



Marsh Bird Monitoring Summary Report

Voyageurs National Park

Natural Resource Report NPS/VOYA/NRR—2018/1640



ON THE COVER

A red-necked grebe on Kabetogama Lake, Voyageurs National Park, Minnesota.
NPS photo.

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Abstract

Secretive marsh birds were surveyed within Voyageurs National Park in 2017 to inform hybrid cattail (*Typha x glauca*) removal and wetland restoration efforts within the park. Sixty-two points distributed in wetlands throughout Rainy Lake and the Namakan Reservoir were surveyed three times. We followed the Standardized North American Marsh Bird Monitoring Protocol which includes both passive listening and playback calls. Nine focal species, including American bittern (*Botaurus lentiginosus*), American coot (*Fulica americana*), black tern (*Chlidonias niger*), least bittern (*Ixobrychus exilis*), pied-billed grebe (*Podilymbus podiceps*), red-necked grebe (*Podiceps grisegena*), sora (*Porzana carolina*), Virginia rail (*Rallus limicola*), and yellow rail (*Coturnicops noveboracensis*) were the focus of the surveys. All of the focal species except for the American coot were observed during the surveys. The most commonly observed focal species were American bittern with 63 observations, red-necked grebe with 52 observations, and Virginia rail with 39 observations. Black terns, red-necked grebes, and pied-billed grebes were observed on the Namakan Reservoir, while yellow rails were only found on Rainy Lake. Yellow rails and least bitterns were each observed seven times, suggesting they are regular summer residents of the park. Future surveys will be essential to determine any local population trends for individual marsh bird species within the park, and to document how these species respond to wetland restoration.

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Introduction

Secretive marsh bird species can serve as indicators of wetland health. They can also signal the success of wetland restoration or the detrimental effects of invasive plants (Lewis and Casagrande 1997, Gibbs et al. 1992, Meanley 1992, Nadeau et al. 2011). Any alteration to water levels, salinity, invertebrate populations, or the amount of emergent plant cover within marsh habitats could impact marsh bird breeding success (Conway 2011, Conway et al. 1993, Conway 1995, Conway et al. 2010, Nadeau et al. 2011). Marsh bird populations also tend to be understudied and under-monitored in most systems, primarily due to sampling challenges. Traditional broad-scale avian monitoring techniques often misrepresent marsh bird population trends because the birds frequently reside in habitats difficult to sample, are secretive, and can be naturally rare (see Ribic et al. 1999).

Understanding the need for marsh bird-specific data, participants at the 2011 National Marsh Bird Workshop endorsed moving away from a general North American Breeding Bird Survey-type monitoring program towards management-based monitoring of marsh birds (Seamans et al. 2013). That same year, a standardized protocol specifically for surveying marsh birds was developed by Conway (2011). Following the decision to move towards management-based monitoring, the Midwest Marsh Bird Monitoring Working Group began identifying questions related to management and marsh birds (Hill 2017). The following are included among the questions: Does controlling invasive wetland plants increase marsh bird use as compared to uncontrolled sample points? What control techniques or environmental conditions maximize use by marsh birds?

The populations of several marsh bird species appear to be in decline within much of Minnesota, even as their populations are stable or increasing in other parts of the country (Pfannmuller et al. 2017). Among those species with downward trends are the American bittern (*Botaurus lentiginosus*), black tern (*Chlidonias niger*), sora (*Porzana carolina*), pied-billed grebe (*Podilymbus gigas*), and American coot (*Fulica americana*). American bittern, black tern, yellow rail (*Coturnicops noveboracensis*), least bittern (*Ixobrychus exilis*), red-necked grebe (*Podiceps grisegena*), and Virginia rail (*Rallus limicola*) are all considered Species in Greatest Conservation Need in Minnesota (MN DNR 2016). The yellow rail is also a Species of Particular Concern and is among the 20 species on the national watch list for the National Audubon Society (2007). The North American Bird Conservation Initiative (2014) designated the black tern as a Common Bird in Steep Decline. However, as surveys suited specifically to marsh birds have only been implemented widely in recent years, population estimates of most marsh bird species are just that: estimates. The apparent decline in numbers highlights the importance of state-wide monitoring of wetland bird species.

An inventory of marsh bird species within Voyageurs National Park (VOYA) was last undertaken in 2012 as part of an International Joint Commission (IJC) review of water-level management (Malick and Windels 2015). Seven of nine focal species were detected, with red-necked grebes, American bitterns, and pied-billed grebes being the most prevalent. American coots and yellow rails were not detected during the surveys, though a single yellow rail was observed outside of the survey time. Including the out-of-survey observation, this inventory represents the first detections of least bitterns and yellow rails in VOYA since the park was established in 1975. However, the 2012 survey had

relatively few survey points, with 32 distributed over three lakes. Additionally, Conway (2015) recommends marsh bird surveys in northern Minnesota begin between 15 May and 1 June. The 2012 surveys began on 11 June, so prime detection opportunities may have been missed.

Over the last several decades, non-native cattail (particularly hybrid cattail *Typha x glauca*) invasions within the wetlands of VOYA have increased dramatically, reflected by a sharp decline in vegetation diversity. Along with displacing native vegetation, hybrid cattails degrade habitat for fish and wildlife, affect recreational opportunities, and negatively affect wild rice (*Zizania palustris*), a plant of cultural significance. Similar invasions in the surrounding region have led to an increase in cattail removal and wetland restoration efforts (Svedarsky et al. 2016). Further, the National Park Service mandates the control of non-native species and restoration of disturbed systems (National Park Service 2006). This has prompted VOYA staff to secure funding to remove non-native cattails and restore the wetlands damaged by invasive cattails.

In 2016, VOYA received funding to begin a cattail removal and wetland restoration effort. Marsh birds were identified as one indicator of wetland biodiversity, along with wetland vegetation, crayfish, and furbearers. The marsh bird survey initiated in 2017 will provide feedback on the cattail removal effects on the VOYA wetland ecosystem. It also establishes a baseline, standard methods, and designated survey points for subsequent marsh bird surveys and monitoring. With widespread cattail removal set to begin in 2018, the other biological indicators will also be monitored before and after cattail removal to understand how cattail treatment affects biodiversity and other wetland characteristics.

Methods

Sixty-two points were surveyed for the 2017 marsh bird species inventory (27 points on Kabetogama Lake, 3 points on Sand Point Lake, and 32 points on Rainy Lake), including 25 points revisited from the 2012 surveys (Malick and Windels 2015) (Figure 1a–1d; Appendix A). Selection of sampling points in 2017 adhered to the methods established during the 2012 surveys. The USGS vegetation map layer (Faber-Langendoen et al. 2007) was used in ArcMap 10.4 to identify wetlands within Voyageurs National Park with $\geq 50\%$ emergent vegetation adjacent to the large lakes. Random points were selected within these wetlands along with alternates if ground reconnaissance determined other points to be unusable. To minimize double counting individual birds during the survey, a minimum distance of 400 meters was established between survey points, whether original stations from 2012, or the new points established in 2017 (per Conway 2015).

Survey methodology followed the multiple observer survey as described by Conway (2015) (also see Nichols et al. 2000, Nadeau et al. 2008). Surveys were conducted from 22 May through 28 June 2017. In that time, three survey rounds were completed at each site. Each round took place within a two-week period. Two observers conducted independent surveys simultaneously. Immediately following the survey, the two observers discussed and noted any discrepancies but did not alter the original data. The timing and location of individual birds was used to determine the maximum number of birds at the survey site for each survey. In the initial survey at each site, observers played pre-recorded bird calls focused toward the center of the wetland so as to cover the maximum area of wetland. Observations during subsequent survey rounds were made at the same location and orientation. Survey points were established in one of two environments: situated along the shoreline where the site was accessed by boat, or deeper in the wetland requiring observers to carry equipment into the site.

Surveys began 30 minutes before sunrise and concluded within 3 hours after sunrise. All observed bird species were recorded at each site, but primary focus was limited to nine species: yellow rail, American bittern, least bittern, sora, Virginia rail, American coot, pied-billed grebe, red-necked grebe, and black tern. Upon arrival at each survey site, observers recorded weather data including temperature, cloud cover, and wind speed and direction. A GPS point was also recorded. A five-minute passive listening period was followed by a six-minute playback period, during which pre-recorded marsh bird calls were broadcast from a Foxpro brand digital game call speaker. The sequence of calls played was least bittern, yellow rail, sora, Virginia rail, American bittern, and pied-billed grebe. The number of individuals of any of the focal species, direction, type of call, and any other pertinent notes were recorded, including estimates of any of the above. Secondary species were also recorded. See Appendix B for a sample datasheet.

