# NOTE

## KNOT YOUR AVERAGE BIRD: A CASE STUDY OF THE *RUFA* RED KNOT IN THE FACE OF CLIMATE CHANGE

By
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*Analyzing the staggering distances traveled by migratory shorebirds, and the challenges faced by these birds during their migration periods, this Article conflates and contrasts the myriad environmental impacts climate change is forcing the globe to contend with. The rufa red knot navigates a migratory path that annually takes it from Tierra del Fuego all the way to Arctic Canada. Because the red knot's course of migration is so lengthy, and because the number of ecosystems it encounters along the way are so diverse, the red knot is emblematic of the challenges faced by both migratory shorebirds, and the coastal ecosystems they rely upon that are now ever eroding due to climate change. Part I of this Article introduces the rufa red knot. Part II discusses the migration of the red knot and examines many of the challenges faced by the species. Part III analyzes the many threats facing the red knot, including climate change and pollution due to coastal fossil fuel extraction. Part IV introduces an environmental management theory based on "ecoscapes." Part V discusses the many laws and regulations addressing the threats facing the red knot. Finally, in Part VI the author discusses how proffered solutions can be maximized for all migratory shorebirds.*

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*HOPE is the thing with feathers*
*That perches in the soul,*
*And sings the tune without the words,*
*And never stops at all,*

*And sweetest in the gale is heard;*
*And sore must be the storm*
*That could abash the little bird*
*That kept so many warm.*

*I've heard it in the chillest land,*
*And on the strangest sea;*
*Yet, never, in extremity,*
*It asked a crumb of me.*

—Emily Dickinson, *Complete Poems*[1]



## I. INTRODUCTION

"[I]t is even more apparent today than it was during the early part of the twentieth century that the environmental and social problems need to be addressed from an interdisciplinary and large-scale perspective."[2] The migration of shorebirds is an unparalleled phenomenon, and because of the expansive range of their migration, these birds will require global, innovative solutions to help combat the problems they face, especially in light of climate change. The *rufa* red knot is a re-

[1] EMILY DICKINSON, *Hope Is the Thing with Feathers*, *in* THE COMPLETE POEMS OF EMILY DICKINSON (Little, Brown, & Co. 1924) (available at http://www.bartleby.com/113/1032.html [http://perma.cc/59CD-HWGQ] (accessed Nov. 26, 2015)).

[2] Eugene P. Odum, *Landscape Ecology of the Future: A Regional Interface of Ecology and Socioeconomics*, *in* INTEGRATING LANDSCAPE ECOLOGY INTO NATURAL RESOURCE MANAGEMENT 461, 462 (Jianguo Liu & William M. Taylor eds., 2002).

markable shorebird that weighs less than a cup of coffee and migrates annually from Tierra del Fuego to Arctic Canada.[3] The extraordinary story of Moonbird, the red knot that has flown the distance of the moon and halfway back over the past eighteen years further exemplifies the shorebird's incredible ability to persevere under the most grueling conditions.[4] Along its way the red knot faces eroded beaches, warming habitats, hunting, and human development.[5] This Article addresses how the unique ecology and migration of the bird impacts the ability of regulators and conservationists to address the ever-diminishing population of this extraordinary species.

The *rufa* red knot is unique because of its intense migration that exposes it to an incredible number of threats. Accordingly, Part II of this Article addresses the migration of the red knot and identifies some of the problems they face. Part III examines the threats to the *rufa* red knot along its path, ranging from climate change to oil pollution in South America. Part IV addresses a management theory that is based on 'ecoscapes.' Part V discusses the laws and regulations that may address the threats the red knot faces, and Part VI discusses how those solutions may be maximized for migratory shorebirds.

## II. DESCRIPTION OF THE *RUFA* RED KNOT: THE INCREDIBLE MIGRATION

### *A. Ecology: Four Ounces of Muscle*

The red knot, *Calidrus canutus*, is a migratory bird that has six distinctive subspecies, and each subspecies utilizes different flyways all over the world.[6] With a worldwide population of about 1.15 million,[7] and with one of the lengthiest migrations on earth,[8] the red knot has captivated scientists and conservationists alike, giving the red knot the pleasure of being one of the world's most studied species of

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[3] U.S. FISH & WILDLIFE SERV., RUFA RED KNOT: *Calidris canutus rufa* (2013) (available at http://www.fws.gov/northeast/redknot/pdf/Redknot_BWfactsheet092013.pdf [http://perma.cc/8MTF-5S8H] (accessed Nov. 26, 2015)).

[4] *The Red Knot Travels Thousands of Miles During Its Yearly Migration, but One Red Knot in Particular Has an Amazing Tale*, THE NATURE CONSERVANCY, http://www.nature.org/ourinitiatives/regions/northamerica/canada/b95-the-toughest-four-ounces-of-life.xml [http://perma.cc/5PV9-QQAG] (accessed Nov. 26, 2015).

[5] Karl Blankenship, *Rising Sea Level Swallowing Red Knot's Migration Stopovers*, BAY J. (Jan. 4, 2015) (available at http://www.bayjournal.com/article/rising_sea_level_swallowing_red_knots_migration_stopovers [http://perma.cc/X5EF-X6Z4] (accessed Nov. 26, 2015)).

[6] Deborah M. Buehler et al., *Reconstructing Paleoflyways of the Late Pleistocene and Early Holocene: Red Knot Calidris canutus*, 94 ARDEA 485, 485 (2006).

[7] *Waterbird Population Estimates: Calidris canutus (Red Knot)*, WETLANDS INT'L, http://wpe.wetlands.org/search?form%5Bspecies%5D=red+knot&form%5Bpopulation%5D=&form%5Bpublication%5D=4 [http://perma.cc/QV85-BM44] (2015) (accessed Nov. 26, 2015).

[8] Jenny R. Isaacs, Protecting New Jersey's Migratory Shorebirds: A Stewardship Model of Conservation 17 (2012) (unpublished M.A. thesis, Ramapo College of New Jersey) (on file with Ramapo College of New Jersey website).

shorebirds.[9] Each of the six populations is recognized as a discrete subspecies, and is identified by its body size and plumage.[10] However, it is the subspecies identified as the *rufa* red knot that was listed as threatened in December 2014 by the United States Fish and Wildlife Service (FWS).[11]

The *rufa* red knot is a medium-sized migratory shorebird that measures about 9 to 11 inches in length.[12] The *rufa* red knot gets its name from its distinctive rufous (red) plumage,[13] yet for much of the year the bird has dusky gray and white plumage.[14] Due to the intensity of its migration, the red knot's body mass varies drastically with the seasons.[15] In early winter, the red knot reaches its lowest average body mass at 4.4 ounces, with the highest average body mass being attained during the spring at 7.2 ounces.[16]

The population size of the *rufa* red knot has been extensively studied, which is why there is evidence of major population decline for the birds migrating between Tierra del Fuego and Canada.[17] The *rufa* population has been counted since the mid-1980s in their wintering grounds in South America, and the same methods and survey techniques have been used for the aerial counts every year.[18] The population once numbered 67,546 in the mid-1980s, but has since dropped to 17,211 in 2006.[19] Moreover, there have been continuous studies since 1982 of the stopover populations in Delaware Bay, which have shown a similar decrease in population size.[20]

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[9] Hugo Ahlenius et al., *Red Knot, Distribution, Breeding Areas, and Migratory Routes, by Subspecies*, GRID-ARENDAL, http://www.grida.no/graphicslib/detail/red-knot-distribution-breeding-areas-and-migratory-routes-by-subspecies_1072 [http://perma.cc/VG7W-ZZRG] (accessed Nov. 26, 2015).

[10] LAWRENCE J. NILES ET AL., RED KNOT CONSERVATION PLAN FOR THE WESTERN HEMISPHERE 11 (1.1 ed. 2010).

[11] Threatened Species Status for the Rufa Red Knot, 79 Fed. Reg. 73,706, 73,706 (Dec. 11, 2014) (to be codified at 50 C.F.R. pt. 17). The *rufa* red knot was listed as threatened throughout its range. The U.S. Fish and Wildlife Service (FWS) based the listing from an analysis of five factors set forth in the Endangered Species Act: (1) the present or threatened destruction, modification, or curtailment of its habitat or range, (2) overutilization for commercial, recreational, scientific, or educational purpose, (3) disease or predation, (4) the inadequacy of existing regulatory mechanisms, or (5) other natural or man-made factors affecting its continued existence. *Id.* at 73,710.

[12] U.S. FISH & WILDLIFE SERV., RUFA RED KNOT ECOLOGY AND ABUNDANCE 2 (2013) (available at http://www.fws.gov/northeast/redknot/pdf/20130923_REKN_PL_Supplement02_Ecology%20Abundance_Final.pdf [http://perma.cc/7FS6-32QZ] (accessed Dec. 27, 2015)).

[13] *Id.*

[14] *Id.*

[15] *Id.*

[16] *Id.*

[17] NILES ET AL., *supra* note 10, at 19–20.

[18] *Id.* at 19.

[19] *Id.* at 1.

[20] *Id.* at 23 fig. 6.

### *B. Migration*

The migration of the *rufa* red knot is one of the most impressive in the animal kingdom, with some of the shorebirds traveling distances of up to 19,000 miles (30,000 km) annually.[21] The red knots manage these long flights, often spanning thousands of miles without stopping, by undergoing significant physiological changes.[22] Prior to departure, the birds gain and store large amounts of fat while reducing the size of a number of digestive organs.[23] These changes enable the red knots to make the lengthy migration from their breeding grounds in the Canadian Arctic to stopover areas along the U.S. Atlantic Coast and then to a number of wintering regions from the southeastern U.S. to Tierra del Fuego in South America.[24] There are four major wintering regions: Tierra del Fuego, the Brazilian wintering population, Texas, and the Florida wintering population.[25]

*Breeding Areas:* The breeding grounds for the *rufa* red knot are almost exclusively located in the Canadian Arctic.[26] Breeding occurs during June, and the red knots usually nest in "dry, slightly elevated tundra locations, often on windswept slopes with little vegetation."[27] According to the limited research that has occurred, breeding areas are typically inland, and foraging areas are located near freshwater wetlands along the arctic coast.[28]

*Staging Areas/Stop-over Sites:* According to the Atlantic States Marine Fisheries Commission (ASMFC),

> [t]he Delaware Estuary is the largest staging area for shorebirds in the Atlantic Flyway and is the second largest staging site in North America. An estimated 425,000 to 1,000,000 migratory shorebirds converge on Delaware Bay to feed and rebuild energy reserves prior to flying an additional 4,000 kilometers to complete their northward migration.[29]

The incredible number of shorebirds that utilize Delaware Bay provide the basis for a $34 million ecotourism industry.[30] Staging areas are especially critical for protecting migratory shorebirds because

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[21] Proposed Threatened Status for the Rufa Red Knot, 78 Fed. Reg. 60,027 (Sept. 30, 2013) (to be codified at 50 C.F.R. pt. 17).

