Red Knot
Photo by Frederick W. Fallon[1]

Petition to List the Red Knot (*Caladris canutus rufa*) as Endangered and request for Emergency Listing under the Endangered Species Act

August 2, 2005

Petitioners:

Delaware Riverkeeper Network

American Littoral Society

Delmarva Ornithological Society

Delaware Chapter of the Sierra Club

New Jersey Audubon Society

I. INTRODUCTION

The Delaware Riverkeeper Network, American Littoral Society, Delmarva Ornithological Society, Delaware Chapter of the Sierra Club and the New Jersey Audubon Society formally petition the United States Fish and Wildlife Service (the "Service") to list the Red Knot (*Caladris canutus rufa*) as endangered pursuant to the Endangered Species Act 16 U.S.C. §§1531 et seq. Petitioners request the Red Knot be emergency listed pursuant to 16 U.S.C. § 1553(b)(7) and urge that Critical Habitat be designated pursuant to 50 C.F.R. § 424.12. This petition is filed under 16 U.S.C. § 1533 (b)(3), 5 U.S.C. § 553, and 50 C.F.R § 424.14, which grant interested parties the right to petition for the issue of a rule from the Assistant Secretary of the Interior.

The Red Knot, *C. c. rufa*, is a medium sized shore bird that undertakes a spectacular 30,000 km hemispheric migration, from its breeding grounds in the central Canadian Arctic to its wintering grounds in Patagonia and the Tierra del Fuego in southern South America. Recent studies demonstrate that the Red Knot, *C. c. rufa*, is on a path to certain extinction if substantial conservation measures are not taken immediately to halt and reverse the species' startling decline.

Failure to grant the requested petition would result in a violation of the Endangered Species Act and permit the continued decline of the Red Knot, *C. c. rufa*, population, ultimately resulting in its extinction. Furthermore, failure to list the Red Knot, *C. c. rufa*, as endangered will adversely affect the aesthetic, environmental, animal diversity, recreational, commercial, research, and scientific interests of petitioning organizations' members and of the citizens of the United States.

II. EXECUTIVE SUMMARY

The intent of this petition is to achieve the prompt placement of the Red Knot (*Caladris canutus rufa*) on the United States' endangered species list. The petitioners specifically request that because of the factors, discussed *infra.*, that pose a significant risk to the well-being of the Red Knot *rufa* and would lead to extinction of the species by 2010, the *C.c. rufa* (or Red Knot *rufa*) be listed forthwith under the emergency listing provisions of the Act.

Red Knot *rufa* is a migratory shore bird. Every spring, Red Knot *rufa* migrates from the southernmost tip of South America at Tierra del Fuego, up the Eastern coast of the Americas through the Delaware Bay, and ultimately to the central Canadian Arctic where it breeds. The Red Knot *rufa* migration is one of the longest among shore birds. Their nearly 30,000 kilometer epic migration includes just a few critically timed and selected rest stops.

The Delaware Bay stopover is one of the most important for the Red Knot *rufa* during their northern migration. The long journey from Brazil to the Delaware Bay results in the Red Knot *rufa* metabolizing a vast portion of their fat and muscle tissue so that when they arrive at the Delaware Bay they are starving and in dire need of food and nutrition. For the brief period they are at the Delaware Bay, the Red Knot *rufa* depend on the available food supplies to regenerate their tissue and gain fat. No major refueling sites exist between the Delaware Bay and the Arctic breeding ground, therefore the Red Knot *rufa* must leave the Delaware Bay well nourished with enough strength and reserves to survive the flight to the Arctic and to breed once they arrive. As a result, the Delaware Bay is a critical refueling area for the Red Knot *rufa*.

The Red Knot *rufa* have a unique ecological relationship with the horseshoe crab (*limulus polyphemus*). Feeding on the horseshoe crab eggs in the Delaware Bay is a critical component of the survival of the Red Knot *rufa* population. The Red Knot *rufa* congregates on the beaches of Delaware Bay to restore their emaciated bodies by feeding on the fatty, lipid-rich eggs of horseshoe crabs. The Delaware Bay is the only place in the world where such a concentrated population of Red Knot *rufa* congregate to feed on horseshoe crab eggs.

Red Knot *rufa* require a "superabundance" of horseshoe crab eggs in order to repair their bodies, restore their strength and acquire migratory fat tissue. Only when there is a superabundance of these eggs are there enough present on the surface of the sand to fill the needs of the Red Knot *rufa*. Red Knot *rufa*, unlike other birds that eat horseshoe crab eggs, are not able to dig in the sand to feed on eggs, they can only eat what is on the surface. Therefore it is crucial to the Red Knot *rufa* that there be a "superabundance" of eggs in the sand. A superabundance of horseshoe crab eggs exists when the sand in the spawning areas is brimming with eggs, making it easy for the famished and emaciated Red Knots to replenish their energy stores.

Research has shown that there are less horseshoe crabs available than previously and consequently many Red Knot *rufa* are no longer able to consume enough horseshoe crab eggs during their Delaware Bay stopover. Red Knots unable to consume enough of the horseshoe crab eggs will not survive the 2,400 kilometer flight to the Arctic.[2] The Red Knot that survives the flight but has not consumed enough will lack sufficient nutritional stores needed to breed and reproduce.[3] As fewer Red Knots breed, fewer chicks are hatching and the population is declining at a rate which would bring the Red

Knot *rufa* population to extinction on or about 2010.[4]

The reason for the inadequate supply of horseshoe crabs eggs is that horseshoe crabs are presently harvested for use as bait for the conch and eel fishing industries. As the horseshoe crab population declines, so does the availability of their eggs. Thus, the fewer horseshoe crabs there are along the Delaware Bay each spring, the less food is available for the migrating Red Knots.[5]

Because nearly all Red Knot *rufa* pass through the Delaware Bay in the spring, a shortage in food at this site has had a direct affect on the birds' survival as a species. Independent studies show an alarming decline in the Red Knot *rufa* population in recent years.[6] For example, from the mid-1980s to 2005, the number of Red Knot *rufa* observed in the main wintering areas in South America decreased from over 51,255 in 2000 to 17,653 in 2005.[7] A separate study of the Red Knot *rufa* observed over a seven year period in the Delaware Bay shows a steady decline in the numbers foraging in the Bay to a current all time low of 13,315.[8]

Even though the Red Knot *rufa* has experienced a significant population decline in this relatively short span of time, it receives little protection. Because the Red Knot *rufa* congregate in such large numbers in small areas along the migratory corridor (such as on the Delaware Bay), deleterious changes to those areas can affect a large portion of the population at one time. Thus, the species continues to be unusually vulnerable to human activities, such as the harvesting of horseshoe crabs, along the Delaware Bay. As the recent reports of population decline demonstrate, there is an urgent need to list the Red Knot *rufa* as an endangered species under the Endangered Species Act, to protect its habitat and to insure sufficient quantities of its primary spring-time food source, the

horseshoe crab eggs.

Listing the Red Knot *rufa* as an endangered species and as an emergency listing under the Act will allow the population to maintain its biological integrity. If action is taken immediately, conservation efforts can be effective in recovering and then maintaining the Red Knot *rufa* population. The Red Knot *rufa* population recovery can be maintained and monitored through a series of programs including, but not limited to: critical habitat designations, aerial surveys, banding studies, moratoriums on horseshoe crab harvests, short term limitations on human use of feeding grounds during the limited periods the birds are feeding during their spring migration, and conservation education. The Service, States and organizations that are currently working together to protect the Red Knot *rufa* can manage each of these programs. Listing the Red Knot *rufa* as an endangered species and an emergency listing under the Endangered Species Act is essential to ensure an immediate, coordinated and comprehensive approach to saving the species whose migratory range transcends political boundaries.

Endangered Species Act Listing Criteria

Pursuant to Section 4 of the Endangered Species Act (16 U.S.C. §1533) and regulations promulgated to implement the Act (50 CFR Part 424), the Red Knot *rufa* must be added to the Federal Endangered Species List because the following criteria apply to its current status:

1. There is a present or threatened destruction, modification or curtailment of habitat or range;
2. Overutlization for commercial, recreational, scientific, and educational

purposes puts it at risk;

3. Disease and predation puts it at risk;

4. Existing regulatory mechanisms are inadequate;

5. Other natural and manmade factors affect its continued existence.

50 CFR §424.11(c).

This petition will show that the Red Knot *rufa* meets the listing criteria under 50 CFR §424.11; that the listing must be regarded as an emergency because the standard rule making procedure is time consuming and further delay in protecting the species must be avoided; the decline of the Red Knot *rufa* population is the most drastic among shorebirds globally; the reason for its decline is the lack of horseshoe crab eggs in the Delaware Bay; current efforts by the States to control and limit horseshoe crab harvests is insufficient; and a horseshoe crab harvest moratorium is recommended as the most effective proposed means to increase horseshoe crab eggs and save the Red Knot *rufa* from extinction. Conservation measures recommended by the Petitioners to save the Red Knot from extinction will help protect other migratory shorebirds (which also rely upon eggs of the horseshoe crabs).

Critical Habitat Designation Criteria

The petitioners also urge that critical habitat be designated in accordance with 50 CFR §424.12, which requires that critical habitat be specified "to maximum extent prudent and determinable at the time a species is proposed for listing."[9] Petitioners believe critical habitat designation is determinable at this time based upon the scientific evidence discussed *infra* regarding the physical and biological features essential to the

recovery of the Red Knot *rufa* and the proposed economic remedy (state and federal appropriations to compensate for the modest loss of income to any effected horseshoe crab fishery) attributable to the listing. [10]

50 CFR 424.12 (a) provides two exceptions to the designation of critical habitat at the time of listing a species. First, a designation of critical habitat is not required if one or both of the following exceptions apply

i. The species is threatened by taking or other human activity, and identification of critical habitat can be expected to increase the degree of such threat to the species, or

ii. Such designation of critical habitat would not be beneficial to the species.

Second, critical habitat will not be determinable when one or both of the following situations exist:

i. Information sufficient to perform required analyses of the impacts of the designation is lacking, or

ii. The biological needs of the species are not sufficiently well known to permit identification of an area as critical habitat.

50 CFR §424.12 (a)(1) and (a)(2).

The scientific data supporting this petition will show that the two exceptions for designating critical habitat do not apply. The vast amount of scientific information and data collected regarding the unique relationship between the Red Knot *rufa*, the horseshoe crab eggs and the Delaware Bay, support the designation of critical habitat.

