Project report

Identification of Important Semipalmated Sandpiper and Red Knot Sites

Along the North American Atlantic and Pacific Flyways

September 2017

Commission for Environmental Cooperation

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List of Abbreviations and Acronyms

AMBI	Arctic Migratory Birds Initiative
CEC	Commission for Environmental Cooperation
IBA	Important Bird and Biodiversity Areas
ISS	International Shorebird Survey
REKN	Red Knot
SESA	Semipalmated Sandpiper
RK	Red Knot
SPS	Semipalmated Sandpiper
United States	United States of America
USFWS	United States Fish and Wildlife Service
WHSRN	Western Hemisphere Shorebird Reserve Network

All site data referenced in this report are available on the Commission for Environmental Cooperation project website *Key North American Migration Sites for Red Knots & Semipalmated Sandpipers* (www.nashorebirds.org).

Executive Summary

The project CEC OP15-16 Arctic Migratory Birds Initiative (AMBI) - Americas Flyway Action Plan seeks to foster North American conservation opportunities for Semipalmated Sandpiper (*Calidris pusilla*) and Red Knot (*Calidris canutus; rufa* and *roselaari* subspecies) by supporting community efforts at the most important habitats for these two species that have very broad breeding ranges and have been identified as key biodiversity indicators for other co-occurring species. As a first step in this process, the Executive Office of the Western Hemisphere Shorebird Reserve Network (WHSRN) housed at Manomet, was hired to compile a list of all sites in North America known to hold significant numbers (1% or more) of the flyway populations of one or both species; to compile information on threats at the sites; and to identify priority sites where local communities might be willing to support nomination of their sites for WHSRN status, and to participate in a conservation network of key sites.

The inventory of key sites for Semipalmated Sandpiper and Red Knot was compiled from published information sources and publicly available databases. Once an initial inventory was compiled, it was sent for review by experts on the relevant species. Sites were then prioritized using the three levels of biological importance used by WHSRN (1, 10 and 30% of the biogeographic population). Detailed information for each site was compiled in a standard site matrix. Information on threats was gathered for all sites where a standardized threat assessment process had been undertaken. Finally, for those sites holding more than 10% of a population, local conservation leads and shorebird experts were contacted to help explore if local communities might be interested in participating in a North American network of sites to conserve shared shorebirds. Priority was given to discussing this with sites that are not already part of WHSRN.

A total of 88 sites were identified as holding 1% or more of the biogeographic populations of Semipalmated Sandpiper (18 sites) and/or Red Knot (79 sites). Standardized threat information was compiled for 34 of these sites. Of the 88 sites, 18 hold 10% or more of one or more biogeographic populations. Of these, one site (Delaware Bay) is important for both the Atlantic population of *rufa* Red Knot and Semipalmated Sandpiper. Of the remaining 17, one is important for Semipalmated Sandpiper, five for the Atlantic population of *rufa* Red Knot, four for the mid-continental population of *rufa* Red Knot, and seven for *roselaari* Red Knot. Nine of the 18 sites are existing WHSRN sites, while a 10th has a WHSRN site included within its boundaries. After discussions with local stakeholders, the top priority sites for WHSRN nomination and for conservation action as part of a site network were considered to be: James Bay, Ontario, Canada; Willapa Bay, Washington State, United States; Georgia Barrier Islands, Georgia, United States; and Bahía de Todos Santos, Baja California, Mexico.

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1 Description of Project

The goal of the CEC OP15-16 Arctic Migratory Birds Initiative (AMBI) - Americas Flyway Action Plan project is to improve conservation outcomes for at-risk shorebirds by informing, engaging and connecting communities in Canada, Mexico and the United States at key sites that share responsibility for their well-being. The project aims to foster North American conservation opportunities for Semipalmated Sandpiper (*Calidris pusilla*) and Red Knot (*Calidris canutus; rufa* and *roselaari* subspecies) by supporting community efforts at the most important habitats for these two species that have very broad breeding ranges and have been identified as key biodiversity indicators for other co-occurring species.

Under the project, the CEC committed to: i) compile a list of all sites in North America known to host significant numbers (>1% of estimated flyway population size) of Semipalmated Sandpiper and/or Red Knot; ii) conduct a threat analysis for all sites including information derived from traditional and local knowledge and; based on this information, iii) work to identify best communities (including Arctic and indigenous communities) to engage in order to assess their interest in participating in a conservation network.