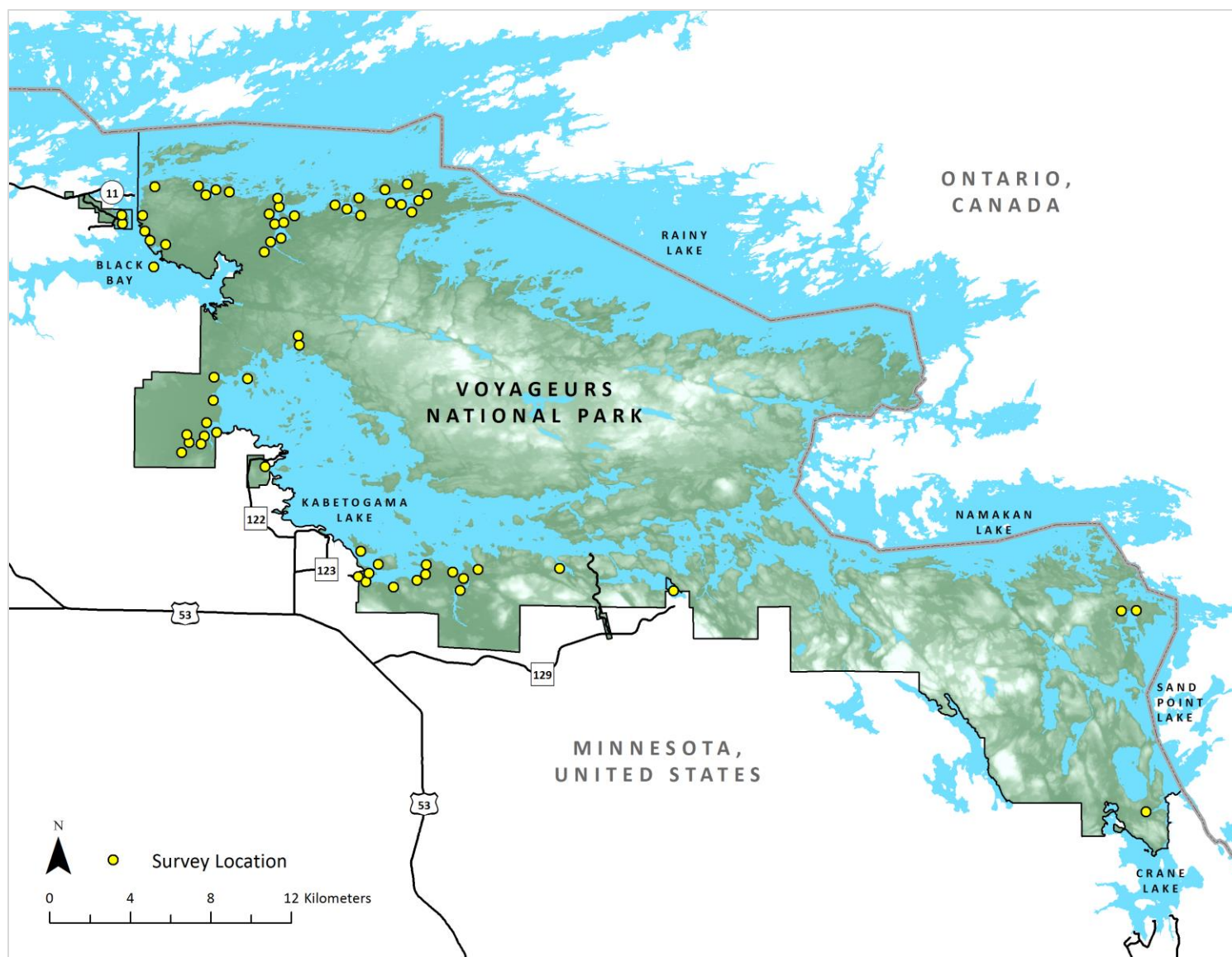


Figure 1a. Marsh bird survey points, Voyageurs National Park, 2017.

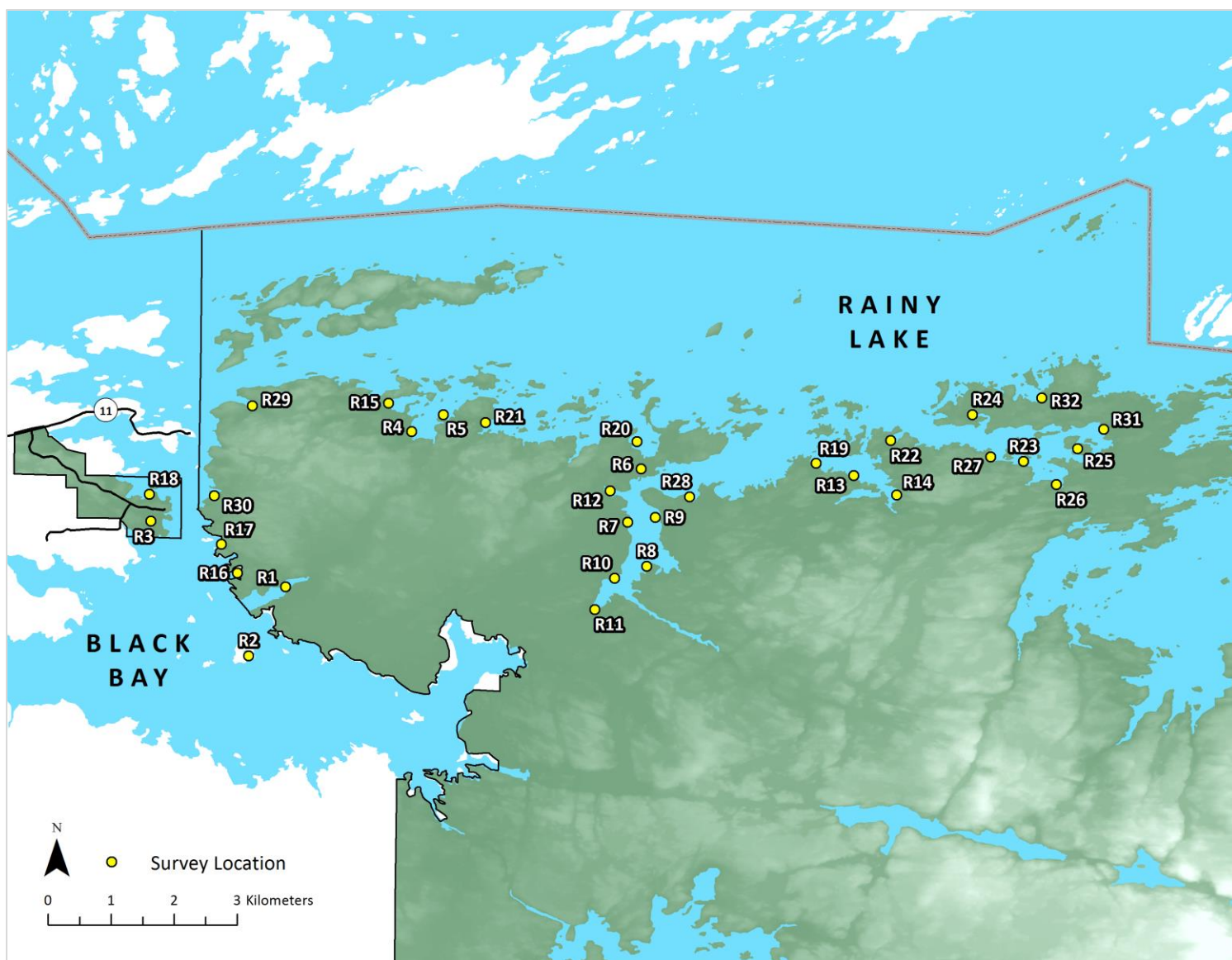


Figure 1b. Rainy Lake marsh bird survey points, 2017.

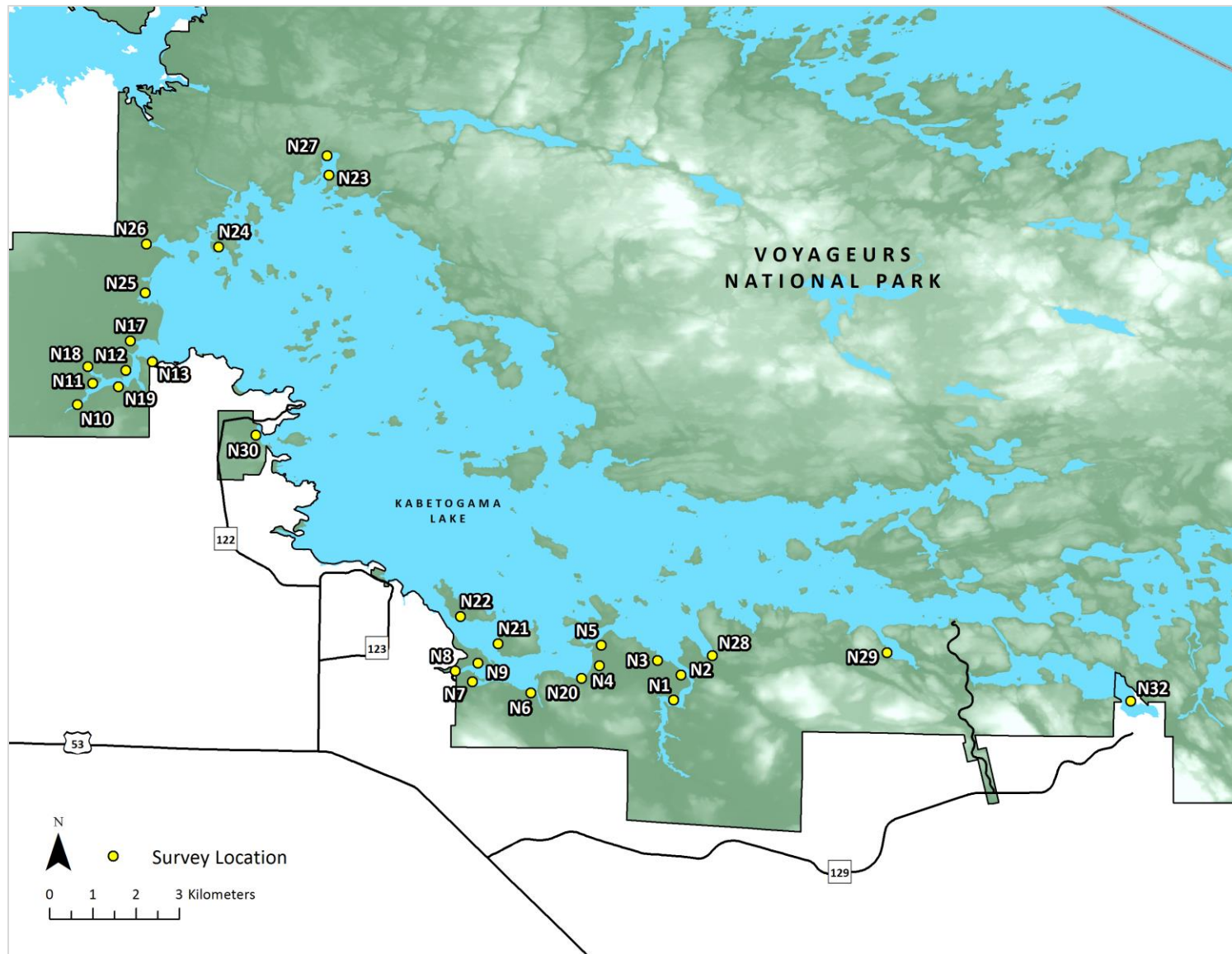


Figure 1c. Kabetogama Lake marsh bird survey points, 2017.

