ENVIRONMENT AND CLIMATE CHANGE CANADA'S CANADIAN WILDLIFE SERVICE, ROYAL ONTARIO MUSEUM, ONTARIO MINISTRY OF NATURAL RESOURCES, BIRD STUDIES CANADA, MOOSE CREE FIRST NATION AND TRENT UNIVERSITY.

James Bay Shorebird Project

2016 Report

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Winter 2017

Photo: Longridge Point

Report summarizing 2016 shorebird survey results from four camps on the western James Bay coast.

Land Acknowledgment

We would like to begin by acknowledging that the work carried out and reported upon here was in Treaty 9 territory and the land on which the study sites are located is the traditional territory of Mushkegowuk (Cree), Ojibwe/Chippewa, Oji-Cree, Algonquin, and Métis Peoples.

Introduction

The Hudson Bay Lowlands are the third largest wetland complex on earth and the coastal ecosystems of southwestern Hudson Bay and James Bay are a global hotspot for breeding and staging waterbirds, waterfowl, shorebirds and other migratory birds (Manning 1952, Ross *et al.* 2003, Abraham and Keddy 2005, Abraham and McKinnon 2011). For shorebirds, the Lowlands are known or believed to harbour significant proportions of the provincial breeding populations of Hudsonian Godwit (*Limosa haemastica*) and Whimbrel (*Numenius phaeopus hudsonicus*) (Manning 1952, Morrison 1987, Skeel and Mallory 1996, Peck and James 1983, Peck 2007, Peck and Sutherland 2007, Prevett 1987, Walker *et al.* 2011). Several Arctic and sub-Arctic breeding shorebird species stage along the Hudson Bay and James Bay coasts to add fat reserves and undertake partial moults (e.g., White-rumped Sandpiper (*Calidris fuscicollis*), Semipalmated Sandpiper (*C. pusilla*)) or complete moults (e.g., Dunlin (*C. alpina*)) in preparation for their migrations (Harrington *et al.* 1991, Parmelee 1992, Warnock and Gill 1996, Hicklin and Gratto-Trevor 2010, Abraham and McKinnon 2011).

Research on shorebirds throughout the Americas in the 1970s led to the establishment of the Western Hemisphere Shorebird Reserve Network (WHSRN) program in 1985 (Morrison 1983, 1984, Myers *et al.* 1987a, b). A site must meet two criteria to be considered for WHSRN designation: demonstrated importance to shorebirds and expressed landowner agreement. Three categories of WHSRN sites are recognised based on peak counts or use by a percentage of a population of a species: Sites of Hemispheric Importance hosting at least 500,000 shorebirds annually, or at least 30% of the biogeographic population for a species; Sites of International Importance hosting at least 100,000 shorebirds annually, or at least 10% of the biogeographic population for a species; and Sites of Regional Importance hosting at least 20,000 shorebirds annually, or at least 1% of the biogeographic population for a species (WHSRN 2009). Landowners must agree to the following three conditions: to make shorebird conservation a priority at the site; to protect and manage the site for shorebirds; and to update WHSRN annually about the status of the site (WHSRN 2009).

During the 1990s, Environment and Climate Change Canada's Canadian Wildlife Service (CWS) compiled an inventory of potential WHSRN sites along the coasts of both Hudson Bay and James Bay (Morrison *et al.* 1991, 1995, Ross *et al.* 2003). In 2016, the Moose Cree First Nation nominated a portion of the James Bay coast as a WHSRN site of Hemispheric importance.

The James Bay shorebird project (hereafter: the project) began when the Royal Ontario Museum (ROM) and the Ontario Ministry of Natural Resources (OMNR) partnered to survey birds at sites along the James Bay coast in 2009. Since then, CWS, ECCC's Wildlife and Landscape Science, Bird Studies Canada (BSC), Nature Canada, Moose Cree First Nation, and Trent University have joined this partnership to continue work on surveys of southbound staging shorebirds. This work initially included bird surveys at sites known to support staging shorebirds, with an emphasis on Red Knot (*C. canutus rufa*) to enable identification of critical habitat, as well as surveys for two species at risk, the Yellow Rail (*Coturnicops noveboracensis*) and Short-eared Owl (*Asio flammeus*). Additional work to collect natural heritage information by staff at the Natural Heritage Information Centre of the OMNR has been conducted in concert with more recent surveys. Currently, the project involves annual surveys of shorebirds staging at established survey sites along the southwestern coast of James Bay.

The overall intention of the James Bay work is to contribute the results to shorebird population assessments and conservation, Important Bird Area and WHSRN designations and protection, and

recovery and protection of the Endangered *rufa* Red Knot[1] and other declining shorebird species. The goals of the project are to:

- increase our ability to estimate population trends of shorebird species staging along the south-western James Bay coast;
- understand movement patterns of these birds and the causes of movements (local and flyway scale); and
- obtain information useful for updating the identification of important shorebird staging habitats, including potential designation as WHSRN sites based on recent research and traditional ecological knowledge.

The objectives to meet these goals are to estimate the:

- variability in shorebird migration phenology (both annually and among species);
- length of stay of staging shorebirds;
- annual variation in the abundance of staging shorebirds;
- habitat and food resource availability for staging shorebirds; and
- minimum proportion of the global Red Knot, subspecies *rufa*, population that uses the southwestern James Bay coast.

Four field camps operated on the southwestern coast of James Bay between 15 July and 9 September 2016: Longridge Point, Little Piskwamish Point, Little Piskwamish Point south, and Northbluff Point (see Figure 1). From these field camps, dedicated volunteers and staff counted shorebirds during their southbound migration. The timing of these counts was driven by the tide cycle, in that birds are more easily counted when they concentrate because of the flooding (incoming) and ebbing (outgoing) tides.

Motus Wildlife Tracking System

The Motus Wildlife Tracking System (Motus; http://motus.org/) comprises a network of coordinated automated radio telemetry towers that is designed to help track the movements of small organisms throughout terrestrial environments (Taylor *et al*. 2017). The purpose of Motus is to facilitate landscape-scale research and education on the ecology and conservation of migratory animals. It is a program of Bird Studies Canada (BSC) in partnership with Acadia University, Western University, the University of Guelph and all collaborating researchers and organizations.

As of September 2016, the array is comprised of over 320 automated VHF radio-receiving stations, positioned throughout the Western Hemisphere. A digital "nano-tag" tracking device is secured to an animal and the signal, specific to the individual tagged animal, can be detected in real-time up to 15 km away from any station. When combined, this array can enable tracking individual animals across a diversity of landscapes covering thousands of kilometres.

The data, which often comprises millions of individual records, are stored locally and at the centralized data management system at BSC's National Data Centre where data is filtered, archived, visualized, and disseminated. Researchers, decisions makers, non-government organizations, and the public can then query those data and examine the movements and behaviours of any individual, or group of individuals, being tracked. This state-of-the-art system is the first of its kind in the world and is open to all researchers and organizations.

[1] The Red Knot was listed as Endangered in Ontario in 2008 under the provincial Endangered Species Act *2007*; in 2007 COSEWIC designated the Red Knot as Endangered; and in 2012 the *rufa* subspecies was listed as Endangered, *roselaari* subspecies was listed as Threatened, and the islandica subspecies was listed as Special Concern under Schedule 1 of the federal *Species at Risk Act* (SARA).

Banding took place at three of the four 2016 James Bay sites, with the objective of affixing a total of 250 VHF radio tags (nanotags) to individuals of our target species: Semipalmated Plover, Least, Semipalmated and White-rumped sandpipers, Dunlin, Red Knot, and Hudsonian Godwit.

Study Areas

The Longridge Point camp (51.7989°N, 080.692°W) has been surveyed annually since 2009. It is located approximately 60 km northwest of Moosonee (Figure 1). The site is characterised by a prominent point that juts out into James Bay. Sheltered areas have formed on either side of the point, where fresh water tributaries flow out into the bay. These areas provide excellent roosting and feeding opportunities for migrant shorebirds. The gradient of the shoreline is very flat. The spruce forest is close to the high tide line, generally within 1 km, and opens to willow thickets and meadow marsh, eventually grading into brackish and saline tidal marshes. Based upon aerial surveys, and supported by ground surveys of this project, the area is known to host large concentrations of shorebirds (e.g., Semipalmated Sandpiper, Red Knot, and Pectoral Sandpiper) during autumn migration.

The Little Piskwamish Point camp (51.6834°N, 080.565°W) has been surveyed annually since 2011. It is located approximately 45 km northwest of Moosonee, and about 20 km southeast of Longridge Point (Figure 1). The habitat is similar to Longridge, except that there is no prominent point. Based upon aerial surveys, and supported by ground surveys of this project, the area is known to host large concentrations of shorebirds (e.g., Red Knots, Dunlin and White-rumped Sandpiper) during southern migration.