2 Methods

2.1 Compile a list of all sites known to host at least 1% of Semipalmated Sandpiper and/or Red Knot biogeographic/flyway populations

This inventory of key sites for Semipalmated Sandpipers *Calidris pusilla* (hereafter SESA) and Red Knots *Calidris canutus; rufa* and *roselaari* subspecies (hereafter REKN) focused on the jurisdictional boundaries of North America including Canada, Mexico and the United States of America. Sites on the northwest coast of the Gulf of Mexico (in Texas and Louisiana) were included in the analysis as part of a mid-continental flyway due to some evidence that some individuals from the three flyways mix in this area (D. Newstead in litt., 28 March 2016).

The project team identified sites holding 1% or more of the relevant flyway population of SESA and REKN in the Atlantic and Pacific flyways. The 1% levels were defined using the most recent definitions and estimates of biogeographic populations for each species. These are:

- Red Knot (*Calidris canutus roselaari*) – 21,770 individuals (Lyons *et al*. 2015)
- Red Knot (*Calidris canutus rufa*) – 42,000 individuals (Andres *et al*. 2012)
- Semipalmated Sandpiper (*Calidris pusilla*) – 2,260,000 individuals (Andres *et al*. 2012)

A recent publication (McKellar et al. 2015) suggested that *rufa* Red Knot population numbers might be higher than the Andres et al. (2012) estimate, with 44,010 estimated as the number stopping-over in Delaware Bay. However, as there is no revised consensus estimate for the total *rufa* population, the Andres et al. 2012 figure was used.

The existence of four separate biogeographic populations for *rufa* Red Knot is increasingly recognized, with each having discrete wintering areas and migration strategies: 1. A long-distance migratory population that winters in southernmost South America (primarily Tierra del Fuego); 2. A medium-distance migratory population wintering in northern Brazil; 3. A short-distance migratory population that winters in the southeastern United States and Caribbean region; 4. A short-distance

migratory population that takes a mid-continental migratory route and winters in the northwest coast of the Gulf of Mexico (primarily the Laguna Madre area in Texas to Louisiana) and also Oaxaca, on the Pacific coast of Mexico. This latter population (including the Oaxaca birds) is believed to number 2000–2500 individuals (Newstead et al. 2013). Although the inventory has focused on sites within the Atlantic and Pacific Flyways in North America, some sites were identified within the mid-continental flyway, primarily for the mid-continental population of *rufa* REKN.

The highest single day counts or estimates of a species at a site were compiled with their respective sources. The data were then qualified as "new" or "old", with the threshold set at 2005/2006 (on the recommendation of L. Niles in litt., 24 February 2016) to help with the prioritization of sites (especially in the United States). Seasonal information, e.g., whether counts were during northbound (spring) or southbound (fall) migration, was also compiled.

As Arctic-nesting shorebirds are generally widely scattered across the landscape and typically do not congregate (when breeding), breeding areas were only included in the inventory when they have already been designated as a WHSRN site or Important Bird Area (IBA) for one or both species.

Initially, information was compiled from the following sources:

1. Western Hemisphere Shorebird Reserve Network (WHSRN) <www.whsrn.org/sites/list-sites>
2. Important Bird and Biodiversity Areas (IBAs) <www.birdlife.org/worldwide/programmes/important-bird-and-biodiversity-areas-ibas>
3. Red Knot conservation plan <www.whsrn.org/sites/default/files/file/Red_Knot_Conservation_Plan_10_02-28_v1.1.pdf>
4. Draft Semipalmated Sandpiper conservation plan (obtained from lead author, David Mizrahi)
5. International Shorebird Survey (ISS), accessed through Manomet <www.manomet.org/program/shorebird-recovery/international-shorebird-survey-iss>
6. Pacific Flyway Shorebird Survey <http://data.prbo.org/apps/pfss/>
7. eBird, information provided by Cornell Lab of Ornithology <http://ebird.org/content/ebird/>
8. Assorted published literature
9. *rufa* Red Knot Endangered Species Act listing documentation <www.fws.gov/northeast/redknot/pdf/QAs_RedKnotpL_FINAL_092713.pdf>
10. Proposed Recovery Strategy and Management Plan for the Red Knot in Canada (this became publicly available for review on 30 March 2016, and was checked for information as far as possible) <www.registrelep-sararegistry.gc.ca/virtual_sara/files/plans/rs_mp_red_knot_e_proposed.pdf>

Once an initial inventory of sites had been compiled, this was shared with relevant species experts to ensure that key sites were not overlooked, and that the most recent information available for each site was included in the inventory. This proved to be particularly important in the case of Canada, where a lot of information appears to be held in databases and sources that are not readily available.