The petitioners:

The **Delaware Riverkeeper Network** is a non-profit membership organization with it main office at P.O. Box 326, Washington Crossing, Pennsylvania, 18977. The Delaware Riverkeeper Network is affiliated with the American Littoral Society and its 6,500 members are committed to restoring and preserving the natural balance of the Delaware River, its tributaries, its watershed and the Delaware Bay, as well as the wildlife supported by these bodies of water.

The **American Littoral Society** is a 501(c)(3) not-for-profit organization headquartered at Building 18, Sandy Hook, Highlands, New Jersey 07732. The American Littoral Society is dedicated to the protection and conservation of coastal zones and their ecosystems.

The **Delmarva Ornithological Society** (DOS), located at P.O. Box 4247, Greenville, Delaware, 19807, includes over 250 members from 9 states. Our members come from diverse backgrounds but share a love of birds and an interest in protecting the habitats on which they depend.

The **Delaware Sierra Club** is a local Sierra Club chapter based in Delaware, located at 203 North Layton Avenue, Wyoming, DE 19934, with a membership in excess of 1450 members. Our organization is actively engaged in environmental issues, from toxic waste sites to recycling to land use issues to habitat and wildlife protection.

The **New Jersey Audubon Society** (NJAS) is a non-profit corporation headquartered at 9 Hardscrabble Road in Bernardsville, New Jersey. Its mission is to preserve the critical habitat and resources of New Jersey and serve endangered wildlife species. NJAS works to develop and encourage conservation by distributing information

about the natural environment, spreading awareness of New Jersey's flora and fauna and how they relate to the habitat they depend on, and by acquiring and maintaining wildlife sanctuaries and educational centers. NJAS currently maintains 34 such sanctuaries and works to advance its goals at eight staffed centers.

III. BIOLOGY OF THE RED KNOT

TAXONOMY

The Red Knot *rufa* belongs to the order Charadriiformes, Family Scolopacidae, Genus *Calidris*, Species *canutus*, Subspecies *rufa*. Its scientific name is *Caladris canutus rufa*. Scientists have recognized four and five subspecies—two subspecies, the *Calidris canutus rufa* (*C.c. rufa*) and the *Calidris canutus roselaari (C.c. roselaari)* —are found in the United States during migration.[11] The *C.c. roselaari* is normally found breeding in Alaska and wintering on the Pacific Coasts of North, Central and South America. [12] During its spring migration North to its central Canadian Arctic breeding ground the *C.c. Rufa* is found along the east coast of the United States, mainly on the Delaware Bay.[13]

GENERAL DESCRIPTION

The Red Knot *rufa* is a medium-sized shorebird with thick legs and a short, tapering bill. For the most part the Red Knot is a quiet bird, making occasional "knuup-knuup" calls while in flight. It is distinguishable among other shorebirds by its colorful plumage. The Red Knot gets its name from the richly-hued breeding plumage which turns its face and under-parts a chestnut red color. Both sexes have similar stature and coloration, with the female having slightly longer wings.

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Other distinguishing characteristics are the bill which is black year round and the legs which are dark gray to black. The Red Knot *rufa* body size is about 23-25 cm (9-10 in); its wingspan reaches 52-56 cm (20-22 in); and its average weight is about 135 g (4.77 ounces).[14]

Males in alternative or non-breeding plumage are barred black and white, with scattered rufous along the back and tail. The breast, throat, flanks and belly are a dark red or salmon. The crown varies between black and gray and/or salmon. Female coloration is similar to males but typically less intense.

Basic plumage is a plain gray on the head and back with light fringes of gray and white along the wings giving an appearance of a white line running the length of the wing when in flight. The under parts are a dull white extending from the breast to the flanks. Molting into basic plumage normally starts during the beginning of the southward migration.

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LIFE SPAN AND BREEDING

Little is known about the life span of the Red Knot *rufa*, but banded adults studied along the Delaware Bay, have an age range estimated between 10 and 13 years. Red Knot *rufa* forms a traditional monogamous mating system during the breeding season. Once a male and female are paired the male initiates sexual displays.

BREEDING

At the end of the spring migration covering 15,000 kilometers (from the Southern tip of South America to the central Canadian Arctic), the Red Knot *rufa* breeds in the Arctic.[15] While in the Arctic, males perform an aerial courtship display as they fly in high circles above their territory, hover on quivering wings, and then glide through the air

while giving mellow calls. While on the ground, the display consists of males holding their wings above their body.

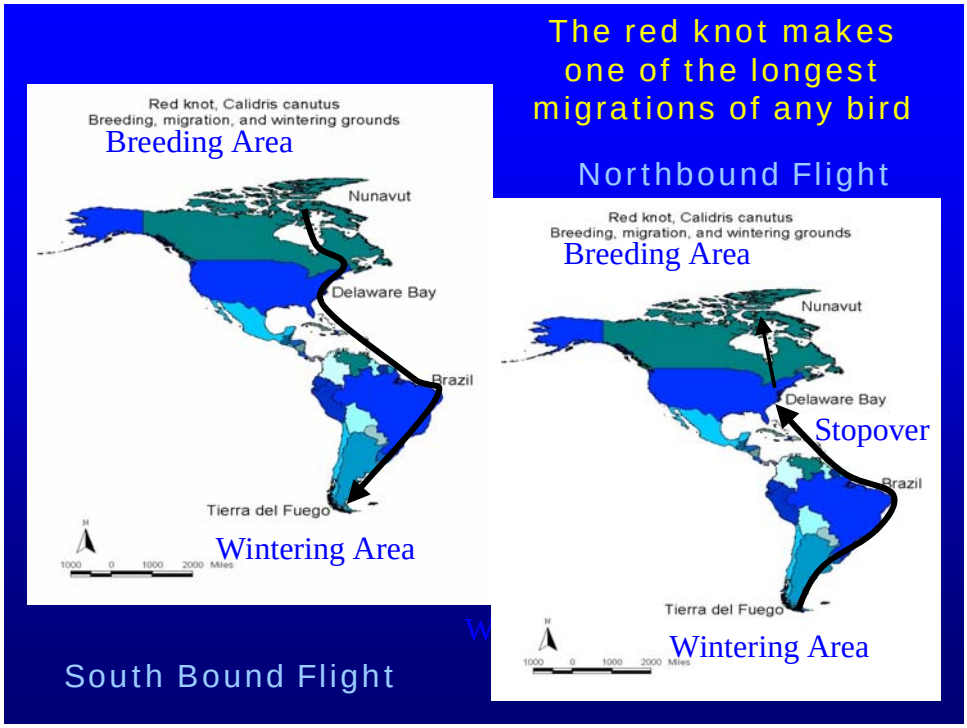
When healthy, the female Red Knot *rufa* lays a clutch of three to four eggs in a shallow nest in the tundra of the Canadian Arctic. Healthy males and females share the duty of incubating the eggs for about three weeks. Shortly after hatching, chicks are able to feed themselves and can leave the nest. Although both parents care for the chicks immediately after hatching, the female leaves after about three weeks, before the young are fully independent.[16]

HABITAT/ RANGE

This species range is from the Southern tip of South America in our winter to the high central Canadian Arctic in our summer.[17] Except for the breeding season in the tundra of the Canadian Arctic, the Red Knot *rufa* is usually found in intertidal, marine habitats, especially near coastal mudflats, estuaries, and bays and their sandy beaches.

The Red Knot *rufa* "winters" from mid-November through mid-March/mid-April on the ocean coasts and large bays in southern South America, along Argentina and Chile, with the most abundant population wintering on the southern tip of South America on the island of Tierra del Fuego. As the Red Knot *rufa* migrates northward each spring, through mid-June, it makes few but critical stops along the coasts of South and North America.[18] The Red Knot *rufa* then migrates North through mid-August to breed on the sparsely vegetated hillsides of the dry, sometimes snow covered, tundra areas of the central Canadian Arctic. During the southward/fall migration, through mid-November, Red Knot *rufa* make stopovers along the coast of the Guiana's and then along the

Atlantic coast of South America to its wintering grounds in the South.[19]



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MIGRATION

Red Knots are marathon migrators, migrating the greatest range of latitude of all Red Knots (70 degrees North to 47 degrees South), thus traveling the farthest of all the knot species.[20] They migrate from southern South America to the central Canadian Arctic, and cover an average of 30,000 kilometers, an epic feat that is completed in about six 4,000 – 5,500 km non-stop intervals.[21] The Red Knots stop in only a few key sites which are strategically timed and selected to offer the birds optimal nourishment that is essential for refueling.[22] The penultimate leg of the spring migration brings the Red Knot *rufa* 5,400 km from Brazil to the Delaware Bay, timed perfectly to coincide with one of the world's largest concentration of spawning horseshoe crabs. After, hopefully, gorging

themselves on the lipid rich horseshoe crab eggs and briefly recuperating at the Delaware Bay, the Red Knot *rufa* flies the final 2,400 km from the Delaware Bay to the central Canadian Arctic breeding grounds[23]

It is important to recognize that Red Knot *rufa* are a highly-specialized, long-distance migrants and that their spring migration is critically timed with the annual spawning of horseshoe crabs along the Delaware Bay. It is estimated that during the spring migration nearly 90 % of the entire population of Red Knot *rufa* can be found on the Delaware Bay in a single day.[24]

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Nearly the entire population of Red Knot *rufa* passes through the Delaware Bay each spring.[25] The Delaware Bay is the quintessential stop over because of the availability of a superabundance of horseshoe crab eggs needed for the bird to gain adequate weight and migratory fat in order to complete its migration and to survive and breed in the Arctic.[26] The Red Knots' tendency to concentrate in a limited number of locations along their migratory corridor makes them vulnerable to the degradation of the resources upon which they depend.[27]

The decline in the number of horseshoe crab eggs available along the Delaware Bay (because of the killing of horseshoe crabs for bait, discussed *infra*.) has caused the substantial decline in the of Red Knot *rufa* population. Scientists who studied the decline of the Red Knot *rufa* population have found that an increasing proportion of the Red Knot *rufa* are not gaining sufficient weight during their stopover in the Delaware Bay.[28] These scientists have concluded that the declines were due to the increasing scarcity of their main food source, the eggs of the horseshoe crab *Limulus polyphemus*.[29]

RE-FUELING AT THE DELAWARE BAY

The Delaware Bay has been a significant stopover for many species of migratory birds because of its habitat and abundant sources of food, including horseshoe crab eggs.[30] In 1992, the Ramser Convention on Wetlands of International Importance Especially as Waterfowl Habitat recognized the Delaware Bay as internationally significant waterfowl habitat and the Delaware Bay was the first Western Hemisphere Shorebird Reserve Network Site. The Western Hemispheric Shorebird Reserve Network is a voluntary, non-regulatory commission which establishes sites with critical habitat for migratory birds with the intention of conserving shorebirds across the Americas. Presently there are 58 sites in seven countries from Alaska to Tierra del Fuego in southern South America.