The Little Piskwamish Point south camp (51.5847°N, 080.538°W) is a new site, which was set up specifically to target Red Knot. It is located near Shegogau Creek, approximately 40 km northwest of Moosonee, and about 10 km south of Little Piskwamish Point (Figure 1). The habitat is similar to Little Piskwamish Point. This site was chosen because of the concentration of Red Knot near Shegogau Creek, making it a good location for focussing capture efforts.

The Northbluff Point camp (51.4879°N, 080.439°W) is the most southerly of the project's field camps surveyed in 2016 and has been surveyed in 2009, 2011, and 2014-2015. Like the other two sites, the shoreline gradient is very flat. An old airstrip, which had once serviced a commercial goose hunt camp, remains inland of this site. From the spruce tree line, willow thickets and meadow marsh eventually grade to brackish and saline tidal marshes. Based upon aerial surveys, and supported by ground surveys of this project, the area is known to host large concentrations of shorebirds (e.g., Semipalmated Sandpiper, White-rumped Sandpiper) during southern migration.

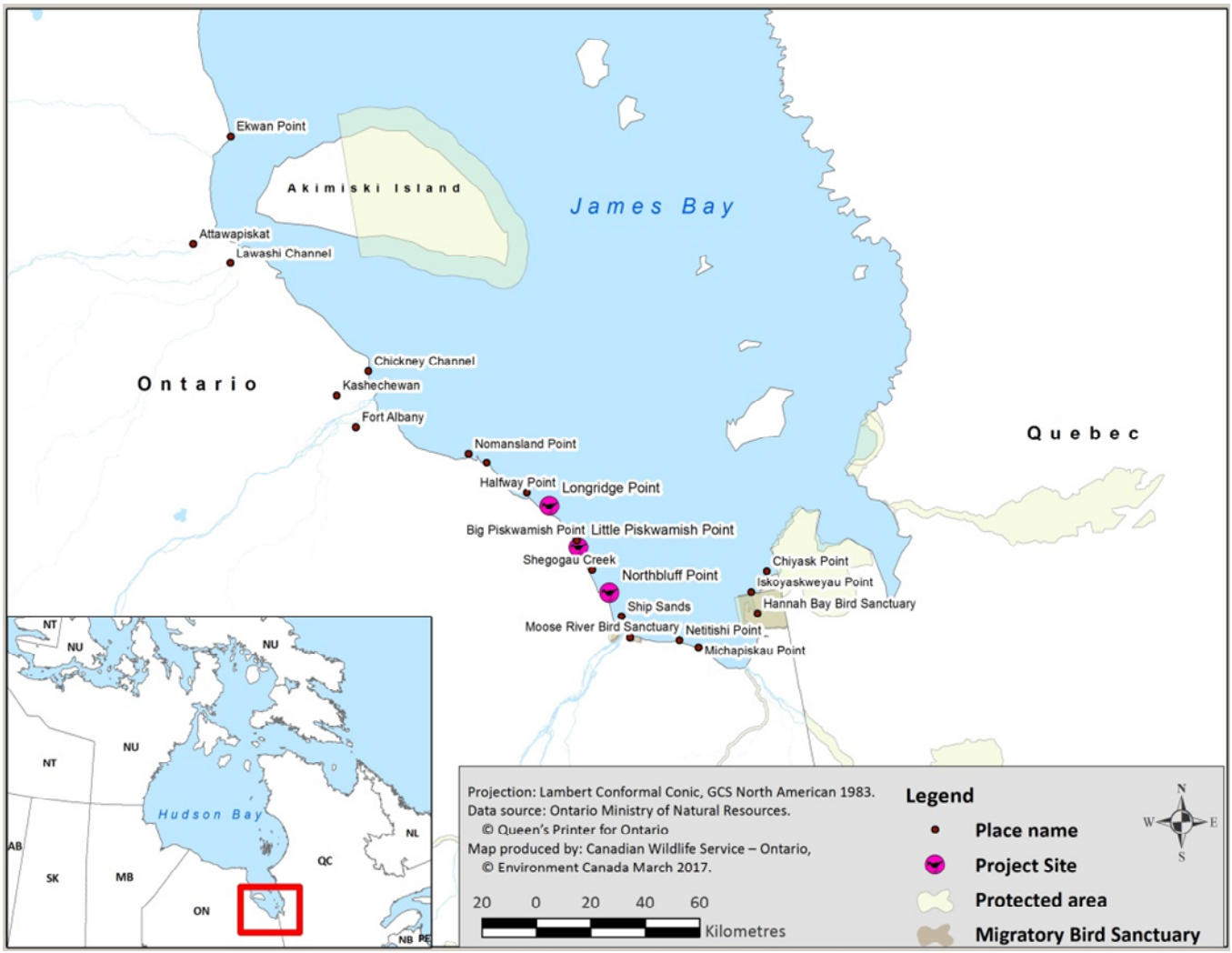
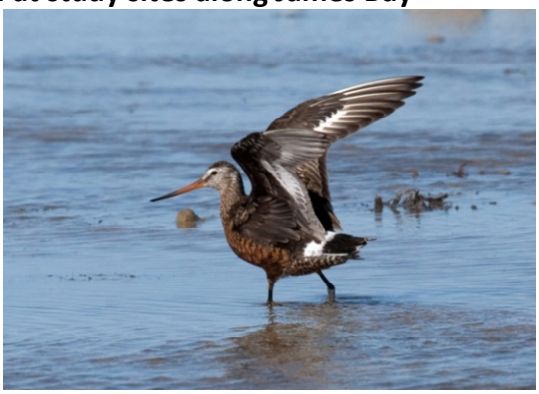


Figure 1. Field camp sites of the James Bay Shorebird Project, 2016. Note Little Piskwamish, South is located at Shegogau Creek between Little Piskwamish Point and Northbluff Point.

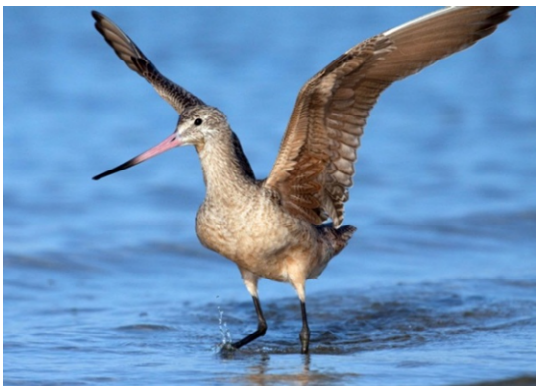
Images of the most commons species encountered at study sites along James Bay

Semipalmated Plover



Hudsonian Godwit

Greater Yellowlegs



Marbled Godwit

Lesser Yellowlegs

Ruddy Turnstone

Red Knot – with individual colour marked flag banded in Argentina

Least Sandpiper

Sanderling

White-rumped Sandpiper

Semipalmated Sandpiper

Pectoral Sandpiper

Dunlin

Results and Discussion

Longridge Point

A maximum of eight people were stationed at Longridge Point during the season. The camp was active from 15 July to 9 September 2016. The period focused on daily surveys to generate estimated totals for the area, passive banding, and banding target species to affix radio tags to these birds. In total, 423 birds were banded and 91 individuals of our target shorebird species were equipped with nanotags during the period. The radio tags sent signals to strategically placed towers notifying researchers of each bird's arrival and departure.

During this season at Longridge Point, a total of 448 hours was spent in the field, which is the second most amount of field time, after 2015, accumulated at this site. There were 174 bird species recorded during this time, which is the highest all-time species richness. After scaling to effort, however, Longridge Point 2016 results were less dramatically different (38.84 species/100 field hours; Table 9). Tables 1 and 2 show the top ten estimated single-day high counts of all bird species and shorebird species, respectively, encountered each month during the survey period. Notable records include an all-time high count for Semipalmated Plover (August); the lowest all-time September site count for Dunlin; the highest all-time site count for Least Sandpiper, peep, and Lesser Yellowlegs (August); the lowest all-time August count for White-rumped Sandpiper; the second all-time highest Pectoral Sandpiper count; and the second highest Canada Goose count for project. Longridge also recorded a number of rarities in 2017. The first Willet (23rd for Ontario's Central and Lowlands region), Franklin's Gull, and Harris' Sparrow records for the project, and the second Prairie Falcon record for the project (fourth for Ontario). The Prairie Falcon was also recorded in 2016 at Little Piskwamish, South.