Once sites were identified, they were prioritized using the three levels of biological importance used by WHSRN (1, 10 and 30% of the biogeographic population) and following the previously cited definitions and estimates of biogeographic populations for each species.

Methodology for matrices

Once an initial list of sites was compiled, the matrices were populated with detailed description for each site. A summary of CEC guidelines for the information included in the matrices follow:

1. *Country, region, nearest municipality or community* – General information about the location of the site.
2. *Species and subspecies present* (RK-*roselaari*, RK-*rufa*, SPS) – Indicate the species present at the site.
3. *Highest concentration population at this site at any time (in number of birds and as a % per species)* – Indicate the highest concentration of the population for each species present at the site and its percentage of the total population of the flyway. The source of the data was provided with a description including whether it was published, based on western science, based on traditional knowledge or/and based on anecdotal evidence.
4. *Geospatial data* – Sites were delineated by projecting all the data from the sources mentioned above into Google Earth. Data overlaying with existing WHSRN sites, IBAs or areas that can be managed in some way of conservation (e.g., Ramsar, Protected Areas), boundaries were followed for those sites. New boundaries were created following publications, habitat requirements for the species and recommendations from reviewers. Sites were geo-referenced in Google Earth map.
5. *Habitat characteristics* – Habitat types and characteristics were added following Ramsar 2012. Some sites will include habitat description for the whole area not only the shorebird-used specific area.
6. *Land ownership* – Land ownership status (private, local, state, and/or federal) was included.
7. *Existing knowledge about the site (including local and traditional knowledge)* – Existing and current conservation work at the site including research, management plans, local and traditional ecological knowledge, and uses of the natural resources were recorded.
8. *Relative importance of site* – Conservation designations for the site (e.g., protected area, Ramsar site) were recorded.
9. *Past site prioritization exercises (e.g., equilibrium analyses)* – Information on prioritization exercises, such as equilibrium analyses, climate change modelling, land use change analyses and species habitat use analyses that were completed for the site were recorded. This information was not as easily available for the sites so only a few matrices include this information.
10. *Work currently underway at site* – Conservation and restoration actions were included in the matrix along with the organizations leading them.

2.2 Integrate known threats into the matrix for all sites hosting at least 1% of Semipalmated Sandpiper and/or Red Knot biogeographic/flyway populations in North America

Information on threats (including, where possible, an assessment of impacts) was incorporated into the matrices for all sites where a standardized threat assessment process had been undertaken. In general, only sites with such assessments were considered given the importance of objective information gathered using standardized processes and threat classifications. Information was compiled from "Site Assessments" undertaken using the WHSRN Site Assessment Tool (see <www.whsrn.org/tools>); and Important Bird and Biodiversity Areas in Danger using the IBA monitoring framework (see <www.birdlife.org/datazone/info/IBAsInDanger>). Threats were also compiled from Ramsar site factsheets, although these do not include information on level of impact. For some sites, information on threats was included from other sources (primarily from site webpages) where this information was readily (and publicly) available.

Six main types of direct or indirect threats were identified to REKN and SESA populations at sites:

- Extraction of non-renewable resources: mining, oil and gas extraction, or other extractive industries present at the site;
- Exploitation of renewable resources: commercial or subsistence fisheries, harvesting of other marine resources (shellfish, marine vegetation), aquaculture;
- Site land-use change: past, current or planned development activities;
- Pollution/contaminants at site: including noise and light pollution;
- Damaging recreational use: causing or may cause disturbance to shorebirds at the site (e.g., ATV use, beach goers, speed boating, etc.);
- Physical alteration of site (independently occurring i.e., not caused by direct human intervention): hydrology, ecology, topography, temperature, sea-level or other physical aspects of the site (e.g., hurricanes, floods, fires). All human-induced land-use changes were excluded from this category.