The United States Shorebird Conservation Plan of 2001 noted the importance of the Delaware Bay to shorebirds that feed on the horseshoe crab eggs in preparation for their continued migration. It stated that the need for the high quality habitat within the Bay still existed and was more essential to many species of shorebirds than ever before.[31]

The horseshoe crab egg diet and rapid body mass gains needed by migratory shorebirds to fly northward has been noted by the USFWS in a 2003 report stating "the life history of long-distance, long-hop shorebird migrants indicates that the availability of abundant food resources at north-temperate stopovers [the Delaware Bay] is critical for completing their annual cycle."[32] The daily weight gains of Red Knot *rufa* in the Delaware Bay are the highest reported for any stopover site or Red Knot population.[33] Because there are no major refueling sites en route between the Delaware Bay and the Arctic, the Delaware Bay is the final and most critical stopover along the northern migration.[34]

The Red Knots arrive at the Delaware Bay fatigued and emaciated from the 5,400 km. flight from the coast of Brazil in South America. At this point, their energy stores have been depleted and their organs have begun to shrink. The Red Knot *rufa* needs to find enough fuel to repair body organs and restore its migratory fat reserves so it can complete its migration. Organs that need to be repaired during Delaware Bay stopover include:

- **Pectoral muscles**—these muscles enable flight. A 1999 study found pectoral muscles of the current Red Knots were smaller relative to the average size of a Red Knot in previous years.[35] The decreased size of pectoral muscles can compromise a Red Knot's ability to fly long distances.
- **Digestive system**—the lining of the intestines protects the body against pathogens ingested with the food.[36] The intestinal mass in Red Knots studied in 1999 were 33% lower than that of birds measured in 1998 and 2000.[37] This reduced intestinal mass results in a suppression of the immune functions within the birds.[38]
- **Liver**— this is the key organ for detoxification in the birds. In 1999 and 2000 the

liver mass of Red Knots was found to have been reduced 33% from the average liver mass in previous years. When this small liver is left unrepaired, its reduced size will negatively affect the long-term health of a Red Knot.

These organs decrease in mass and usefulness over the course of the long migration, hence the need to refuel with fatty lipid rich horseshoe crab eggs in order to regain body mass, rebuild their organs and add extra body fat. The Red Knot *rufa's* ability to refuel in a short period of time, roughly three weeks, and their selection of the horseshoe crab eggs for their migratory fattening is a phenomenal and unique biological marker.[39] Studies have shown that the Red Knot *rufa* can absorb the dietary fatty acids from the horseshoe crab eggs virtually intact, thus facilitating the rapid weight gain necessary for migratory survival.[40]

While in the Delaware Bay, the Red Knot *rufa* feeds almost exclusively on eggs from spawning horseshoe crabs. Unlike the other birds that feed on horseshoe crab eggs, Red Knot *rufa* are not able to dig in the sand to reach the eggs. The Red Knot *rufa* only eats the eggs on the surface of the sand; thus, the existence of a superabundant supply of eggs is critical so that the surface of the sand is bursting with eggs. [41]

The Red Knot *rufa* performs one of the most rapid "fattening" events in nature.[42] It must double its body mass with the lipid rich horseshoe crab eggs in order to meet its nutritional needs for the final 2,400 km. leg of the spring migration and to have enough fuel to survive and breed once it arrives in the central Canadian Arctic.[43] A Red Knot will double its body mass, from 90-120 g. upon arrival in the Delaware Bay to 180-220 g. upon departure, only if conditions at Delaware Bay are favorable.[44] The key to favorable conditions at the Delaware Bay is the availability of a superabundance of horseshoe crab

eggs.[45]

Red Knots refuel over a period of 19–22 days and must have stored 1,890 kilojoules of energy (about 47 grams of fat) while at the Delaware Bay.[46] The U.S. Fish and Wildlife Service's (USFWS) Shorebird Technical Committee reported on the Shorebird-Horseshoe Crab Assessment for the Atlantic States Marine Fisheries Commission (ASMFC) (2003) that horseshoe crab egg consumption is estimated at 18,000 eggs per day per Red Knot. That is a weight gain of 2.6 to 8.0 grams per day while at the Delaware Bay stopover.

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Failure to gain adequate weight while at the Delaware Bay has impacted the reproductive productivity of the Red Knot *rufa*.[47] Baker, A.J., et al., state that "…[L]owered recruitment of second-year birds in wintering flocks indicate[] that breeding success was reduced by refueling problems in adults in Delaware Bay." Fecundity issues for the Red Knot are the result of reductions in the functional size of

vital organs at departure from the Delaware Bay, leading to reproductive failure and/or enhanced mortality.[48]

THE DECLINE OF HORSESHOE CRAB EGGS

Recent studies have shown that the decrease in available horseshoe crab eggs at the Delaware Bay stopover is the cause of the decreased weight gain for the Red Knot.[49] The decrease in horseshoe crab eggs is evidenced by the decline in spawning horseshoe crabs along the Delaware Bay shore.[50]

Unfortunately, horseshoe crabs are used as bait to catch American eel and conch. Although both male and female crabs are killed for bait, the egg laden female is preferred because of its meat chemical attractant to the eels and conch fish.[51] This "chemo-attractant" makes the egg-laden females highly desirable for use as bait. Once a horseshoe crab is collected, it is tied to the bottom of a wire conch trap or eel pot. The chemo-attractant in the horseshoe crab draws conch or eel into the traps. Conch and eel that are caught in the Delaware Bay are then sold for use as food or bait.

As a result of killing the egg-laden female horseshoe crabs, the horseshoe crab population has decreased significantly.[52] As the egg-laden crabs disappear, fewer horseshoe crabs babies are hatching, there are fewer crabs to spawn in the spring and fewer eggs are being laid. Because these eggs are a critical source of nourishment for the Red Knot *rufa*; a shortage of horseshoe crab eggs has a direct negative impact on the Red Knot *rufa* population.

Between 1990 and 1996, the commercial eel and conch fishing industries increased dramatically.[53] During this growth, horseshoe crabs were harvested at a higher rate according to a survey of the trawlers in the Delaware Bay. The records reflected a

six-fold decline in the numbers of horseshoe crabs caught by the late 1990's.[54] Studies show a decline in the average weights of Red Knot *rufa* departing from the Bay also coincided with the increase in the eel and conch fishing industry (and related horseshoe crab harvesting.)[55]

The State of New Jersey and the State of Delaware have placed temporary limits on the horseshoe crab harvest in the past.[56] These programs were coordinated with horseshoe crab management plans and annual quotas on horseshoe crab catches promulgated by the Atlantic States Marine Fisheries Commission (ASMFC). These programs only caused a leveling of available of horseshoe crabs but have not increased the availability of horseshoe crab eggs to meet the needs of Red Knot *rufa*.[57]

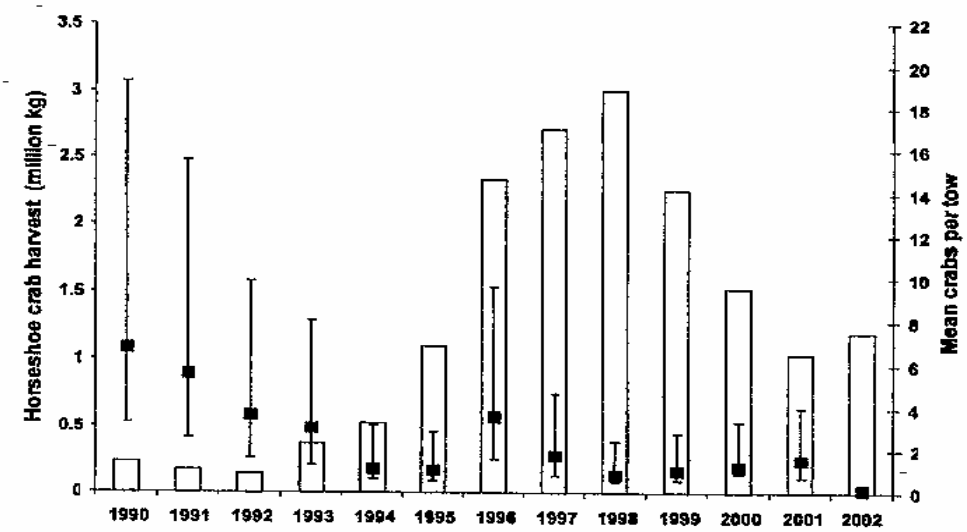


FIGURE 2. The annual harvest of horseshoe crabs (million kg; open bars) from 1990 to 2002 compared to the results of a baywide trawl of crabs (filled squares; ±95% confidence intervals) during the same period conducted by the Delaware Division of Fish and Wildlife (Atlantic States Marine Fisheries Commission 1998; S. Michels, unpubl. data). The first mandatory reporting of the horseshoe crab harvest was in 1993, so previous harvest estimates are probably underestimates. Harvest restrictions were applied in 1996 and 1998.

Morrison, R.I.G, R.K. Ross & L.J. Niles, L.J., 2004, Declines in wintering populations of red knots in southern South America. Gondor106, 60 – 70, p. 68.

CONCLUSION RE: BIOLOGY

The biology of the Red Knot *rufa* is highly specialized. The small and quiet Red Knot *rufa* has evolved into one of the world's most extreme migrators. Not only is the

body of this migratory bird engineered to withstand lengthy periods of demanding physical activity (so severe that it shrinks the Red Knot's internal organs), the Red Knot *rufa* has adapted its metabolic structure to absorb the lipid rich horseshoe crab eggs and double its weight within three weeks.[58] The behavior and nutritional needs of the species has evolved to synchronize its migration with one of the World's largest annual buffets of horseshoe crab eggs in the Delaware Bay.