Table 1. Top 10 estimated single-day high counts of all bird species encountered each month at Longridge Point, 15 July to 9 September 2016.

Common Name	July High Count
Semipalmated Sandpiper	1567
Red Knot	1337
Black Scoter	1000
White-rumped Sandpiper	955
Bonaparte's Gull	670
peep sp.	500
Hudsonian Godwit	368
Canada Goose	325
Ruddy Turnstone	240
Pectoral Sandpiper	210

Common Name	August High Count
peep sp.	10017
Canada Goose	5387
White-rumped Sandpiper	4225
Black Scoter	4006
Semipalmated Sandpiper	2614
Bonaparte's Gull	2049
Pectoral Sandpiper	1490
Red Knot	1269
Lesser Yellowlegs	776
Least Sandpiper	741

Table 1 (continued). Top 10 estimated single-day high counts of bird species encountered each month at Longridge Point, 15 July to 9 September 2016.

Common Name	September High Count
Canada Goose	1847
Black Scoter	984
Pectoral Sandpiper	935
Northern Pintail	879
White-rumped Sandpiper	854
Bonaparte's Gull	580
Red Knot	523
Semipalmated Sandpiper	515
peep sp.	500
Snow Goose	385

Table 2. Top 10 estimated single-day high counts of shorebird species encountered each month at Longridge Point, 15 July to 9 September 2016.

Common Name	July High Count
Semipalmated Sandpiper	1567
Red Knot	1337
White-rumped Sandpiper	955
peep sp.	500
Hudsonian Godwit	368
Ruddy Turnstone	240
Pectoral Sandpiper	210
Lesser Yellowlegs	146
Greater/Lesser Yellowlegs	123
Greater Yellowlegs	104

Common Name	August High Count
peep sp.	10017
White-rumped Sandpiper	4225
Semipalmated Sandpiper	2614
Pectoral Sandpiper	1490
Red Knot	1269
Lesser Yellowlegs	776
Least Sandpiper	741
Ruddy Turnstone	577
Semipalmated Plover	494
Hudsonian Godwit	388

Common Name	September High Count
Pectoral Sandpiper	935
White-rumped Sandpiper	854
Red Knot	523
Semipalmated Sandpiper	515
peep sp.	500
Dunlin	282
Hudsonian Godwit	203
Semipalmated Plover	199
Sanderling	167
Least Sandpiper	144

Little Piskwamish Point

A maximum of five people were stationed at Little Piskwamish Point. The camp was active from 15 July to 9 September 2016. During this period a total of 483 hours were spent in the field recording 147 bird species. This is 185 more hours ever spent in the field at this site, and the highest number of species recorded at this site all-time, despite being the lowest all-time species per 100 field hours (30.43, Table 9).

Tables 3 and 4 show the top ten estimated single-day high counts of bird species and shorebird species, respectively, encountered each month during the survey period. The highest all-time site count for Sanderling was recorded for both August and September. The highest all-time site count for Least Sandpiper and peep for August. Notably, the first Pileated Woodpecker for the project was recorded at Little Piskwamish in 2016.

Piskwamish represents the most important of our study sites for Red Knots.

Table 3. Top 10 estimated single-day high counts of bird species encountered each month at Little Piskwamish Point, 15 July to 9 September 2016.

Common Name	July High Count
Semipalmated Sandpiper	4500
Red Knot	3000
White-rumped Sandpiper	1102
Canada Goose	620
Mallard	450
Pectoral Sandpiper	360
Greater Yellowlegs	197
Hudsonian Godwit	165
Dunlin	150
Bonaparte's Gull	102

Common Name	August High Count
White-rumped Sandpiper	15621
Semipalmated Sandpiper	7739
Calidris sp.	5000
Northern Pintail	2090
peep sp.	1700
Red Knot	1341
Canada Goose	810
Least Sandpiper	757
Bonaparte's Gull	588
Dunlin	560

Common Name	September High Count
Canada Goose	3000
White-rumped Sandpiper	2222
Semipalmated Sandpiper	1726
Northern Pintail	1250
Dunlin	1033
Calidris sp.	500
Sanderling	388
American Black Duck	300
Green-winged Teal	300
Red Knot	205

Table 4. Top 10 estimated single-day high counts of shorebird species encountered each month at Little Piskwamish Point, 15 July to 9 September 2016.

Common Name	July High Count
Semipalmated Sandpiper	4500
Red Knot	3000
White-rumped Sandpiper	1102
Pectoral Sandpiper	360
Greater Yellowlegs	197
Hudsonian Godwit	165
Dunlin	150
Lesser Yellowlegs	78
Least Sandpiper	53
Semipalmated Plover	22

Common Name	August High Count
White-rumped Sandpiper	15621
Semipalmated Sandpiper	7739
Calidris sp.	5000
peep sp.	1700
Red Knot	1341
Least Sandpiper	757
Dunlin	560
Greater Yellowlegs	463
Sanderling	292
Hudsonian Godwit	274

Common Name	September High Count
White-rumped Sandpiper	2222
Semipalmated Sandpiper	1726
Dunlin	1033
Calidris sp.	500
Sanderling	388
Red Knot	205
Pectoral Sandpiper	177
Hudsonian Godwit	86
Greater Yellowlegs	80
Least Sandpiper	63

Little Piskwamish Point south

A maximum of five people were stationed at Little Piskwamish Point south. The period focused on daily surveys to generate estimated totals for the area, banding target species and affixing radio tags to these birds. The camp was active from 30 July to 12 August. During this period a total of 94.9 hours were spent in the field recording 90 bird species. This represents the eighth highest species per 100 field hours for the project (94.82, Table 9). In total, 289 birds were banded, and seven nanotags were attached to individual Red Knots.

Tables 5 and 6 show the top ten single-day estimated high counts of bird species and shorebird species, respectively, encountered each month during the survey period. This site had the highest all-time Red Knot count for the project. The second Prairie Falcon for the project (fourth for Ontario), was first recorded at Longridge Point before spending time at Little Piskwamish South.

This is the first season significant time was devoted to this location at Piskwamish, which represents the most important of our study sites for Red Knots.

Table 5. Top 10 estimated single-day high counts of bird species encountered each month at Little Piskwamish Point south, 30 July to 12 August. Note that only two days are included in the July records for this site.

Common Name	July High Count
Semipalmated Sandpiper	2000
Red Knot	1500
White-rumped Sandpiper	175
Red-winged Blackbird	90
Hudsonian Godwit	85
American Black Duck	54
Lesser Yellowlegs	40
Dunlin	30
Canada Goose	28
White-winged Crossbill	27

Common Name	August High Count
White-rumped Sandpiper	20000
Semipalmated Sandpiper	11000
Red Knot	6200
Canada Goose	900
Dunlin	900
Black Scoter	400
Hudsonian Godwit	300
Mallard	225
American Black Duck	160
Tree Swallow	130

Table 6. Top 10 estimated single-day high counts of shorebird species encountered each month at Little Piskwamish Point, 30 July to 12 August. Note that only two days are included in the July records for this site.

Common Name	July High Count
Semipalmated Sandpiper	2000
Red Knot	1500
White-rumped Sandpiper	175
Hudsonian Godwit	85
Lesser Yellowlegs	40
Dunlin	30
Least Sandpiper	16
Pectoral Sandpiper	16
Semipalmated Plover	4
Ruddy Turnstone	3

Common Name	August High Count
White-rumped Sandpiper	20000
Semipalmated Sandpiper	11000
Red Knot	6200
Dunlin	900
Hudsonian Godwit	300
Greater Yellowlegs	112
Lesser Yellowlegs	96
Least Sandpiper	85
Pectoral Sandpiper	60
Semipalmated Plover	39

Northbluff Point

A maximum of six people were stationed at Northbluff Point. The camp was active from 16 July to 9 September 2016. During this period, a total of 393.8 hours was spent in the field, which is the most amount of time spent in the field at this site all-time. However, when scaled for effort, this is not much different from previous years (36.83, Table 9). The period focused on daily surveys to generate estimated totals for the area, banding target species and affixing radio tags to these birds. There were 145 bird species observed during this time, which is the second most recorded at this site. In total, 299 birds were banded and 59 individuals of our target shorebird species were equipped with nanotags during the period.

Tables 7 and 8 show the top ten single-day estimated high counts of bird species and shorebird species, respectively, encountered each month during the survey period. August saw the highest all-time site counts for Ruddy Turnstone, Red Knot, and Pectoral Sandpiper at Northbluff. The lowest all-time September count for White-rumped Sandpiper. The first Northern Parula and Black-throated Green Warblers for the project were recorded in August (the Parula continued into September). Finally, some of the highest Northern Pintail counts and the highest all-time Green-winged Teal counts for the project were recorded in August and September.