[22] *Id.*

[23] *Id.*

[24] U.S. FISH & WILDLIFE SERV., *supra* note 12, at 2.

[25] *Id.* at 2, 9. There is some uncertainty as to the exact subspecies the wintering red knots in Maranhão, Brazil and Florida belong too, as there is some chance they may belong to the subspecies *roselaari* that breeds in Alaska. *Id.* at 5.

[26] Proposed Threatened Status for the Rufa Red Knot, *supra* note 21, at 60,026–27.

[27] U.S. FISH & WILDLIFE SERV., *supra* note 12, at 10.

[28] *Id.*

[29] ATLANTIC STATES MARINE FISHERIES COMM'N, INTERSTATE FISHERY MANAGEMENT PLAN FOR HORSESHOE CRAB 13 (1998) (available at http://www.asmfc.org/uploads/file/hscFMP.pdf [http://perma.cc/UZH9-4B96] (accessed Nov. 26, 2015)).

[30] TED L. EUBANKS ET AL., WILDLIFE-ASSOCIATED RECREATION ON THE NEW JERSEY DELAWARE BAYSHORE 6 (2000) (available at https://secure.filesanywhere.com/fs/v.aspx?v=8972628e59606dbbad6a (accessed Nov. 26, 2015)).

> shorebirds use few major stopovers during the spring migration; shorebirds arrive at stopover sites with little or no fat reserves; and shorebirds demonstrate loyalty to staging areas. An estimated eighty percent of the hemispheric population of red knots . . . use Delaware Bay as a staging area.[31]

Delaware Bay is significant to the *rufa* red knot due to the substantial number of horseshoe crabs that lay eggs on the sandy beaches around high tide.[32] Horseshoe crab eggs are high in protein and help the red knot regain body mass before its next long flight to breeding grounds in the Arctic.[33] The exhausted rufa red knot reaches Delaware Bay with digestive organs reduced in size and with limited capacity to digest hard-shelled bivalves, the red knot's usual food source.[34] The abundant horseshoe crab eggs are therefore a very valuable food source because they are "easily digested and metabolized into fat and protein."[35] While the horseshoe crab eggs allow the birds to rebuild their organs and achieve high mass gains, a major disadvantage of this reliance is that there is no similar food source available in the Bay in case of shortage.[36]

There are numerous other important stopover sites that occur along the Atlantic coast and in South America.[37] Along the Atlantic Coast, these include the barrier islands of Virginia, the barrier islands of South and North Carolina, and the Assateague Island National Seashore in Maryland.[38] The barrier islands are a critical source of blue mussels and other hard shell bivalves that are the primary food source of the red knot outside of Delaware Bay.[39] However, these sites are considered not to be as important as Delaware Bay, because a successful breeding season and survival depend on the red knot's ability to arrive in Canada in good health and at the appropriate time, which is determined by the availability of horseshoe crab eggs.[40] Lastly, the stopover sites in South America and the Caribbean typically have similar habitats, with mangroves, mudflats, and sandy beaches being used for foraging.[41]

*Wintering Habitats:* Red knots migrate from their breeding grounds in Canada to four distinct areas in the Western Hemisphere: (1) Tierra del Fuego, Chile; (2) Maranhão, Brazil; (3) Texas; and (4) the

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[31] ATLANTIC STATES MARINE FISHERIES COMM'N, *supra* note 29, at 13.

[32] Sarah M. Karpanty et al., *Horseshoe Crab Eggs Determine Red Knot Distribution in Delaware Bay*, 70 J. OF WILDLIFE MGMT. 1704, 1704 (2006).

[33] *Id.*

[34] Philip W. Atkinson et al., *Rates of Mass Gain and Energy Deposition in Red Knot on Their Final Spring Staging Site is Both Time- and Condition-Dependent*, 44 J. OF APPLIED ECOLOGY 885, 893 (2007).

[35] Lawrence J. Niles et al., *Effects of Horseshoe Crab Harvest in Delaware Bay on Red Knots: Are Harvest Restrictions Working?*, 59 BIOSCIENCE 153, 154 (2009).

[36] NILES ET AL., *supra* note 10, at 2.

[37] *Id.* at 38–39.

[38] *Id.* at 49–50.

[39] *Id.*

[40] *Id.* at 39.

[41] *Id.* at 62.

southeastern U.S. in mainly Florida and Georgia.[42] The red knot winters in large flocks in a few key intertidal wetlands in these areas.[43] While it is unclear exactly how many birds utilize each of these sites historically, the majority of the species migrates to Tierra del Fuego each year.[44] The population that winters in Tierra del Fuego has been especially significant for understanding the overall health of the species, thus the substantial decrease in this population over the last twenty years has concerned conservationists and scientists.[45] In the mid-1980s, the population of red knots wintering in southern Chile numbered nearly 53,000.[46] By 2006, their numbers dropped to 17,000.[47]

However, the red knot populations generally return to the same wintering sites each year.[48] Therefore, the wintering populations of the *rufa* red knot that remain in the U.S. offer promising sites for the purpose of protecting the species.[49] This is because the red knot is unique in that its migratory path almost exclusively follows the coastline.[50] While there is some variability in population densities based on the abundance and availability of certain hard-shelled bivalves, the sandy beaches from South Carolina to Florida will host red knots each winter.[51] Researchers have therefore been able to identify areas of high use along the Atlantic Coast, which may be helpful in identifying critical habitat (under the Endangered Species Act) or implementing other modes of protection in the future.[52]

## III. DANGERS FACING THE RED KNOT

Scientists estimate that the Earth is losing species at a rate of 1,000 to 10,000 species per year.[53] The primary causes of extinction are habitat loss and degradation.[54] Unfortunately for conservationists and regulators, protecting against habitat loss and degradation is "the single most difficult challenge to endangered species protection."[55]

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[42] U.S. FISH & WILDLIFE SERV., *supra* note 12, at 12.

[43] *Id.* at 23–25.

[44] NILES ET AL., *supra* note 10, at 19.

[45] Guy Morrison et al., *Declines in Wintering Populations of Red Knots in Southern South America*, 106 THE CONDOR 60, 60–61 (2004).

[46] U.S. FISH & WILDLIFE SERV., *supra* note 12, at 39.

[47] *Id.*

[48] *Id.* at 16.

[49] Joanna Burger, *Migration and Over-Wintering of Red Knots Along the Atlantic Coast of the United States*, 114 THE CONDOR 302, 309 (2012).

[50] *Id.*

[51] NILES ET AL., *supra* note 10, at 38.

[52] *Id.*

[53] G. TYLER MILLER & SCOTT SPOOLMAN, ENVIRONMENTAL SCIENCE 163 (15th ed. 2015).

[54] Patrick Parenteau, *Rearranging the Deck Chairs: Endangered Species Act Reforms in an Era of Mass Extinction*, 22 WM. & MARY ENVTL. L. 227, 233 (1998).

[55] Jason Totoiu, *Building a Better State Endangered Species Act: An Integrated Approach Toward Recovery*, 40 ENVTL. L. REP. 10299, 10301 (2010).

This prediction does not bode well for the *rufa* red knot, as its primary threat, according to its listing by FWS, is habitat loss and degradation.[56]

### *A. Climate Change Effects*

At one point in time over-harvesting of horseshoe crab populations in Delaware Bay was the greatest risk to the survival of the *rufa* red knot.[57] However, in the wake of climate change, the migratory bird faces a host of new threats throughout its range.[58] Climate change has the potential to decimate the *rufa* population because of the sheer number of vectors through which it is capable of affecting the species, ranging from food supply,[59] to habitat loss,[60] to increased predation.[61] However, loss or shift in habitat due to rising and warming sea levels is a concern that the shorebirds must confront along their entire migratory path.[62]

Because of its importance as a stopover site, critical to the species is the erosion of the tidal mudflats in Delaware Bay due to rising sea levels.[63] Scientists have estimated future sea level scenarios as a result of climate change and found that there will be major losses in Delaware Bay.[64] The Bay is predicted to lose 60% or more of the red knot's intertidal habitat under a 50% probability scenario for sea level rise.[65] While under extreme sea level rise, scientists project a net gain of habitat as coastlines retreat inland. However, this assumes that shoreline protection structures do not inhibit the natural migration landward of the coastline.[66]

In order to combat erosion and sea level rise, many local and state governments are resorting to either shoreline hardening techniques or beach re-nourishment projects.[67] The impacts of these projects vary depending on the technique selected and the site's utility to the red

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[56] Threatened Species Status for the Rufa Red Knot, 79 Fed. Reg. 73,706, 73,707 (proposed Dec. 11, 2014) (to be codified at 50 C.F.R. pt. 17).

[57] *Id.*

[58] *Id.* at 73,708.

[59] *Id.* at 73,707.

[60] *Id.*

[61] *Id.* at 73,708.

[62] NILES ET AL., *supra* note 10, at 70.