The availability of horseshoe crab eggs in the Delaware Bay is crucial because the eggs not only supply nourishment to rebuild body organs and gain body mass to fuel the flight to the breeding grounds, they also provide stores of nourishment during the first few weeks after arrival in the Arctic when food is scarce.[59] Because of this unique dependence upon the horseshoe crab eggs, if the Red Knot cannot find an adequate amount of eggs during the northward migration through the Delaware Bay, the undernourished adults will either perish en route to the Arctic, or will be unable to survive and/or breed once they arrive.[60]

The dependence of the Red Knot upon the horseshoe crab eggs in the Delaware Bay causes the Red Knot to be highly susceptible to declines in the horseshoe crab eggs. If this key rest stop for the Red Knots continues to be compromised and the abundance of horseshoe crab eggs does not increase, the Red Knots will not find adequate nourishment that can both repair the damage to their organs from the mammoth migratory flight from South America and provide them with the fuel needed for migrating to and breeding in the harsh tundra of the central Canadian Arctic.

IV. POPULATION TREND

Most recently, comparisons of aerial surveys performed annually in May and early June found that the number of Red Knots in the Delaware Bay has consistently declined over the past seven years, from 50,360 in 1998 to 13,315 in 2004.[61] The number of Red Knots passing through the Delaware Bay saw the most significant downturn between 2004 and 2005, during which the peak counts of the Red Knot dropped 40%. The current population represents the lowest number of Red Knots recorded in the past 20 years.[62]

It is clear that the Red Knot *rufa* population has decreased drastically over the past 20 years and it is currently experiencing one of the most severe declines among shorebirds globally.[63] At the current rate of population decline, extinction of the Red Knot will likely occur on or about the year 2010.[64] Despite this dire prediction, with proper protection, the Red Knot's fate could be turned around and its story could be a tale of success. Listing the Red Knot *rufa* as an endangered species is the key to ensuring the survival of this unique migratory bird.

CURRENT STATUS

Undeniably, Red Knot *rufa* are disappearing at an alarming rate. Where the number of Red Knots migrating through the Delaware Bay used to reach well above 100,000, the most recently reported count is a shocking 13,315 birds.[65] According to recent studies, in the last ten years, the Red Knot population has declined more than 90%.[66] From the mid-1980s to 2003, the number of Red Knots observed in the main wintering areas in South America decreased from 67,500 to 30,000—a 45% decline.[67] In

August of 2004, the United States Fish and Wildlife Service evaluated new information and issued a revision to its March 2000 study.[68] In this recent revision, the Red Knot is listed as a "highly imperiled" shorebird.[69] The November 2004 study in Tierra del Fuego found that the number of Red Knots in the wintering areas had decreased an additional 40% since the 2003 population count![70]

AERIAL COUNTS

Annual aerial counts of wintering flocks of Red Knots in Tierra del Fuego recorded a decline in the population from 51,000 to 27,000 between the years 2000 and 2002.[71]

TABLE 2. Summary of counts of Red Knots wintering on the coast of Argentina and Chile. Subtotals are **shown for the core sites in Tierra del** Fuego (Argentina and Chile) and for the principal wintering site for this **subspecies of Red Knot, Bahia** Lomas. Counts from 1982–1985 refer to atlas counts in Morrison and Ross **(1989). Eco-units and locations** are shown in Figure 1.

Country Eco-unit	Survey years 1982–1985	2000	2001	2002	2003
Argentina					
Peninsula Valdes	5023			650[a]	350
Golfo San Jorge	8691			679	210
Rio Gallegos	550			700	0
Tierra del Fuego	10 470	5550		5070	4400
Chile					
Tierra del Fuego	**42 762**	45 705	29 745	**22 172**	**25 515**
Total all sectors	**67 496**	51 255	**29 745**	**29 271**	**30 475**
Subtotals for core areas Argentina and Chile					
Tierra del Fuego (% of total)	**53 232 (79)**	**>51 255**		**27 242 (93)**	**29 915 (98)**
Chile					
Bahia Lomas (% of total)	**41 910 (62)**	**45 250**	**29 745**	**21 855 (75)**	**25 500 (84)**

[a] Not all sectors surveyed.

Morrison, R.I.G, R.K. Ross & L.J. Niles, L.J., 2004, Declines in wintering populations of red knots in southern South America. Gondor106, 60 – 70, p.65.

Scientists questioned whether the low numbers in Tierra del Fuego were a result of the Red Knot population merely spreading out along the coast. However, a January 2003 aerial survey of sites along the Patagonian coast (known to support flocks of wintering Red Knots in the 1980s) located only 560 birds; and a December 2003 survey in northern

Brazil found only a small population (about 5000–7000 birds). Thus, there is no evidence that birds are redistributing themselves elsewhere along the flyway.[72] The low numbers in Tierra del Fuego are consistent with the trends toward the extinction of the Red Knot on or about the year 2010. [73]

As the following graph depicts, the predicted population trends for 10 years, from 2000 to 2010, without immediate action by the Department of the Interior, the Red Knot *rufa* population will be near extinction.

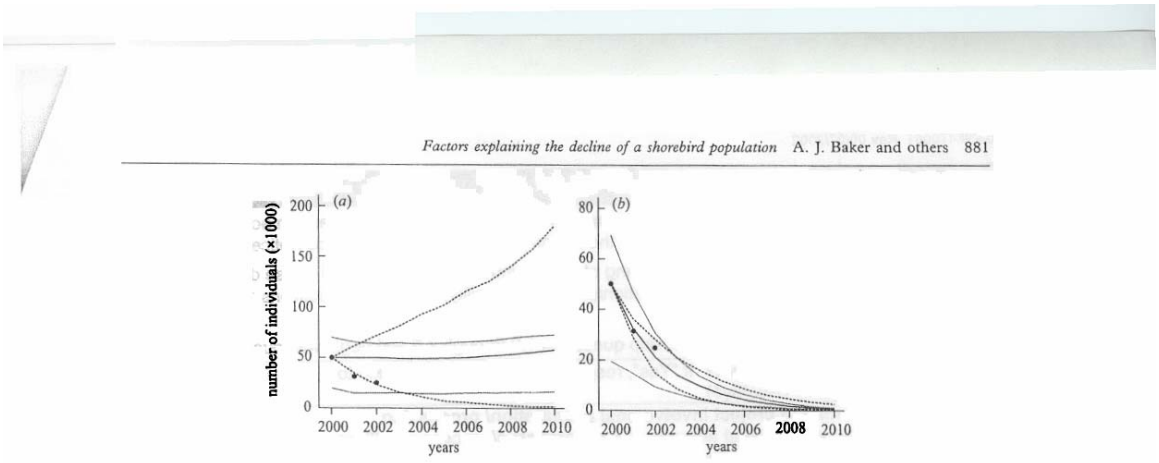


Figure 4. Predicted population trends and associated 95% confidence limits for adults (dashed lines), predicted population trends for juveniles (lower grey line) and the sum of these two (top grey line) for 10 years from 2000, with (*a*) constant adult survival of 85% and juvenile survival of half that of adults (population growth parameter $\lambda = 1$) and (*b*) constant adult survival of 56% and juvenile survival of half that of adults ($\lambda = 0.66$). The closed dots represent the aerial censuses of the overwintering flock of adults in TDF. The 95% upper and lower confidence limits are based on 1000 bootstrap iterations.

Baker, A.J., P.M. Gonzalez, T. Piersma, L.Niles, I.L.S. Nascimento, P. Atkinson, N.Clark, C.D.T. Minton, M.K.Peck, & G. Aarts. 2004. Rapid population decline in red knots: fitness consequences of decreased refueling rates and late arrival in Delaware Bay. Proc. R.Soc. Lond. B 2004, 271, 875-882. p. 881.

BANDING STUDIES

Banding studies have also demonstrated that the Red Knot population has drastically declined.[74] Banding studies in the Delaware Bay have shown that in recent years an increasing proportion of Red Knots is unable to gain sufficient weight to enable it to migrate to the breeding grounds.[75]

CONCLUSION RE: POPULATION TREND

At this moment, the Red Knot is perilously close to extinction. Red Knot numbers were already precarious in 2003, and the recent 2004 study is even more alarming. According to the most recent study funded by the USFWS , within one year (between 2003 and 2004), *the number of Red Knots observed at the Delaware Bay has decreased an additional 40%.*[76] At this rate, if the Red Knot is not listed as an Endangered Species, the population would soon dip below the threshold of sustainability and extinction would be inevitable. The time to list the Red Knot as an Endangered Species is now; the standard rule making procedure under the ESA will take too long hence an emergency listing of this species is required.

V. NATURE, DEGREE, AND IMMEDIACY OF THREAT

At the current rate of population decline, extinction of the Red Knot will likely occur on or about the year 2010.[77] The main threat to the survival of the Red Knot is the degradation of its primary food source in a key refueling spot along its northward migratory route. The primary reason for the declining Red Knot numbers is the over-harvest of horseshoe crabs in the Delaware Bay, where the density of spawning horseshoe crabs has been stable or has declined 4% (but has not increased despite imposition of harvest limits) over the past six years in the Delaware Bay.[78] The spawning density studies show a significant decline in horseshoe crabs along the Delaware shore in the Delaware Bay.[79] The benthic trawl survey of horseshoe crabs, conducted from October 4 through October 29, 2004, showed a significant decrease in primiparous female horseshoe crabs (those that are mature but have not yet spawned) from 2002 through

2004 within the peripheral area of the Delaware Bay—indicating that the horseshoe crab harvest from 1993 through 1995 has caused the number of female horseshoe crabs to decline to an all time low in 2005.[80]

Other shore bird species relying on the horseshoe crab eggs, such as the Ruddy Turnstone and Sanderling, are also experiencing a population decline.[81] Unlike the Red Knot *rufa*, the Ruddy Turnstone actively digs on the beach to reach the horseshoe crab eggs. It is alarming that the number of Turnstones at the Delaware Bay is still declining in spite of this competitive advantage over the Red Knot *rufa*. In the Delaware Bay, Red Knot *rufa* are so dependent on the availability of horseshoe crab eggs that any change in the number of eggs will directly affect the Red Knot *rufa* population.[82]

Currently, the shores used by Red Knot *rufa* are also used recreationally and commercially. Because the Red Knot *rufa* congregates in such large numbers in small areas along the migratory corridor, any deleterious changes to those areas can affect a large portion of the population at one time. The Red Knot *rufa* has been concentrating on different beaches in an effort to avoid humans and find a superabundance of horseshoe crab eggs. The Red Knot *rufa* does not adapt quickly and may not be able to recover from these changes as quickly as other bird species because of the Red Knot's low breeding rate (Red Knots only lay 3-4 eggs once a year).[83] Action needs to be taken now to protect the Red Knot *rufa* from extinction due to human activities.