Table 7. Top 10 estimated single-day high counts of bird species encountered each month at Northbluff Point, 16 July to 9 September 2016.

Common Name	July High Count
Semipalmated Sandpiper	2985
Canada Goose	2385
White-rumped Sandpiper	720
Lesser Yellowlegs	593
Calidris sp.	450
Hudsonian Godwit	449
Greater Yellowlegs	255
Mallard	249
Pectoral Sandpiper	194
Red-winged Blackbird	134

Common Name	August High Count
Semipalmated Sandpiper	20989
White-rumped Sandpiper	7399
Calidris sp.	6999
duck sp.	1800
Pectoral Sandpiper	1143
Green-winged Teal	1094
Canada Goose	1081
Red Knot	1015
Hudsonian Godwit	762
Northern Pintail	762

Common Name	September High Count
Canada Goose	3073
Northern Pintail	1349
Semipalmated Sandpiper	1301
Dunlin	1163
Pectoral Sandpiper	905
Snow Goose	619
Calidris sp.	571
Green-winged Teal	559
White-rumped Sandpiper	533
Mallard	332

Table 8. Top 10 estimated single-day high counts of shorebird species encountered each month at Northbluff Point, 16 July to 9 September 2016.

Common Name	July High Count
Semipalmated Sandpiper	2985
White-rumped Sandpiper	720
Lesser Yellowlegs	593
Calidris sp.	450
Hudsonian Godwit	449
Greater Yellowlegs	255
Pectoral Sandpiper	194
Least Sandpiper	102
Greater/Lesser Yellowlegs	100
Semipalmated Plover	100

Common Name	August High Count
Semipalmated Sandpiper	20989
White-rumped Sandpiper	7399
Calidris sp.	6999
Pectoral Sandpiper	1143
Red Knot	1015
Hudsonian Godwit	762
Semipalmated Plover	271
Greater Yellowlegs	248
Ruddy Turnstone	241
Lesser Yellowlegs	226

Table 8 (continued). Top 10 estimated single-day high counts of shorebird species encountered each month at Northbluff Point, 16 July to 9 September 2016.

Common Name	September High Count
Semipalmated Sandpiper	1301
Dunlin	1163
Pectoral Sandpiper	905
Calidris sp.	571
White-rumped Sandpiper	533
Black-bellied Plover	234
Greater Yellowlegs	209
Least Sandpiper	205
Sanderling	175
Hudsonian Godwit	171

Across all sites

The 2016 season had a number of highlights across all sites. The highest banding total for the project was achieved at 1,010, of which 157 nanotags were affixed to target shorebird species. There were a number of all-time high one-day counts (summed across sites), most notably Red Knot (Table 10). On the other side, all-time low one-day counts (summed across sites), notably Short-eared Owl and White-rumped Sandpiper (Table 11).

Motus towers, banding and tagging

In May 2016, seven temporary Motus towers were set-up at sites on the southwestern coast of James Bay (Figure 2). These autonomous VHF receivers detect and store records of individual nanotagged birds. Individuals tagged at the study sites and elsewhere (either on northbound migration or on the breeding grounds), while near the tower, are recorded on a regular interval depending on the duty cycle of the nanotag (e.g., every nine seconds). These towers operated from 17 May to 1 December. The tower at East Bay (furthest east tower; Figure 2) collapsed sometime in June and was not functional for the remainder of the season. Technical issues at the Northbluff Point tower limited its functionality throughout the season. Various attempts to avoid flooding and other technical issues have been pursued to date. For example, we have tried placing the battery and gnome above the flood line, repositioning the tower, plugging all holes entering the gnome and the action packer holding the battery and gnome. Some technical issues are difficult to avoid.

Banding and tagging activities were focussed at Longridge Point, Little Piskwamish Point, south, and Northbluff Point; no trapping and banding took place at Little Piskwamish Point. Shorebird trapping followed a non-standardized[2] approach using mist-nets, bow nets, whoosh nets and a box net; trapping was conducted both day and night and throughout the tidal cycle. Along with recording standard morphometrics (age, weight, exposed culmen, wing cord, flattened wing cord, fat score), each shorebird was marked with a uniquely coded alphanumeric leg flag, except some Semipalmated and Least sandpipers, and a uniquely coded USGS metal band.

[2] Non-standard banding means that although we followed standard banding procedures, we did not band at the same time or location each day, or with the same effort each trapping session. Standard banding is a term used by banding groups such as those in the Canadian Migration Monitoring network. This requires that banding stations keep nets in the same location year-to-year and operate them for specified periods each day the station is operational in a given season.

Table 9. Number of species, field hours, and species per 100 field hours at each site for years 2009 to 2016. The number of species per 100 field hours ranks locations.

Year	Location	Number of species	Field hours	Species per 100 field hours
2009	Ship Sands Islands	27	8.00	337.50
2009	Northbluff Point	55	32.00	171.88
2009	Missisicabi River	52	32.00	162.50
2009	South of Attawapiskat	40	32.00	125.00
2011	Little Piskwamish Point	124	108.00	114.81
2013	Little Piskwamish Point	137	131.00	104.58
2009	Longridge Point	109	112.00	97.32
2016	Little Piskwamish Point South	90	94.92	94.82
2012	Little Piskwamish Point	120	134.50	89.22
2009	Albany	41	48.00	85.42
2014	Northbluff Point	142	180.83	78.53
2012	Chickney Point	122	193.47	63.06
2013	Longridge Point	114	195.83	58.21
2014	Longridge Point	133	239.42	55.55
2011	Northbluff Point	113	215.50	52.44
2014	Little Piskwamish Point	139	293.83	47.31
2012	Longridge Point	165	359.80	45.86
2013	Hannah Bay--East Point	132	291.43	45.29
2015	Northbluff Point	161	384.67	41.85
2016	Longridge Point	174	448.00	38.84
2015	Little Piskwamish Point	115	298.00	38.59
2010	Longridge Point	147	396.00	37.12
2016	Northbluff Point	145	393.75	36.83
2011	Longridge Point	115	336.00	34.23
2015	Longridge Point	167	533.50	31.30
2016	Little Piskwamish Point	147	483.08	30.43

Table 10. All-time high single-day counts for all sites combined in 2016. Count represents the summed total of same-day counts across all sites.

Species	Count
American Black Duck	677
Northern Shoveler	59
Green-winged Teal	1,154
Common Goldeneye	423
Bald Eagle	10
Yellow Rail	24
Sora	16
Semipalmated Plover	654
Red Knot	6,677
Stilt Sandpiper	9
Sanderling	555
Buff-breasted Sandpiper	24
Pectoral Sandpiper	2,415
Solitary Sandpiper	15
Great-horned Owl	4
Boreal Owl	7
Olive-sided Flycatcher	9
Alder Flycatcher	22
Blue-headed Vireo	6
Common Raven	102
Horned Lark	218
Black-capped Chickadee	18
Boreal Chickadee	34
Red-breasted Nuthatch	23
Golden-crowned Kinglet	10
Ruby-crowned Kinglet	51
Bohemian Waxwing	15
Common Yellowthroat	15
Palm Warbler	109
Dark-eyed Junco	25
Rusty Blackbird	56
Pine Siskin	46

Table 11. All-time low one-day counts recorded for the project, summed across sites, 2016.

Species	Count
Common Merganser	4
American White Pelican	20
Great Blue Heron	1
Short-eared Owl	1
White-rumped Sandpiper	2,015
Caspian Tern	1
European Starling	5

Figure 2. Locations of the project's seven Motus towers, showing direction and relative coverage of antennas. Active 17 May to 1 December 2016.

Non-standard[3] mist-netting was conducted in a variety of habitats within each study site. Non-shorebird species were banded with a uniquely coded USGS metal band and standard morphometrics were recorded.

Nanotag efforts targeted seven shorebird species (Semipalmated Plover, Semipalmated Sandpiper, Least Sandpiper, White-rumped Sandpiper, Dunlin, Red Knot and Hudsonian Godwit). Species and age targets were established; there were no targets established for birds that were marked with a leg flag or a metal band only. Age and species targets for nanotags were revised during the season to account for changes in abundance of the target groups and to maximize data collection while birds were

[3] Non-standard banding means that although we followed standard banding procedures, we did not band at the same time or location each day, or with the same effort each trapping session. Standard banding is a term used by banding groups such as those in the Canadian Migration Monitoring network. This requires that banding stations keep nets in the same location year-to-year and operate them for specified periods each day the station is operational in a given season.

staging in the study areas. In addition to affixing a nanotag, marking with a leg flag and metal band and recording standard morphometrics, blood samples (up to 200µL) were taken. Blood sampling is primarily for determining correlates of length of stay, condition-related changes in fatty acids, DNA sex typing, and to establish diet through stable isotope analysis. In total, 157 nanotags were affixed to individuals of our target species (Table 12). Over 60% of the individuals tagged were hatch-year birds.

