throughout the state with a total of 240 attendees.
- Attendees included participants from; NJDEP, NJDOT, USFWS, USDA-NRCS, USNPS, private consulting firms, New Jersey Audubon, The Nature Conservancy, municipal environmental commissions, county government and the general public.
- Landscape Project Trainings need to be at computer lab facilities so each attendee can gain hands-on experience using the GIS.

Conclusions:

- Attendance at our trainings continues to grow at a steady rate throughout the state. A wide range of people from a number of backgrounds attend technical trainings.
- Through course evaluations participants have expressed a need to extend the session length of each training, and to have two types of trainings: basic and advanced.
- Trainings need to be geared toward specific audiences such as township environmental commissions.
- In addition to making the maps available to people, ENSP staff needs to be involved to make sure the maps are being interpreted correctly.

Recommendations:

- Continue to offer trainings at multiple locations throughout the state, and at facilities that have computer labs so each attendee can gain hands-on experience with the Landscape Map using the GIS software.
- Continue and expand advertising to encourage new people to attend the trainings and promote the Landscape Project overall. Expand length of training and offer advanced as well as beginner sessions.
- Partner with Association of New Jersey Environmental Commissions (ANJEC) to provide customized training for municipal environmental commissions.
- Continue to stay involved at the local and the state level to ensure the mapping is being interpreted correctly.

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