AREAS WHERE THE RED KNOT IS THREATENED

During the spring migration, nearly the entire Red Knot *rufa* population stops over on the Delaware Bay and feeds on horseshoe crab eggs along the beaches. In

particular, Red Knot *rufa* rely on the eggs on several key beaches along the Bay.[84] In Delaware, specific beaches Red Knots historically depended upon include Kitts Hummock, St. Jones River, Port Mahon, Bowers Beach, South Bowers, Greco Canal Beach, Mispillion Harbor, and Slaughter Beach. In New Jersey, Red Knots depended upon beaches from Cape May to Reeds Beach and Egg Island to Nantuxent Cove along the Delaware Bay.

Reduction of spawning horseshoe crabs on these beaches is the primary threat to the Red Knot population. While the Red Knots are searching for horseshoe crab eggs, humans have been harvesting the horseshoe crabs by the truckload—for use as bait. The horseshoe crabs are taken for bait and killed during their spawning season. As more horseshoe crabs are taken during spawning season, naturally fewer and fewer horseshoe crab eggs are available to nourish the migrating Red Knots.

Human and animal disturbances on these beaches also threaten the Red Knot *rufa* population. Studies of the influence of disturbances demonstrate that gulls (birds that are less affected by humans), dogs and other disturbances, easily out-compete the Red Knot *rufa* and other migratory birds for the horseshoe crab eggs.[85]

FISHING INDUSTRY

Prior to the overharvest of horseshoe crabs for bait during the 1990's, the Delaware Bay was one of the top four most important shorebird migration sites in the world.[86] Horseshoe crabs spawned en masse in a concentrated area along the Delaware Bay and were thus too easily picked off the beach by the truckload by a handful of harvesters. This human interference interrupted the normal process of the horseshoe

crabs' reproduction, ultimately reducing the key food source for the migrating Red Knot *rufa*. The harvesting of horseshoe crab continues to interfere with the food source of the Red Knot *rufa*.

OTHER ALLEGED BUT UNSUPPORTTED CAUSES OF THREAT

The identified cause for the severe downturn in the Red Knot *rufa* population is the decline of the Red Knot *rufa* major food-source—horseshoe crab eggs. While others have put forth alternative theories, none of them are supported by the science. For example:

1. Degradation of the Red Knot *rufa* habitat in South America is not a practicable theory as to the decrease in the Red Knot *rufa* population. There is no evidence of a lack of food, or other problems, at the wintering area in Tierra del Fuego or other South American locations. In fact, other migratory birds (such as the Hudsonian Godwit) feeding in the same areas and on same prey as the Red Knot *rufa* in South America have not seen a population decline.[87] Also, there is no indication of any disease causing a decline in the numbers of Red Knots in Tierra del Fuego.

2. Hunting of the Red Knot *rufa* in South America has been suggested as a cause of the reduction of Red Knots. In fact, there is absolutely no evidence of any change in habitat or human interference such as hunting in its wintering location in Tierra Del Fuego, or any other location in South America, that affects the Red Knot *rufa* population.[88]

3. Finally, the last theory proposed as to why the Red Knot *rufa* is disappearing is that, given the lack of a superabundance of horseshoe crab eggs in the Delaware Bay,

Red Knot *rufa* may be engaging in exploratory behavior to find other sources of food along its migratory path. Although a portion of the diet of a migrating Red Knot *rufa* includes mollusks and small invertebrates, fatty lipid rich horseshoe crab eggs provide the most efficient refueling substance and comprise the main portion of the Red Knot's diet while in the Delaware Bay—hence the biological reason why the Red Knot *rufa* choose to stop and refuel specifically at the Delaware Bay. Small mollusks and invertebrates are available to the Red Knot *rufa* in certain locations along its migratory path; however, none of these areas can provide the critical nutrition found in the horseshoe crab eggs. In addition, a migratory bird species that has an adopted migratory path is unable to quickly change its flight patterns to accommodate for a lack of food.[89] And the speed at which the Red Knot *rufa* is heading towards extinction does not allow time for the trial and error needed for explorations of alternate refueling areas.

CONCLUSION RE: THREATS

The main threat to the survival of the Red Knot *rufa* is the destruction of its primary food source in a key refueling spot along its grueling migratory route. The well temporal and synchronized relationship between the Red Knot *rufa* and the annual spawning of the horseshoe crab makes the Delaware Bay a unique source of life-sustaining nourishment. The migration of the Red Knot *rufa* has evolved to coincide with the largest concentration of spawning horseshoe crabs in the world; thus, the migratory path from Tierra del Fuego to the Arctic offers no feasible last-leg alternative providing similar quality and quantity of nutrition to that of the superabundance of horseshoe crab eggs available in the Delaware Bay. The survival of the Red Knot *rufa* is

critically linked to the availability of horseshoe crab eggs in the Delaware Bay.

The primary cause of the decline of horseshoe crab eggs is the use of adult horseshoe crabs as bait for conch and eel fishing. If left unchecked, this human activity in the Delaware Bay will cause the population of the Red Knot *rufa*, *a* unique wading bird, to disappear on or about the year 2010. Of the different conservation options discussed, scientists recommend a complete harvest moratorium on horseshoe crabs as the most effective means to increase the availability of eggs and save the Red Knot from extinction. For the moratorium to be effective it must be applied uniformly across State lines. The recent horseshoe crab egg density studies and trawling surveys, showing a declining number of spawning horseshoe crabs, demonstrate the failure of the current Atlantic States Marine Fisheries Commission fisheries' management plan for the horseshoe crab. If the Red Knot population is to recover from existing harms, action must be taken now to alter the harmful effects of human activity in the Delaware Bay.

V. REASONS FOR CONSIDERATION OF ENDANGERED SPECIES ACT LISTING FOR THE RED KNOT

Petitioners have provided irrefutable evidence based upon the best scientific and commercial data available that the Red Knot *rufa* will likely be extinct on or about the year 2010 without immediate protection under the Federal Endangered Species Act through an emergency listing. There has been no adequate action to date from any state or government agency to reverse the trend of the rapidly declining Red Knot *rufa* population.

The declining population of Red Knot *rufa* cannot be attributed to fluctuations in breeding cycles or alterations in migration patterns. Population trend estimates have been

consistently negative for several decades.[90] As reported by Morrison, population estimates of 100,000-150,000 in the early 1990s fell to 80,000 in the latter part of the decade, and the numbers have fallen even further "with drastic declines of *rufa* occurring on the major wintering grounds in southern South America in recent years." [91]

Between 2000 and 2002, the Red Knot *rufa* population size at Tierra del Fuego declined alarmingly from 51,000 to 27,000, which Baker, et al. concludes "seriously threaten[s] the viability of this subspecies." According to the study, "demographic modeling predicts imminent endangerment and an increased risk of extinction of the subspecies without urgent risk-averse management."[92] In other words, if these levels of decline continue, "the population is predicted to approach extremely low numbers by 2010 when the probability of extinction will be correspondingly higher than it is today."[93]

The Baker curve is not merely hypothetical. Subsequent research demonstrates that red knot numbers are falling precipitously in proportions that match Baker's projections.[94] Indeed, the latest counts show that numbers of Red Knot *rufa* on both the Delaware Bay and Tierra del Fuego are at their lowest point in the 20-year period of the survey.[95] At present rates of decline, extinction within 5-years, urges a serious probability.

The five-year extinction trajectory for the Red Knot *rufa* is an imminent crisis requiring immediate action. According to Niles, et al., "That [Baker, et al.] predicted extinction of the New World Red Knot in five years should motivate all professionals working on the horseshoe crab and shorebirds to take a fresh look at our work and determine prudent actions that best serve this species as it moves perilously close to collapse."[96] For these reasons, and those that follow, we believe ESA listing is

appropriate and necessary.

1. 50 CFR 424.11(c)(1): The present or threatened destruction, modification, or curtailment of habitat or range;

With shorebird populations declining worldwide, international attention has focused on the dependence of shorebirds upon critical stopover areas during their migration.[97] The Delaware Bay is the most important of these stopovers. Traditionally, shorebirds would use the Delaware Bay, and its formerly abundant supplies of horseshoe crab eggs, to "forage intensively" to gather enough fuel in the form of fat and muscle protein to complete the 2,400 km migration to the Canadian Arctic.[98] Numerous studies detail that the shorebird diet during stopover in the Delaware Bay consists primarily of horseshoe crab eggs.[99]

Baker's analysis of capture-recapture data collected in the wintering populations in Tierra del Fuego/Patagonia and from the "critically important last refueling stop in Delaware Bay reveals the dramatic drop in annual survival that occurred between the 1999/2000 … and the 2000/2001 migration years."[100]. The study demonstrated that "there are striking fitness consequences for both adult survival and the numbers of second-year birds in wintering populations of red knots that are correlated with the amount of nutrient stores accumulated in Delaware Bay, the last stopover site before they migrate to breeding grounds in the Canadian Arctic." [101]

As noted previously, red knots and other shorebirds depend upon the traditional abundance of horseshoe crab eggs in Delaware Bay to refuel for the remainder of their journey to the Arctic breeding grounds. Unfortunately, reductions in spawning horseshoe crab populations have caused significant decreases in the availability of horseshoe crab eggs on Delaware Bay beaches since the 1980s.[102]

Baker's work illustrates the impact of the loss of this nutrient source on the Red Knot. The amount of food available at Delaware Bay directly affects the bird's ability to gain mass for the final leg of its journey. Baker et al. (2004) found that the Red Knot has shown increasing signs of energetic stress in refueling on Delaware Bay since 1999 and that there was a significant decrease of 70% of well conditioned Red Knots (200 g or greater) between the years 1997/1998 – 2001/2002. Consequently Baker et al. (2004) conclude:

> There has therefore been a significant increase in the proportion of red knots departing Delaware Bay that are under-conditioned for the joint energetic demands of migration to and breeding success in the Artic. (p. 878)

As egg supplies declined in the late 1990s, Baker also found real physiological impacts in the Red Knot: critical organs reduced in size compared with prior years; reduced pectoral muscles relative to expected size; reductions in intestinal mass by up to one-third; and reduction in liver size by one-third. These changes compromise flight, suppress immune function, and compromise long-term health.[103]

The increased observance of under-conditioned knots can clearly be linked to reduced food availability along Delaware Bay.[104] Morrison et al. (2003) confirm this:

> … studies in Delaware Bay suggest that increased adult mortality of Red Knots resulting from inability to gain sufficient weight prior to migration to breeding grounds could account for the magnitude of the observed declines. (p. 68)

Indeed research on Red Knots and other species at staging, breeding, and wintering areas confirm that Delaware Bay is the most critical variable. There is no evidence of a lack of food, or other problems, at the staging area in Tierra del Fuego or other South American locations. In fact, other migratory birds (such as the Hudsonian Godwit) feeding in the

same areas and on same prey as the Red Knot in South America have not seen a population decline.[105] Also, there is no indication of any disease causing a decline in the numbers of Red Knots in Tierra del Fuego.