Movement of tagged birds through the Motus network is shown in figures 3 to 7. Red Knot and Pectoral Sandpiper appear to have departed James Bay for the Eastern Seaboard. From here, those birds were detected flying through the Caribbean to South American non-breeding grounds. The veracity of detections in Columbia is questionable. Some tag frequencies are more prone to false detections at towers located in areas with high radio-frequency activity. Interestingly, one individual Red Knot appears to have wintered in Texas. Ruddy Turnstone and Least Sandpiper were last detected on the Eastern Seaboard. The detection of a Least Sandpiper in Chile is questionable. Finally, tagged Lesser Yellowlegs primarily flew from James Bay to Atlantic Canada.

Table 12. Species and ages of shorebirds banded and affixed with a nanotags across all sites, 2016.

Species	Age	Count
LESA	HY	33
LEYE	HY	8
PESA	AHY	3
PESA	HY	12
REKN	AHY	8
REKN	HY	1
RNPH	HY	1
RUTU	AHY	1
RUTU	ASY	1
RUTU	HY	2
SEPL	AHY	1
SEPL	ASY	4
SEPL	HY	16
SEPL	SY	3
SESA	AHY	9
SESA	ASY	1
SESA	HY	26
WRSA	AHY	25
WRSA	ASY	1
WRSA	HY	1
Total		**157**

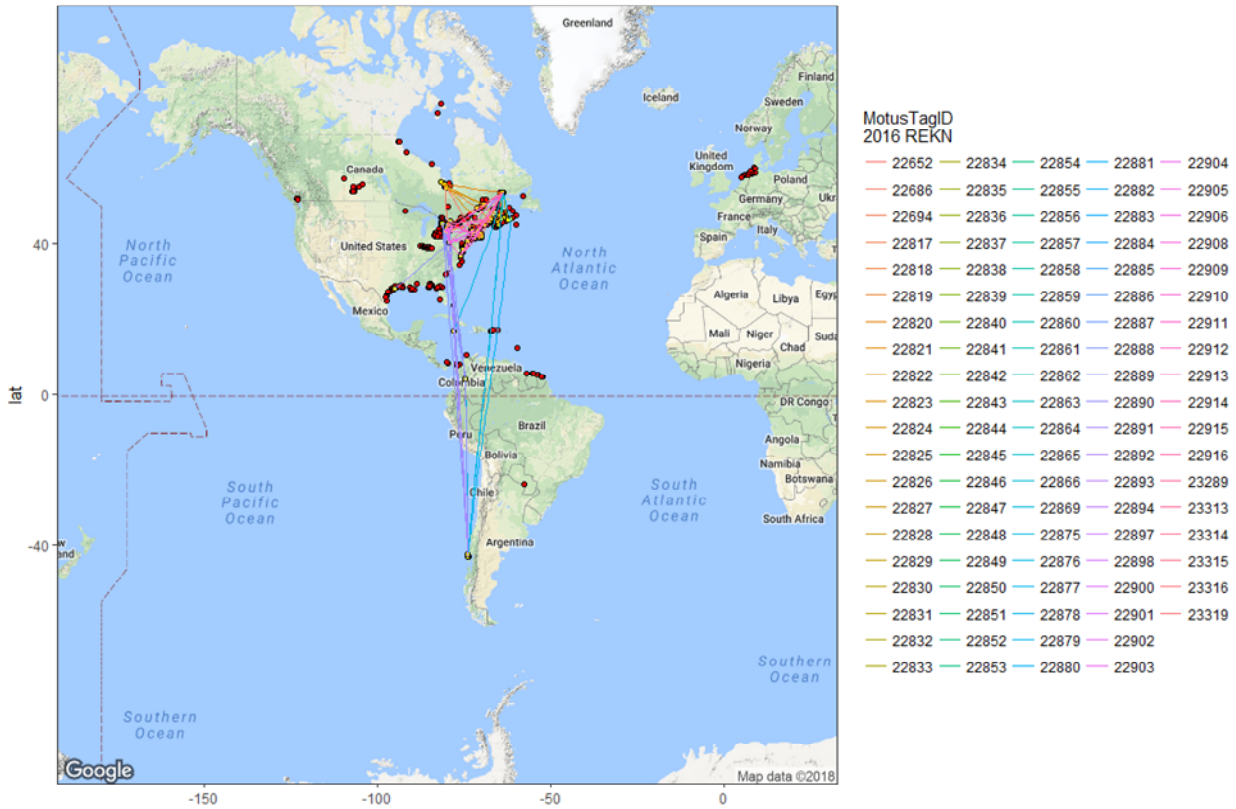


Figure 3. Movement of individually nanotagged Red Knot across the Motus Network, 2016. Red dots represent active towers in the network; yellow dots represent towers where individual tags were detected.

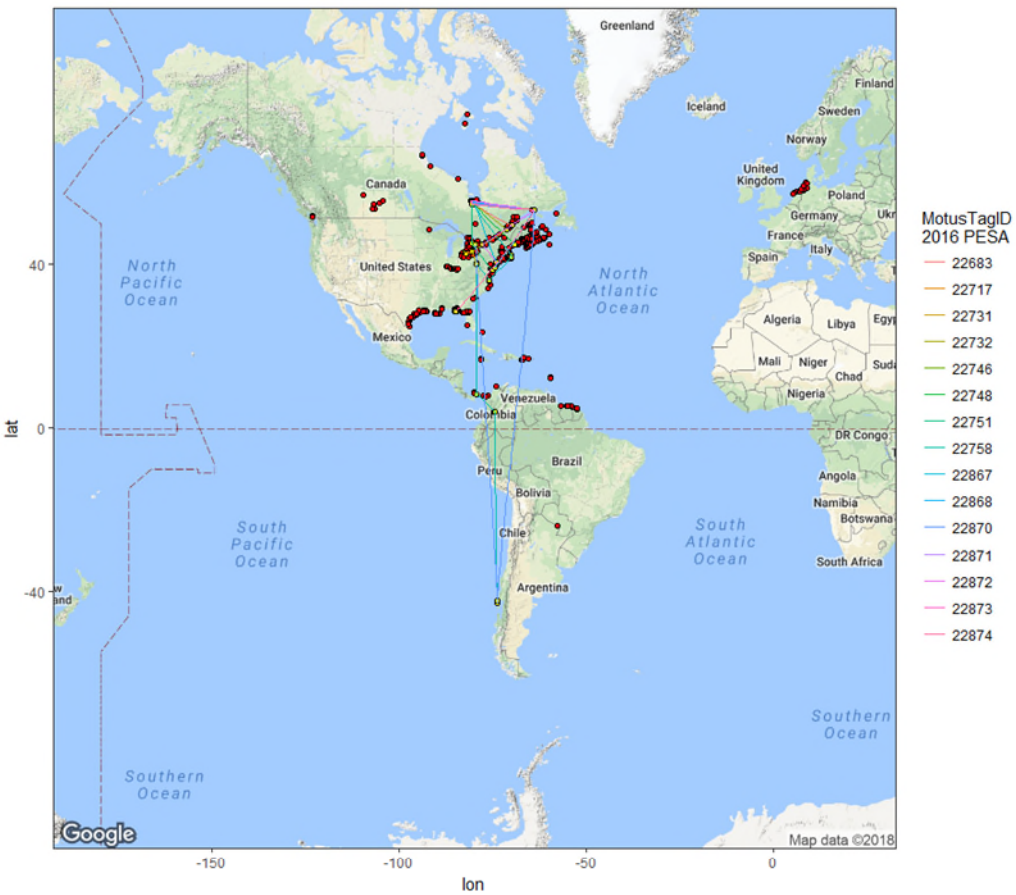


Figure 4. Movement of individually nanotagged Pectoral Sandpiper across the Motus Network, 2016. Red dots represent active towers in the network; yellow dots represent towers where individual tags were detected.