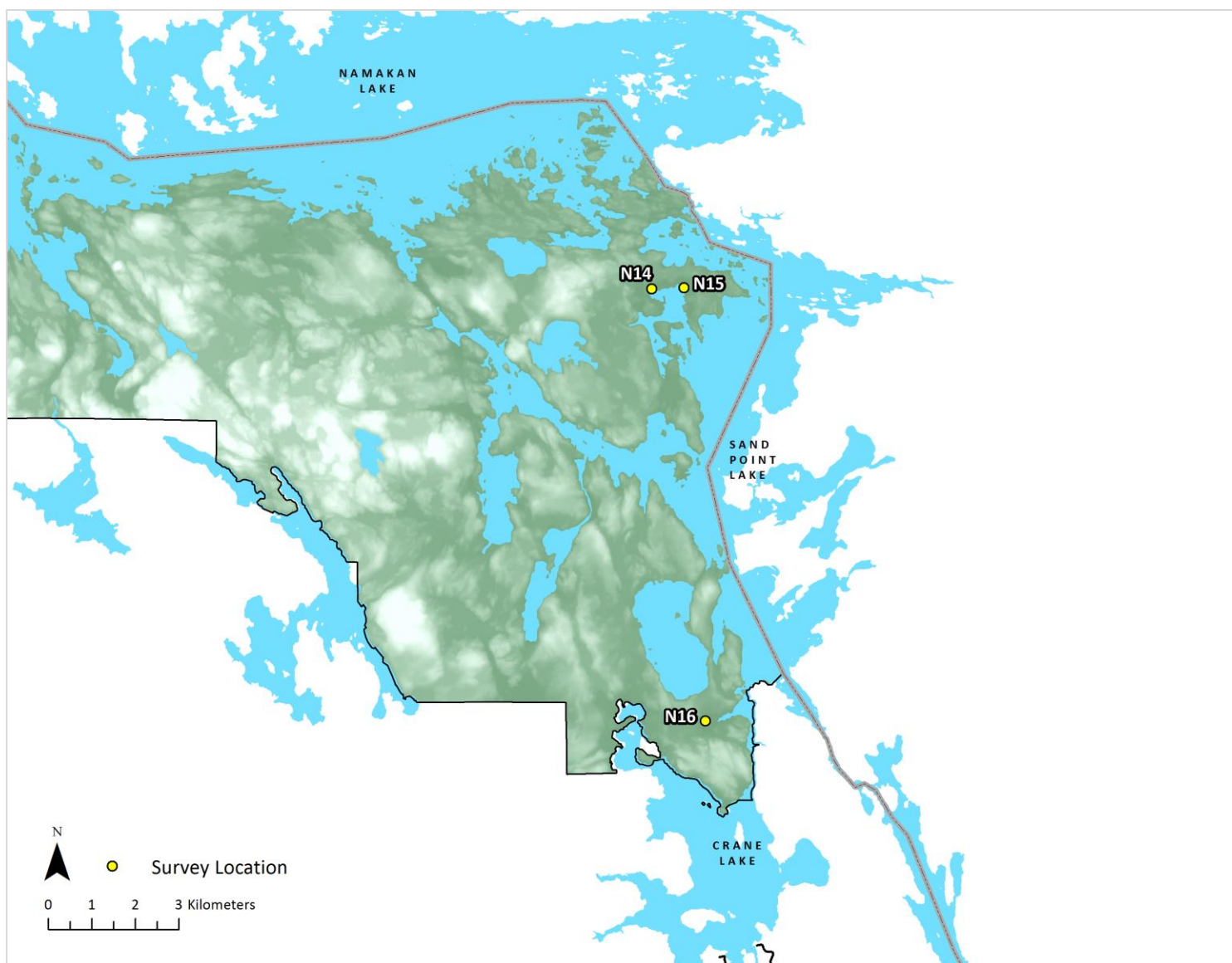


Figure 1d. Sand Point Lake marsh bird survey points, 2017.

Results

Three rounds of surveys were completed between 22 May and 28 June 2017. Survey 1 was completed between 22 May and 2 June, Survey 2 between 5 June and 16 June, and Survey 3 between 19 June and 29 June. Four technicians completed the surveys in groups of two, resulting in 312 total person-hours devoted to surveying and traveling to and from points. Survey conditions were considered good to excellent, as all surveys were conducted with wind speeds <16 km/hr (10 mph) and most <8 kph (5 mph). Background noise was recorded as faint for most surveys, with only a few noted as moderate. No surveys were carried out during sustained precipitation or heavy fog. A total of 21 bays were surveyed, with between one and eight individual points per bay. Tom Cod Bay had the most individual bird observations with 71, while Blind Ash and Olson Bays had zero observations each (Table 1).

Table 1. Total number of observations of focal wetland bird species in 21 wetlands in Voyageurs National Park, Minnesota. Three surveys were conducted from 22 May through 29 June 2017.

Lake	Bay	Number of Points	Total individuals: focal species	Average # birds per survey point per round
Kabetogama	Tom Cod	7	71	3.4
Kabetogama	Irwin	7	57	2.7
Kabetogama	Daley	3	23	2.6
Rainy	Reuter Creek	1	4	1.3
Rainy	Alder Creek	3	12	1.3
Kabetogama	Duck	2	7	1.2
Rainy	Black Bay Narrows	4	13	1.1
Rainy	Squaw Island	1	3	1
Rainy	Dove	4	12	1
Rainy	Cranberry	8	19	0.8
Sand Point	Alligator	1	2	0.7
Rainy	Soboleski	1	2	0.7
Rainy	W Black Bay	2	3	0.5
Sand Point	Swansons	2	2	0.3
Kabetogama	Mud	1	1	0.3
Kabetogama	Echo Island	1	1	0.3
Rainy	Lost	7	5	0.2
Kabetogama	NW Kab	3	1	0.1

Table 1 (continued). Total number of observations of focal wetland bird species in 21 wetlands in Voyageurs National Park, Minnesota. Three surveys were conducted from 22 May through 29 June 2017.

Lake	Bay	Number of Points	Total individuals: focal species	Average # birds per survey point per round
Kabetogama	Moose	2	0	0
Kabetogama	Blind Ash	1	0	0
Rainy	Olson	1	0	0

Focal Species

Eight of the nine focal species were observed at least once throughout the surveys (Figure 2). American coot was not observed. The most commonly observed focal species was American bittern, with 63 total observations, followed by red-necked grebe with 52 total observations, and Virginia rail with 39 total observations. Red-necked grebes, pied-billed grebes, and black terns were only observed on Kabetogama Lake, and yellow rails were only observed on Rainy Lake (Figure 3, Tables 2 and 3). See Appendix C for individual species distribution maps.