Red Knots are highly vulnerable to degradation of the resources upon which they depend to accomplish their migrations.[106] Morrison et al. (2004) have identified four factors that cause this vulnerability.

> (1) a tendency to concentrate in a limited number of locations during migration and on the wintering grounds, so that deleterious changes can affect a large proportion of the population at once; (2) a limited reproductive output, subject to vagaries of weather and predator cycles in the Arctic, which in conjunction with long lifespan suggests slow recovery from population declines; (3) a migration schedule closely timed to seasonally abundant food resources, such as horseshoe crab (*Limulus polyphemus*) eggs during spring migration in Delaware Bay (Tsipoura and Burger 1999), suggesting that there may be limited flexibility in migration routes or schedules; (4) occupation and use of coastal wetland habitats that are affected by a wide variety of human activities and developments (Bildstein et al. 1991). (p. 61)

The factors stated above, specifically numbers one and three, have made red knots especially vulnerable to changes in horseshoe crab fishery in Delaware Bay.[107] As Baker[108] concludes:

> The decline in the average departure masses of red knots follows the dramatic increase in commercial fishing that began in 1990 and peaked in 1995/96 to provide bait for eel and conch fisheries (Walls et al. 2002), and also reflected a six fold decline in the number of horseshoe crabs caught in survey trawls in Delaware Bay by the Delaware Division of Fish and Wildlife (S. Michels, unpublished data, cited in Andres (2003)). We contend that the over-harvesting of horseshoe crabs in the past and the erosion of beaches in Delaware Bay have jointly reduced the number of foraging areas for shorebirds, and has concentrated the birds into a few key locales where crab eggs are locally abundant. There is strong evidence that the increasing dependence of birds on so few vulnerable areas and the increasing proportion of poor-conditioned birds at departure time have direct and serious implications for the continuing viability of the *rufa* subspecies.

2. 50 CFR 424.11 (c)(2): Overutilization for commercial, recreational, scientific, or educational purposes;

The unique biological relationship between the Red Knot *rufa* and the horseshoe crab spawning activity creates an extraordinary and direct connection between the overutilization of the horseshoe crab and decline in the Red Knot *rufa* population. [109] While the Red Knot *rufa* itself is not overutilized for commercial, recreational, scientific or educational purposes, the survival of the Red Knot *rufa* is critically and directly dependant upon protecting its food source at its most important migratory stopover where the commercial overutilization of the horseshoe crab has caused a significant decline in available horseshoe crab eggs. The vulnerability of horseshoe crabs for commercial purposes and the consequent decline in available horseshoe crab eggs has caused the decline in the Red Knot *rufa* population. [110]

3. 50 CFR 424.11 (c)(3): Disease or predation;

Reduction in food sources, due to the harvesting of horseshoe crabs and the resulting loss of available eggs in the Delaware Bay, has increased the Red Knot's susceptibility to disease. Baker found that the Red Knot *rufa* 's inability to obtain adequate fuel reserves has serious physical consequences for the bird. "The lining of the intestine and the mucosa it produces protect the body against pathogens ingested with the food (Schat & Myers 1991). Reductions in intestinal mass (33% lower in 1999) have been experimentally shown to suppress immune function (Sanderson 2001)."[111] The lack of food in Delaware Bay thus not only impacts the red knots' ability to gain weight and

undergo the physiological changes necessary to complete its migration, but it also increases the bird's vulnerability to disease.

Competition from other species for diminishing food resources is a documented negative factor. Studies have found that gulls foraging on the beaches of Delaware Bay can directly or indirectly compete with shorebirds for horseshoe crab eggs.[112]

4. 50 CFR 424.11 (c)(4): The inadequacy of existing regulatory mechanisms;

Although the decline in Red Knot *rufa* populations has been apparent for a decade, the Red Knot *rufa* is presently without federal protection under the Endangered Species Act and receives only minimal protection under the Migratory Bird Treaty Act (MBTA). The MBTA protects against direct take of birds, nests, and eggs, but the act provides no authority for protection of habitat or food sources.

Because of its documented significance to numerous shorebirds, the Delaware Bay is a Western Hemisphere Shorebird Reserve Network (WHSRN) site. WHSRN status brings international attention to the species and encourages local conservation initiatives both in the United States and throughout the species' migratory range, but these efforts are voluntary. Although the Bay benefits from international interest and scientific study, such efforts provide no legal authority to protect the Red Knot *rufa*.

Management efforts to protect the Red Knot *rufa* on Delaware Bay currently involve local, state, and federal agencies, but there is little consistency or coordination across state lines. The states of New Jersey, Delaware, Maryland, and Virginia are active in Red Knot *rufa* conservation to varying degrees, and New Jersey has listed the bird as a state threatened species.

The states, in conjunction with the Atlantic States Marine Fisheries Commission ("ASMFC"), currently manage the Delaware Bay horseshoe crab fishery—which, as demonstrated above, has significant and direct consequences for the Red Knot *rufa*. In December of 1998, ASMFC adopted an interstate fishery management plan for the horseshoe crab. Implementation of this management plan included a reduction in the coast-wide harvest of horseshoe crabs for use as eel and conch bait and placed a quota on the number of horseshoe crabs permitted to be caught or taken.[113] Also, in November 1999 ASMFC and the FWS formed the Shorebird Technical Committee to address the potential impact of horseshoe crab management on shorebirds.[114] Recent reports published by the D.S. Smith (February 7, 2005) and D. Hata (June 17, 2005) (copies attached as Appendix "F." and "G" respectively) provide information on the monitoring plans and show that the horseshoe crab, particularly the egg producing females, are in decline.[115] The ASMFC horseshoe crab harvest quotas and the temporary short-term harvest moratoriums in New Jersey have slowed the decline in the horseshoe crab population, but have been insufficient to increase the amount of horseshoe crab eggs as needed by the Red Knot *rufa*.

The ASMFC has jurisdiction over the coastal fisheries resources of the Atlantic States. Thus, the ability of the ASMFC to protect the habitat of the Red Knot *rufa* and other shore birds is limited by its exclusive statutory authority over coastal fisheries.[116] Upon listing the Red Knot as endangered, the ASMFC will have jurisdiction to control the horseshoe crab fishery as is necessary to protect the habitat of the Red Knot *rufa*.[117]

5. 50 CFR 424.11(c)(5): Other natural or manmade factors affecting its continued existence.

Study after study has shown that the single most significant cause of the decline in

the Red Knot *rufa* population is the acceleration of the harvesting of horseshoe crabs on the Delaware Bay that began in the 1990's. Recent reductions in crab harvests have not increased horseshoe crab egg densities to the level needed to provide adequate weight gain for the Red Knot *rufa*. It is clear that the number of horseshoe crabs that spawn in the Delaware Bay must increase and not merely be maintained. Adequate controls and changes to the fishery are thus overdue and must be implemented immediately to halt the Red Knot's extinction trajectory.

A related factor is the tendency of Red Knot *rufa* populations to flock together in concentrated masses, leaving the entire population particularly "vulnerable to loss of key resources."[118] Counts of Red Knot *rufa* at peak migration on Delaware Bay have shown that between 42 and 92 percent of the entire adult *rufa* population may be present in the same location at any single day.

Seasonal variations that either reduce horseshoe crab productivity or affect breeding habits of the Red Knot *rufa* also play a role. The low number of surviving Red Knot *rufa* population will be at a significant risk for extinction from any catastrophic event—be it weather changes or disease—because there will not be enough genetic variations in the gene pool for the species to survive.[119] Previously, the Red Knot *rufa* population was sufficiently abundant to provide a buffer against such variations, but as the Red Knot *rufa's* numbers dip below the point of sustainability, such factors could combine to push the species over the edge to extinction.

Global warming may also have a particularly strong negative impact on the species, as it is expected to impact significantly the polar and temperate regions where the Red Knot breeds and winters. Additionally, all major known staging sites are on the

temperate coastlines, where sea level rise is predicted to be the greatest. As Baker has noted, erosion of shoreline habitat is also a likely factor in the Red Knot's decline.[120]

CONCLUSION RE: LISTING FACTORS

Studies by Baker, Morrison, Niles and others have documented the dramatic decline in the population of the *rufus* subspecies of the Red Knot. Most disturbingly, research by Baker et al (2004) indicates that if Red Knot *rufa* populations continue to decline at their present rate, the bird could go extinct by or near 2010. New research, by Niles, et al (2005) confirms that this extinction trajectory remains on track. The evidence shows that the decline of the Red Knot *rufa* closely corresponds to the massive increase in harvesting of the horseshoe crab on the Delaware Bay in the past decade. This harvesting and the failure of State and Federal governments to adequately address the issue, along with other changes in the Delaware Bay ecosystem, has led to a significant reduction in food resources for the Red Knot *rufa* and other shorebirds that depend on the Delaware Bay for refueling during their trans-continental migrations.

The Red Knot, *rufa*, because of its specialized feeding and migration ecology, could be considered an indicator of ecosystem integrity. (Conclusions from the International Wader Study Group Conference 2003). A remarkable bird worth conserving in its own right, the Red Knot also is a symbol for the shorebird community and the ecosystem processes it depends on for survival. The Delaware Bay is a critically important spring stopover for the Red Knot and other migratory birds, but overexploitation of food resources is impacting their ability to make productive use of this habitat and reach their Arctic breeding grounds to breed successfully. Efforts to

preserve the Red Knot will also promote the conservation and restoration of numerous shorebirds and the Delaware Bay ecosystem itself.

Protection efforts to date have failed to address site-specific threats to the Red Knot *rufa* (i.e. habitat loss and availability of forage at Delaware Bay). Conservation and management strategies on a regional scale are necessary for the preservation of the species.

VI. LIST RED KNOT AS ENDANGERED AND DESIGNATE CRITICAL HABITAT

The Red Knot *rufa* is in danger of extinction throughout all of its range due to its inability to gain sufficient weight to complete its migration and to survive to reproduce in its central Canadian Arctic breeding grounds. Simply maintaining the current inadequate number of horseshoe crab eggs in the Delaware Bay will not reverse that trend. Because the Red Knot *rufa* relies upon the ecosystem of the Delaware Bay as a critical stopover and refueling location, the Endangered Species Act is the best tool available to protect the Red Knot *rufa* from extinction. Listing the Red Knot *rufa* as endangered and identifying the Delaware Bay, or portions thereof, as its critical habitat will provide a means whereby the ecosystem, upon which the Red Knot *rufa* depends, may be conserved and a program for the conservation of the Red Knot *rufa* can be put in place.