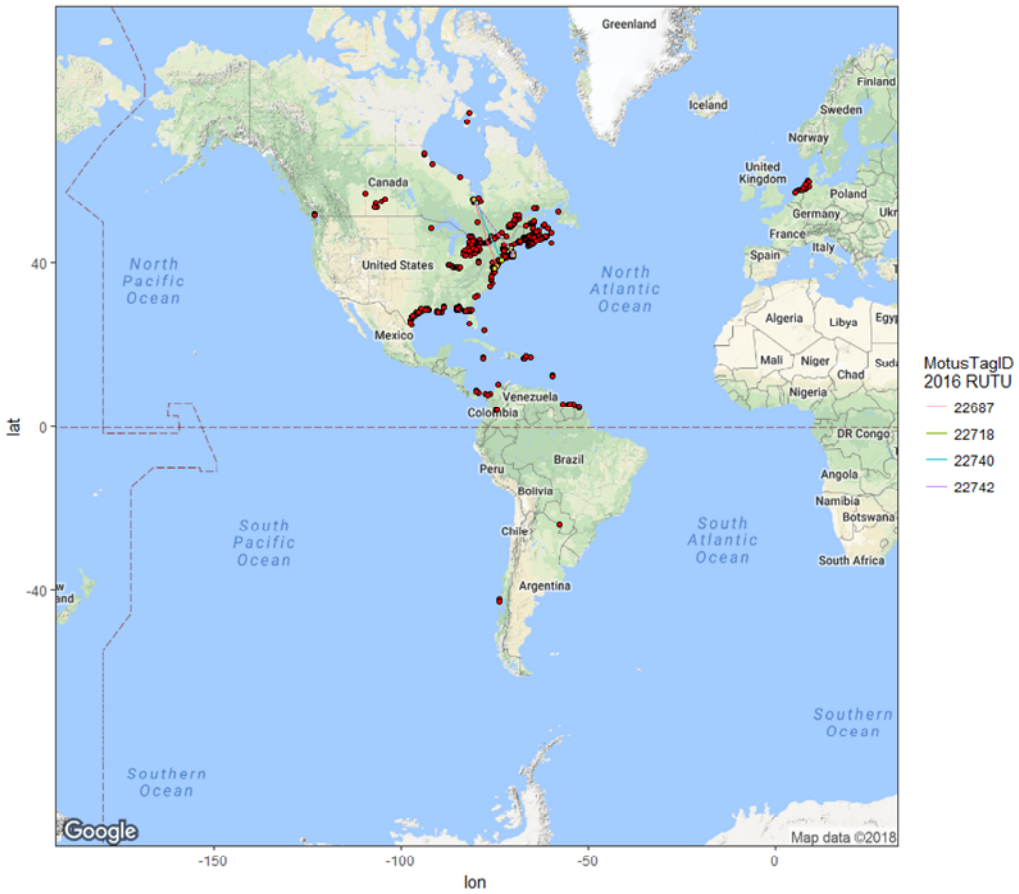


Figure 5. Movement of individually nanotagged Ruddy Turnstone across the Motus Network, 2016. Red dots represent active towers in the network; yellow dots represent towers where individual tags were detected.

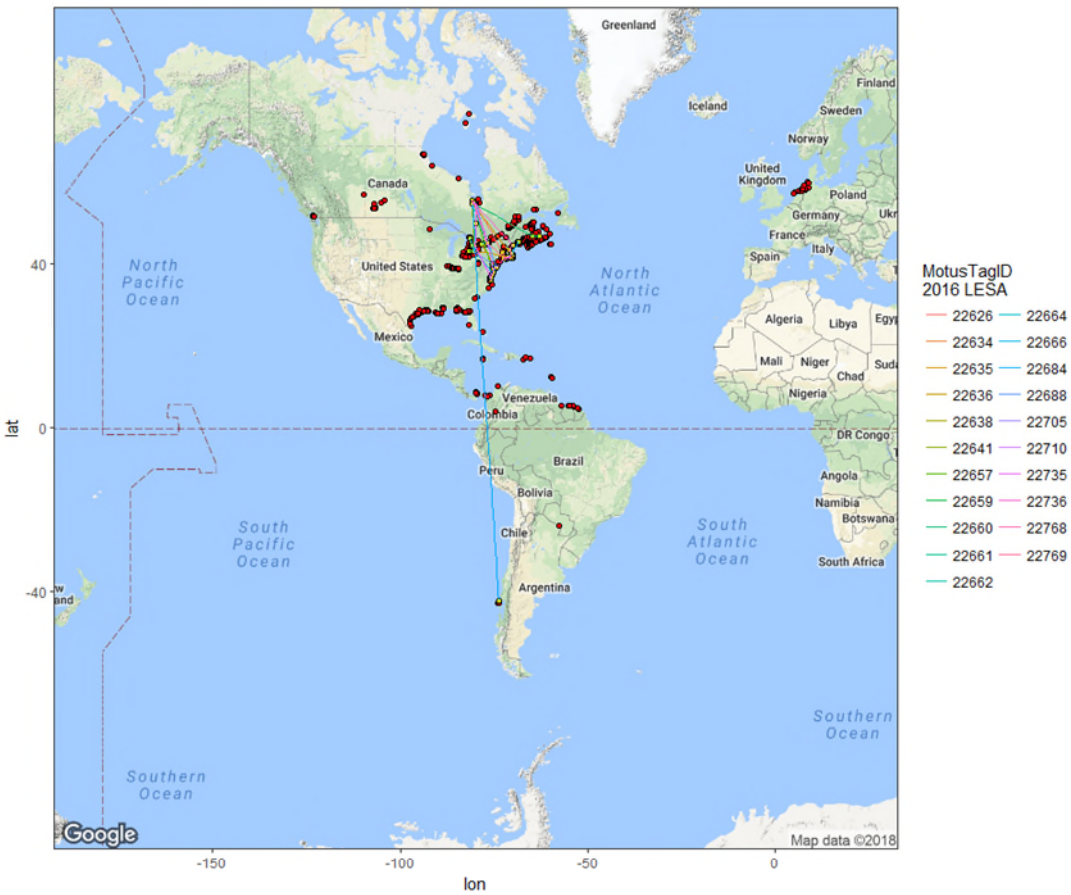


Figure 6. Movement of individually nanotagged Least Sandpiper across the Motus Network, 2016. Red dots represent active towers in the network; yellow dots represent towers where individual tags were detected.

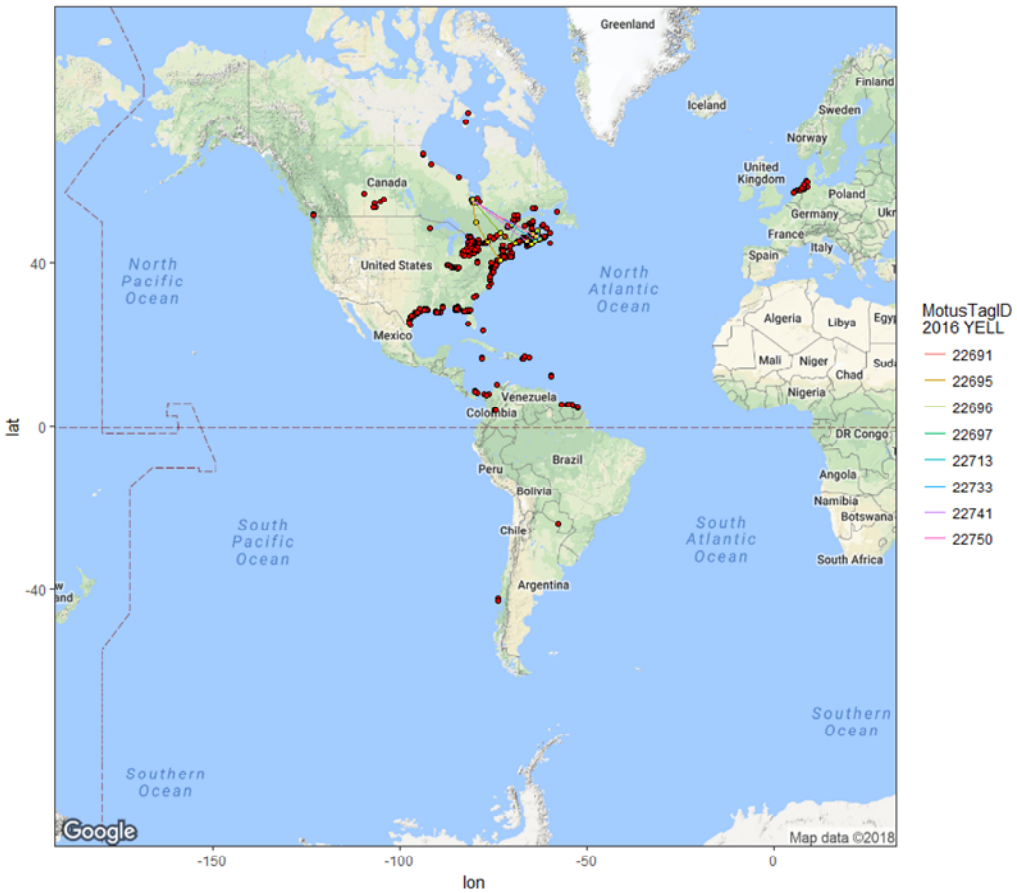


Figure 7. Movement of individually nanotagged Lesser Yellowlegs across the Motus Network, 2016. Red dots represent active towers in the network; yellow dots represent towers where individual tags were detected.

