Wildlife Populations: Red Knot

Background

Photo credit: http://www.public-domain-image.com/free-images/fauna-animals/birds/knot-birds-pictures/flock-of-red-knot-birds-on-sand-calidris-canutus-rufa

The red knot, *Calidris canutus,* is an attractive shorebird that is now an endangered species in New Jersey. It has a remarkable life cycle. After journeying from the southern tip of South America, red knots arrive on the shore of Delaware Bay in May and gorge themselves on horseshoe crab eggs in preparation for the long flight to their Arctic breeding grounds. The red knot is one of six shorebird species where the majority of the western hemisphere's population uses the bay as a spring migratory stopover. The red knot, the largest and the stockiest of the breeds, arrives on the bay in its breeding plumage, which consists of a distinctive breast of brilliant, rusty red that extends up the neck and around the eyes. This red bleeds somewhat into the patterned black, brown, gray, and white coloration on its wings and back. The red knot has a short, straight, black bill. It passes through New Jersey again in August and September on its journey back to wintering grounds in South America. [1]

Red knots begin arriving on Delaware Bay during the first week of May. Formerly, their average peak population in mid-May was approximately 46,000 birds (with a range from 1986 to 1995 of approximately 25,500 to 94,500). Since the large harvests of horseshoe crabs which began in the mid-1990s, the average peak numbers of red knots has declined to less than 26,000 (range from approximately 13,000 to 50,000 from 1996 to 2014). The lowest numbers have been recorded in the 2003 to 2011 period. Major concentrations are found at Reed's Beach, Kimbels Beaches at the US Fish & Wildlife Service Refuge, Norbury's Landing, Moore's Beach, and Fortescue, but they can also be found on the coastal marsh and isolated beaches of the Cape May peninsula including Brigantine Natural Area, Stone Harbor Point and the Holgate National Wildlife Refuge.

On Delaware Bay, red knots depend primarily on horseshoe crab eggs and, therefore, frequently can be found in areas of dense horseshoe crab spawning, usually sandy beaches with gentle slopes and minimal wave action.[2] When they arrive on the bay, red knots have little or none of the fat they accumulated while in South America. Many birds will burn muscle to reach the bay. By the end of May, red knots need to reach an average weight of 180 grams or more to reach their Arctic nesting grounds in adequate breeding condition; in general doubling their arrival weight in Delaware Bay.

Red knot success is closely tied to the reproductive success of horseshoe crabs. Horseshoe crabs dig into the sand to lay their eggs about 5 to 30 cm down. However, red knots rely on eggs exposed when nesting areas are disturbed by wave action or the digging action of multiple horseshoe crabs laying eggs in the same area. To create new nests, the crabs inadvertently dig up old nests and expose previously laid eggs. If crab numbers drop to a low density, then eggs remain largely unavailable to most shorebirds. Red knots have been observed feeding on mussel beds on the Atlantic Coast marsh, but as a food resource the hard-shelled mussels are inadequate for the birds to gain weight quickly during their brief stopover period (~12 - 14 days). Only soft, fat-rich horseshoe crab eggs can be easily digested, and metabolized quickly into fat. Because these eggs were (formerly) so numerous, knots could gain 8 to an astounding 15 grams of weight per day. Rapid weight gain is especially important for red knots migrating from greater distances (e.g., from Tierra del Fuego) that are more time constrained while on the Delaware Bay stopover. The loss of horseshoe crab egg resources has most dramatically impacted these longer-distance migrants. By late May to the beginning of June, with what fat resources they have been able to accumulate in the Delaware Bay, the birds leave for the Canadian Arctic tundra. They arrive there by the second week of the month, often facing wintry conditions and sometimes nearly 100 percent snow cover. Red knots make their nest scrapes in snow-free areas. After laying their eggs, the male and female share incubation and, depending on the degree of snow cover and melting of ice over wetlands, may not have access to food for the first week or two, relying on the fat accumulated in the Delaware Bay. Invertebrate prey near their inland nesting areas may be unavailable until the third or fourth week of June, when the eggs begin to hatch. Females begin migrating south by mid-July, followed by males and then by the hatching--year offspring. Significant numbers of red knots stopover in New Jersey on southbound migration in mid-July and remain for three to six weeks before departing for South America (long-distance migrants) or two months or more to molt flight feathers (short-distance migrants). Abundant prey (small clams and mussels) along Atlantic coast inlet areas and beaches, especially North Brigantine Natural Area, Stone Harbor/Hereford Inlet and Avalon, allow long-distance migrants to make rapid weight gain prior to trans-Atlantic flights to South American wintering areas. Short-distance migrant red knots remain on New Jersey's Atlantic Coast for more than two months to undergo flight feather molt before sub-freezing weather in late-November and December pushes birds to southeast US and Caribbean wintering areas.