[63] *Id.*

[64] *Id.*

[65] *Id.*

[66] *Id.*

[67] Hard stabilization, or shoreline armoring, refers to constructing permanent structures such as seawalls, groins, or jetties. These structures are built to either reduce wave action or protect property. More often than not they reduce beach access and cause erosion of neighboring properties. On the other hand, beach re-nourishment projects add sand directly to an eroding shore to restore beaches. KAREN GREENE, ATLANTIC STATES MARINE FISHERIES COMM'N, BEACH NOURISHMENT: A REVIEW OF THE BIOLOGICAL AND PHYSICAL IMPACTS 3, 5 (Nov. 2002) (available at http://www.asmfc.org/uploads/file/beachNourishment.pdf [http://perma.cc/MTU8-2W57] (accessed Nov. 26, 2015)).

knots.[68] If the beaches are being used for nesting and breeding, beach re-nourishment projects are much more likely to impact the shorebirds than if they are merely using the beach for feeding and resting during migration.[69] In addition, research has shown that beach re-nourishment projects may benefit other endangered or threatened species, such as sea turtles and shorebirds, because such projects can restore their habitats.[70]

Climate change will not only affect the red knot through beach erosion; the resulting warmer waters and increased weather events could produce a 'mismatch' of the shorebird's stopover and horseshoe crab spawning.[71] Research by the United States Geological Survey (USGS) linked not only crab abundance, but also the timing of horseshoe crab spawning to the health of the red knot.[72] The mismatch theory states that the "timing of food resource availability can dictate productivity, population growth, and abundance in animal populations."[73] Because migrating red knots face both energy and temporal restraints during migration, their survival rate is very much influenced by resource availability.[74] The mismatch occurs because the spawning of horseshoe crabs is initiated not only "by tides and lunar cycles, but also water temperatures and wave-generating storms" that occur as a result of climate change.[75] These environmental fluctuations do not affect the migration of the red knot, which depend on lunar signals for when to migrate.[76] The result is horseshoe crabs laying their eggs prior to the red knot's arrival and little available food for the birds to rebuild body mass.[77] Climate change has not only affected the red knot's food source in Delaware Bay, but has also affected the shorebird's ability to hunt for blue mussels in Virginia's barrier islands.[78] The College of William and Mary conducted a population study and found that the population of red knots declined sharply in this region.[79]

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[68] *Id.* at 31.

[69] The red knot may be affected by beach re-nourishment projects if they are nesting on the beach because they are at risk of being displaced by dredging equipment, such as pipelines. Moreover, sand that is placed on the beach may crush eggs, hatchlings, or adult birds. *Id.*

[70] *Id.* at 5.

[71] Conor P. McGowan et al., *Demographic Consequences of Migratory Stopover: Linking Red Knot Survival to Horseshoe Crab Spawning Abundance*, 2 ECOSPHERE 1, 2 (2011).

[72] *Id.* at 16.

[73] *Id.*

[74] *Id.*

[75] *Id.*

[76] *Id.*

[77] McGowan, *supra* note 71, at 12.

[78] Karl Blankenship, *Rising Sea Levels Swallowing Red Knots Migration Stopovers*, BAY J., (Jan. 4, 2015) (available at http://www.bayjournal.com/article/rising_sea_level_swallowing_red_knots_migration_stopovers [http://perma.cc/R9BJ-3CUJ] (accessed Nov. 26, 2015)).

[79] *Id.*

While the study may reflect a general decrease in the overall population, the effects of climate change may also play a distinct role in the decline at this site.[80] The *rufa* red knot feeds on blue mussels that thrive in the marshes behind the barrier islands; however, the mussels are extremely sensitive to warmer temperatures, causing the mussels to retreat northward at a rate of 7.5 kilometers per year.[81] The Nature Conservancy, FWS, and the state of Virginia own most of the barrier islands, resulting in habitat that is relatively remote and undeveloped. Yet, this protection will not avoid the "timing mismatches" when the red knot's stopovers no longer coincide with the location of the mussels.[82]

### *B. Beach Development and Human Disturbance*

Along much of the U.S. shoreline and the beaches in South America, a major threat to the *rufa* red knot is loss of habitat due to development and human disturbance.[83] While the most well understood impacts occur within Delaware Bay, disturbances along the red knot's wintering sites are increasingly becoming a recognizable concern.[84] Disturbances commonly include people and their dogs, off road vehicles (ORVs), and fishermen.[85] Human disturbance continues to be a concern at nearly all the wintering sites, but fortunately, since 2002, many sections of the New Jersey coastline are closed during horseshoe crab spawning season in order to protect this critical stopover site.[86]

In Florida, Georgia, and South Carolina (the wintering sites) there are few documented impacts on red knot habitat.[87] While it is suspected that shoreline hardening and beach re-nourishment projects may be significantly altering their habitat, there is no clear evidence as to the extent of the threat these activities pose at those sites.[88] In North Carolina and South Carolina, the birds primarily rest for a short term during fall and spring, maybe for a few weeks.[89] However, it is

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[80] *Id.*

[81] *Id.*

[82] *Id.*

[83] NILES ET AL., *supra* note 10, at 71.

[84] *Id.* at 72.

[85] *Id.* at 71, 75.

[86] *Id.*

[87] *See id.* at 102–11 (comparing the lack of stopover habitat management programs from Florida, Georgia, and South Carolina to other wintering states like New Jersey and Delaware, which both employ extensive programs like aerial and ground surveys).

[88] *See* ATLANTIC STATES MARINE FISHERIES COMM'N, LIVING SHORELINES: IMPACTS OF EROSION CONTROL STRATEGIES ON COASTAL HABITATS 12 (Jessie C. Thomas-Blate ed., Feb. 2010) (available at http://www.asmfc.org/uploads/file/hms10LivingShorelines.pdf [http://perma.cc/CAD4-4FUZ] (accessed Nov. 26, 2015)) ("The importance of natural sandy beaches as foraging, nesting, and nursery areas is well known. However, the ecological impacts of shoreline hardening on populations of associate species are not well understood. As a result, these impacts are often overlooked in permitting and policy decision-making processes.").

[89] LAWRENCE J. NILES ET AL., STATUS OF THE RED KNOT IN THE WESTERN HEMISPHERE 28–29 (Carl D. Marti ed., 2008) (available at http://www.state.nj.us/dep/fgw/

during this brief time when many of the small towns along the coast complete their beach restoration or dredging projects.[90] These projects must occur during this time in order to avoid impacts to nesting sea turtles and spawning fish during the summer months.[91]

### *C. Horseshoe Crab Harvesting*

Another significant threat to the *rufa* red knot is the supply of their main food source at their stopover site in Delaware Bay.[92] The eggs of the horseshoe crabs were once abundant on the shores of Delaware Bay, but the adult crab populations were exploited in the 1990s.[93] While the initial decline in the *rufa* red knot has been linked to the over-harvesting of horseshoe crabs,[94] expansive harvesting regulations adopted by Atlantic states have greatly improved the overall health of horseshoe crab populations.[95] Therefore, with the red knot's primary food source no longer at imminent risk of collapse, horseshoe crab harvesting is an ancillary concern to climate change effects.[96] However, the adult crabs are still harvested for a number reasons, ranging from their use as bait for American eel and conch fisheries, to their use in the biomedical industry.[97] While biomedical industry use does not result in total mortality, studies have indicated that 10–15% of the crabs used for such purposes do not survive the bleeding process.[98]

During the 1990s there was a substantial increase in horseshoe crab harvesting.[99] Between 1992 and 1997, the reported harvest of horseshoe crabs grew from 100,000 to more than 2 million, a 20-fold

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ensp/pdf/literature/status-assessment_red-knot.pdf [http://perma.cc/E88R-ZTFH] (accessed Nov. 26, 2015)).

90 *See* JENNIFER L. LUKENS, NATIONAL COASTAL PROGRAM DREDGING POLICIES: AN ANALYSIS OF STATE, TERRITORY, & COMMONWEALTH POLICIES RELATED TO DREDGING & DREDGED MATERIAL MANAGEMENT 95 (Apr. 2000) (available at http://coast.noaa.gov/czm/media/finaldredge.pdf [http://perma.cc/FY56-UDGJ] (accessed Nov. 26, 2015)) (noting that permits for dredging in South Carolina are restricted to November through March to avoid sea turtle nesting, and that in North Carolina permit applicants for dredging must demonstrate that their project will have minimum adverse impacts on the life cycles of estuarine animals).

91 *Id.*

92 McGowan, *supra* note 71, at 2.

93 *See id.* ("One hypothesis proposed to explain the decline is over-harvesting of horseshoe crabs (*Limulus polyphemus*) in the mid-Atlantic states, which may affect red knots stopping over in that region . . . .").

94 *Id.*

95 *Id.*

96 Threatened Species Status for the Rufa Red Knot, *supra* note 56, at 73,708.

97 *See* ATLANTIC STATES MARINE FISHERIES COMM'N, *supra* note 29, at 3 ("Horseshoe crabs are collected by the biomedical industry to produce Limulus Amebocyte Lysate. This industry bleeds individuals and releases the animals live after the bleeding procedure.").

98 *Id.*

99 *Id.*

increase.[100] There is a critical link between the health of the horseshoe crab population and the success of the red knot.[101] Yet, while the population of the red knot is relatively well understood, there remains great uncertainty as to the health of the horseshoe crab populations, the numbers that can be harvested sustainably, and how many are necessary to support migratory birds.[102] Recent data from the Horseshoe Crab Stock Assessment Subcommittee of the ASMFC continue to show that harvests along these regions are unsustainable.[103]

### *D. Other*

The extensive migration of red knots also places them in an assortment of dangers that they do not necessarily face while in the U.S. One of the more uncertain dangers they face is from oil spill pollution, especially in their wintering grounds in Tierra del Fuego, Chile and Maranhão, Brazil.[104] Tierra del Fuego, specifically Bahía Lomas, was once the site of several active oil platforms.[105] The major concern, however, stems from increased drilling off the coast of nearby Argentina and the subsequent increased boat traffic that poses a risk of oil spills.[106] According to the Western Hemisphere Shorebird Reserve Network (WHSRN) there have been significant declines in the Bahía Lomas population, and that trend is likely linked to the oil industry because it is "virtually the only significant human activity in the area."[107] Oil pollution remains a concern in Maranhão because of exploratory drilling off the coast and the risk of spills, despite little being known about the red knots that winter in Brazil.[108]

## IV. "ECOSCAPE" MODEL OF CONSERVATION

Due to the red knot's migratory path and the sheer number of threats the red knots face, traditional models of conservation may not

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100 NILES ET AL., *supra* note 10, at 64.