2.3 Identify sites in North America that are key for the conservation of one or both of the two species and where communities are interested in engaging in a conservation network

For those sites holding more than 10% of a population, local conservation leads and shorebird experts were contacted to help explore if local communities might be interested in participating in a North American network of sites to conserve shared shorebirds. Priority was given to discussing this with sites that are not already part of WHSRN.

3 Results and Discussion

3.1 Compile a list of all sites known to host at least 1% of Semipalmated Sandpiper and/or Red Knot biogeographic/flyway populations

A total of 88 sites were identified holding at least 1% of the Semipalmated Sandpiper and/or Red Knot populations in North America, summarized in Table 1, with a full list of sites presented in an Excel site spreadsheet. Each species has its own kml file where the sites with new data have a green color and white for old data (Appendix 2 – Google Earth kml files). Each site description can be found in their detailed matrices in Appendix 3.

Table 1 Summary of North American sites holding >1% of Red Knot and/or Semipalmated Sandpiper populations

Country	Semipalmated Sandpiper	*rufa* Red Knot - Atlantic	*rufa* Red Knot – mid-continental	*roselaari* Red Knot	Total sites per country
Canada	11	12	0	0	17
Mexico	0	0	1	8	9
United States	7	46	3	9	62

Note: Some sites hold 1% of the populations of both SESA and REKN and thus the totals of sites per species per country do not necessarily sum to the total sites per country. This summary includes sites with new and old data.

In the following section the results are summarized per country, highlighting those sites holding more than of 10% of one or more populations. A full list of North American sites holding ≥10% of Red Knot and/or Semipalmated Sandpiper populations is provided in Table 2 below.

3.1.1 Canada

In Canada, there is a total of seventeen (17) sites spread across seven provinces (Alberta, Manitoba, New Brunswick, Nova Scotia, Ontario, Quebec and Saskatchewan). Four sites with recent ("new") data hold more than 10% of the REKN (Mingan Archipelago, Bay of Fundy, James Bay, and Nelson River Estuary-Churchill) or SESA population (Bay of Fundy).

During migration, Semipalmated Sandpipers prefer the Bay of Fundy's intertidal mudflats as a key southbound stopover habitat in Canada. The Bay of Fundy is extremely dynamic because of the large tide, and the prey assemblage in each mudflat can change rapidly and dramatically. The *rufa* Red Knot were mainly observed in the saltmarshes in the Nelson River Estuary and James Bay, and limestone flats in the Mingan Archipelago.

3.1.2 Mexico

Eight out of the total of nine sites in Mexico were identified for *roselaari* Red Knot, with one site identified for the mid-continental population of *rufa* Red Knot. As was expected from existing knowledge of Semipalmated Sandpiper migration and wintering routes, no significant sites were identified in Mexico for this species. All the site matrices were completed for Mexico (six sites with new data and three with old data).

Sites found to hold 10% or more of the *roselaari* population were: Complejo Lagunar Ojo de Liebre-Guerrero Negro, Alto Golfo de California y Delta de Río Colorado and the Marismas Nacionales. Laguna Superior holds more than 10% of the mid-continental *rufa* population (if all the birds present there are *rufa* Red Knot).

3.1.3 United States of America

Sixty-two sites were identified for the United States. Of these 62 sites, 10 have recent ("new") data showing them to hold 10% or more of the REKN or SESA populations. There are four sites holding 10% or more of the *roselaari* REKN population, two in Alaska and two in Washington. Three sites hold 10% or more of the mid-continental *rufa* REKN population. Three sites hold 10% or more of the Atlantic *rufa* REKN population. Just one site holds 10% or more of the SESA population (albeit with data from 1986), this being the same as one of the *rufa* REKN sites (Delaware Bay).

