NJ DEPARTMENT OF ENVIRONMENTAL PROTECTION
DIVISION OF FISH AND WILDLIFE

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DELAWARE BAY MIGRATORY SHOREBIRD PROJECT

REPORT FOR 2006

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PLAN AND BUDGET: FISCAL YEAR 2007

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2006 Delaware Bay Migratory Shorebird Project Report

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Introduction

In this report, we describe the results of work conducted in the 2006 shorebird season and follow with a proposal for work in the 2007 season. We acknowledge the continued financial support of the Natural Lands Trust which has provided long term funding for NJ Shorebird Program and a critical match for raising short term funding from a variety of sources. This year they included State Wildlife Grants, Conserve Wildlife Foundation, The Neotropical Bird Conservation Act, The US Fish and Wildlife Foundation, The US Fish and Wildlife Service, The Coastal America Program, Defenders of Wildlife, Stockton University, Virginia Tech and individual donors.

Summary of 2006 Season

The Threat to the Red Knot Population has continued to increase.

This year new investigations in Delaware Bay, wintering areas in the U.S. and South America and the Arctic suggest an increasing threat to the red knot. Weekly surveys on the Delaware Bay continue to reflect a decline in the baywide population, now lower than at any other time of the survey (Figure 1). Numbers of other species, including ruddy turnstone decreased sharply this year.

Counts conducted in three wintering areas reflect the decline in the Delaware Bay. Isotope analyses of feathers collected from knots captured on Delaware Bay indicate they over winter in three discrete areas – Florida and adjacent southeast states, northern Brazil and Tierra del Fuego. While a recent survey of the relatively small Brazilian wintering population found a slight decline (Baker et al 2006), the main population in Tierra del Fuego remains at record low numbers (Morrison pers. comm., Niles et al 2006a)(Figure 2). In a new survey conducted this year in the southeast U.S., biologists found just over 4,500 birds, with 3,020 in Florida (Niles et al 2006b) (Table 1). This was 43 percent of the previous estimate of 7,000 individuals in Florida and far lower than the original estimate of

10,000 reported in 1990's, (Niles et al. 2006a). Together the counts of the three red knot winter populations yield a Western Hemisphere's population of 26,847 far lower than the estimate published in the National Shorebird Plan of 2001 of 150,000 birds Brown et al. 2001). In light of our work the estimate has been recently revised to 30,000 birds (Morrison et al 2006) .

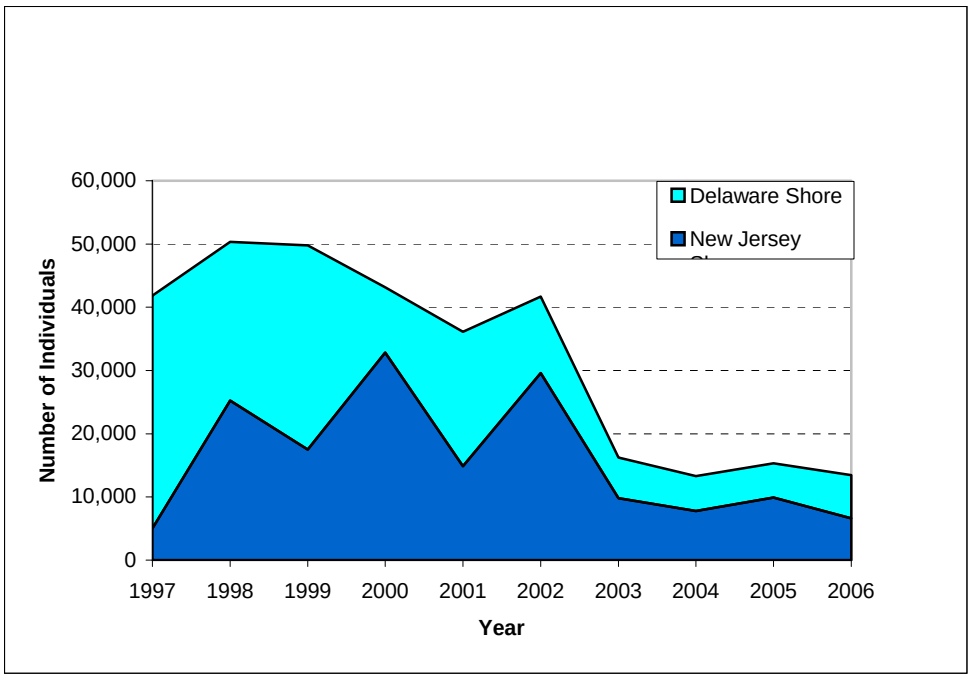

Figure 1. Peak Counts of Red Knots on the Delaware Bay Migratory Stopover 1997 - 2006. The 2006 survey was the lowest recorded in the 20 year history of the survey