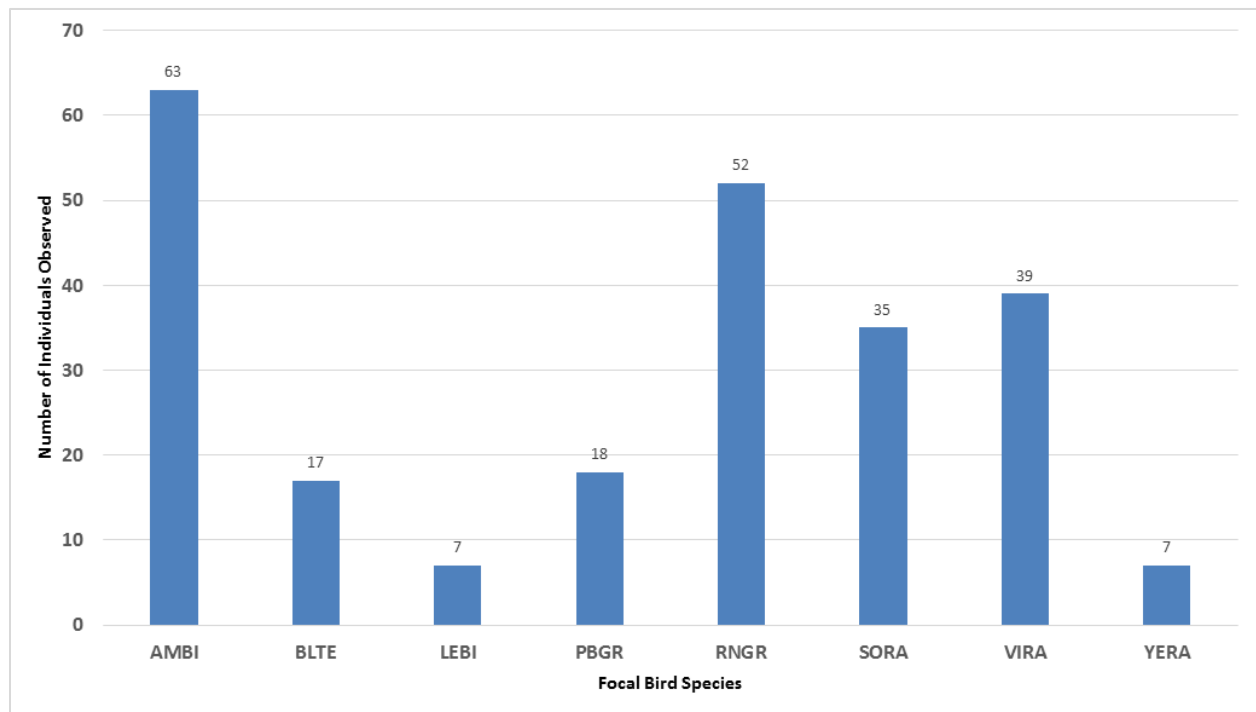


Figure 2. Total observations (visual or aural) of eight focal marsh bird species at 62 wetland points sampled May–June 2017 in Voyageurs National Park, Minnesota. AMBI = American bittern. BLTE = Black tern. LEBI = Least bittern. PBGR = Pied-billed grebe. RNGR = Red-necked grebe. VIRA = Virginia rail. YERA = Yellow rail.

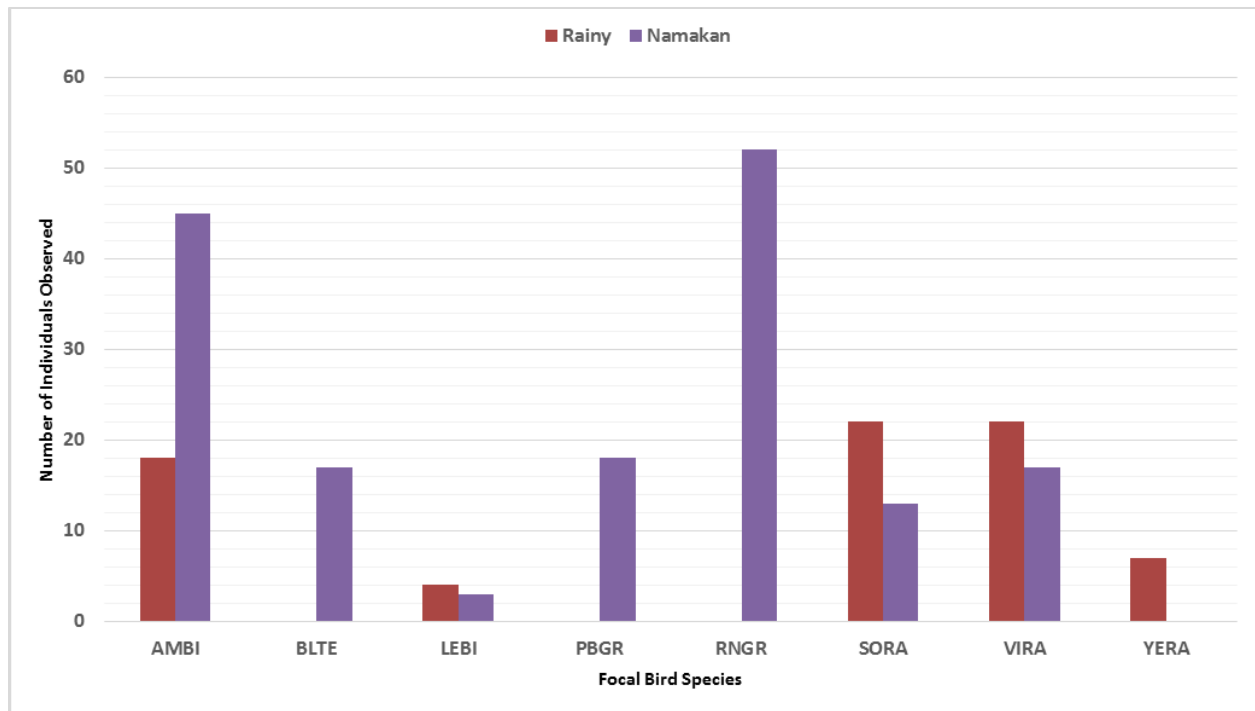


Figure 3. Total observations (visual or aural) of eight focal marsh bird species at 62 wetland points sampled May–June 2017 on Rainy Lake and Namakan Reservoir in Voyageurs National Park, Minnesota. AMBI = American bittern. BLTE = Black tern. LEBI = Least bittern. PBGR = Pied-billed grebe. RNGR = Red-necked grebe. VIRA = Virginia rail. YERA = Yellow rail.

Table 2. Number of individuals observed for each focal bird species during three visits to 21 wetlands in Voyageurs National Park, Minnesota, 22 May–28 June 2017.

Species	Namakan Reservoir Observations			Rainy Lake Observations		
	Round 1	Round 2	Round 3	Round 1	Round 2	Round 3
American bittern	12	21	12	5	5	8
American coot	0	0	0	0	0	0
Black tern	3	13	1	0	0	0
Least bittern	0	1	2	2	2	0
Pied-billed grebe	1	0	17	0	0	0
Red-necked grebe	12	22	18	0	0	0
Sora	1	1	11	17	5	0
Virginia rail	4	2	11	7	7	8
Yellow rail	0	0	0	0	3	4

Table 3. Summary of individual bird observations during three visits to 21 wetlands in Voyageurs National Park, Minnesota, 22 May–28 June 2017.

Total Observations	Namakan	Rainy	Grand Total
Round 1	33	31	64
Round 2	60	22	82
Round 3	72	20	92
All Rounds	165	73	238

Species Richness

We detected 69 species in total, 61 of which were secondary species (Appendix D). The three most common secondary species were red-winged blackbird (*Agelaius phoeniceus*) with 3,714 individuals, black-capped chickadee (*Poecile atricapillus*) with 553 individuals, and common loon (*Gavia immer*) with 278 individuals.

Discussion

American bittern, Virginia rail, and sora were commonly observed within the Namakan Reservoir (includes Kabetogama and Sand Point Lakes) and Rainy Lake within VOYA in both the 2012 and 2017 surveys, and each of them is an important species to monitor for population trends within the park. The Great Lakes Marsh Monitoring Program, based in Canada, found a 3.7% decline per year in Virginia rail populations near the Great Lakes (Tozer 2013). American bittern and sora populations appear to be higher west of the park in the Prairie Pothole Region, yet are lower in northcentral and northeastern Minnesota (Sauer et al. 2017).

A single yellow rail was observed within the park in 2012, and the 2017 survey sought to confirm whether yellow rails regularly breed within VOYA. In the 2017 survey, yellow rails were identified seven times on Rainy Lake, verifying that the species does occur within the park. As this species (along with least bittern) occurs rarely, the last two surveys indicate that they are summer residents of VOYA. Future studies and monitoring are necessary to confirm breeding success and to gauge the size of yellow rail populations.

A single least bittern was observed in the 2012 survey, while there were seven observations in the 2017 survey. As this is another naturally rare species, the last two surveys indicate that they are summer residents of VOYA. Many range maps do not include VOYA as an area of summer breeding for least bitterns, which may now require revision. Specifically, the 2017 Minnesota Breeding Bird Atlas does not include the species in the VOYA region. Future studies and monitoring are necessary to confirm breeding success and to gauge the size of local least bittern populations.

Although red-necked grebes were fairly common in certain parts of Kabetogama Lake in both the 2012 and 2017 surveys (see Appendix C), they are one of the Species of Greatest Conservation Need in Minnesota due to continued loss of breeding habitat (MN DNR 2012). Every August, VOYA researchers survey all shorelines to assess common loon breeding. As red-necked grebe chicks are near adult size and highly visible at this same time, we suggest incorporating red-necked grebes into the annual loon breeding survey by recording all red-necked grebe adults and chicks in order to assess long-term productivity of these sensitive birds.

Black terns were observed on Kabetogama Lake in 2017. In Minnesota, this species has shown a statistically significant decline in population of 6.29% per year since 1967. The cumulative loss has been nearly 96% (Pfanmuller et al. 2017). Black terns rarely nest in points with >75% vegetation cover, suggesting that wetlands dominated by hybrid cattails may be suboptimal habitat that could be linked to population declines (Heath et al. 2009).

Black terns, pied-billed grebes, and red-necked grebes were observed only on Kabetogama Lake in both the 2012 and 2017 surveys. Their absence from Rainy Lake may be explained by that lake's topography: the lake has more rocky shoreline and Canadian Shield geology than Kabetogama, suggesting less marsh bird habitat (Kallemeyn et al. 2003). However, Black Bay on Rainy Lake is topographically similar and in close proximity to Kabetogama Lake, yet neither grebes nor black terns have been observed there either. Future surveys may shed light on why those particular species

are not present on Rainy Lake. It is suggested that the cattail removal project, with several treatment points within Black Bay, may improve marsh bird habitat and support a greater diversity of species. Monitoring will be required to confirm this hypothesis.