Extinction of the Red Knot *rufa* is preventable, but action must be taken immediately. First, the Red Knot *rufa* must be emergency listed as endangered under the Endangered Species Act; once it is listed as endangered, the Red Knot *rufa* population can recover through proper management of their critical habitat. Second, increased

horseshoe crab egg densities—the key to the survival of the Red Knot *rufa*—must be the focus of any fisheries management program. Third, beach closures during the brief migratory stopover period must be seriously considered. Finally, plans that are already in existence for monitoring the bird population and controlling the horseshoe crab egg densities can be improved upon.

In accordance with 50 CFR 424.12, critical habitat should be specified to the maximum extent prudent and determinable at the time a species is proposed for listing. The critical habitat designation is prudent because of the imminent risk of extinction of the Red Knot *rufa*; it is determinable because repairing the damage done to the horseshoe crab population by prohibiting harvesting for bait is the best method of saving the Red Knot according to the experts in the field.[121] The Petitioners respectfully suggest that the Service review the various spawning beaches to determine the appropriate action, such as temporary beach closures. Horseshoe crab harvest moratoriums on both land catches and sea catches are vital.

SUGGESTED CONSERVATION PROGRAM:

FOOD-SOURCE MANAGEMENT

As demonstrated by the horseshoe crab density study and horseshoe crab trawl survey the number of spawning horseshoe crabs has steadily declined over the past 15 years.[122] Managing this population of horseshoe crabs is critical to the survival of the Red Knot.

Part of the horseshoe crab egg density and horseshoe crab population management could consist of regulating human activities that deplete the number of

horseshoe crabs in the Delaware Bay. It is respectfully suggested that increasing the densities of horseshoe crab eggs can best be implemented by placing a moratorium on horseshoe crab harvesting in Maryland, Delaware, New Jersey, and New York.

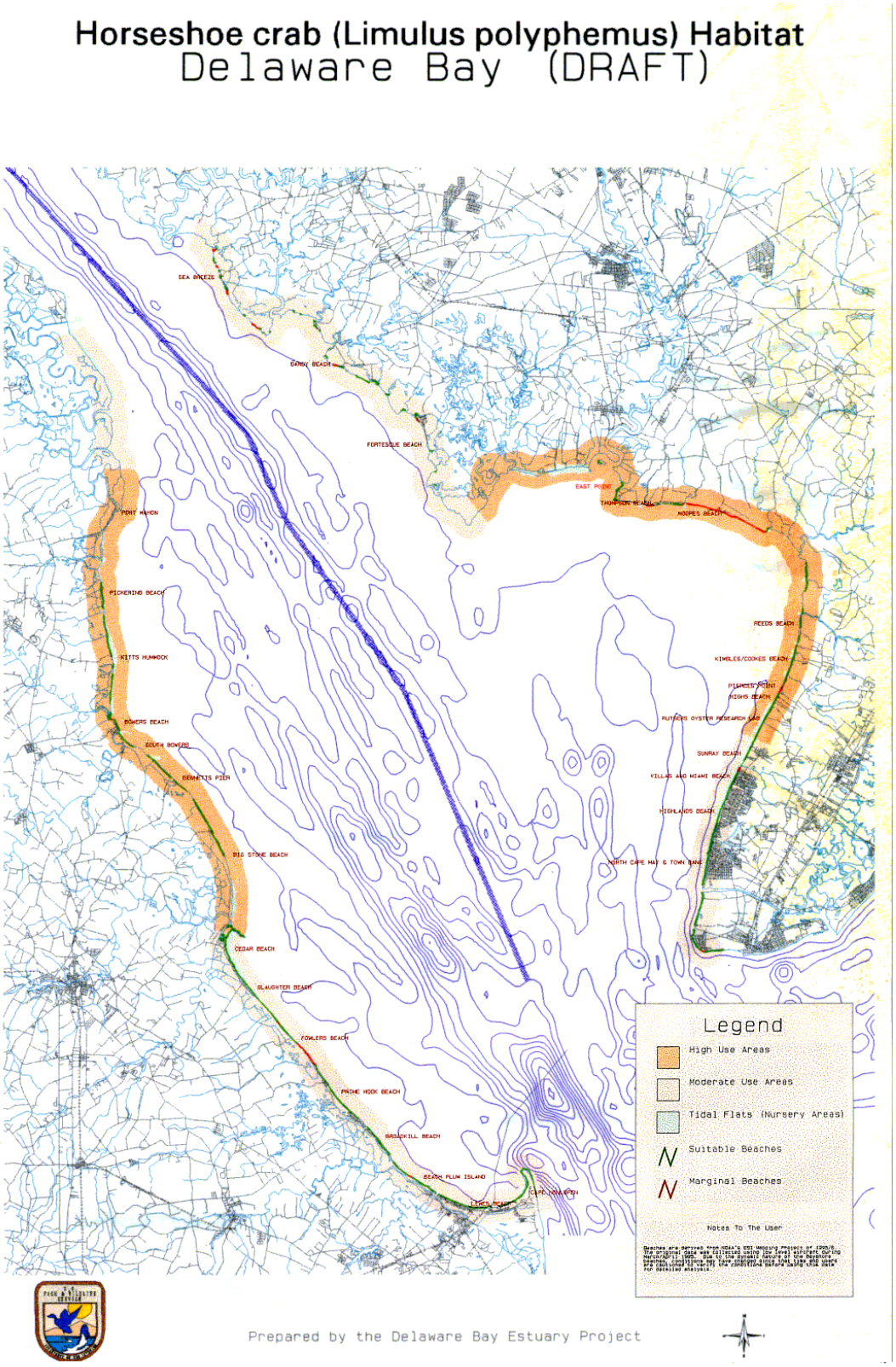
The Atlantic States Marine Fisheries Commission (ASMFC) promulgated a quota system that presently allows the continuing take of horseshoe crabs. As the recent reports by Smith and Hata show, this quota system is not working. The use of reduced harvest limits and bait bags has not proven to date to be an effective strategy for restoring the density of horseshoe crab eggs needed by the Red Knot *rufa*. A complete moratorium is suggested to provide adequate time for the recovery of the superabundance of horseshoe crab eggs. An immediate moratorium has the potential to sustain the Red Knot *rufa* population until the horseshoe crab population increases to the point of providing the superabundance of eggs found on the Delaware Bay shores in the early 1980's—before the decline in spawning horseshoe crabs.

Upon the sufficient recovery of horseshoe crabs needed to produce a superabundance of eggs that equals those quantities found in the early 1980's, a horseshoe crab management plan established by the ASMFC could again go into effect provided that plan was consistent with the needs and sustainability of the ecosystem.

MONITORING PLANS

Monitoring plans are currently in place for the Red Knot *rufa* and the horseshoe crab. Fisheries management plans and monitoring programs should be continued so that the Red Knot 's food source can be evaluated each spawning season.

SUGGESTED AREAS FOR CRITICAL HABITAT DESIGNATION



The USFWS map above identifies the spawning areas for horseshoe crabs along the Delaware Bay. Beaches and properties known to be spawning beaches for horseshoe crabs and feeding grounds for Red Knots are easily identified. Beaches where Red Knots roost at night are also easily identified.

Petitioners also suggest that human contact be banned for the brief migration period the Red Knot stops over at the Delaware Bay. Any beach designated as critical habitat should be closed to the public from May 1 through June 15 each year to provide ample opportunity for the early and late arrivals of Red Knots to have access to the horseshoe crab eggs and to roost at night.

PROVIDE CERTAINTY THAT CONSERVATION EFFORT WILL BE IMPLEMENTED & EFFECTIVE

- The conservation efforts suggested by the petitioners can be implemented in the following ways
    - The Service can work with the National Marine Fisheries to enforce any moratorium on horseshoe crab catches (the Service will have jurisdiction over the beaches, the National Marine Fisheries Service will have jurisdiction over the trawls).
    - The ASMFC monitoring programs will continue to count the horseshoe crabs and monitor spawning activities.
    - When the Red Knot population returns to the pre-1985 numbers of 150,000, the horseshoe crab densities would likely be consistent with the densities of the early 1980's. The Red Knot could then be downgraded to threatened and the habitat could be protected through the implementation

of a horseshoe crab harvest quota, alternative bait sources and/or the required use of bait bags. Jurisdiction could then be handed over to the Atlantic States Marine Fisheries Commission to conserve the horseshoe crab fishery.

- The conservation effort suggested by the petitioners will be effective for the following reasons
    - The Red Knot will be protected in all of the States where it land on its migratory path.
    - There will be a consistent habitat protection program that will be applied uniformly across the Delaware Bay, its ecological system, and in Virginia and Maryland where horseshoe crabs begin their annual trek to the Delaware Bay shores for spawning.
    - The habitat protection program will allow the horseshoe crab population to recover thereby increasing the density of horseshoe crab eggs and creating the superabundance of eggs needed by the Red Knot.
    - Once the Red Knot numbers return to the 150,000 range the harvest moratorium can be lifted and the Red Knot can be sustained through a horseshoe crab management program that will place annual quotas on the permitted horseshoe crab harvest at a level that is protective of the horseshoe crab population and the protective of the quantity of horseshoe crab eggs needed for the long term survival of the Red Knot..

CONCLUSION

The Red Knot *rufa* is an extraordinarily well studied species of significant international interest. Scientific data on the Red Knot *rufa* is abundant and numerous studies now document the species' rapid and alarming decline. The work of Morrison, Baker, Niles, Minton, Sitters and other internationally-renowned authorities provides indisputable evidence of the precipice on which the Red Knot *rufa* now sits. Rarely has available data been as abundant and authoritative as it is with respect to the Red Knot *rufa*.

Petitioners urge the U.S. Fish and Wildlife Service to make an Endangered Species Act listing based on "the best scientific or commercial data available." Petitioners are convinced that the data in this case clearly supports emergency listing. The Service is urged to issue an emergency listing because the Red Knot *rufa* population is unusually vulnerable to human interference and highly imperiled and the standard rule making procedure is insufficient to save the species. Because the conservation efforts suggested in this petition can be effectively implemented, the critical habitat designation can and should be established. We urge emergency listing of the Red Knot *rufa* pursuant to the Endangered Species Act.

Petitioners specifically reserve the right to supplement this petition as new information becomes available.