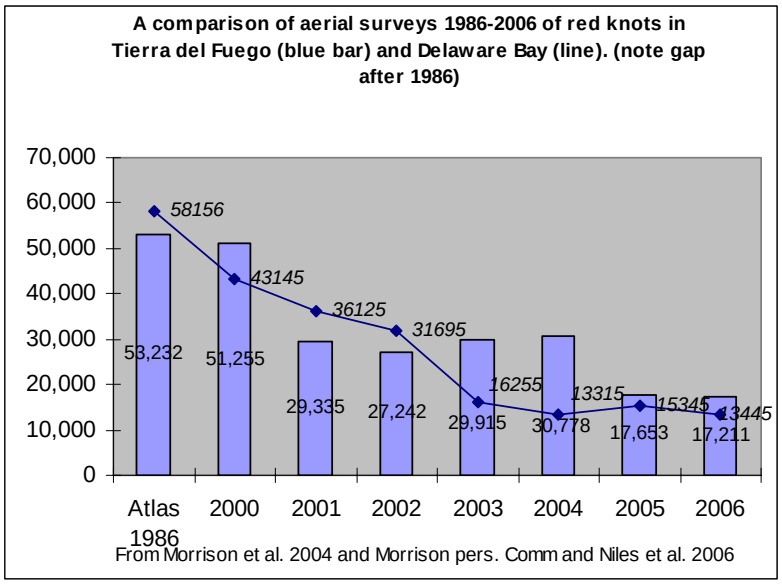

Figure 2. Number of red knots in South American wintering areas 1985-2006 compared to numbers on the Delaware Bay . Both 2006 counts are the lowest in the history of each survey.

Table 1. The number of red knots counted during the Winter Survey of Piping Plover conducted between Jan 23- Jan 19, 2006. The Florida count was far lower than the 10,000 originally estimated in 1990.

State	Number of Red Knots	Number of Sites Surveyed	Survey Start date	Survey End Date
Florida	3,020	34	1/23/2006	2/6/2006
Georgia	485	1	2/6/2006	2/6/2006
South Carolina	583	42	1/23/06	2/19/06
North Carolina	455	35	1/25/06	2/19/06
Virginia	26	21	1/23/06	2/10/06
Total	4,569	133		

Our Arctic survey this year indicated each wintering population may be breeding in discrete areas Increasing the threat to this rapidly dwindling population. If true, the effective size of the breeding population may be much smaller and more vulnerable to genetic drift, inbreeding, and random shifts in productivity and survival characteristic of small populations of animals.

The Viability of the Delaware Bay remains impaired because low density of Horseshoe Crab Eggs.

The number of horseshoe crabs remain at record lows and has yet to show signs of improvement (Smith et al. 2005, ASMFC 2006). The result is an inadequate availability of eggs on the Delaware Bay necessary to allow birds to refuel and go on to breed in the Arctic. Surveys of horseshoe crabs conducted over the last six years show no signs of improvement (D. Hernadez pers. comm.)(Figure 3) .

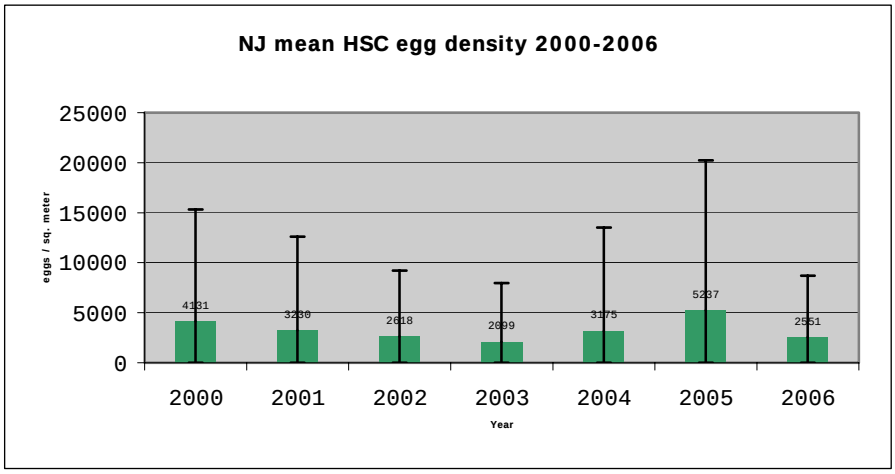

Figure 3. Mean density of eggs/m^2 counted on NJ side of the Delaware Bay 2000 to 2006.