Trends

The weight of evidence strongly indicates that the loss of horseshoe crab resources on the Delaware Bay since the late 1990s has caused the red knot population to decline.[3] In general numbers, both horseshoe crabs and red knots have declined by over 75 percent since the early 1990s.[4] Five other shorebird species that rely on the Delaware Bay have declined overall by 50 percent during the period 1998 to 2007.[5]

The red knot population declined relatively rapidly from the late 1990s to 2004. Since then the Delaware Bay stopover population has apparently stabilized at a lower level (See Figure 1). The long-term aerial survey (1986-2014) was designed to assess trend in shorebird relative abundance on bayshore beaches. The increase in red knot numbers, starting in 2009, are due largely to the addition of ground counts within Mispillion Harbor, DE -- a location inland of the aerial survey route with high egg resources and periodic high numbers of red knots. Counts within the Harbor allow a more accurate assessment of peak red knot numbers in years when many birds use the Harbor.

There is some evidence of recent improvements in the portion of red knots reaching a departure weight of 180 grams by 26-28 May; in 2008 this portion was 14%, but had climbed to 54% in 2012 and has remained relatively stable to 2014 (53%), (Figure 1). While this is hopeful, egg resources supported nearly twice the number of red knots in 1997-1998 with 60-87% reaching adequate departure weight.

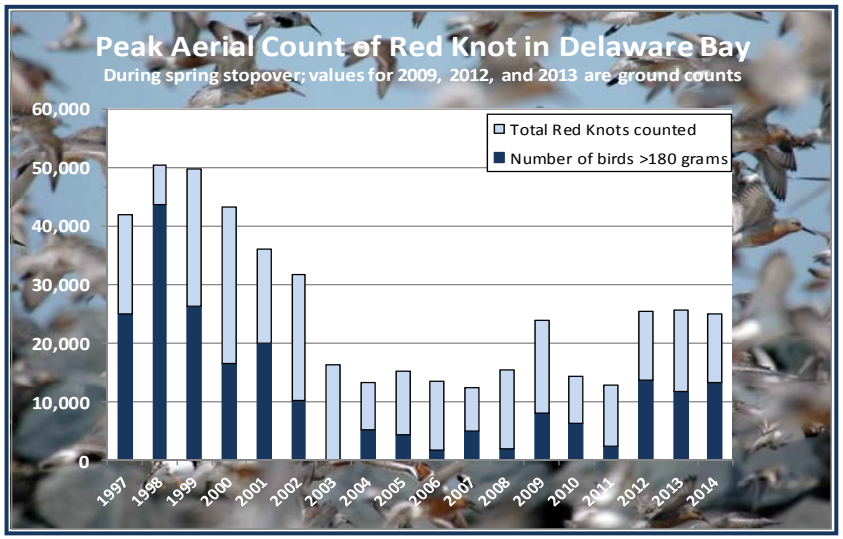

Figure 1

Photo credit: http://www.public-domain-image.com/free-images/fauna-animals/birds/knot-birds-pictures/flock-of-red-knot-birds-in-flight

At least some of the improvement in portion of birds weighing over 180g is due to several years of settled weather, favoring more widely distributed crab spawning and egg resources and less competition among shorebirds. Moreover, since 2003, efforts to reduce human disturbance on NJ bayshore beaches has allowed red knots and other shorebirds to maximize foraging on limited egg resources. Mean available egg densities (in the top 5 cm of sand) are no higher than in 2005, when the first baywide surveys were completed, and remain much lower than the 50,000 eggs/m^2 considered necessary for a recovery of the red knot population.[6] Mispillion Harbor, DE, is an exception. Protected from all weather, and earlier warming of water, this area favors consistently high densities of spawning crabs and surface eggs – more than one to two orders of magnitude larger than mean densities on Delaware and New Jersey beaches, respectively. While Mispillion Harbor is very important, it can support only a portion of red knots and other shorebirds that come to the bay, and shorebirds occur in high densities increasing competition for eggs and attracting avian predators like the peregrine falcon. Despite these difficulties, Mispillion will continue to be an important protected area for shorebirds (See Figure 2).[7]