Respectfully submitted:

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VII. INFORMATION SOURCES

- Morrison, R.I.G, R.K. Ross & L.J. Niles, L.J., 2004, Declines in wintering populations of red knots in southern South America. Gondor106, 60 – 70. Copy attached as Appendix "A."
- Niles, L.J, A. Dey, H. Sitters. & C. Minton, 2005. From slide show presentation on the report on the status of red knots on the Delaware Bay with recommendations for the 2005 filed season. Copy attached as Appendix "B."
- Baker, A.J., P.M. Gonzalez, T. Piersma, L.Niles, I.L.S. Nascimento, P. Atkinson, N.Clark, C.D.T. Minton, M.K.Peck, & G. Aarts. 2004. Rapid population decline in red knots: fitness consequences of decreased refueling rates and late arrival in Delaware Bay. Proc. R.Soc. Lond. B 2004, 271, 875-882. Copy attached as Appendix "C."
- Conclusions from the 2003 International Wader Study Group Conference, 28 September 2003, Cadiz, Spain. Copy attached as Appendix "D."
- Targett, N.M., K .M. Ferrari. Journal of Chemical Ecology, Vol. 29, No. 2, February 2003. Chemical Attractants in Horseshoe Crab, limulus polyphemus, Eggs: The Potential For an Artificial Bait." Copy is attached as Apendix "E."
- Smith, D., S. Bennett, February 7, 2005. "Horseshoe Crab Spawning Activity in Delaware Bay: 1999-2004." Copy is attached as Appendix "F."
- Hata, D. "Preliminary analysis of the 2004 horseshoe crab benthic trawl survey" Horseshoe Crab Research Center, Virginia Polytechnic Institute and State University, Blacksburg, Virginia, June 17, 2005. Copy is attached as Appendix "G."

[1] Copyrighted, DE Audubon Society, website address http://audubon2.org/webapp/watchlist/viewSpecies.jsp?id=173)
[2] Baker, A.J., P.M. Gonzalez, T. Piersma, L.Niles, I.L.S. Nascimento, P. Atkinson, N.Clark, C.D.T. Minton, M.K.Peck, & G. Aarts. 2004. Rapid population decline in red knots: fitness consequences of decreased refueling rates and late arrival in Delaware Bay. Proc. R.Soc. Lond. B 2004, 271, 875-882. p. 879.
[3] International Study Group "Waders are declining worldwide: Conclusions from the 2003 International Wader Study Group Conference" 28 September 2003, Cadiz, Spain, p. 4.; June slide show presentation by Larry Niles, et al. Petitioners reserve the right to supplement petition to include additional references and reports including, *inter alia*, pending Status Report prepared by Larry Niles, et al, for the United States Fish and Wildlife Service, August, 2005.
[4] Baker, A.J., et al., *supra.* note 2, at 881.
[5] Niles, L.J, A. Dey, H. Sitters. & C. Minton, June 2005 presentation and slide show reporting on the status of red knots on the Delaware Bay with recommendations for the 2005 field season. Petitioners reserve the right to supplement current petition to include additional references and reports including, *inter alia*, pending Status Report prepared by Larry Niles, et al, for the United States Fish and Wildlife Service, August, 2005.
[6] International Study Group, *supra.* note 3, at 3.
[7] Morrison, R.I.G, R.K. Ross & L.J. Niles, L.J., 2004, Declines in wintering populations of red knots in southern South America. Gondor106, 60 – 70, at 63, 64; Niles, L.J, et al., *supra.* note 5.
[8] Niles, L.J, et al., *supra.* note 5.
[9] 50 CFR §424.12 (a)
[10] Id.; See also 2001 and 2004 amendments to the Horseshoe Crab Management Plan of the Atlantic States Marine Fisheries Commission, re: the economic values of the horseshoe crab harvests.
[11] Morrison, R.I.G., et al., *supra.* note 7, at 61.
[12] Baker, A.J., et al., *supra.* note 2, at 876.
[13] Id.
[14] From the Cornell Lab of Ornithology: http://birds.cornell.edu/programs/AllAboutBirds/BirdGuide/Red_Knot_dtl.html
[15] Baker, A.J., et al., *supra* note 2 at 881.
[16] Audubon Society's website, http://audubon2.org/webapp/watchlist/viewSpecies.jsp?id=173)
[17] Baker, A.J., et al., *supra.* note 2, at 876.
[18] Id.
[19] From the Cornell Lab of Ornithology: http://birds.cornell.edu/programs/AllAboutBirds/BirdGuide/Red_Knot_dtl.html
[20] Baker, A.J., et al., *supra.* note 2, at 876.
[21] Id., *citing* Harrington 2001
[22] Baker, A.J., et al., *supra.* note 2, at 876.
[23] Id,
[24] From the Cornell Lab of Ornithology: http://birds.cornell.edu/programs/AllAboutBirds/BirdGuide/Red_Knot_dtl.html
[25] Morrison, R.I.G, et al., *supra.* note 7, at 61; Niles, L.J, et al, *supra* note 5.
[26] Baker, A.J., et al, *supra.* note 2, at 876; July 29, 2005 Conversation with G. M. Haramis, U.S. Geological Survey, Patuxent Wildlife Research Center, Bletsville Lab, c/o BARC-EAST Bldg. 308, Rm 114, 10300 Baltimore Avenue, Beltsville, MD 20705. Petitioners reserve the right to supplement petition to include additional relevant references and reports.
[27] Morrison, R.I.G, et al., *supra.* note 7, at 61; Niles, L.J, et al., *supra* note 5.
[28] Baker, A.J., et al., *supra* note 2 at 881; Niles, L.J, et al., *supra* note 5.
[29] Id.
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[31] U.S. Shorebird Conservation Plan, 2001.
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[33] Baker, A.J., et al., *supra* note 2 at 876.
[34] Id.
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functional organ and muscle groups during refueling in a long-distance migrating shorebird. *Physiol. Biochem. Zool*. 72, 405-415.
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[37] Baker, A.J., et al., *supra* note 2 at 881, *citing* Sanderson 2001
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[39] Niles, L.J., et al., *supra* note 5; July 29, 2005 Conversation with G. M. Haramis, U.S. Geological Survey, Patuxent Wildlife Research Center, Bletsville Lab, c/o BARC-EAST Bldg. 308, Rm 114, 10300 Baltimore Avenue, Beltsville, MD 20705. Petitioners reserve the right to supplement petition to include additional relevant references and reports.
[40] July 29, 2005 Conversation with G. M. Haramis, U.S. Geological Survey, Patuxent Wildlife Research Center, Bletsville Lab, c/o BARC-EAST Bldg. 308, Rm 114, 10300 Baltimore Avenue, Beltsville, MD 20705. Petitioners reserve the right to supplement petition to include additional relevant references and reports.
[41] Niles, L.J, *supra.* note 5.
[42] Haramis, G.M., *supra*, note 49
[43] Baker, A.J., et al., *supra.* note 2, at 876.
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[45] Id.
[46] Id.
[47] Id. at 877.
[48] Id. at 878.
[49] Niles, L.J, et al., *supra* note 5.
[50] Niles, L.J, et al., *supra* note 5. July conversation with Larry Niles, referencing Smith, D., S. Bennett, "Horseshoe Crab Spawning Activity in Delaware Bay: 1999-2004." February 7, 2005; and Hata, D., "Preliminary analysis of the 2004 horseshoe crab bentic trawl survey" June 17, 2005 Horseshoe Crab Research Center, Virginia Polytechnic Institute and State University, Blacksburg, Virginia.
[51] Targett, N.M., K .M. Ferrari. Journal of Chemical Ecology, Vol. 29, No. 2, February 2003. Chemical Attractants in Horseshoe Crab, limulus polyphemus, Eggs: The Potential For an Artificial Bait." p.1.
[52] Hata, D. "Preliminary analysis of the 2004 horseshoe crab benthic trawl survey" June 17, 2005 Horseshoe Crab Research Center, Virginia Polytechnic Institute and State University, Blacksburg, Virginia, p.9. It must be noted that the statistical analysis of this report is incomplete. Petitioners reserve the right to supplement this data with the full and complete statistical analysis as soon as it becomes available. See Figure two of the report, demonstrating that the decline in primiparous females is the most dramatic; Niles, L.J, et al., *supra* note 5.
[53] Targett, N.M., et al., *supra.* note 60 at 1.
[54] Baker, A.J., et al., *supra.* note 2, at 876.
[55] Baker, A.J., et al., *supra.* note 2, at 876.
[56] N.J.A.C. 7:25-18.16; DE. New Jersey added a two-week moratorium on horseshoe crab harvest in 2005; Delaware did not.
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[58] Haramis, G.M., *supra.* note 49.
[59] Id.
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[72] Morrison, R.I.G, et al., *supra.*. note 7, at 67, 68.
[73] Niles, L.J, et al., *supra.* note 5.
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[75] Id.
[76] Niles., L.J., et al., *supra.* note 5.
[77] Baker, A.J., et al., *supra.* note 2 at 876.
[78] Baker, A.J., et al., *supra* note 2 at 881; See also Smith, D., S. Bennett, February 7, 2005. "Horseshoe Crab Spawning Activity in Delaware Bay: 1999-2004." It must be noted that the statistical analysis in this report is not complete. Petitioners reserve the right to supplement this data with the full and complete statistical analysis as soon as it becomes available.
[79] Id.
[80] Hata, D. "Preliminary analysis of the 2004 horseshoe crab bentic trawl survey" Horseshoe Crab Research Center, Virginia Polytechnic Institute and State University, Blacksburg, Virginia, June 17, 2005. p.3. It must be noted that the statistical analysis of this report is incomplete. Petitioners reserve the right to supplement this data with the full and complete statistical analysis as soon as it becomes available.
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[82] Morrison, R.I.G, et al., *supra.* note 7, at 67.
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[86] June 2003 Delaware Bay Shorebird-Horseshoe Crab Assessment Report and Peer Review (p.87), listing specific areas where the Red Knot is threatened.
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[88] Niles, L.J., et al., *supra.* note 5.
[89] Baker, A.J., et al., *supra.* note 2 at 876.
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[93] Id., at 881.
[94] Niles, L.J, et al., *supra.,* note 5.
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[101] Id., at 881.
[102] Morrison, R.I.G., et al., *supra.* note 7 at 68.
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[106] Id., at 67.
[107] Id.; Niles, L.J., et al., *supra* note 5.
[108] Baker, A.J., *supra.* note 2 at 881.
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[114] Id.
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