Despite low egg densities, weight gain on the Delaware Bay was adequate because of low shorebird numbers.

The most important measure of the function of the Delaware Bay stopover is the ability of shorebirds to gain weight. Red knots must attain weights of at least 185 grams ("Threshold Departure Weight") to have sufficient energy to reach the Arctic and initiate nesting. In 2006 red knot weight gain was erratic and generally less than average of the last ten (Figure 4) but by the end of the season weight gain was adequate. For the entire period of trapping, mean catch weights from 1997 through 2002 were generally at or above the mean for the entire period (1997 - 2006) while mean catch weights for 2003 to 2006 were generally below the mean for the period.

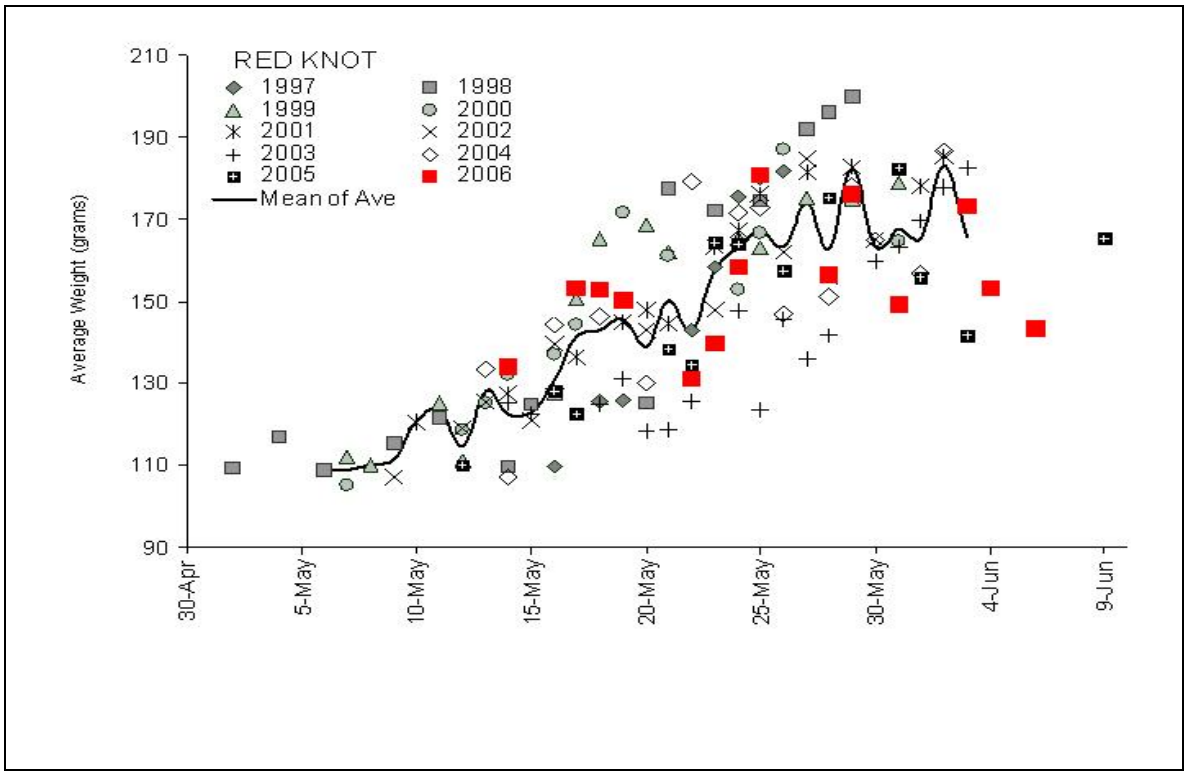

Figure 4. Mean weight of red knot catches on Delaware Bay during spring migration 1997 to 2006.