Other banding activities at each site resulted in trapping and banding of local breeding individuals and their young and migrant passerines. Together with the shorebird trapping effort, 1,010 individuals of 20 species were banded. Close to 90% of the individuals banded were shorebird species, accounting for 60% of the species banded (Table 13).

Table 13. Species and ages of birds banded across all sites, 2016.

Species (four-letter code)	Age	Count
AMGP	HY	1
AMPI	HY	1
BASA	HY	1
DUNL	AHY	1
DUNL	HY	5
LESA	AHY	2
LESA	HY	130
LEYE	HY	9
NESP	AHY	1
PESA	AHY	3
PESA	HY	19
REKN	AHY	9
REKN	HY	1
RNPH	HY	1
RUBL	HY	8
RUTU	AHY	2
RUTU	ASY	1
RUTU	HY	3
RWBL	HY	1
SAVS	AHY	3
SAVS	HY	90
SEPL	AHY	1
SEPL	ASY	5
SEPL	HY	41
SEPL	SY	4
SESA	AHY	110
SESA	ASY	1
SESA	HY	482
WPWA	HY	2
WRSA	AHY	66
WRSA	ASY	1
WRSA	HY	1
WWCR	AHY	2
WWCR	SY	1
YEWA	HY	1
Total		**1,010**

Aerial Survey

Guy Morrison and Ken Ross conducted surveys by helicopter between 9 and 12 August 2016. They flew an OMNRF Eurocopter A Star 350 B2 covering the coast from the Quebec border in the east up to Ekwan Point to the northwest, including Akimiski Island (Figure 10). General identification to size category (small, medium, and large shorebird) were made. Where species are readily identified, such as Red Knot and Hudsonian Godwit, these individuals were recorded to species. Results are presented in Figures 8 and 9. Significant concentrations of shorebirds were noted between Northbluff Point and Little Piskwamish Point (sector 7), around Chickney Channel (sector 14; the highest concentration at over 40,000 individuals), and the south shore of Akimiski Island (sector 21). Total counts across the entire survey area of over 10,000 individuals we made for Red Knot, Hudsonian Godwit, and small Calidrids.

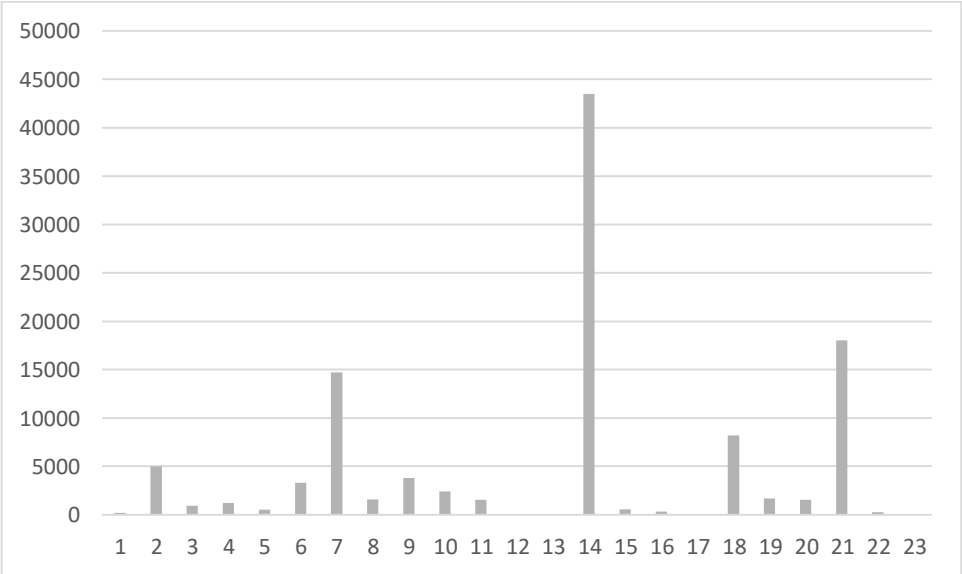
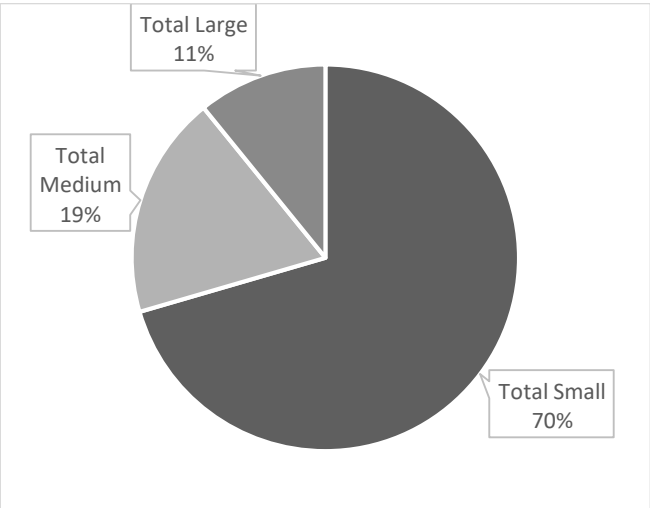


Figure 8. Total shorebirds recorded at each sector during the James Bay coastal aerial survey from the Quebec border in the east to Ekwan Point in the northwest, including Akimiski Island 9-12 August 2016.



Size category	Species
Small	Spotted Sandpiper
Small	Sanderling
Small	Peep
Medium	Black-bellied Plover
Medium	Ruddy Turnstone
Medium	Unknown yellowlegs species
Medium	Lesser Yellowlegs
Medium	Greater Yellowlegs
Medium	Red Knot
Medium	Unknowndowitcher species
Large	Whimbrel
Large	Hudsonian Godwit
Large	Marbled Godwit

Figure 9. Proportion of each shorebird size category recorded during the aerial survey, 2016. Table shows the species size-category assignments.