Table 2 North American sites holding ≥10% of Red Knot and/or Semipalmated Sandpiper populations

Country	Region	Site	Species	Count	Type	%	Source	WHSRN
Canada	Quebec	Mingan Archipelago	RK-*rufa*	7,200	Total passage population	>10%	Baker 2009	No
			SPS	100,000	Total estimate	>1%	Aubry pers. comm (February 2016)	
Canada	New Brunswick and Nova Scotia	Bay of Fundy	SPS	289,116	Total passage population (2011-2014 average)	>10%	J. Paquet unpubl. data	Yes
			RK-*rufa*	1700	Total estimate	>1%	Hicklin 1987	
Canada	Ontario	James Bay	RK-*rufa*	4,885	2014 adult passage population/26 July-25 August (4,885 - range: 2,320-10,120)	>10%	Iverson and Friis unpubl. data	No
			SPS	100,000	Total estimate	>1%	IBAs Canada 1997 (old data)	
Canada	Manitoba	Nelson River Estuary - Churchill	RK-*rufa*	4,259	Two-day maximum count	>10%	McKellar *et al*. 2015	No
Mexico	Baja California Sur	Complejo Lagunar Ojo de Liebre-Guerro Negro	RK-*roselaari*	6,498	Total estimate	>30%	WHSRN site nomination form; Carmona *et al*. 2008	Yes
Mexico	Baja California and Sonora	Alto Golfo de California y Delta de Rio Colorado	RK-*roselaari*	6,060	Maximum day count	>30%	WHSRN site nomination form	Yes

Mexico	Nayarit and Sinaloa	Marismas Nacionales	RK-*roselaari*	2,025	Maximum day count	>10 (almost, 9.3%)	eBird 2015 (David Molina 2/20/2010); Pacific Flyway Shorebird Survey and the Migratory Shorebird Project	Yes
Mexico	Oaxaca	Laguna Superior	RK (mid-continent)	300	Maximum day count	>10%	Carmona *et al*. 2013; See also: <www.manomet.org/newsletter/scientific-expedition-mexico-discovers-shorebird-wintering-site>	No
United States	New Jersey and Delaware	Delaware Bay	SPS	267,348	Maximum day count (May-June 1986)	>10%	Clark and Niles 1993	Yes
			RK-*rufa*	25,548	Total estimate	>30%	A. Dey, pers. comm. in Andres *et al*. 2012 ; WHSRN site nomination form	
United States	Georgia	Georgia Barrier Islands	RK-*rufa*	18,000	Total estimate	>30%	Lyons *et al*. 2015	Partial
				12,000 (Altamaha River Delta)	Total estimate	>10%	Schneider and Winn 2010	
United States	Washington	Grays Harbor	RK-*roselaari*	5,665	Maximum day count (8 May 2010)	>10%	Buchanan *et al*. 2011	Yes
United States	Washington	Willapa Bay	RK-*roselaari*	2,530	Maximum day count	>10%	Buchanan 2008	No
United States	Alaska	Yukon Delta National Wildlife Refuge	RK-*roselaari*	6,400	Maximum day count	>30%	Carmona *et al*. 2013; McCaffery *et al*. 2009	Yes
United States	Alaska	Copper River Delta	RK-*roselaari*	4,250	Maximum day count	>10%	Cooper and Gabrielson 2014 (Alaska Shorebird Group annual summary)	Yes
United States	South Carolina	Kiawah Island-Seabrook Island	RK-*rufa*	6,000	Maximum day count	>10%	eBird (Aaron Given 4/13/2015)	No

United States	Texas	Laguna Madre (Mustang Island, and Padre Island)	RK (mid-continent)	2,546	Maximum day count	100%	B. Sandifer, pers. comm. in Newstead *et al*. 2013	Yes
United States	Louisiana	Barataria Terrebonne	RK (mid-continent)	550	Maximum day count	22%	eBird (Erik Johnson, Rebecca Doane and Kelly Alm 5/7/2015)	No
United States	Louisiana	Chandeleur Islands (Breton National Wildlife Refuge)	RK (mid-continent)	500	Maximum day count	20%	eBird (David Muth 4/7/2011)	No

Notes: Abreviations for species follow CEC matrix guidelines: RK-*roselaari* for *Calidris canutus roselaari*, RK-*rufa* for *Calidris canutus rufa* and SPS for *Calidris pusilla*.