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

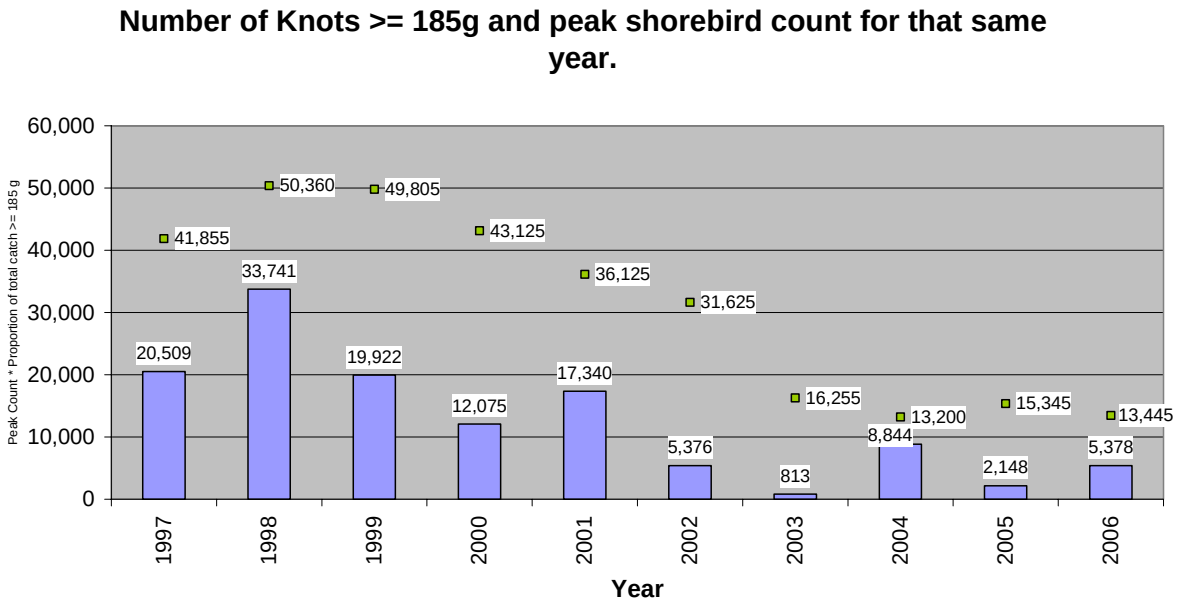

Figure 5. Number of red knot migrants reaching threshold departure weight (≥ 185 g) on the Delaware Bay Stopover compared to the peak count for the same year .

A moratorium of crab harvests imposed this year will improve conditions on Delawre Bay and a new federal status will improve protection elsewhere.

On the positive side the State of New Jersey passed a two-year moratorium on horseshoe crab harvesting. The moratorium took effect in 2006 and will continue in 2007. Despite the failure of the Atlantic States Marine Fish Commission (ASMFC) to adopt the moratorium, The State of Delaware has proposed a similar two-year moratorium but they are being sued and the outcome is not yet certain. The ASMFC proposed a male only harvest despite objections by DE and NJ and nearly all environmental groups and scientific organizations focusing on birds. The moratorium in NJ will be lifted only if conditions on the bay improve.

This year biologists with the ENSP Conserve Wildlife Foundation and other organizations from around the world completed a comprehensive status assessment of the red knot (Niles et al 2006). After a peer review that included the ASMFC horseshoe crab and shorebird technical committees as well as scientists from USGS, USFWS and a number of academic intuitions, the assessment was submitted in final form to the USFWS in August

2006. In October 2006 the US Fish and Wildlife Service announced the knot would receive a new federal status indicating the need to be listed as a threatened species. Unfortunately, the Service precluded the listing because of insufficient resources within the Service.

All current data substantiate the prediction that the red knot will be extinct within 5 years.

Overall the picture is gloomy. Baker et al (2004) estimated the extinction probability of the red knot based on survival rates and weight gain from the Delaware Bay that predicted extinction of the red knot by about 2010 . Using actual counts conducted in Tierra del Fuego including 2006, the model prediction of extinction remain accurate (Figure 6).