A recent study suggests that cattail removal in the prairie pothole region does not affect marsh bird abundance in the following breeding season (Hill 2017). Few other studies compare marsh bird populations between cattail-invaded and more natural wetlands, but there are several studies that have revealed the habitat preferences of certain marsh bird species. Rails prefer a mix of water and emergent vegetation, open mudflats, and relatively low stem densities of aquatic plants (Tacha and Braun 1994). Virginia rails are often absent from wetlands without shallow-water pools or mudflats (Conway and Eddleman 1994). Additionally, yellow rails show a preference for sedge wetlands (Goldade et al. 2002). Pied-billed grebes, American bitterns, and least bitterns typically nest in large, relatively deeper wetlands, particularly points with low percent cover of woody vegetation (Hill 2017). In summary, wetlands dominated by hybrid cattail are typically suboptimal habitat for marsh birds. Additional monitoring will occur in VOYA to measure marsh bird response to cattail removal and wetland restoration.

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Appendix A. Characteristics of sampling points used during marsh bird surveys in Voyageurs National Park, June 2017. Coordinates are in UTM's, Zone 15, NAD 1983.

*Site revisited from 2012 surveys.

Lake	Wetland Name	Site Name	Easting	Northing	Wetland Type	Shoreline/Interior	Survey Azimuth
Kabetogama	Daley Bay	N1*	504608.2	5362882	emergent marsh	interior	330
Kabetogama	Daley Bay	N2*	504784.2	5363465	emergent marsh	interior	51
Kabetogama	Daley Bay	N3*	504232.2	5363797	wet meadow	shoreline	299
Kabetogama	Irwin Bay	N4*	502885.2	5363678	wet meadow	interior	280
Kabetogama	Irwin Bay	N5*	502929.2	5364151	wet meadow	interior	322
Kabetogama	Irwin Bay	N6*	501298.2	5363051	wet meadow	interior	330
Kabetogama	Irwin Bay	N7*	499939.2	5363307	emergent marsh	shoreline	18
Kabetogama	Irwin Bay	N8*	499548.2	5363559	emergent marsh	interior	280
Kabetogama	Irwin Bay	N9*	500071.2	5363742	emergent marsh	shoreline	338
Kabetogama	Tom Cod Bay	N10*	490781.2	5369733	emergent marsh	shoreline	118
Kabetogama	Tom Cod Bay	N11*	491140.2	5370230	emergent marsh	shoreline	42
Kabetogama	Tom Cod Bay	N12*	491909.2	5370533	emergent marsh	interior	338
Kabetogama	Tom Cod Bay	N13*	492518.2	5370726	emergent marsh	shoreline	158
Sand Point	Swansons Bay	N14*	537450.2	5361861	emergent marsh	shoreline	0
Sand Point	Swansons Bay	N15*	538190.2	5361888	emergent marsh	shoreline	78
Sand Point	Alligator Bay	N16*	538682.2	5351901	wet meadow	interior	60
Kabetogama	Tom Cod Bay	N17	492012.7	5371212	emergent marsh	shoreline	283

Appendix A (continued). Characteristics of sampling points used during marsh bird surveys in Voyageurs National Park, June 2017. Coordinates are in UTM's, Zone 15, NAD 1983. *Site revisited from 2012 surveys.

Lake	Wetland Name	Site Name	Easting	Northing	Wetland Type	Shoreline/Interior	Survey Azimuth
Kabetogama	Tom Cod Bay	N18	491026.6	5370615	rooted and floating marsh	shoreline	318
Kabetogama	Tom Cod Bay	N19	491730.3	5370149	emergent marsh	shoreline	225
Kabetogama	Irwin Bay	N20	502471.2	5363387	lakes and streams	shoreline	180
Kabetogama	Duck Bay	N21	500541.5	5364186	emergent marsh	shoreline	90
Kabetogama	Duck Bay	N22	499664	5364816	emergent marsh	shoreline	30
Kabetogama	Moose Bay	N23	496618.6	5375056	emergent marsh	shoreline	140
Kabetogama	NW Kabetogama	N24	494056.4	5373393	emergent marsh	shoreline	310
Kabetogama	NW Kabetogama	N25	492355	5372323	emergent marsh	shoreline	320
Kabetogama	NW Kabetogama	N26	492385.3	5373455	lakes and streams	shoreline	290
Kabetogama	Moose Bay	N27	496568.7	5375507	emergent marsh	shoreline	348
Kabetogama	Mud Bay	N28	505504	5363914	emergent marsh	shoreline	190
Kabetogama	Blind Ash Bay	N29	509555.2	5363977	emergent marsh	shoreline	28
Kabetogama	Echo Island Bay	N30	494923.9	5369025	emergent marsh	shoreline	320
Rainy	Reuter Creek	R1*	489974.2	5380037	rooted and floating marsh	shoreline	81
Rainy	Squaw Island	R2*	489385.2	5378943	lakes and streams	shoreline	335
Rainy	West Black Bay	R3*	487831.2	5381080	wet meadow	interior	110
Rainy	Dove Bay	R4*	491974.2	5382504	emergent marsh	shoreline	241
Rainy	Dove Bay	R5*	492476.2	5382773	rooted and floating marsh	shoreline	114
Rainy	Cranberry Bay	R6*	495622.2	5381912	wet meadow	interior	212

Appendix A (continued). Characteristics of sampling points used during marsh bird surveys in Voyageurs National Park, June 2017. Coordinates are in UTM's, Zone 15, NAD 1983. *Site revisited from 2012 surveys.

Lake	Wetland Name	Site Name	Easting	Northing	Wetland Type	Shoreline/Interior	Survey Azimuth
Rainy	Cranberry Bay	R7*	495408.2	5381066	wet meadow	shoreline	280
Rainy	Cranberry Bay	R8*	495709.2	5380365	emergent marsh	shoreline	90
Rainy	Cranberry Bay	R9*	495847.2	5381143	emergent marsh	shoreline	64
Rainy	Cranberry Bay	R10	495196.9	5380175	emergent marsh	shoreline	318
Rainy	Cranberry Bay	R11	494882.9	5379679	wet meadow	shoreline	225
Rainy	Cranberry Bay	R12	495126.3	5381562	emergent marsh	shoreline	315
Rainy	Alder Creek	R13	498996.1	5381803	emergent marsh	shoreline	190
Rainy	Alder Creek	R14	499676.6	5381496	emergent marsh	shoreline	112
Rainy	Dove Bay	R15	491608.4	5382956	emergent marsh	shoreline	245
Rainy	Black Bay Narrows	R16	489207.6	5380258	emergent marsh	shoreline	36
Rainy	Black Bay Narrows	R17	488951.3	5380717	emergent marsh	shoreline	110
Rainy	West Black Bay	R18	487805.3	5381511	emergent marsh	shoreline	164
Rainy	Alder Creek	R19	498398.3	5382000	emergent marsh	shoreline	195
Rainy	Olson Bay	R20	495555.3	5382344	emergent marsh	shoreline	288
Rainy	Dove Bay	R21	493147.8	5382646	emergent marsh	shoreline	300
Rainy	Lost Bay	R22	499585	5382362	emergent marsh	shoreline	235
Rainy	Lost Bay	R23	501696.6	5382031	emergent marsh	shoreline	90
Rainy	Lost Bay	R24	500883.9	5382771	emergent marsh	interior	340
Rainy	Lost Bay	R25	502554.6	5382231	emergent marsh	shoreline	60

Appendix A (continued). Characteristics of sampling points used during marsh bird surveys in Voyageurs National Park, June 2017. Coordinates are in UTM's, Zone 15, NAD 1983. *Site revisited from 2012 surveys.

Lake	Wetland Name	Site Name	Easting	Northing	Wetland Type	Shoreline/Interior	Survey Azimuth
Rainy	Lost Bay	R26	502215.7	5381661	wet meadow	shoreline	230
Rainy	Lost Bay	R27	501175	5382101	emergent marsh	shoreline	233
Rainy	Cranberry Bay	R28	496388.6	5381470	emergent marsh	shoreline	222
Rainy	Black Bay Narrows	R29	489445.7	5382912	rooted and floating marsh	shoreline	104
Rainy	Black Bay Narrows	R30	488837.8	5381483	lakes and streams	shoreline	48
Rainy	Lost Bay	R31	502967.4	5382541	lakes and streams	shoreline	65
Rainy	Soboleski Bay	R32	501986.6	5383039	emergent marsh	shoreline	130

Appendix B. Sample datasheet for marsh bird surveys in Voyageurs National Park, Minnesota.