3.2 Integrate known threats into the matrix for all sites hosting at least 1% of Semipalmated Sandpiper and/or Red Knot biogeographic/flyway populations in North America

Information on known threats has been compiled from "Site Assessments" undertaken at WHSRN sites using the WHSRN Site Assessment Tool (see <www.whsrn.org/tools>). Site Assessments have been undertaken at 14 sites of importance for Semipalmated Sandpiper and/or Red Knot. Information has also been compiled from a recent assessment of threats at IBAs, with data available from four sites of importance for one or both species, and from Ramsar sites, with information available for five sites. Standardized threat information was also found for an additional 11 sites. Thus, threat information is presented in the matrices for a total of 34 sites.

3.3 Identify sites in North America that are key for the conservation of one or both of the two species and where communities are interested in engaging in a conservation network

The focus of this action item has been sites that qualify as being of either hemispheric or international importance, but are not currently part of the WHSRN network. Sites of international importance are those which hold 10% or more of the biogeographic population, while sites of hemispheric importance hold 30% or more. A total of 18 sites of international or hemispheric importance have been identified in North America (see Table 2). Of these 18 sites, nine are existent WHSRN sites, one has a WHSRN site included within its boundaries, and eight are not WHSRN sites. Of the latter, three are in Canada and are important for *rufa* Red Knot; one is in Mexico and is important for the mid-continental *rufa* population; and four are in the United States, with one important for *roselaari*, one for *rufa* and two for the mid-continental population of *rufa*. Priority should be given to discussing with the eight sites that are not WHSRN sites to assess their potential interest in forming part of a conservation network.

Bibliography

Alexander, S.A. and C.L. Gratto-Trevor. 1997. *Shorebird migration and staging at a large prairie lake and wetland complex: the Quill Lakes, Saskatchewan*. Occasional Paper Number 97, Canadian Wildlife Service, Prairie and Northern Region.

Andres, B.A., P.A. Smith, R.I.G. Morrison, C.L. Gratto-Trevor, S.C. Brown and C.A. Friis. 2012. Population estimates of North American shorebirds. *Wader Study Group Bulletin* 119(3): 178–194.

Arce, N., R. Carmona, E. Miramontes, V. Ayala-Perez, A. Hernández-Alvarez and L.F. Mendoza. 2015. An overwintering group of Red Knots *Calidris canutus roselaari* in Las Garzas Lagoon, Nayarit, Mexico. *Wader Study* 122(2): 135–141.

Baker, A.J. 2009. *Continuing Monitoring Annual Survival and Recruitment in the Endangered Red Knot Population Passing through Mingan Archipelago* (Project #1440). Unpublished report submitted to World Wildlife Fund, Toronto, Canada.

Beyersbergen, G.W. and D. Duncan. 1995. *Shorebird abundance and migration at Chaplin/Old Wives/Reed Lakes, Saskatchewan.* Internal Canadian Wildlife Service Report, Prairie and Northern Region, Edmonton, Alta.

Beyersbergen, G. W. and D. C. Duncan. 2007. *Shorebird Abundance and Migration Chronology at Chaplin Lake, Old Wives Lake and Reed Lake, Saskatchewan: 1993 and 1994*. Canadian Wildlife Service Technical Report Series No. 484. Prairie and Northern Region. Edmonton, Alberta.

BirdLife International. 2016. Important Bird and Biodiversity Areas factsheets: North America. Downloaded from <www.birdlife.org>, accessed 17 January 2016.

Bishop, M.A., J.B. Buchanan, J.A. Johnson and B. McCaffrey, in prep. , Spring stopover sites used by the Red Knot *Calidris canutus roselaari* in Alaska, United States: connectivity between Controller Bay-Copper River Delta and Yukon-Kuskokwim river deltas.

Buchanan, J.B. 2008. The spring 2008 survey of Red Knots *Calidris canutus* at Grays Harbor and Willapa Bay, Washington. *Wader Study Group Bulletin* 115(3): 177–181.

Buchanan, J. B., L.J. Salzer, G.J. Wiles, K. Brady, S.M. Desimone and W. Michaelis. 2011. An investigation of Red Knot *Calidris canutus* spring migration at Grays Harbor and Willapa Bay, Washington. *Wader Study Group Bulletin* 118(2): 97–104.