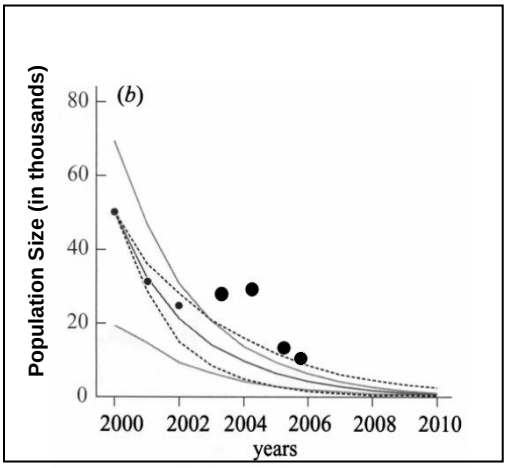

Figure 6. The projected population of red knot (2000 to 2010) based on survival rate determined by resightings of marked birds. The model predicts extinction by 2010 because of decline in adult survival. Large dots represent aerial surveys of red knots from South American wintering sites in Tierra del Fuego. The 2006 aerial survey fell within the model prediction.

The Natural Lands Trust Funding is Critical to the Recovery of the Red Knot

All of these problems that exist today will take years to recover. Most biologists agree that red knots will be slow to respond to increases in horseshoe crab egg densities because of normally-low productivity rates associated with most Arctic breeders. Currently, we are unable to determine if the red knot population has stopped declining.

In the meantime, DFW and CWF biologists have initiated several innovative management programs to improve conditions for knots and crabs. This year, all important beaches on the Delaware Bay were closed to human use to prevent the disturbance of feeding shorebirds. Protection was expanded to include two Atlantic coast areas important for roosting and foraging -- Stone Harbor Point/Hereford Inlet and Malibu Beach Wildlife Management Area

(Longport sod banks). Volunteer stewards explained the reasons for closure to the public and conservation officers were available to help stewards deal with people contrary to the message. DFW and CWF biologist also constructed gull exclosures on two beaches to help diminish the impact of gulls competing with shorebirds for horseshoe crab eggs.

DFW and CWF biologists continued to lead one of the most intensive shorebird research programs in the world. This project includes the banding of birds with unique leg bands and fielding a team of biologists to resight them. With more than 60% of all previously-banded birds resighted, this project will allow a more up-to-date assessment of adult red knot survival that can be used to update the extinction model.

Finally, DFW and CWF biologist have completed new work in the Arctic assessing the range of different wintering populations of red knots; in Florida, conducting the first survey of wintering knots, and in the Gulf of St. Lawrence discovering a new southbound stopover.

Perhaps the most important accomplishment of the year was the completion of the Red Knot Status Assessment. This work, which took over two years to complete, included an intensive internal and extensive peer review conducted by the US Fish and Wildlife Service. The assessment was the technical basis for the USFWS decision that the knot warrants listing. Soon the assessment will be published on the internet and in the Wader Study Group Bulletin (see attached executive summary).

Over the next few years our work will continue to focus on protection and recovery efforts and increasingly focus on the development of sophisticated computer models. These models will help determine how many crabs are needed to recover the red knot back to its original population of over 100,000 birds from the current estimate of just under 27,000 birds. We will also begin implementing the Conservation Plan set forth in the Status Assessment. We will initiate a new international effort to assess threats in all important stopover and wintering areas and propose new conservation measures to ameliorate them. We will focus on Bahia Lomas, Chile the most important knot wintering area in Tierra del Fuego.

The recovery of the red knot will take years. Although it would have been best avoided, the experience has provided a unique situation that has engaged conservation scientists and

activists from around the world. The plight of the red knot and the decline of the Delaware Bay is now well known and, more importantly, well documented. Once recovered, the collapse of this truly unique ecological treasure is unlikely to ever occur again.