101 *Id.* at 63.

102 *Id.* at 1–2.

103 JOHN A. SWEKA ET AL., ATLANTIC STATES MARINE FISHERIES COMM'N, 2013 HORSESHOE CRAB STOCK ASSESSMENT UPDATE 16 (Aug. 2013) (available at http://www.asmfc.org/uploads/file/52a88db82013HSC_StockAssessmentUpdate.pdf [http://perma.cc/PK2Y-GFBP] (accessed Nov. 26, 2015)).

104 Proposed Threatened Status for the Rufa Red Knot, *supra* note 21, at 60,087.

105 *Id.*

106 In May 2004, the Berge Nice collided with a tugboat resulting in a spill of oil stretching 10 kilometers along the coast of Tierra Del Fuego. Pablo García-Borboroglu et al., *Petroleum Pollution and Penguins: Marine Conservation Tools to Reduce the Problem*, *in* MARINE POLLUTION: NEW RESEARCH 15 (Tobias N. Hofer, ed. 2008) (available at http://oilspill.fsu.edu/images/pdfs/oil-pollution-penguins.pdf [http://perma.cc/6RLU-HKTC] (accessed Nov. 26, 2015)).

107 NILES ET AL., *supra* note 10, at 74.

108 The wintering habitat consists of 150 kilometers of highly fragmented shore that is difficult to survey, even from the air. Allan J. Baker et al., *Assessment of the Wintering Area of Red Knots in Maranhão, Northern Brazil, in February 2005*, 107 WADER STUDY GROUP BULL. 10–11 (2005).

be successful in addressing those threats. Therefore, because the "ecoscape" model of conservation combines not only considerations of ecology but also "trans-political governance," it may offer a promising solution for the red knot.[109] An ecoscape is defined as a "landscape or seascape that transcends political boundaries and, instead, creates boundaries based on sustaining ecological functions and on protecting human needs for living landscapes."[110] The author, Anastasia Telesetsky, introduced this concept to show that "ecological governance requires deliberate human-initiated efforts to connect physical environmental places with the various groups of people making decisions about the given landscape or seascape."[111] As regulators and conservationists move forward from the listing of the red knot under the Endangered Species Act (ESA), they may want to consider molding the red knot's migratory path into an ecoscape scale management scheme, taking into account the subsequent U.S. and international laws, existing protected habitats, and local solutions.

## V. EXISTING LAWS AND REGULATIONS: THE CURRENT STATE OF PROTECTION FOR THE RED KNOT

### *A. Laws in the United States*

*Migratory Bird Treaty Act (MBTA)*: Prior to the FWS listing of the *rufa* red knot as a threatened species, the only federal law in the U.S. that provided specific protection for the red knot was the MBTA of 1918.[112] Enacted to ratify a treaty between the U.S. and Britain,[113] the law was aimed at halting the "indiscriminate slaughter" of migratory birds.[114] However, the MBTA is only criminally enforceable, as it is a strict liability statute that prohibits hunting, taking, and killing of migratory birds.[115] "Take" was broadly defined by FWS as meaning to "pursue, hunt, shoot, wound, kill, trap, capture, or collect," or an at-

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[109] Anastasia Telesetsky, *Ecoscapes: The Future of Place-Based Ecological Restoration Law*, 14 VT. J. ENVTL. L. 493, 497 & n.15 (2013) (defining governance as "activities backed by shared goals that may or may not derive from legal and formally prescribed responsibilities and that do not necessarily rely on police powers to . . . attain compliance.") (citing James N. Rosenau, *Governance, Order, and Change in World Politics*, *in* GOVERNANCE WITHOUT GOVERNMENT: ORDER AND CHANGE IN WORLD POLITICS 1 (James N. Rosenau & Ernst-Otto Czempiel eds., 1993)).

[110] *Id.* at 494.

[111] *Id.* at 524.

[112] Migratory Bird Treaty Act of 1918, 16 U.S.C. §§ 703–712 (2011). The red knot is listed as a protected game species under international treaties with Canada and Mexico. Convention for the Protection of Migratory Birds, U.K.-U.S., Aug. 16, 1916, 12 U.S.T. 375; Convention for the Protection of Migratory Birds and Game Mammals, Mex.-U.S., Feb. 7, 1936, 9 U.S.T. 1017.

[113] 16 U.S.C. §§ 703–712.

[114] Convention for the Protection of Migratory Birds, *supra* note 112.

[115] "[I]t shall be unlawful at any time, by any means or in any manner, to pursue, hunt, take, capture, kill, attempt to take, capture, or kill, possess, offer for sale, sell, offer to barter, barter, offer to purchase, purchase, deliver for shipment, ship, export, import, cause to be shipped, exported, or imported, deliver for transportation, transport

tempt to carry out any of those activities.[116] FWS has also been granted permitting authority for scientific research, so that the MBTA assures that best practices are used when red knots are used as a part of a scientific study.[117]

While the MBTA criminalizes the taking of the red knot, modern threats such as climate change are not the traditional harms Congress intended to be covered under the MBTA.[118] Where the harm is not linked to climate change, however, the MBTA might provide some protection against an incidental take.[119] This is because courts have broadly interpreted the MBTA to prohibit an incidental take,[120] and the MBTA does not provide permits for an incidental take of any migratory birds.[121] The MBTA's authority over incidental takes was firmly solidified in 2001 by President Clinton's Executive Order, which clarified "take" to include both intentional and unintentional take.[122] Therefore, where *rufa* red knots are incidentally "taken" by oil spills, beach development, or wind turbines, there may be relief under the MBTA. However, this expansive protection has been criticized for possibly leading to absurd criminal prosecutions and for being too vague.[123] Therefore, courts have narrowed the incidental take provision to consider factors such as: (1) the foreseeability of harm,[124] (2) the inherent dangerous nature of an activity,[125] (3) whether there was due care in avoiding incidental takes,[126] and (4) whether the take oc-

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or cause to be transported, carry or cause to be carried, or receive for shipment, transportation, carriage, or export, any migratory bird . . . ." 16 U.S.C. § 703(a).

116 50 C.F.R. § 10.12 (2007).

117 50 C.F.R. § 21.23(a) (1998).

118 Meredith B. Lilley & Jeremy Firestone, *Wind Power, Wildlife, and the Migratory Bird Treaty Act: A Way Forward*, 38 ENVTL. L. 1167, 1177 (2008).

119 *Id.* at 1182.

120 *See* United States v. FMC Corp., 572 F.2d 902, 908 (2d Cir. 1978) (affirming the district court and holding that a "take" of a migratory bird protected under the MBTA could be unintentional); United States v. Corbin Farm Serv., 444 F. Supp. 510, 531 (E.D. Cal 1978), *aff'd*, 578 F.2d 259 (9th Cir. 1978) (affirming that a "take" under the MBTA could be unintentional); United States v. Moon Lake Elec. Ass'n, 45 F. Supp. 2d 1070, 1074 (D. Colo. 1999) (holding that an unintentional "take" is still a violation of the MBTA). All of these cases agree that an unintentional "take" of a migratory bird is still a violation of the MBTA.

121 Lilley, *supra* note 118, at 1180.

122 Responsibility of Federal Agencies to Protect Migratory Birds, 66 Fed. Reg. 3,853 (Jan. 17, 2001).

123 *See* United States v. Rollins, 706 F. Supp. 742, 744 (D. Idaho 1989) (reversing the conviction on the grounds that the statutory standard was too vague and led to an unreasonable conviction).

124 *See Moon Lake Elec. Ass'n*, 45 F. Supp. 2d at 1077 (The court's "proximate causation analysis necessarily requires the trier of fact to determine whether a particular type of physical conduct has a propensity to injure or kill a protected bird.").

125 *See FMC Corp.*, 572 F.2d at 908 (confirming conviction under the MBTA regardless of intent because the birds died incident to a dangerous activity).

126 *See Rollins*, 706 F. Supp. at 744 (The court pointed to the defendant's due care in conduct and how this releases the defendant from the "tra[p]" of the MBTA).

curred as a result of lawful, commercial activity.[127] If this trend carries, it would make for an uncertain future for migratory birds if the courts were to give incidental takings concessions regarding wind turbine collisions, oil spills, or beach development.[128]

Furthermore, and more significant to the *rufa* red knot, is that there are no provisions in the MBTA that protect habitats of listed species unless habitat modification directly results in mortality or destruction of an active nest.[129] Therefore, no habitat in the U.S. is protected under the MBTA because the *rufa* red knot does not have breeding grounds in the lower forty-eight states.[130] Moving forward, the MBTA will most likely not provide significant protection to the *rufa* red knot because it is unable to address the most pressing issue to the species, loss of habitat due to climate change.

*Endangered Species Act*: Often considered the "pit bull of environmental laws,"[131] the ESA functions as one of the key "pillars" of U.S. environmental policies.[132] While the ESA offers a number of tools to protect imperiled species, protection of a species under the ESA is only triggered when FWS lists the species as endangered or threatened under section 4.[133] A species is listed as "endangered" when it is in "danger of extinction throughout all or a significant part of its range," while a species is "threatened" only when it is "likely to become an endangered species within the foreseeable future."[134] Once a species is listed it is enveloped by the protections of sections 7 and 9; section 7 states that the federal government must ensure its actions will not

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127 *See* United States v. Brigham Oil & Gas, L.P., 840 F. Supp. 2d 1202, 1213 (D.N.D. Jan. 17, 2012) ("[I]t is highly unlikely that Congress ever intended to impose criminal liability on the acts or omissions of persons involved in lawful commercial activity which may indirectly cause the death of birds protected under the Migratory Bird Treaty Act.").