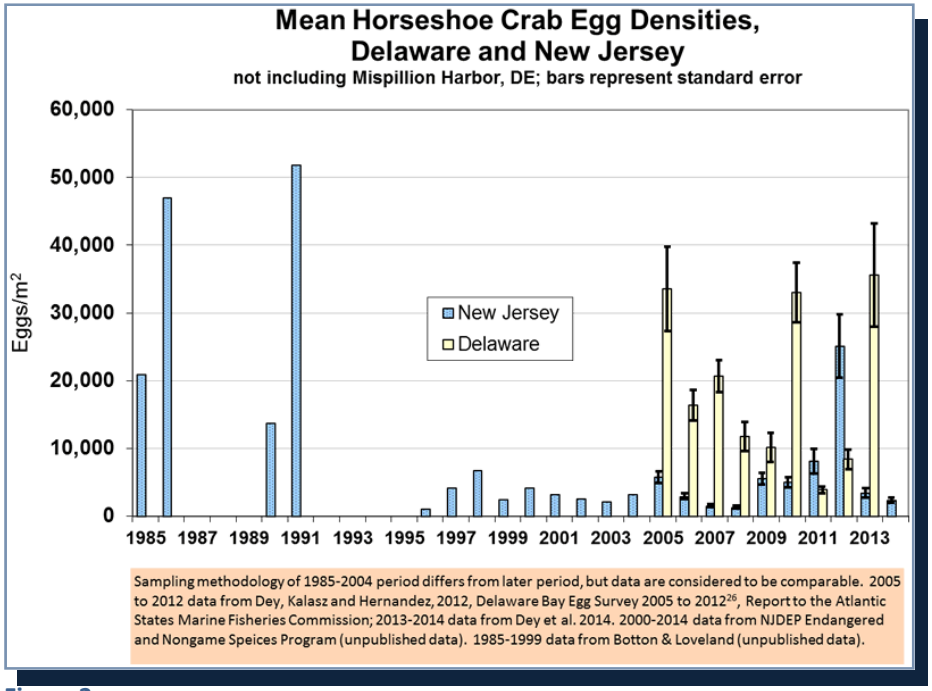

Figure 2

In January 2011, red knot abundance in the main South American wintering areas in Tierra del Fuego, Chile, declined by nearly 40 percent (16,250 in 2010 to 9,850 in 2011) after seven years of stability. Since then, this wintering population has fluctuated annually between ~10,000 and 14,770 individuals (2012-2014). As recently as 2000, this single wintering site held the majority of the Hemisphere's red knots (>51,000). This wintering population, comprised of long-distance migrants, has declined most rapidly; 72% in 15 years. [8] Overall, a hemispheric population that once exceeded >86,000 in the mid-1980's may number just under 25,000 individuals as of spring 2014.

Outlook and Implications

Most biologists agree that the red knot population will take time to recover because of normally low reproductive rates associated with Arctic-breeding shorebirds. Red knots are relatively long lived and reproduction is normally episodic (i.e., when Arctic conditions are favorable), but the key to adult survival and reproductive success is fat stores from Delaware Bay. A rapid recovery of horseshoe crabs and eggs would allow the majority of red knots to maximize productivity, stabilize and begin population recovery.

Management efforts by the states and ASMFC led to a decrease in harvest of horseshoe crabs from over 2 million per year in the late 1990s to approximately 500,000 per year in 2009-2012.[9] In 2013, harvest increased to 698,561[10] primarily due to the implementation of an all-male harvest in DE, MD and VA and the larger quota of male crabs allowed in Delaware and Maryland. (See Figure 3[11])

Over a decade of horseshoe crab monitoring via an Atlantic coast benthic trawl (non-breeding), a spawning crab survey and an egg density survey in Delaware Bay, have not shown increasing trends in crab abundance. These surveys were designed and sanctioned by ASMFC Technical Committees. [12,13,14]

On March 25, 2008, in an effort to increase horseshoe crab populations, the New Jersey legislature passed and then New Jersey Governor Corzine signed legislation enacting a moratorium on the harvesting of horseshoe crabs that is to remain in place until the populations of both horseshoe crabs and red knots have returned to a level where they will be self sustaining as determined by a peer-review panel of qualified shorebird and horseshoe crab ecologists and the Endangered and Nongame Species Advisory Committee. However, it is increasingly clear that without significant additional reduction of horseshoe crab mortality from various sources including bait harvest, lysate production, by-catch and illegal harvest, horseshoe crabs and their eggs are not likely to increase in the short-term and this continues to jeopardize red knot recovery.