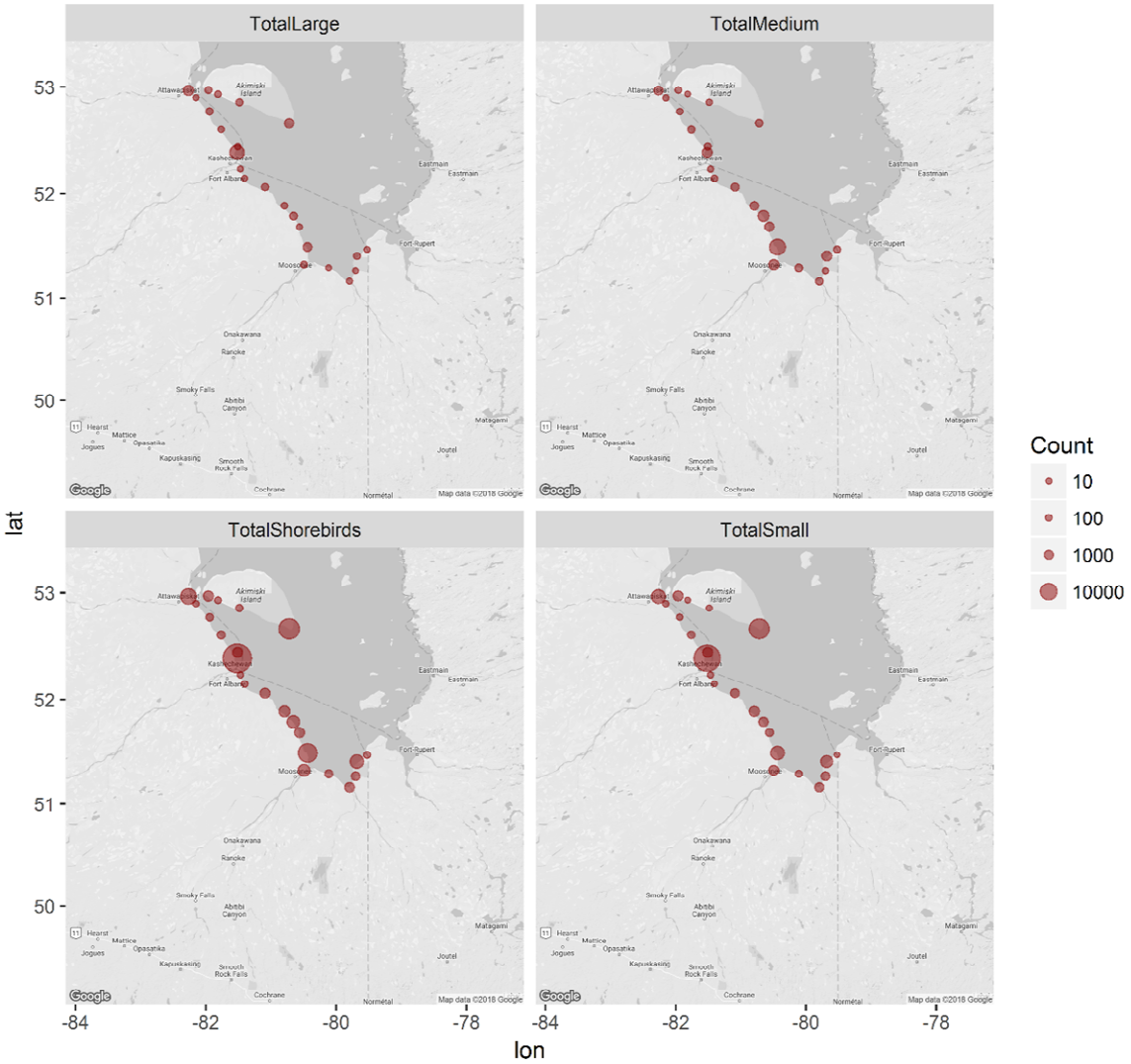


Figure 10. Counts and concentrations of size groupings of shorebird species, including sum total (TotalShorebirds) of all individual recorded during the aerial survey 9-12 August 2016.

Nanotagged individuals were tracked during the aerial survey (Figure 11). Concentrations of tags between Longridge Point and Northbluff Point are a result of the banding and tagging efforts there. Most tags detected outside of this region of the coast were of birds tagged elsewhere.

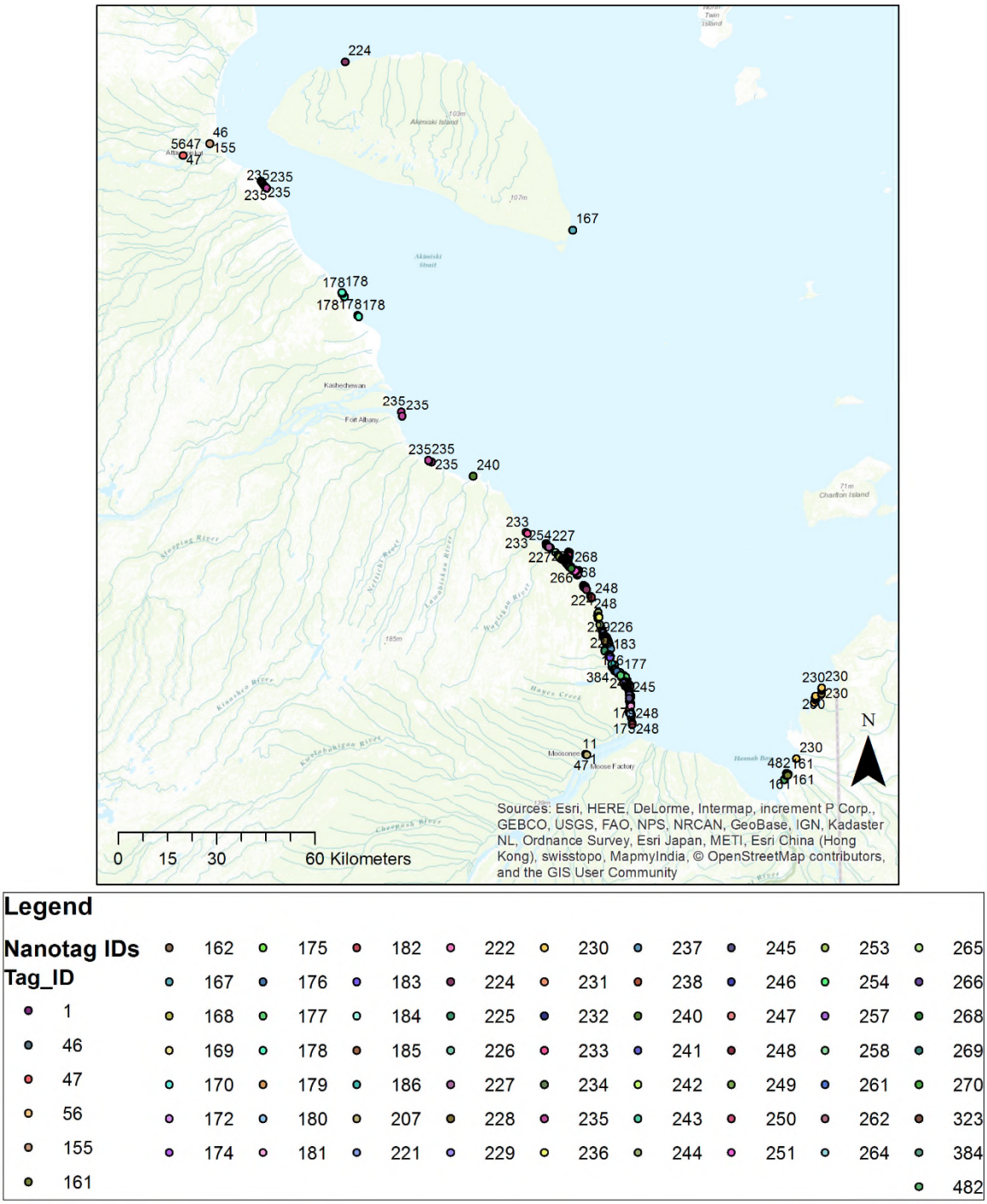


Figure 11. Detections of nanotagged individuals during the aerial survey, 9-12 August 2016. Figure courtesy of Allie Anderson, Trent University.

Advances in methodology

The project began using a double-observer, segment-survey technique in 2016 to inform detectability and sampling error and to improve species density estimation. Each day, counts of all shorebirds occurred between designated segments of the study area and occurred within 2.5 hours of high tide. Segments ran parallel to the coastline and were 500 metres long. Start- and end-points were programmed into a hand-held GPS unit and boundaries were marked out at the beginning of the season.

A team of no less than two crewmembers, walked a transect in a linear fashion, allowing for some weaving to spot birds from the vegetation line to the tide line. Using dependent double observer counts, each day's survey had a designated primary observer and secondary observer/data recorder. The secondary observer acted as the data recorder. The primary observer made their count independently and called the information out to the secondary observer/recorder. The secondary observer reported any individuals the primary observer missed, but did not count flocks the primary observer counted. Each observation is attributed to either the primary or the secondary observer. These counts include separate counts for adults and juveniles for each segment. When flocks were too big to get a good estimate of age proportions, surveyors took a random sub-sample of 50 birds to get the age proportions. Flock behaviour is noted for each observation, based on three broad categories—feeding, loafing, and flying. The behaviour noted reflects what more than 50% of the flock is doing at the time of observation. In addition, weather conditions are collected at the beginning of the survey. If weather conditions change significantly during surveying, conditions are recorded again. Results of the surveys will allow us to better estimate passage populations of shorebirds using James Bay.

Future Workplans

With sufficient resources and pending the outcomes of various analyses, we plan to allocate effort to addressing each of the project's objectives over the coming years. To address the objectives of estimating variation in migration phenology and in the abundance of staging shorebirds, we will continue daily monitoring of shorebirds on the ground. In addition, we will conduct aerial surveys following standardized methodology used in previous aerial surveys of the James Bay coast. To address the objective of estimating the availability of staging habitat and food resources, we will continue invertebrate sampling and collecting tissue and fecal samples to understand the availability of key food resources for staging shorebirds. To address the objectives of estimating the length of stay of staging and the value of southern James Bay to the global Red Knot, subspecies *rufa*, population, we will increase our daily effort for flag resighting. In addition, we will continue to trap and attach nanotags to shorebirds at study sites, and continuing deployment of temporary Motus towers at various sites along the coast that will be used to detect nanotagged shorebirds. This project will continue to contribute to the larger Motus network. More information is available at motus.org.

Finally, analyses are underway to understand how best to approach annual surveys of staging shorebirds at sites along the western James Bay coast. Part of this work entails drafting a sampling plan, with a goal for completion of winter 2019. In the meantime, surveys either will continue in an effort to maintain annual coverage at core sites, such as Longridge Point, while gaining new or updated information from other survey locations that are new to the project or where surveyed historically.

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