128 *See, e.g.*, Andrew G. Ogden, *Dying for a Solution: Incidental Taking Under the Migratory Bird Treaty Act*, 38 WM. & MARY ENVTL. L. & POL'Y REV. 1 (2013) (discussing the unofficial practice of FWS to utilize its prosecutorial discretion under the MBTA to motivate compliance from the industries that tend to cause incidental takes, resulting in the "uneven enforcement of the MBTA's prohibitions, legal uncertainty for potential violators, lack of universal compliance with the voluntary guidelines, and steadily escalating bird deaths."). *See also* Migratory Bird Permits, 80 Fed. Reg. 30,032 (filed May 26, 2015) (to be codified at 50 C.F.R. pt. 21) (indicating that FWS is considering incidental take permits under the MBTA to ensure greater consistency for regulated parties that have taken action to avoid bird mortalities, and a mitigation mechanism for industries that cannot avoid mortalities through best practices).

129 16 U.S.C. § 707(a).

130 *Guide to North American Birds—Red Knot*: *Calidris canutus,* NAT'L AUDUBON SOC'Y, https://www.audubon.org/field-guide/bird/red-knot [http://perma.cc/Y8P3-SVW2] (accessed Nov. 26, 2015).

131 *See* Michael J. Bean, *The Endangered Species Act and Private Land: Four Lessons Learned from the Past Quarter Century*, 28 ENVTL. L. REP. 10,701 (1998) (The phrase was initially devised by Don Barry, Assistant Secretary for Fish, Wildlife, and Parks in the Department of the Interior.).

132 151 CONG. REC. H8576 (daily ed. Sept. 29, 2005) (statement of Rep. Farr).

133 16 U.S.C. § 1533 (2014).

134 16 U.S.C. § 1532(6), (20).

harm the species or result in destruction of the species habitat,[135] and section 9 states that no private actor or governmental agency may take an endangered or threatened species.[136]

Since 2004 conservation groups have been petitioning FWS to list the *rufa* red knot species as endangered under the ESA.[137] However, FWS continuously responded by stating that emergency listing of the species was not warranted.[138] In 2006, FWS placed the species on the "candidate species list,"[139] and subsequently received a petition from the New Jersey Horseshoe Crab Representatives to remove the *rufa* red knot from the candidate list.[140] In 2011, however, a court-approved multi-district litigation settlement agreement between FWS and the Center for Biological Diversity specified that a listing determination would be made by 2013.[141] The migratory shorebird was finally listed in the Federal Register as threatened on December 11, 2014.[142] In addition to the general prohibitions under section 9 against taking listed species,[143] section 4(a) of the ESA requires that "to the maximum extent prudent and determinable, [the Secretary] shall, concurrently with making a determination under paragraph (1) that a species is an endangered species or a threatened species, designate any habitat of such species which is then considered to be critical habitat[.]"[144] Critical habitat is defined as:

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135 16 U.S.C. § 1536 ("Each Federal agency shall . . . insure that any action authorized, funded, or carried out by such agency . . . is not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of habitat of such species . . . .").

136 16 U.S.C. § 1538(a)(1)(B); *see also* 16 U.S.C. § 1532(19) ("The term 'take' means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.").

137 Petition from Caroline Kennedy & James Roberson, Defenders of Wildlife, on behalf of Am. Bird Conservancy et al., to U.S. Fish & Wildlife Serv. (July 28, 2005) (available at http://www.fws.gov/northeast/redknot/defenders.pdf [http://perma.cc/QL2U-3BL8] (accessed Nov. 26, 2015)).

138 Response Letter from Marvin E. Moriarty, Regional Director, EPA Region 5, to Defenders of Wildlife (available at https://www.defenders.org/publications/red_knot_petition_response_01-05.pdf [http://perma.cc/C4FQ-8RUZ] (accessed Nov. 26, 2015)).

139 Plant and Animal Species that are Candidates or Proposed for Listing, 71 Fed. Reg. 53,756, 53,758 (Sept. 12, 2006) (to be codified at 50 C.F.R. pt. 17).

140 U.S. Fish & Wildlife Serv., Previous Federal Actions: Supplement to Endangered and Threatened Wildlife and Plants; Proposed Threatened Status for the Rufa Red Knot (*Calidris canutus rufa*) (2013) (available at http://www.fws.gov/northeast/redknot/pdf/20130923_REKN_PL_Supplement01_PreviousActions_Final.pdf [http://perma.cc/HK3Z-RHHM] (accessed Nov. 26, 2015)).

141 U.S. Fish & Wildlife Serv., U.S. Fish & Wildlife Service Protects the Rufa Red Knot as Threatened Under Endangered Species Act: Questions and Answers (2014) (available at https://www.fws.gov/home/feature/2014/pdf/QAs_red_knot_finallisting-12-8%20FINAL.pdf [http://perma.cc/948M-3BGL] (accessed Nov. 26, 2015)).

142 50 C.F.R § 17.31 (2014).

143 "[I]t is unlawful for any person subject to the jurisdiction of the United States to . . . take any such species within the United States or the territorial sea of the United States . . . ." 16 U.S.C. § 1538(a).

144 16 U.S.C. § 1533(a)(3)(A).

> (i) the specific areas within the geographical area occupied by the species, at the time it is listed in accordance with the provisions of section 1533 of this title, on which are found those physical or biological features (I) essential to the conservation of the species and (II) which may require special management considerations or protection; and
>
> (ii) specific areas outside the geographical area occupied by the species at the time it is listed in accordance with the provisions of section 1533 of this title, upon a determination by the [FWS] that such areas are essential for the conservation of the species.[145]

The ESA's designation of critical habitat outside the geographical area occupied by the species may provide an ideal tool for FWS to respond to the impacts of climate change on the red knot.[146] As the red knot's food source shifts vertically due to changing temperatures, and its wintering grounds shift horizontally due to rising sea levels, FWS will face a number of challenges in fully protecting these areas.[147] However, FWS may be able to proactively protect these areas where they can reasonably predict the species will migrate to adapt to climate change.

In the case that FWS were to identify future critical habitat for the red knot based on expected shifts caused by climate change, the proposal would most likely have to be a locally specific plan.[148] There is much uncertainty in calculating the future ranges of endangered and threatened species based on climate change data.[149] While FWS has considered climate change data, the agency has rejected proposals to protect additional habitat where the proposal was merely based on a regional climate change plan.[150] For instance, in identifying critical habitat for the lynx, FWS considered a number of factors such as snow cover, forest type, and density of the snowshoe hare population.[151] FWS declined to protect the future range of the lynx because these conditions depended on fluctuations in the environment at a local scale; therefore, a regional plan showing a 'future availability' of habitat for the lynx was not sufficiently specific for FWS to make a rational decision.[152] The ESA does not permit FWS to "cast a net over

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145 *Id.* § 1532(5)(A).

146 J.B. Ruhl, *Climate Change and the ESA*, 88 B.U. L. REV. 1, 36 (2008).

147 Designation of critical habitat must take "into consideration the economic impact, the impact on national security, and any other relevant impact." 16 U.S.C. § 1533(b)(2).

148 *See* All. for Wild Rockies v. Lyder, 728 F. Supp. 2d 1126, 1141–42 (D. Mont. 2010) (noting that reporting mechanisms used to designate lynx habitat are primarily useful for regional planning and inappropriate for large-scale planning of habitat designation for the lynx).

149 Wilfried Thuiller, *Patterns and Uncertainties of Species' Range Shifts Under Climate Change*, 10 GLOBAL CHANGE BIOLOGY 2020, 2026 (2004).

150 Revised Designation of Critical Habitat for the Contiguous United States Distinct Population Segment of the Canada Lynx, 74 Fed. Reg. 8,616, 8,621 (Feb. 25, 2009) (to be codified at 50 C.F.R. pt. 17).

151 *All. for Wild Rockies*, 728 F. Supp. 2d at 1142.

152 *Id.* at 1143.

tracts of land with the mere hope that they will" someday develop the potential to be critical habitat.[153]

Moreover, identifying critical habitat for other species of endangered migratory shorebirds has been a long-term endeavor.[154] The most analogous species protection arises from the designation of critical habitat for the piping plover, a small migratory shorebird that nests directly on sandy beaches.[155] Initially published in 2001, sixteen years after the plover was listed as threatened in the entirety of its range, and endangered in the Great Lakes watershed, the critical habitat designation for the piping plover covered 137 coastal areas including eighteen in North Carolina.[156] The original designation of four units of critical habitat in North Carolina was challenged in court in 2004 by the Cape Hatteras Access Preservation Alliance (CHAPA) over concerns that the designation would lead to limits, or a complete ban, on off-road vehicle use.[157] The D.C. Circuit subsequently vacated the critical habitat designation and remanded to FWS to clarify the designation of those units because of errors in the ESA process.[158] Shortly thereafter, FWS made available a draft of its economic analysis, environmental assessment, and a final designation in 2008.[159] Despite the conflict with National Park Service interim measures that permitted off-road vehicles on these sites in North Carolina, the court held the designation of critical habitat within Cape Hatteras National Seashore was not "arbitrary and capricious."[160] While this case sets the tone for designation of critical habitat on public lands, it seems to imply further difficulties facing the red knot if critical habitat will need to be designated on private lands.[161]

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153 Cape Hatteras Access Pres. Alliance v. Dep't of Interior (*Cape Hatteras I*), 344 F. Supp. 2d 108, 122 (D.C. Cir. 2004).

154 *See* Cape Hatteras Access Pres. Alliance v. Dep't of Interior (*Cape Hatteras II*), 731 F. Supp. 2d 15, 17–18 (D.C. Cir. 2010) (illustrating the lengthy process of critical habitat designation for the piping plover); Am. Bird Conservancy v. Kempthorne, 559 F.3d 184, 186–187 (3d Cir. 2009) (observing that the initial process for a species to even receive special notice from FWS, prior to critical habitat designation, can take months or years).

155 *See Cape Hatteras II*, 731 F. Supp. 2d at 18 (describing the critical designated habitat for the piping plover under the ESA, which prompted the Cape Hatteras Access Preservation Alliance to challenge FWS and Department of the Interior's authority to promulgate restrictions on affected portions of land).

156 *Id.* at 19; Final Determination of Critical Habitat for Wintering Piping Plovers, 66 Fed. Reg. 36,038 (July 10, 2001) (to be codified at 50 C.F.R. pt. 17).