Summary of 2006 Activities

1) **Annual aerial surveys were conducted in cooperation with Delaware Division of Fish and Wildlife using the same method since 1986.** We conducted six weekly surveys between early May and early June covering peak migration dates. Shorebird numbers peaked on May 30 at 141,520, 30 percent below the long-term average. Peak red knot counts remained low in 2006 at 13,445 – 64 percent below the long-term mean. Ruddy turnstones were 71 percent below average – the lowest count ever. The Sanderling peak count of 16,740 was slightly above the long-term average.
2) **Just over 3,000 shorebirds were captured, measured and individually marked in NJ and DE, bringing the total banded to approximately 45,000 since 1997.** ENSP and CWF again hosted an international and domestic team of researchers. During the period May 10 to June 6, researchers and approximately 40 volunteers banded 2,000 shorebirds (684 red knots, 461 turnstones, 855 sanderling) and recaptured 183 birds (81 knots, 35 turnstones, 64 sanderling) on the NJ bayshore. Catch effort was limited to reduce disturbance and stress on foraging birds. 2006 was the fourth year we individually marked red knots and the third year for turnstones and sanderling. Resighting of marked birds provides the basis for accurate estimation of adult survival. Preliminary survival estimates will be forthcoming for red knots, turnstones and sanderlings in 2007.
3) **We carried out year four of a radio telemetry study to track movements of red knots in the bay.** We again deployed 18 automated tracking stations at key sites in Delaware Bay. Twenty red knots were outfitted with transmitters on the Atlantic coast of New Jersey to assess the potential for differential habitat use by knots using coastal habitats. Concurrently, via collaboration with Virginia Polytechnic Institute, 45 red knots were outfitted with transmitters on coastal Virginia to assess coastal habitat use and track migration through Delaware Bay. Three important results were observed: again in 2006, the baywide population of red knots roosted

on Stone Harbor Point on the highest spring tides making this roost area one of the most important in the Bay and stressing the need to create safe roost areas elsewhere in the Bay; while NJ coast knots were found to use habitats throughout the bay, Virginia coast knots were not detected on Delaware Bay. Abundant bivalves (*Donax variabilis*) combined with undisturbed foraging opportunities on The Nature Conservancy's Virginia Coast Preserve provided sufficient food to allow VA knots to migrate directly to the Arctic bypassing Delaware Bay.

4) **Volunteer Stewards and Division Conservation Officers protected beaches from disturbance for the fourth year**. In addition to viewing platforms at Reed's Beach, Norburys Landing and Fortescue, Shorebird Stewards and Conservation officers worked together to reduce disturbance to shorebirds on beaches and educate the public. ENSP biologists held two shorebird meetings: one to convene Shorebird Stewards and shorebird survey volunteers, brief them on study results and gear up for the coming season; the second was the annual training for shorebird steward volunteers. Funds from the Natural Lands Trust allowed the Division to assign Conservation Officers to patrol important shorebird beaches during the last two weeks of May and the week after Memorial Day.

5) **CWF and Stockton College staff and student interns conducted surveys of horseshoe crab egg density to monitor trends in the crab population.** 2006 was the second and final year of side-by-side egg sampling to calibrate the NJ pit-sampling method with the USGS baywide core sampling method instituted in 2005. Statistical comparison showed the two methods are comparable providing an uninterrupted data series of egg densities in NJ for the period 2000 to 2006. Results from 2005 and 2006 Delaware egg surveys will be available this year. This is the first time that the same sampling methodology has been carried out on both sides of Delaware Bay. Baywide egg densities will allow development of statistical models that tell us how many crabs we need to achieve eggs densities necessary to recover the Delaware Bay stopover and the red knot.

6) **ENSP staff and CWF continued to work with conservation and planning groups on all-bird conservation planning**. Biologists from CWF, Manomet Center for Conservation Sciences and ENSP completed a red knot conservation plan, called for in the federal status assessment, and Hemispheric in scope. ENSP held the first all-bird planning meeting this September and is moving forward on

development of standardized monitoring methodologies for shorebirds, wading birds, and landbirds.

7) **ENSP staff recruited and trained volunteers to assist with shorebird research projects**. Approximately 50 foreign and domestic volunteers, most returning from prior years, assisted with shorebird banding, crab egg surveys, beach protection and resighting marked shorebirds.
8) **ENSP staff and volunteers conducted intensive baywide observations for individually- marked shorebirds.** 2006 marked the fourth year for knots and third year for sanderling and turnstones of marking with unique alpha-numeric codes. Resighting of individually-marked birds provides the most accurate method of survival estimation. In the coming year, we will have updated and preliminary adult survival estimates for red knot and ruddy turnstone and sanderling, respectively. Survival is key to assessing population health.
9) **NJ Audubon biologists continued study of mass gains in semipalmated sandpipers.** Dr. David Mizrahi continued his study of semipalmated sandpipers in the Thompson's Beach and Fortescue area under contract with ENSP. Semipalmated sandpipers, also a species of conservation concern, parallel declines in mass gains observed in red knots over the last ten years and adds support for continued, strong conservation measures. Dr. Mizrahi is also marking and resighting individual birds to produce survival estimates.
10) **ENSP biologists completed a status assessment for red knot in August 2006.** Fifteen coauthors and 40 contributors completed a comprehensive assessment of the status of the red knot. The document provides a complete review of all existing literature and publishes many unpublished reports from sites throughout the flyway. The assessment was peer reviewed both inside and outside the USFWS and was the basis for the Service's announcement that the knot deserves federal listing. They precluded the listing because of insufficient resources.
11) **Biologists from ENSP, CWF, Virginia Polytechnic Institute and Stockton College repeated an aerial survey of radio equipped red knots in the Arctic.** A team of biologists partially funded by NLT have tracked radio equipped knots to determine breeding concentration areas and habitat. In the fourth year of the study biologists focused on the question- do birds from the different wintering areas breed in different breeding areas? If so than the smaller population would