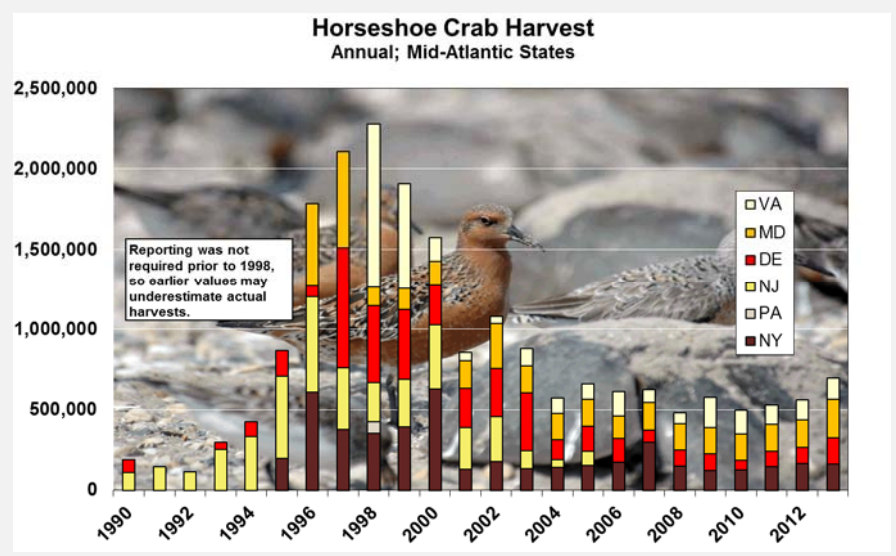

Figure 3

Photo credit: http://www.public-domain-image.com/free-images/fauna-animals/birds/knot-birds-pictures/flock-of-red-knot-birds-on-sand-calidris-canutus-rufa

In an effort to offset the continued impact on the red knot, biologists have also initiated several management programs to improve conditions for red knots and horseshoe crabs, such as the closing of important beaches on the Delaware Bay to prevent the disturbance of feeding shorebirds. This volunteer protection effort includes two additional Atlantic coast areas important for shorebird roosting. In addition, projects to determine red knot population status continue. These projects include collection of key data for long-term model development, horseshoe crab egg counts, shorebird weight surveillance, and individual marking of red knots for long-term survival and population estimates.

In 2012, Hurricane Sandy devastated several horseshoe crab spawning beaches in Cape May and Cumberland Counties, New Jersey. NJ DEP and a collective of government and non-government groups, including American Littoral Society, Conserve Wildlife Foundation of NJ, New Jersey Audubon, New Jersey Natural Lands Trust, met to coordinate actions to restore damaged spawning habitats. With funding from the National Fish and Wildlife Foundation (NFWF) and the

Community Foundation of New Jersey, four beaches in Cape May County and one in Cumberland County, were ready for the arrival of horseshoe crabs and red knots by May 2013 (See: http://www.nfwf.org/whoweare/mediacenter/video/Pages/red-knots-video.aspx).

Restoration efforts continued in 2014 with funding from the Department of the Interior, and additional restoration grants from NFWF that will focus on beach and marsh restoration in the Delaware Bay (Cumberland County) (see http://www.restorenjbayshore.org/) and beach habitat restoration on the Atlantic Coast in 2015-2016 (see http://www.njaudubon.org/SectionResearch/Projects/StoneHarborPointRestoration.aspx).