157 *Cape Hatteras I*, 344 F. Supp. 2d at 117.

158 *Id.* at 124, 136–37.

159 *Cape Hatteras II*, 731 F. Supp. 2d at 18.

160 *Id.* at 36.

161 While private property interest groups argue that the ESA has a detrimental impact on private property when an endangered species is present, in reality there have been very few instances of projects not being approved. Amy Armstrong, *Critical Habitat Designations Under the Endangered Species Act: Giving Meaning to the Requirements for Habitat Protection*, 10 S.C. ENVTL. L. J. 53, 78–79 (2002).

*Moratoria on Crab Harvesting*: The *rufa* red knot is not the only species of shorebird that heavily relies on horseshoe crabs for rebuilding energy reserves prior to continuing their migration.[162] At least eleven species of migratory birds use the horseshoe crab eggs as a means to replenish their body fat, which is crucial during migrations because such birds have high daily energy expenditures.[163] The birds forage for the crab eggs as waves of nesting horseshoe crabs uncover the eggs.[164] It is unlikely that the shorebirds themselves have a significant impact on the crab populations, because the majority of the eggs that are washed up would not survive due to heat stress and desiccation.[165]

The ASMFC first initiated monitoring of the horseshoe crab harvests in 1998,[166] and in 2000 the ASMFC initiated state-by-state quotas that set limits on all Atlantic states where crabs were harvested for bait.[167] Since that time at least two states (Delaware and New Jersey) have improved their own management plans.[168] While Delaware implemented a moratorium on the harvesting of female horseshoe crabs, New Jersey successfully implemented a complete moratorium on horseshoe crab harvesting in 2008.[169] Additionally, the National Marine Fisheries Service (NMFS) established the Carl N. Shuster, Jr. Horseshoe Crab Reserve, which prohibits the harvest of horseshoe crabs in nearly 1,500 square miles of federal waters off of Delaware Bay.[170] In 2006, Delaware proposed two management strategies in response to the revised Interstate Fisheries Management Plan for Horseshoe Crabs (IFMP) issued by the ASMFC.[171] The addendum to the IFMP called for reduced bait harvest thresholds, but imposed no restrictions for biomedical harvests contingent on low mortality rates from the harvest.[172] The state's Department of Natural Resources and Environmental Control proposed to implement more stringent provisions in the form of either a two-year moratorium or a limited har-

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162 ATLANTIC STATES MARINE FISHERIES COMM'N, *supra* note 29, at 13.

163 *Id.*

164 *Id.* at 13–14.

165 *Id.*

166 *Id.* at 1. The management plan was not adopted to specifically protect the food source of migratory shorebirds, even though they are identified. The primary concern of the plan was to protect horseshoe crabs because they are a critical food source for the endangered loggerhead sea turtle, which was, and remains, a federally listed endangered species. *Id.*

167 NILES ET AL., *supra* note 10, at 95.

168 *Id.*

169 Niles et al., *supra* note 35, at 154.

170 NILES ET AL., *supra* note 10, at 95.

171 *Id.* at 96.

172 JOHN T. TANACREDI ET AL., BIOLOGY AND CONSERVATION OF HORSESHOE CRABS, 309–10 (John T. Tanacredi et al. eds., 2009) (explaining that horseshoe crabs are harvested for biomedical purposes because their blood is valuable for screening medical equipment for bacterial contamination).

vest.[173] The Delaware Supreme Court held that the state's moratorium on horseshoe crab harvesting did not have a rational basis in fact and was invalid.[174] Placing a moratorium on harvesting, instead of a limited harvest, was based on mere speculation.[175] The state did not have evidence to support that a moratorium would effectively make a difference in horseshoe crab egg availability.[176]

*State Beach Restoration & Armoring Laws*: While beach re-nourishment projects do have the potential to harm migratory shorebirds, the *rufa* red knot may reap some benefits from these projects.[177] According to the National Oceanic and Atmospheric Administration (NOAA), fifteen of the Atlantic states conduct beach re-nourishment projects.[178] In most states, beach restoration is reviewed under a general permit process for either alteration of the shoreline, construction below the mean high tide, or as disposal of dredged materials.[179] Some states, such as New York and Delaware, treat re-nourished beaches as a shore protection structure, while New Jersey views the projects as a non-structural measure.[180] However, Florida has the most extensive beach restoration policies of the Atlantic States, which may be valuable to the wintering population of the *rufa* red knot.[181]

While beach restoration may be beneficial to the red knot, state laws that permit armoring are detrimental to the bird. All the Atlantic states that the *rufa* red knot migrates through, except Maine, Maryland, New Jersey, North Carolina, and South Carolina, allow the hard armoring of beaches against coastal erosion.[182] Fortunately, many of the Atlantic coast states have shifted from hard armoring to "soft stabilization," which involves dune creation, restoration, and reshaping in addition to beach re-nourishment.[183]

### *B. Laws in Other Countries*

As the red knot migrates from Tierra del Fuego to Canada, it flies over and stops in a number of countries, each with their own regulations (or lack of regulations) aimed at helping to protect the shorebird. Although the U.S. has listed the species as threatened, other countries

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173 *See* Bernie's Conchs, LLC v. State, C.A. No. 06A-12-005-RFS, 2007 Del. WL 1732833, slip op. at *1 (Del. Super. Ct. 2007) (proposing minimum measures of compliance in order to protect the horseshoe crab).

174 *Id.*

175 *Id.* at *9.

176 *Id.*

177 GREENE, s*upra* note 67, at 31.

178 U.S. DEP'T OF COM. ET AL., TECHNICAL DOCUMENT NO. 00-01, STATE, TERRITORY, AND COMMONWEALTH BEACH NOURISHMENT PROGRAMS: A NATIONAL OVERVIEW 5–6 (2000) (available at https://coast.noaa.gov/czm/media/finalbeach.pdf [http://perma.cc/W9Y2-VWVB] (accessed Nov. 26, 2015)).

179 *Id.* at 6.

180 *Id.*

181 *Id.* at 8–9.

182 GREENE, *supra* note 67, at 4.

183 *Id.*

in the Caribbean and Central and South America, as well as Canada, also play a critical role in protecting the red knot. In fact, many of the countries that the red knot migrates through have existing laws to protect threatened species. However, as noted in the report compiled by FWS, many experts have little faith in the ability of these regulations to be successfully enforced.[184]

In Canada, the *rufa* red knot is protected under the Species At Risk Act (SARA).[185] The SARA only applies to species on federal lands, but it does protect listed endangered or threatened species against killing, harm, harassment, capture, or take, and it protects against damage or destruction of the species' "residence."[186] However, there is an exception for migratory birds protected under the Migratory Birds Convention Act (MBCA), and because the red knot is listed under the MBCA, it is protected throughout its range in Canada.[187] Similar to the MBTA in the U.S., neither the MBCA or SARA provide for protection of the red knot's habitat, and because the primary concern for the shorebird in Canada is loss of habitat due to climate change, there is little these laws can accomplish to protect the *rufa* red knot.

Currently, a number of Caribbean Islands have regulations either to protect endangered species, to prohibit hunting, or to forbid destruction of habitat.[188] However, only a few countries have regulations that identify and address the threats facing the red knot at these stopover sites.[189] Islands such as Jamaica[190] and the Bahamas have hunting regulations that list the red knot as a protected species for which hunting is prohibited year round.[191] This is because, historically, shorebirds were extensively hunted in the Caribbean Islands.[192] Because it is still a common practice in many of the islands and many do not have

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184 JUHANI OJASTI, FAO FORESTRY DEP'T, WILDLIFE UTILIZATION IN LATIN AMERICA: CURRENT SITUATION AND PROSPECTS FOR SUSTAINABLE MANAGEMENT pt. 4.1.1 (1996) [hereinafter WILDLIFE UTILIZATION] (available at http://www.fao.org/docrep/t0750e/t0750e0r.htm#4.1.1%20policy%20and%20legislation [http://perma.cc/6956-8LCF] (accessed Nov. 26, 2015)) ("[N]early half (48 percent) of the experts consulted believed the legislation in force in their respective countries to be obsolete or unrealistic, 26 percent found it adequate, 22 percent satisfactory and 4 percent virtually non-existent . . . .").

185 Species at Risk Act, S.C. 2002, c. 29; Gov. of Canada, *Red Knot Rufa Subspecies*, http://www.registrelep-sararegistry.gc.ca/species/speciesDetails_e.cfm?sid=980#ot2 (accessed Nov. 26, 2015).

186 S.C. 2002, c. 29, s. 32.

187 *Id.* at c. 29, s. 34.

188 U.S. FISH & WILDLIFE SERV., INADEQUACY OF EXISTING REGULATORY MECHANISMS: PROPOSED THREATENED STATUS FOR THE RED KNOT 3 (2014) (available at http://www.fws.gov/northeast/redknot/pdf/20130923_REKN_PL_Supplement04_FactorD_Final.pdf [http://perma.cc/C54X-K4SQ] (accessed Dec. 30, 2015)).

189 *Id.*

190 *Id.* at 4.