Carmona, R., N. Arce, V. Ayala-Perez and G.D. Danemann. 2008. Abundance and phenology of Red Knots in the Guerrero Negro-Ojo de Liebre coastal lagoon complex, Baja California Sur, Mexico. *Wader Study Group Bulletin* 115(1): 10–15.

Carmona, R., N. Arce, V. Ayala-Perez, A. Hernández-Alvarez, J.B. Buchanan, L.J. Salzer, P.S. Tomkovich, J.A. Johnson, R.E. Gill, Jr., B.J. McCaffery, J.E. Lyons, L.J. Niles, and D. Newstead. 2013. Red Knot *Calidris canutus roselaari* migration connectivity, abundance and non-breeding distribution along the Pacific coast of the Americas. *Wader Study Group Bulletin* 120(3): 168–180.

Clark, K., L. Niles and J. Burger.1993. Abundance and distribution of shorebirds migrating on Delaware Bay, 1986- 1992. *Condor* 95: 694–705.

Comisión Nacional de Áreas Naturales Protegidas. 2012. *Estudio Previo Justificativo para el establecimiento del área natural protegida con la categoría de Área de Protección de Flora y Fauna Bahía de Santa María, en el Estado de Sinaloa*. México. [In Spanish]

Cooper, E. and M. Gabrielson. 2014. *Red Knot (Calidris canutus roselaari) surveys on the Copper River Delta during spring migration*. Alaska Shorebird Group Annual Summary. <www.fws.gov/alaska/mbsp/mbm/shorebirds/pdf/ASG Summaries_2014.pdf>.

L.G. de Repentigny. 1999. Fichier insulaire du Fleuve Saint-Laurent. Service canadien de la faune, Environnement Canada, région du Québec. [In French]

Duncan, C.D. 2006. The Western Hemisphere Shorebird Reserve Network (WHSRN). Waterbirds around the world. Eds. G.C. Boere, C.A. Galbraith & D.A. Stroud. *The Stationery Office, Edinburgh, UK*, 682-686.

eBird Basic Dataset. Version: EBD.2015. Cornell Lab of Ornithology, Ithaca, New York. Nov 2015.

Hicklin, P. W. 1987. The migration of shorebirds in the Bay of Fundy. *Wilson Bulletin* 99: 540–570.

Koes, R.F. and P. Taylor. 1993. Prairie Provinces Region. *Field Notes* 47(3): 423–425.

Lahrman, F.W. 1972. Unusually large flock of Knots and Ruddy Turnstones feeding in stubble field. *Blue Jay* 30: 226.

Lock, A.R., R.G.B. Brown and S.H. Gerriets. 1994. *Gazetteer of Marine Birds in Atlantic Canada: an atlas of sea bird vulnerability to oil pollution.* Canadian Wildlife Service Environmental Conservation Branch, Environment Canada Atlantic Region.

Lyons, J. E., W.L. Kendall, J.A. Royle, S.J. Converse, B.A. Andres and J.B. Buchanan. 2015. Population Size and Stopover Duration Estimation Using Mark–Resight Data and Bayesian Analysis of a Superpopulation Model. *Biometric* 72(1): 262–271.

McCaffery, B.J., R.E. Gill, Jr., C.M. Handel and C.R. Ely. 2009. *The status of Red Knots during spring migration in Alaska*. In: T. Piersma (compiler). Global Flyway Network: progress report for 2008, 72–73.

MacTavish, B. 1993. American Birding Association. *Field Notes* 47(5).

MacTavish, B. 1995. American Birding Association. *Field Notes* 49(5).

Mawhinney, K., P.W. Hicklin and J.S. Boates. 1993. A Re-evaluation of the Numbers of Migrant Semipalmated Sandpipers, *Calidris pusilla*, in the Bay of Fundy during fall migration. *Canadian Field-Naturalist* 107: 19–23.

McKellar, A.E., R.K. Ross, R.I.G. Morrison, L.J. Niles, R.R. Porter, J. Burger, D.J. Newstead, A.D. Dey and P.A. Smith. 2015. Shorebird use of western Hudson Bay near the Nelson River during migration, with a focus on the Red Knot. *Wader Study* 122(3): 201–211.