Voyageurs National Park Marsh Bird Monitoring Survey 2017																			
Primary Observer: <u>CK</u>					Secondary Observer: <u>AG</u>														
Date: <u>06/05/17</u>			UTMs: <u>0499946 5363305</u>			Wind Direction: <u>NNE</u>													
Time: <u>0745</u>			Observer Bearing: <u>11</u>			Sky Code: <u>0</u>													
Site: <u>N7</u>			Temp C°: <u>17</u>			Noise Code: <u>1</u>													
Round: <u>1 (2) 3</u>			Wind Speed: <u>2.0</u>																
Put a "V" in the appropriate column if the bird was seen and put the Call Type if heard. Place an "E" after the count if the number was estimated.																			
Direction	Bearing	Distance (Meters)	Species	Responded During											Observed by Partner	Notes / Secondary Species	Count	Visual Confirmation	Inside Survey Time
				Min 1	Min 2	Min 3	Min 4	Min 5	Min 6 - LEBI	Min 7 - YERA	Min 8 - SORA	Min 9 - VIRA	Min 10 - AMBI	Min 11 - PBGR					
0	200	BTE	PK	PK	PK		V	V							V - flying	22	Y	Y	
120	130	RNGR													Y visual before	1	Y	N	
230	90	VIRA								KI	KI			T	Y survey, where we parked boat	1	N	Y	
															-visual confirmation of VIRA after survey				
															overbird calling	1	N	Y	
															RWBB	25	Y	Y	
															Wilson's snipe winnowing	1	Y	Y	
Site Notes:																			
Background Noise: 0 - No noise 1 - Faint noise 2 - Moderate noise (probably can't hear some birds beyond 100m)																			
3 - Loud noise (probably can't hear some birds beyond 50m) 4 - Intense noise (probably can't hear some birds beyond 25m)																			
Sky: 0 - Clear or a few clouds 1 - Partly cloudy or variable sky 2 - Cloudy or overcast 3 - Fog or smoke 4 - Drizzle 5 - Snow 6 - Showers																			
American Bittern:				Least Bittern:				Sora:				Virginia Rail:				Yellow Rail:			
PL - pump-er-lunk				COO - coo				WH - whinny				G - grunt				CC - click-click			
CP - chu-peep				KAK - kak				PW - per-weep				T - tick-it				CA - cockle			
KO - kok				ERT - ert				KEE - keep				KI - kicker				WHZ - wheeze			
Black Tern:				American Coot:				Pied-Billed Grebe:				Red-Necked Grebe:							
PK - per-kik				HU - hic-up				OW - owhoop				LH - laughing honk							
K - kik				HK - honk				HY - hyena				AT - alarm tick							
CK - chitter kik				BU - burr-up															

entered
all 6/14

Appendix C. Observation locations for individual focal marsh bird species.

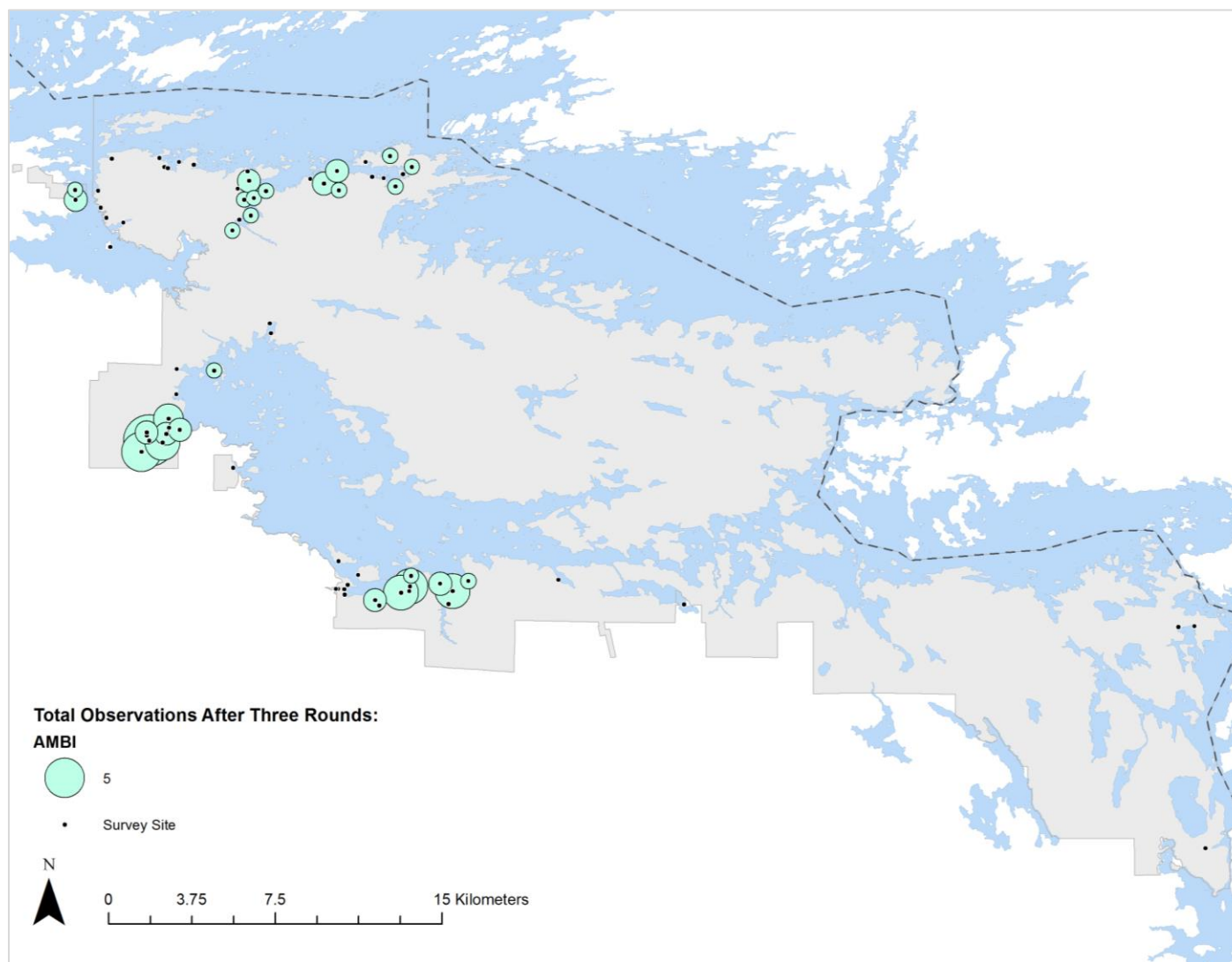


Figure C1. American Bittern. Marker size is proportional to the number of observations.

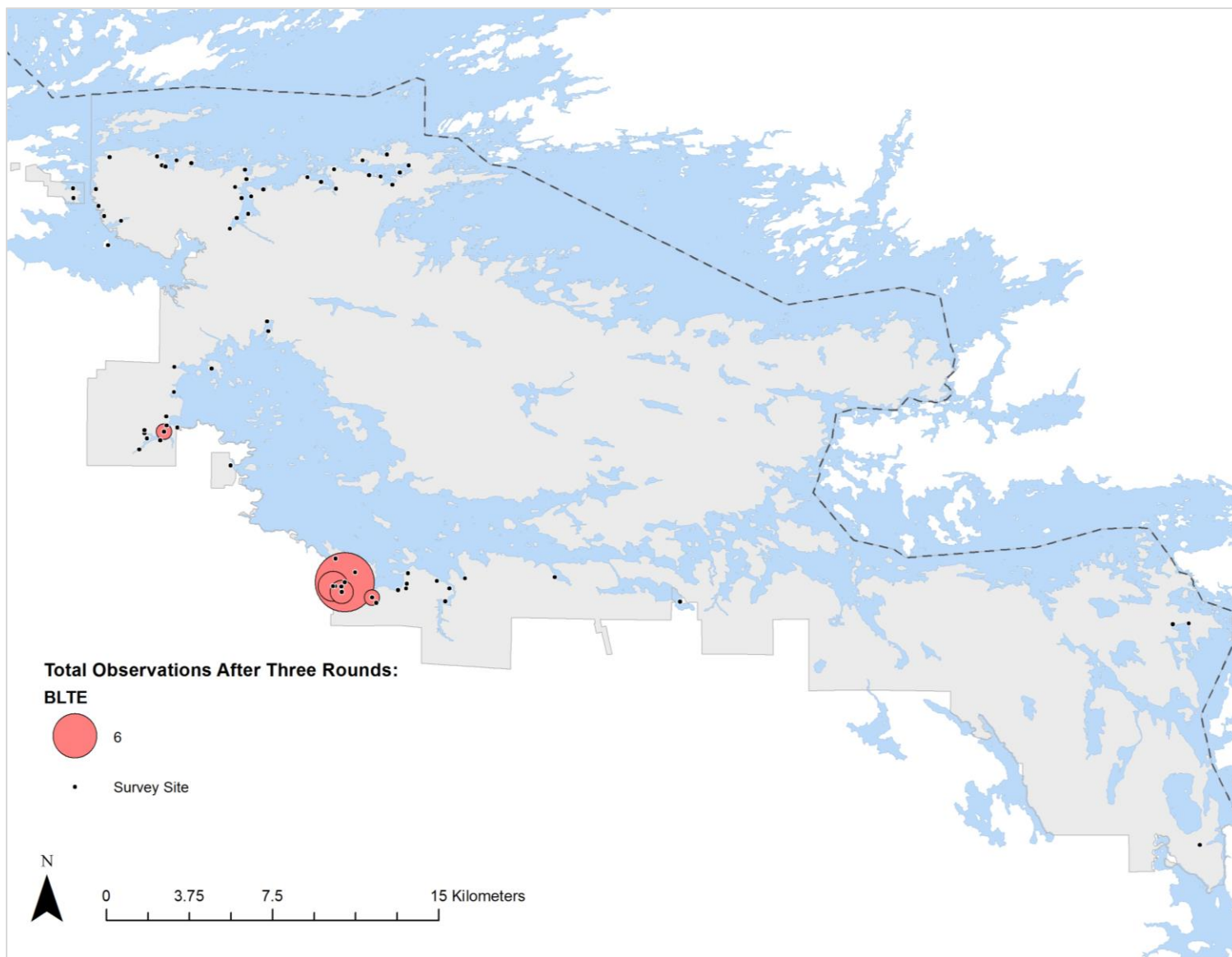


Figure C2. Black Tern. Marker size is proportional to the number of observations.