191 *Id.*

192 Wayne Burke, *Shorebird Conservation on Barbados*, 4 J. OF THE BARBADOS MUSEUM & HIST. SOC'Y 284, 286 (2009) (available at http://www.whsrn.org/sites/default/files/file/Shorebird_Conservation_Barbados_Dec09.pdf [http://perma.cc/U8JL-YQ8W] (accessed Nov. 26, 2015)) (noting that many of the islands are especially critical as a stop-over for the shorebirds during adverse weather).

applicable hunting regulations, some countries, such as Guadalupe, have initiated education and outreach programs to help hunters identify listed species.[193] In contrast, some islands have taken very minimal measures, such as Barbados, which lacks regulation and only has voluntary agreements with hunters to stop harvesting the red knot.[194]

Countries in Central and South America have taken significantly greater steps toward adopting environmental protection regulations. The two most relevant countries are Brazil and Argentina because of the red knot's migration pattern. Brazil adopted the Environmental Crimes Law in 1998,[195] which extends the public trust over all wild fauna and prohibits any takings.[196] In Argentina, where the red knot winters, there are no federal regulations; only guidelines exist for the individual provinces.[197] Only two provinces have declared that the conservation of migratory shorebirds is in the "provincial interest" and have prohibited "the modification of wetlands that are critical for the conservation of migratory shorebirds."[198] The lack of understanding about the legal protections needed for red knots in these countries poses a significant concern for successful protection of the species.[199] While many countries protect against hunting, there is little knowledge of the effectiveness of these laws, and there are still a number of countries where hunting is unregulated, or we simply are not aware of the regulations.[200] As summarized by FWS, there is a severe lack of information for countries outside the U.S. regarding "the protection or management of red knot habitat, and regarding the regulation of other activities that threaten the red knot such as development, disturbance, oil spills, environmental contaminants, and wind energy development."[201]

### *C. International Measures*

*Western Hemisphere Shorebird Reserve Network:* The WHSRN is a voluntary, non-regulatory coalition of hundreds of private and public

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193 Lawrence J. Niles, *Hunting Shorebirds in Guadeloupe*, A RUBE WITH A VIEW BLOG, http://arubewithaview.com/category/uncategorized [http://perma.cc/KPP8-XZUL] (accessed Nov. 26, 2015).

194 *Shorebird Hunting Workshop Summary and Supplemental Information*, SHOREBIRDPLAN.ORG, http://www.shorebirdplan.org/wp-content/uploads/2015/08/HuntingWorkshop.pdf [http://perma.cc/ML9H-VF69] (Aug. 31, 2011) (accessed Nov. 26, 2015).

195 Decreto No. 9.605, de 12 de Febrero de 1998, DIÁRIO OFICIAL DA UNIÃO [D.O.U.] de 2.13.1998 (Braz.).

196 *Id.*

197 WILDLIFE UTILIZATION, *supra* note 184, at pt. 4.1.1.

198 *New Law Protects and Celebrates Shorebirds in Rio Negro Province, Argentina*, WHSRN.ORG, http://www.whsrn.org/news/article/new-law-protects-and-celebrates-shorebirds-rio-negro-province-argentina [http://perma.cc/LQU5-H8YU] (July 12, 2011) (accessed Nov. 26, 2015).

199 WILDLIFE UTILIZATION, *supra* note 184.

200 *Id.* at pt. 5.4.

201 U.S. FISH & WILDLIFE SERV., *supra* note 188, at 7.

organizations in thirteen countries whose mission is to conserve shorebird species and their habitats through a network of key sites across the Americas.[202] Currently the WHSRN has ninety-one sites registered in the network, from Alaska to Tierra del Fuego.[203] Sites qualify for the WHSRN based on two criteria: "1) hosting at least 20,000 shorebirds [per year], or at least 1% of a biogeographic population of a shorebird species; and 2) the explicit agreement of the landowner to protect and manage habitat for shorebirds."[204] While identifying an area for the network does not confer protection under the law, as part of the WHSRN site, managers complete a Site Assessment Tool, which provides a network-wide picture of the status of all the sites and enables the WHSRN to identify target areas for advocacy and fundraising.[205] Moreover, recognition as a nationally or internationally significant wildlife area may be considered as an incentive to protect the area by a court.[206] For example, in finding that an impact analysis was insufficient to ensure the protection of migratory shorebirds, the Tenth Circuit Court of Appeals acknowledged the international significance of wetlands abutting the Great Salt Lake due to its designation as a WHSRN site.[207]

In a number of ways, the WHSRN has been valuable to the *rufa* red knot. The WHSRN has provided scientific assistance, site-based conservation activities, conservation planning, and community engagement.[208] While laws and regulations in the U.S. may be a viable option, many other countries do not have resources to enforce their laws.[209] The WHSRN has helped to construct nature centers in the red knot's critical migratory stopovers and wintering grounds, initiating "Pride campaigns" centered on the red knot,[210] and published the Red

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202 *WHSRN's Mission*, WHSRN.ORG, http://www.whsrn.org/about-whsrn/whsrns-mission [http://perma.cc/JH3G-GQSL] (accessed Nov. 26, 2015).

203 *WHSRN Sites*, WHSRN.ORG, http://www.whsrn.org/whsrn-sites [http://perma.cc/H22D-NYDY] (accessed Nov. 26, 2015); *WHSRN Sites*, WHSRN.ORG, http://www.whsrn.org/sites/list-sites [http://perma.cc/J56W-K573] (accessed Nov. 26, 2015) (listing protected sites in the following countries: Argentina, Brazil, Canada, Chile, Colombia, Ecuador, Mexico, Panama, Paraguay, Peru, Suriname, U.S., and Uruguay).

204 NILES ET AL., *supra* note 10, at 85.

205 *WHSRN Site Assessment Tool*, WHSRN.ORG, http://www.whsrn.org/tools [http://perma.cc/FCZ4-PETN] (accessed Nov. 26, 2015).

206 Utahns for Better Transp. v. U.S. Dep't of Transp., 305 F.3d 1152, 1180 (10th Cir. 2002) (recognizing that the wetlands abutting the Great Salt Lakes are internationally important because they are a link in the WHSRN and that a 1,000-foot impact analysis on wildlife for roadway construction was not sufficient in order to ensure that an internationally significant wildlife area would remain capable of protecting migratory birds).

207 *Id.*

208 *WHSRN's Mission*, *supra* note 202.

209 MICHAEL FAURE, ENFORCEMENT ISSUES FOR ENVIRONMENTAL LEGISLATION IN DEVELOPING COUNTRIES 18 (1995) (available at http://archive.unu.edu/hq/library/Collection/PDF_files/INTECH/INTECHwp19.pdf [http://perma.cc/9XXM-LH8P] (accessed Nov. 26, 2015)).

210 *Protecting the Winter Habitat of the Famed Red Knot*, RARE.ORG, http://www.rare.org/sites/default/files/RedKnotWEB.pdf [http://perma.cc/WE9S-DECD] (accessed Nov. 26, 2015) (Three "Pride campaigns" have been launched in Argentina, from

Knot Species Conservation Plan.[211] Additionally, in the U.S. the WHSRN listed Delaware Bay as the first site ranked of "hemispheric importance."[212]

*Bonn Convention:* The Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention)[213] is a multilateral treaty under the United Nations Environment Program, which seeks to provide immediate protection to animals listed in Appendix 1 of the treaty.[214] The mission of the treaty is to conserve or restore the places where the animals live, diminish obstacles to migration, and control other factors that might endanger them.[215] The convention was born out of a need to bring together range states, where a single species often spans several countries with individual jurisdictions and national conservation strategies.[216] Argentina, the only country that is a party to the treaty along the red knot's migration, proposed to list the *rufa* red knot under Appendix 1, and after a determination that it was endangered the species was added in 2005 to Appendix 1 of the Convention.[217] The parties to the Convention agreed "to strive towards strictly protecting [listed] animals," but listing of the red knot has not resulted in any significant protection for the species as compared to the WHSRN.[218]

*Ramsar Convention on Wetlands:* The Ramsar Convention on Wetlands came into force in 1975, and is a multilateral treaty aimed at protecting wetlands and their resources.[219] The Convention's mission

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San Antonio Bay, to Río Gallegos Estuary, and Costa Atlantica. San Antonio Bay is one of the most important stopover sites for the red knot, and while it is a protected area, it is located next to a popular summer beach-town. To protect against human disturbance, organizers have completed the zoning and permitting for an ATV trail that will avoid impacting critical spots for the red knot. In Rio Gallegos the greatest threat is unmanaged solid waste reaching the bird's habitat, therefore the campaign organizers have established a partnership with the local stores to donate reusable bags with the campaign logo, conducted training workshops for teachers on solid waste management, and prepared a float for the spring parade with the red knot front and center.).

211 Charles Duncan, *Manomet SRP/WHSRN & the Rufa Red Knot*, WHSRN.ORG, http://www.whsrn.org/sites/default/files/file/srp-whsrn_rekn_activities_14_12-22.pdf [http://perma.cc/X3SB-837C] (accessed Nov. 26, 2015).

212 *History &Background*, WHSRN.ORG, http://www.whsrn.org/about-whsrn/history-background [http://perma.cc/4RZJ-U9EK] (accessed Nov. 26, 2015).

213 Convention on the Conservation of Migratory Species of Wild Animals, June 23, 1979, 1651 U.N.T.S. 28395 [hereinafter Bonn Convention] (available at http://www.cms.int/en/convention-text [http://perma.cc/VGU2-6CHJ] (accessed Nov. 26, 2015)).

214 NILES ET AL., *supra* note 10, at 86.

215 Bonn Convention, *supra* note 215.

216 COLIN A. GALBRAITH ET AL., A REVIEW OF MIGRATORY BIRD FLYWAYS AND PRIORITIES FOR MANAGEMENT: CMS TECHNICAL SERIES PUBLICATION NO. 27 56 (2014) (available at http://www.cms.int/sites/default/files/publication/CMS_Flyways_Reviews_Web.pdf [http://perma.cc/2HZH-6XHL] (accessed Nov. 26, 2015)).

217 NILES ET AL., *supra* note 10, at 86.

218 *Id.*

219 Convention on Wetlands of International Importance Especially as Waterfowl Habitat 1971, *opened for signature* Feb. 2, 1971, 996 U.N.T.S. 14583 [hereinafter Ramsar Convention] (available at http://portal.unesco.org/en/ev.php-URL_ID=15398&URL_

is for the "conservation and wise use of all wetlands through local and national actions and international cooperation, as a contribution towards achieving sustainable development throughout the world."[220] There are currently 168 contracting parties, 2,186 sites, and 2 million hectares designated as wetlands of International Importance.[221]

The designation of Ramsar sites is of critical importance to the red knot, because outside of the U.S., it is the only conservation protection in a number of its migratory habitats.[222] The southern tip of Chile in Bahía Lomas (Lomas Bay) is the single most critical wintering ground for the *rufa* red knot outside of Tierra del Fuego in Argentina.[223] With the tidal bay hosting over 50% of the *rufa* red knot species, it is crucial habitat for the species and is only protected under the Ramsar Convention.[224] Moreover, the Ramsar Convention has designated Delaware Bay as a site of International Significance as well.[225]

## VI. SOLUTIONS: WHAT'S NEXT?

The "Red Knot Conservation Plan" published by the WHSRN sets out a list of goals for stabilizing and ideally increasing the *rufa* red knot population.[226] Many of the goals involve improving scientific studies of the various populations in their breeding, stopover, and wintering grounds.[227] Other goals are: (1) "recover and maintain Delaware Bay horseshoe crab egg densities to levels sufficient to sustain stopover populations of all shorebirds . . . [and] (2) control impact of disturbance at all stopovers and wintering areas . . . ."[228] These goals may be addressed by critical habitat designation under the ESA, im-

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DO=DO_TOPIC&URL_SECTION=201.html [http://perma.cc/EZ8R-FXUK] (accessed Nov. 26, 2015)).