In October 2006 the US Fish and Wildlife Service (USFWS) declared the red knot a candidate species for federal listing as threatened. In 2007, the Service precluded listing as threatened because of insufficient resources within the Service. Because the ongoing annual monitoring of red knots and horseshoe crab eggs by NJ DEP and Delaware Department of Natural Resources and Environmental Control (DNREC) has shown no improvement in red knot populations and horseshoe crab egg resources, the USFWS commenced work in August 2011 on the listing proposal for red knot. On December 9, 2014, the USFWS announced that the red knot was listed as federally threatened; the listing became effective on January 12, 2015. (Final Rule, see http://www.fws.gov/policy/library/2014/2014-28338.html

More Information

Migratory Shorebirds:
http://www.njfishandwildlife.com/ensp/shorebird_info.htm
http://www.conservewildlifenj.org/protecting/projects/shorebird/

Shorebird and Horseshoe Crab Spawning Beach Restoration - Projects and Reports:
http://www.littoralsociety.org/index.php/programs/habitat-restoration/del-bay-horseshoe-crab-beach-resoration
http://www.restorenjbayshore.org/
http://www.njaudubon.org/SectionResearch/Projects/StoneHarborPointRestoration.aspx
http://www.nfwf.org/whoweare/mediacenter/video/Pages/red-knots-video.aspxl
Inquiries regarding red knot survey data should be directed to Amanda Dey, Principal Zoologist, Endangered & Nongame Species Program, Division of Fish and Wildlife, 8747 Ferry Road, Millville, NJ 08332 (856) 785-2711 amanda.dey@dep.nj.gov or Kathy Clark, Supervising Zoologist, Endangered & Nongame Species Program, Division of Fish and Wildlife, 500 E. State Street, P.O. Box 400, Trenton, NJ 08625-0400, (609) 292-9400 or (609) 628-2103.

References

[1]Beans, B. E., and L. Niles, eds. 2003. *Endangered and Threatened Wildlife of New Jersey.* Rutgers University Press, New Brunswick, NJ.
[2]Dey, A., M. Danihel, L. Niles, K. Kalasz, G. Morrison, B. Watts, H. Sitters. 2014. Update to the Status of Red Knot (Calidris canutus rufa) in the Western Hemisphere, August 2014. Report provided to the US Fish and Wildlife Service and the Atlantic States Marine Fisheries Commisison.
[3]Baker, A. J. , P. M. Gonzalez, T. Piersma, L. J. Niles, I. L. S. do Nascimento, P. W. Atkinson, N. A. Clark, C. D. T. Minton, M. K. Peck, G. Aarts. 2004. Rapid population decline in red knot: Fitness consequences of decreased refueling rates and late arrival in Delaware Bay. Proceedings of the Royal Society B 25:125-129. (*Available on the web from Google Scholar*).
[4]NJ Department of Environmental Protection, Division of Fish and Wildlife, unpublished peak aerial count data.
[5]Niles, L. J., J. Bart, H. P. Sitters, A. D. Dey, K. E. Clark, P. W. Atkinson, A. J. Baker, K. A. Bennett, K. S. Kalasz, N. A. Clark, J. Clark, S. Gillings, A. S. Gates, P. M. Gonzalez, D. E. Hernandez, C. D. T. Minton, R. I. G. Morrison, R. R. Porter, R. K. Ross, and C. R. Veitch. 2009. Effects of Horseshoe Crab Harvest in Delaware Bay on Red Knots: Are Harvest Restrictions Working? *Bioscience 59*:153-164. (*Available on the web from Google Scholar*).
[6]Dey, Danihel, Niles, Kalasz, Morrison, Watts, Sitters. 2014
[7]Dey, Danihel, Niles, Kalasz, Morrison, Watts, Sitters. 2014
[8]Morrison, Guy, and David Mizrahi, 2014, personal communication to Amanda Dey, NJDEP, from Guy Morrison, Canadian Wildlife Service and David Mizrahi, NJ Audubon Society.
[9]ASMFC, 2013
[10]ASMFC, 2013
[11]Data used for figure received 2-18-2015 from Amanda Dey, NJDEP Division of Fish and Wildlife, based on landings data from NY to VA from the National Marine Fisheries Service (1970s to 1997) and the Atlantic States Marine Fisheries Commission (1998 to 2013). The ASMFC did not require reporting of HS crab landings prior to 1998, so the NFMS data was used, converted from pounds to number of crabs.
[12]Dey, Danihel, Niles, Kalasz, Morrison, Watts, Sitters. 2014
[13]Atlantic States Marine Fisheries Commission, Fishery Management Report No. 32, Interstate Fishery
[14]Management Plan for Horseshoe Crab, December 1998. 67 pp.
Atlantic States Marine Fisheries Commission, 2013 Review of the Fishery Management Plan for Horseshoe Crab (*Limulus polypheums*), March 2012. 29 pp.