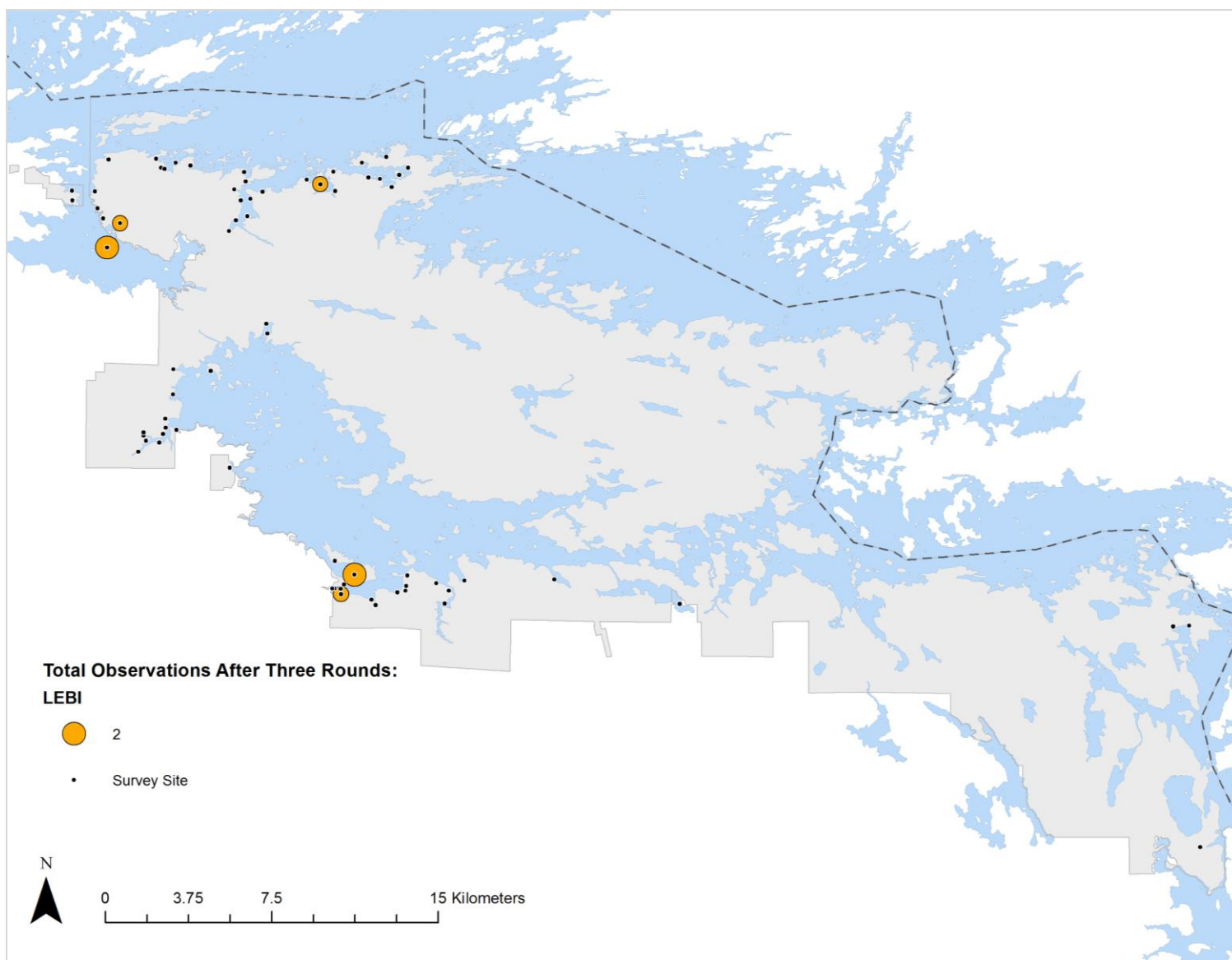


Figure C3. Least Bittern. Marker size is proportional to the number of observations.

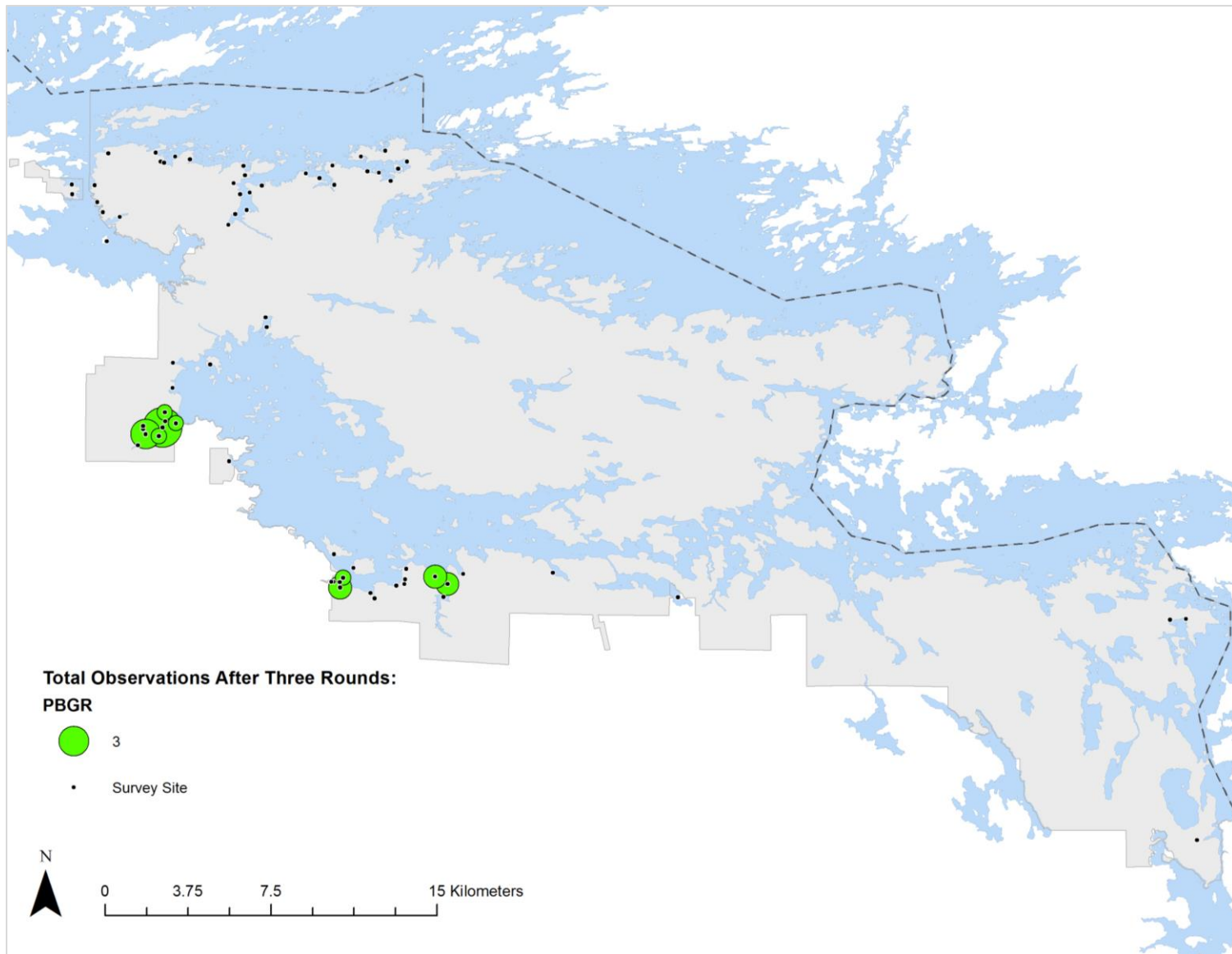


Figure C4. Pied-billed Grebe. Marker size is proportional to the number of observations.