Mendoza, L.F. and R. Carmona. 2013. Distribución espacial y temporal de aves playeras en Laguna San Ignacio, Baja California Sur, México. *Revista de Biología Tropical* 61:229–241. [In Spanish]

Morrison, R.I.G., R.W. Butler, G.W. Beyersbergen, H.L. Dickson, A. Bourget, P.W. Hicklin, J.P. Goossen, R.K. Ross and C.L. Gratto-Trevor. 1995. *Potential Western Hemisphere Shorebird Reserve Network Sites for Shorebirds in Canada.* Second Edition. Canadian Wildlife Service Technical Report Series No. 227. Canadian Wildlife Service, Ottawa.

Newstead, D.J., L.J. Niles., R.R. Porter,A.D. Dey, J. Burger and O.N. Fitzsimmons. 2013. Geolocation reveals mid-continent migratory routes and Texas wintering areas of Red Knots *Calidris canutus rufa*. *Wader Study Group Bulletin* 120(1): 53–59.

Niles, L. J., H. P. Sitters, A. D. Dey, N. Arce, P. W. Atkinson, V. Ayala-Pérez, A. J. Baker, J.B. Buchanan, R. Carmona, N. A. Clark, C. Espoz, J.D. Fraser, P. M. González, B. A. Harrington, D. E. Hernández, K. S. Kalasz, R. N. Matus, B.J. McCaffery, C. D. T. Minton, R. I. G. Morrison, M. K. Peck, W. Pitts, I. L. Serrano, and B. D.Watts. 2010. *Update to the Status of the Red Knot*

Calidris canutus in the Western Hemisphere. <www.nj.gov/dep/fgw/ensp/pdf/redknot_update4-10.pdf>.

Niles, L., H. Sitters, A. Dey and Red Knot Status Assessment Group. 2010. *Red Knot Conservation Plan for the Western Hemisphere (Calidris canutus), Version 1.1*. Manomet Center for Conservation Sciences, Manomet, Massachusetts, United States. <www.whsrn.org/sites/default/files/file/Red_Knot_Conservation_Plan_10_02-28_v1.1.pdf>.

Niles, L.J., J. Burger, R.R. Porter, A.D. Dey, C.D.T. Minton, P.M. Gonzalez, A.J. Baker, J.W. Fox and C. Gordon. 2010. First results using light level geolocators to track Red Knots in the Western Hemisphere show rapid and long intercontinental flights and new details of migration pathways. *Wader Study Group Bulletin* 117(2): 123–130.

Niles, L.J., J. Burger, R.R. Porter, A.D. Dey, S. Koch, B. Harrington, K. Iaquinto and M. Boarman. 2012. Migration pathways, migration speeds and non-breeding areas used by northern hemisphere wintering Red Knots *Calidris canutus* of the subspecies *rufa*. *Wader Study Group Bulletin* 119(2): 195–203.

Runge, C.A., J.E. Watson, S.H. Butchart, J.O. Hanson, H.P. Possingham and R.A.Fuller. 2015.Protected areas and global conservation of migratory birds. *Science* 350(6265): 1255–1258.

Schneider, T. and B. Winn. 2010. *Red Knot: Species Account in Georgia*. Georgia Wildlife. <www.georgiawildlife.com/sites/default/files/uploads/wildlife/nongame/pdf/accounts/birds/calidris_canutus.pdf>.

Smith F.M., B.D. Watts, J. E. Lyons, and T. S. Keyes. 2014. *Investigating Population Dynamics of Red Knot Migration along the Georgia Coast through Mark/Recapture Analysis of Resights*. Center for Conservation Biology Technical Report Series, CCBTR-14-03. College of William and Mary/Virginia Commonwealth University, Williamsburg, VA. <https://griffingroups.com/file/download/165020>.

Western Hemisphere Shorebird Reserve Network (WHSRN). 2006. WHSRN sites with Google Earth (kmz file). Western Hemisphere Shorebird Reserve Network, Manomet, Massachusetts. <www.whsrn.org/sites/list-sites>, accessed 7 January 2016.

Western Hemisphere Shorebird Reserve Network (WHSRN). 1987. WHSRN Site Profiles: Bay of Fundy. Western Hemisphere Shorebird Reserve Network, Manomet, Massachusetts. <www.whsrn.org/site-profile/bay-fundy>, accessed 16 February 2016.