increase the already high probability of extinction. Sixty five red knots were outfitted with transmitters on coastal New Jersey and Virginia and tracked in the US to improve our understanding of habitat use outside the Delaware Bay. The search for these birds, mostly known to winter in Florida with ten known to winter in South America, took place in areas previously known to be used by South American winters in earlier surveys. We located only two birds, which was far fewer birds than predicted, both coming from the small radio equipped group known to winter from South America. Although not conclusive it appears red knots from different wintering areas breed separately.

12) **A small team of biologists from the US and Canada surveyed knots in a newly discovered south bound stopover in the Gulf of St. Lawrence.** Biologist found over 300 individually birds banded in the Delaware Bay, Florida and South America. Surveys suggest nearly half the hemisphere's population use the stopover compelling canadian biologists to propose the site for national recognition.

WORK PLAN FOR 2007

Work Plan for 2007 Season

ENSP biologists propose that the work plan for 2007 centers on these areas:

1) Monitoring shorebird populations in Delaware Bay, Tierra Del Fuego, Florida and the Arctic
2) Measuring shorebird condition in each location especially the Delaware Bay.
3) Monitoring crab egg density as indicators of Delaware Bay stopover viability and participating in the baywide egg survey
4) Minimizing human disturbance by managing viewing areas, volunteer stewards and employing Conservation Officers.
5) Monitoring populations of knots turnstones and sanderling with intensive baywide surveillance of marked birds.
6) Create a comprehensive model predicting long-term horseshoe crab and habitat needs for all shorebirds on the bay.
7) Organize an east-coast surveillance of shorebirds in migration to document potential shift in migration patterns of red knots and other shorebirds.
8) Monitoring red knot winter population in South America to determine trend in population size and yearly recruitment.

9) Improving hemispheric conservation using the Western Hemisphere Shorebird Reserve Network and assisting managers in other sites to assess short term threats.

These projects are partially funded through the trust. We will continue to seek funding from other sources to help support the work in Delaware Bay and elsewhere in the Flyway.

Protection

ENSP biologists will protect shorebirds from disturbance that disrupts and displaces them from prime habitats.

a) The ENSP and CWF will install and maintain viewing areas in three locations; Reed's Beach, Fortescue and Norbury's Landing, and assist TNC, NLT and NJCF with other viewing areas.
b) ENSP and CWF staff will maintain existing protection along the bayshore by enlisting land managers, shorebird stewards, and Conservation Officers in a protection approach that includes area closures during the peak migration period of May 15-June 4. New, detailed signs, and fencing where appropriate, will be used to increase awareness and compliance.
c) The ENSP and CWF biologists will recruit and train shorebird stewards to protect beaches through the migration period. Volunteers will help in education and protection, as well as in gathering data.
d) ENSP and CWF biologists will conduct shorebird banding as a cooperative protection effort in the Bay and the flyway. The banding team will be sponsored and led by ENSP and CWF, and focus on banding and re-sighting shorebirds to characterize weight gain as an indicator of Delaware Bay viability and changing horseshoe crab numbers.
e) A team of volunteers led by ENSP and CWF biologists will cover the entire bayshore to re-sight previously marked bird. Now in it’s fourth year the project will determine population levels, survival rates and assess population trends for the Bay and the entire hemisphere population.
f) ENSP and CWF biologists will participate in the Western Hemisphere Shorebird Reserve Network Council, the National Shorebird Plan, All Bird Conservation, and other national planning initiatives to protect and manage critical shorebird sites locally and in the flyway.

g) ENSP and CWF biologists will complete the federal status assessment for candidate designation of the red knot population by publishing it in a scientific journal.