220 *The Ramsar Convention and Its Mission*, RAMSAR.ORG, http://www.ramsar.org/about/the-ramsar-convention-and-its-mission [http://perma.cc/43RA-6K9F] (accessed Nov. 26, 2015).

221 *Contracting Parties to the Ramsar Convention on Wetlands*, RAMSAR.ORG, http://archive.ramsar.org/cda/en/ramsar-about-parties-parties/main/ramsar/1-36-123%5E23808_4000_0 [http://perma.cc/V8S4-ZT82] (Sept. 4, 2014) (accessed Nov. 26, 2015) (noting that countries along the red knot's migration that are parties to the Ramsar Convention are Argentina, Brazil, Jamaica, Bahamas, Barbados, Canada, and the U.S.).

222 NILES ET AL., *supra* note 10, at 19.

223 *Id.* at 97.

224 *Id.* at 13, 97 (noting that Bahía Lomas is a site of International Significance, which is determined under Art. 2 of the Convention as: "Wetlands should be selected for the List on account of their international significance in terms of ecology, botany, zoology, limnology or hydrology. In the first instance wetlands of international importance to waterfowl at any season should be included." RAMSAR CONVENTION, *supra* note 220, at Art. 2).

225 *Information Sheet on Ramsar Wetlands: Delaware Bay*, RAMSAR.ORG, https://rsis.ramsar.org/RISapp/files/RISrep/US559RIS.pdf [http://perma.cc/NC2P-JDPD] (1992) (accessed Nov. 26, 2015).

226 NILES ET AL., *supra* note 10, at 4.

227 *Id.*

228 *Id.*

proving legislation to protect these areas, or by place-based, community level protection.

Due to the effects of climate change, the reshuffling of the red knot's habitat is a concern that may in part be addressed by its recent listing under the ESA. The ESA allows for designation of critical habitat outside the geographical area occupied by the species when it is "essential for the conservation of such species."[229] In some instances, models are capable of predicting where a species habitat may migrate as their environment shifts due to rising sea levels and water temperatures.[230] FWS has taken this approach with respect to the critical habitat designation for the Preble's meadow jumping mouse.[231] The agency included small streams within the critical habitat, despite smaller streams not being particularly important to the species, and the agency did so because it made their populations less susceptible to "long-term climate change" impacts.[232]

Designation of critical habitat for the red knot must take into account their shifting food sources on a local scale. The ability to designate critical habitat outside the *rufa* population's current stopover sites in Virginia and Delaware will be crucial in continuing to protect the species.[233] It is important to note that, while proactively protecting the blue mussels and horseshoe crabs is a step in the right direction, this designation assumes the ability of the red knot to adapt to their changing environment.[234] Because the timing of their migration is not set by environmental influences, but by lunar cycles, there is some doubt that they will be resilient to these shifts even with additional protection over their expanded habitat.[235]

Additionally, despite expansive harvest restrictions for horseshoe crabs, there remain concerns over identifying "ideal" numbers for res-

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229 16 U.S.C. § 1533(b)(6)(C)(i) (2014).

230 Traditionally, "empirical niche modeling" has been used to analyze climate change effects. This method uses statistical relationships between a species' current distribution and abundance to identify an "environmental space," and then apply that environmental space to climate change projections. This method produces maps of widespread biodiversity loss and has been used to call for "radical and immediate intervention measures." However, this model is limited in that it fails to account for all aspects of a species' vulnerability: exposure, sensitivity, and adaptive capacity. This sort of vulnerability assessment is a much more helpful tool in identifying species that are at high risk. Terence P. Dawson et al., *Beyond Predictions: Biodiversity Conservation in a Changing Climate*, 332 SCIENCE 53, 53 (2011).

231 Ruhl, *supra* note 146, at 36.

232 Designation of Critical Habitat for the Preble's Meadow Jumping Mouse (*Zapus hudsonius preblei*), 68 Fed. Reg. 37,276, 37,285–86 (June 23, 2003) (codified at 50 C.F.R. pt. 17).

233 *See* Niles et al., *supra* note 35, at 160 (noting the directly proportional correlation between the horseshoe crab population and the red knot migratory population).

234 *See* McGowan, *supra* note 71, at 16 ("If water temperatures or storm frequency in the mid-Atlantic region were to increase significantly, the timing of spawning could shift and become temporally mismatched with shorebird migration, which depends primarily on celestial cues and is less susceptible to environmental variation . . . .").

235 *Id.*

toration of both the horseshoe crabs and the red knots.[236] As stated by New Jersey Assemblyman John McKeon, "New Jersey is part of an intercontinental community that shares the responsibility to sustain migratory shorebirds . . . by preserving their vital food source."[237] The health of the red knots was historically linked to the crabs, and there still needs to be active conservation of the crabs to maintain the health of the shorebirds.[238] However, the baseline historical number of crabs is somewhat unclear itself.[239] Although the goals set for horseshoe crab numbers appear to be forward-looking, they are really looking back to a time when we presumed the red knot population was healthy.[240] While there have been studies of the red knot population since the 1980s, there is still great uncertainty about "the size of the horseshoe crab population, the numbers that can be harvested without adverse impact, and the number of horseshoe crabs necessary to support migratory shorebird populations."[241] Therefore, it will take much more than a mere moratorium on horseshoe crab harvesting to save the red knot. Active management of the crabs as their habitat shifts, and continued research on the horseshoe crabs, is necessary to restore the red knot population.[242]

Restoring beaches that provide stopover and wintering habitat for the red knot is another method for protecting the *rufa* population. The benefits of beach restoration are not only felt by the red knots—beaches with soft hardening projects (beach re-nourishment, dune enhancement, and beach bulldozing) also provide valuable ecosystem services to private landowners and the public as well.[243] Fortunately, many of the Atlantic states already have beach restoration programs; nevertheless, they need to be sustained. Protecting ecosystem services is recognized globally as a valuable investment, because, as in the case of re-foresting mangroves on the coasts of Indonesia and Bangladesh, they serve as imperative primary blocks to ever increasing natural disasters.[244]

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236 Niles et al., *supra* note 35, at 160.

237 Press Release, N.J. Audubon Soc'y, N.J. Legislators Pass Important Act to Save Shorebirds from Extinction (Mar. 17, 2008) (available at http://www.njaudubon.org/Portals/10/Conservation/PDF/HScrab031808.pdf [http://perma.cc/G8A2-3YNN] (accessed Nov. 26, 2015)).

238 Niles et al., *supra* note 35, at 162–63.

239 *Id.*

240 *Id.*

241 *Id.*

242 *See* Telesetsky, *supra* note 109, at 521 ("What is needed more than ever is an approach to restoration that focuses not on the surface aspects of restoration but on system functions.").

243 *See id.* at 514–15 (finding that ecosystem services means a valuation of the ecosystem functions because they have inherent value for humans both ecologically and economically).

244 *Id.* at 515–16.

Lastly, regulators must consider identifying and protecting red knot habitat on an ecoscape scale.[245] The general theory is to identify not only a single, isolated area to protect, but to consider the red knot's habitat as a part of an ecosystem-wide scale of place-based protection.[246] While setting horseshoe crab harvesting limits is a necessary regulatory mechanism, that mechanism only identifies a single threat, managing for that condition alone will not protect the red knot against climate change and human disturbance.[247] The goal in protecting the red knot should be expanded to consider food availability and beach disturbances along its entire migratory path, especially on a local level.[248] Considering the complicated network of regulations, property interests, and environmental threats along its migration, the red knot needs a mechanism that does not seek to address these issues independently. Ecoscape management is a promising tool for migratory species such as the red knot because it can connect regulators and conservationists across ecological boundaries. The work of the WHSRN has already begun to mirror this approach by successfully identifying stopover sites throughout South America and working to either clean up or protect those sites with local actors.[249] By expanding the work of the WHSRN, which encourages and supplements efforts of local and regional governments to protect these critical areas, the red knot may have a truly ecosystem-wide protected habitat.

## VII. CONCLUSION

Despite the seemingly large numbers of red knot populations elsewhere in the world, the subspecies of concern in the eastern U.S. is the *rufa* red knot. This is because the legislative history of the ESA reflects a "consistent policy decision by Congress that the U.S. should not wait until an entire species faces global extinction before affording a domestic population segment of a species protected status."[250] The impacts on the red knot are therefore no less significant because populations elsewhere are stable; climate change is a serious threat to both its habitat and food source. Through critical habitat designation, cooperative educational outreach, and adoption of place-based measures, there remains a fighting chance for the red knot. Moreover, there are a number of endangered migratory species that will require similar protections due to climate change, and it would be prudent of FWS and other state and local regulators to begin to address these impacts by first addressing the red knot.

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[245] *Id.* at 494.
[246] *Id.*
[247] *Id.* at 514.
[248] Telesetsky, *supra* note 109, at 521.
[249] *Protecting the Winter Habitat of the Famed Red Knot*, *supra* note 210.
[250] Sw. Ctr. for Biological Diversity v. Babbitt, 926 F. Supp. 920, 924 (D. Ariz. 1996) (citing H.R. REP. NO. 412, at 10 (1973), *as* reprinted in 1978 U.S.C.C.A.N. 2989, 2998).