Planning

We will work to design and implement monitoring and management activities that will enhance Delaware Bay, NJ habitats and the region as set forth in the Status Assessment and other planning efforts.

a) ENSP and CWF biologists will coordinate planning with shorebird habitat management among Northeast states guided by the Red Knot Status Assessment. The focus of this effort will be Delaware Bay, including the Atlantic and Delaware Bay marshes and Atlantic beach habitats.
b) ENSP and CWF biologists will use the status assessment to complete a Comprehensive Plan for the Red Knot as part of Manomet Conservation Center's effort to develop plans for the most important shorebird population in the hemisphere. The Plan will be used by Western Hemisphere Shorebird Reserve Network to help raise new funds for international shorebird protection.
c) With additional funding from Fish and Wildlife Foundation ENSP and CWF biologists will work with Biologists from four other countries to do an assessment of all important stopovers and wintering areas on the North and South American Atlantic coast. The primary goal will be to establish threats to places other than the Delaware Bay.

Monitoring

The ENSP will continue a monitoring program to assess shorebird population trends and habitat use on Delaware Bay as called for in the status assessment plan and by the National Shorebird planning groups.

a) ENSP will continue aerial surveys of bay beaches for shorebirds according to standardized methods used since 1986, and analyze for trends.
b) Using the volunteers ENSP and CWF biologists will organize and conduct daily ground counts of shorebirds to determine local distribution and correlations with

horseshoe crab spawning, beach disturbances and closures, habitat types and tidal cycles.

c) CWF biologists will continue the study of habitat use using telemetry to document shorebird movements in response to horseshoe crab egg availability, and detect roosting sites and mass movements in the bay. 18 Automated Radio Telemetry System (ARTS) will monitoring movement throughout the bay for the entire shorebird season. Data will be analyzed by a contracted biologist familiar with the system.

d) ENSP and CWF biologists will expand resighting effort to include individually-marked ruddy turnstones and sanderlings to develop estimates of adult survival. It is known that adult survival of red knot is linked to sufficient mass gains on Delaware Bay. While red knots are most reliant on crab eggs, mass gains and peak numbers of turnstones and sanderlings have also declined.

e) Contract biologists from Stockton will conduct standardized sampling of horseshoe crab eggs on NJ Bay beaches. Egg density is the best index of shorebird food resources. Biologists will conduct side-by-side sampling to calibrate the two methods and ensure comparability of prior NJ egg density data.

f) NJ Audubon biologists will continue study of mass gain and stopover length of stay in semipalmated sandpipers. This study, has identified problems in this species that have corroborated the findings in other shorebirds. A final report will be created for peer review publication this year.

g) A team of biologists will create a working foraging model for red knot on the Delaware Bay stopover. The model will incorporate all data currently gathered including weight gains, departure weights, adult survival, horseshoe crab spawning activity and available egg densities, foraging and egg depletion rates, competition from other avian species, disturbance, harvest data and abiotic factors (beach geography, substrate composition, diurnal and lunar tidal cycles, water temperature). This model will provide a predictive tool for understanding factors affecting the densities of horseshoe crab eggs and foraging rates of red knot populations. Ultimately it will be used to estimate the egg densities necessary to support all shorebirds on the bay. Outside funding will be sought to add support this work . Foundation.

h) Organize an east-coast surveillance during May to document flocks of shorebirds along the Atlantic Coast. Surveillance will be carried out through weekly ground surveys by volunteers (Florida to Massachusetts) and at least one aerial survey by state shorebird biologists in Georgia, South Carolina, North Carolina and Virginia.

This effort is necessary to understand if shorebirds are shifting migration patterns to other areas of the east coast or if shorebird populations using the Delaware Bay are declining.

i) ENSP and CWF biologists will continue aerial survey of red knot wintering population and monitoring immature recruitment in South America. This work will help to evaluate the condition of the entire population and provide the necessary data to evaluate the current extinction model. NLT funds will supplement funds raised from other sources for the project.

j) ENSP and CWF biologists will complete a paper on Arctic surveys this year. NLT funds will supplement outside funding to continue the survey of designated study areas identified in previous surveys.

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