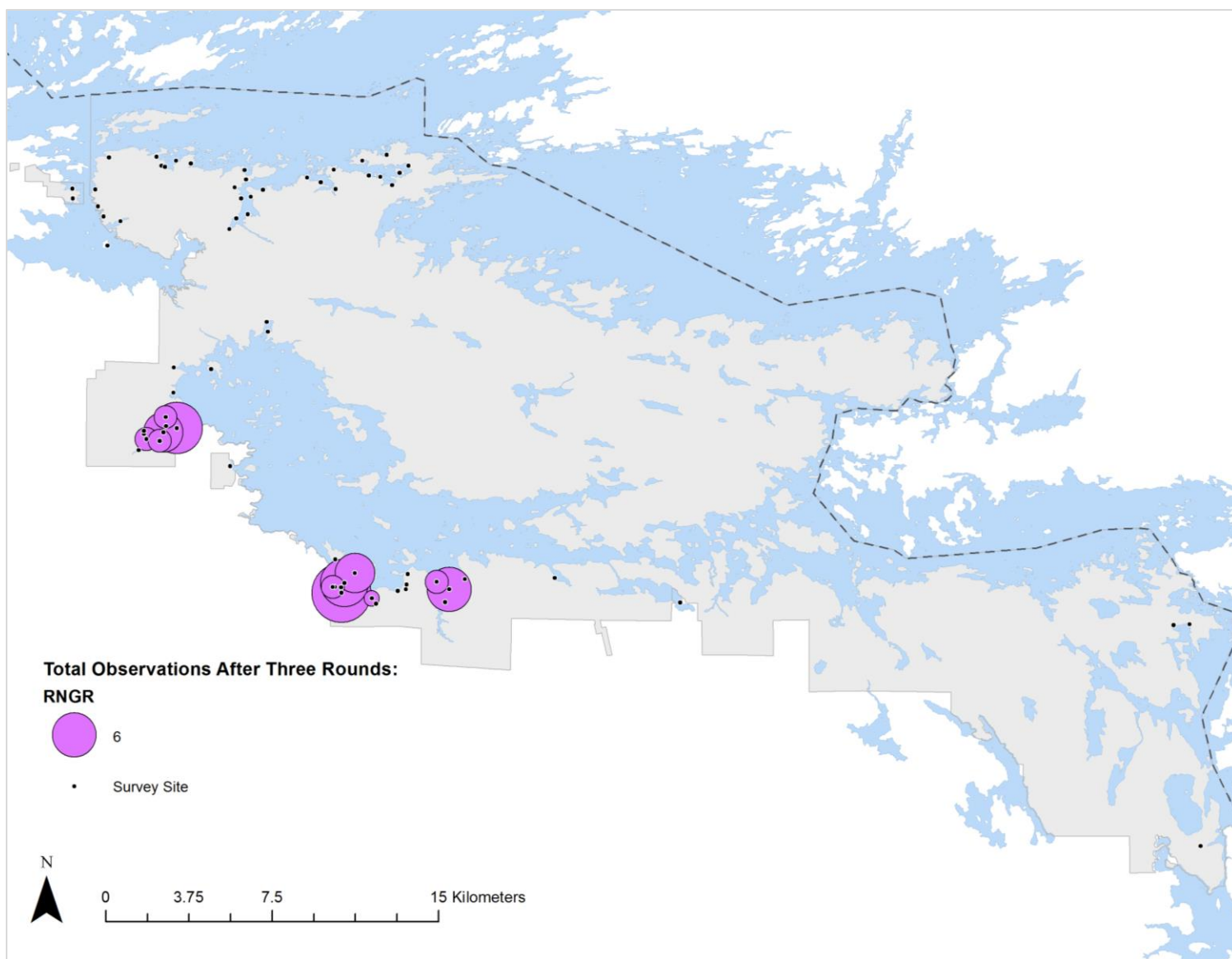


Figure C5. Red-necked Grebe. Marker size is proportional to the number of observations.

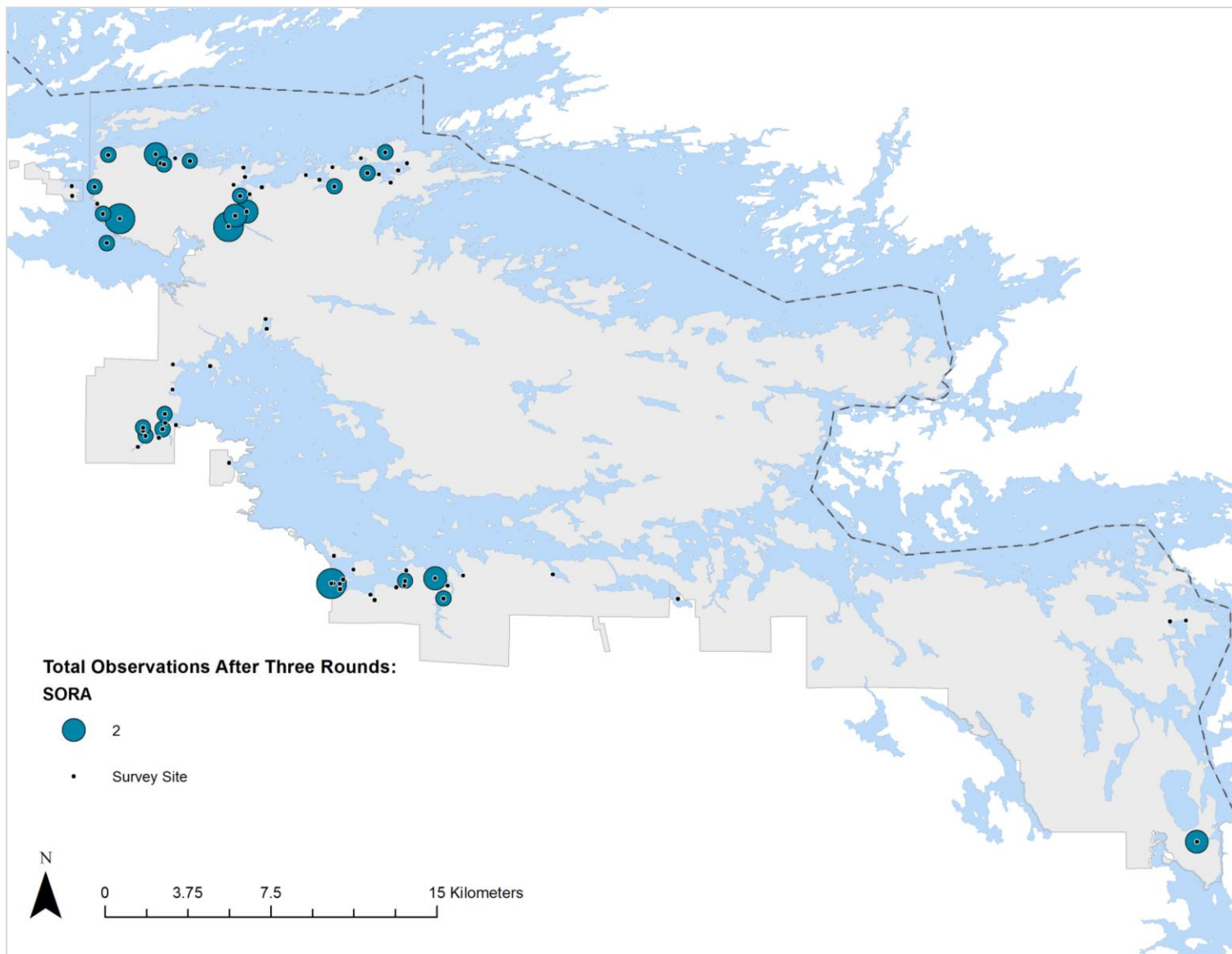


Figure C6. Sora. Marker size is proportional to the number of observations.

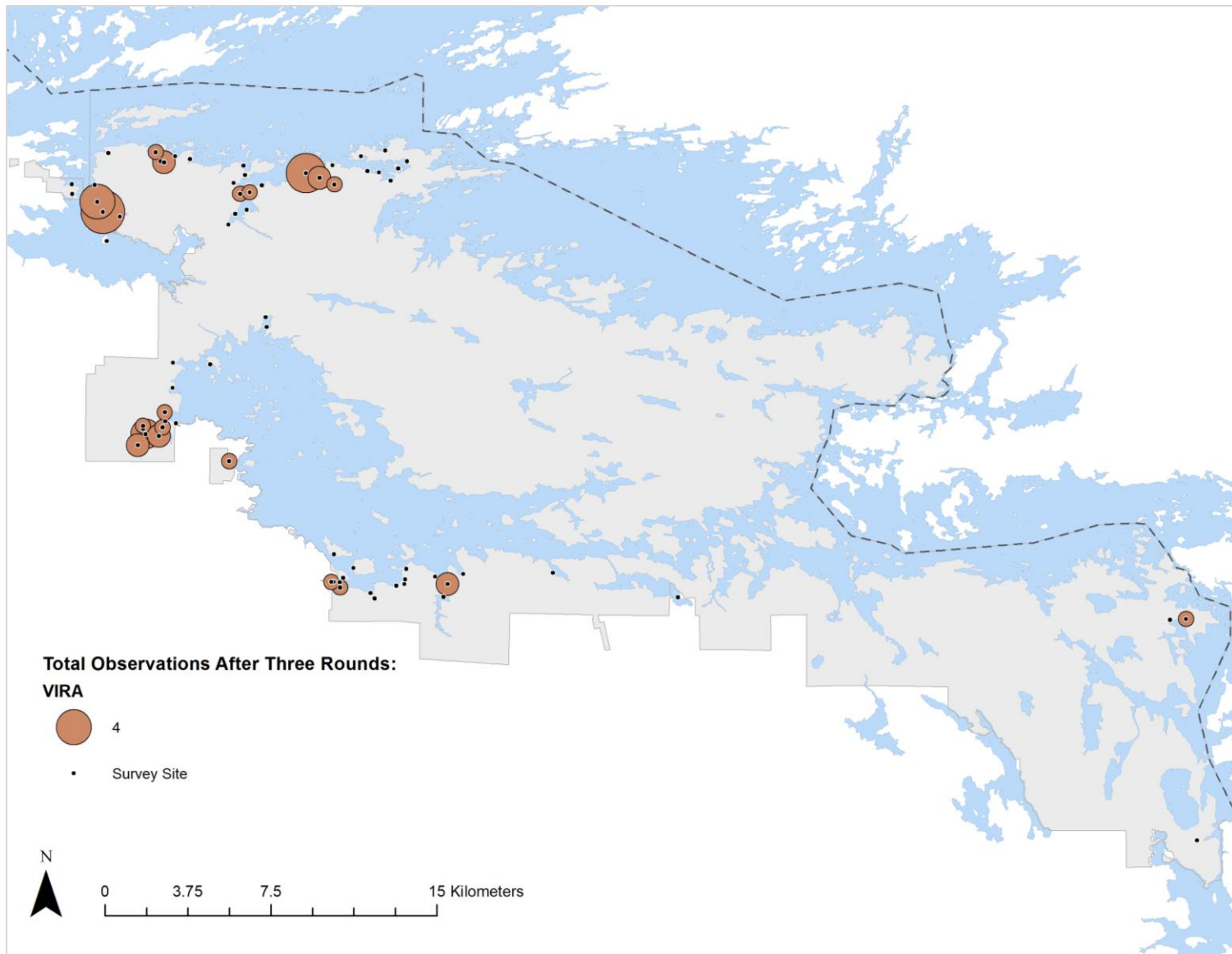


Figure C7. Virginia Rail. Marker size is proportional to the number of observations.

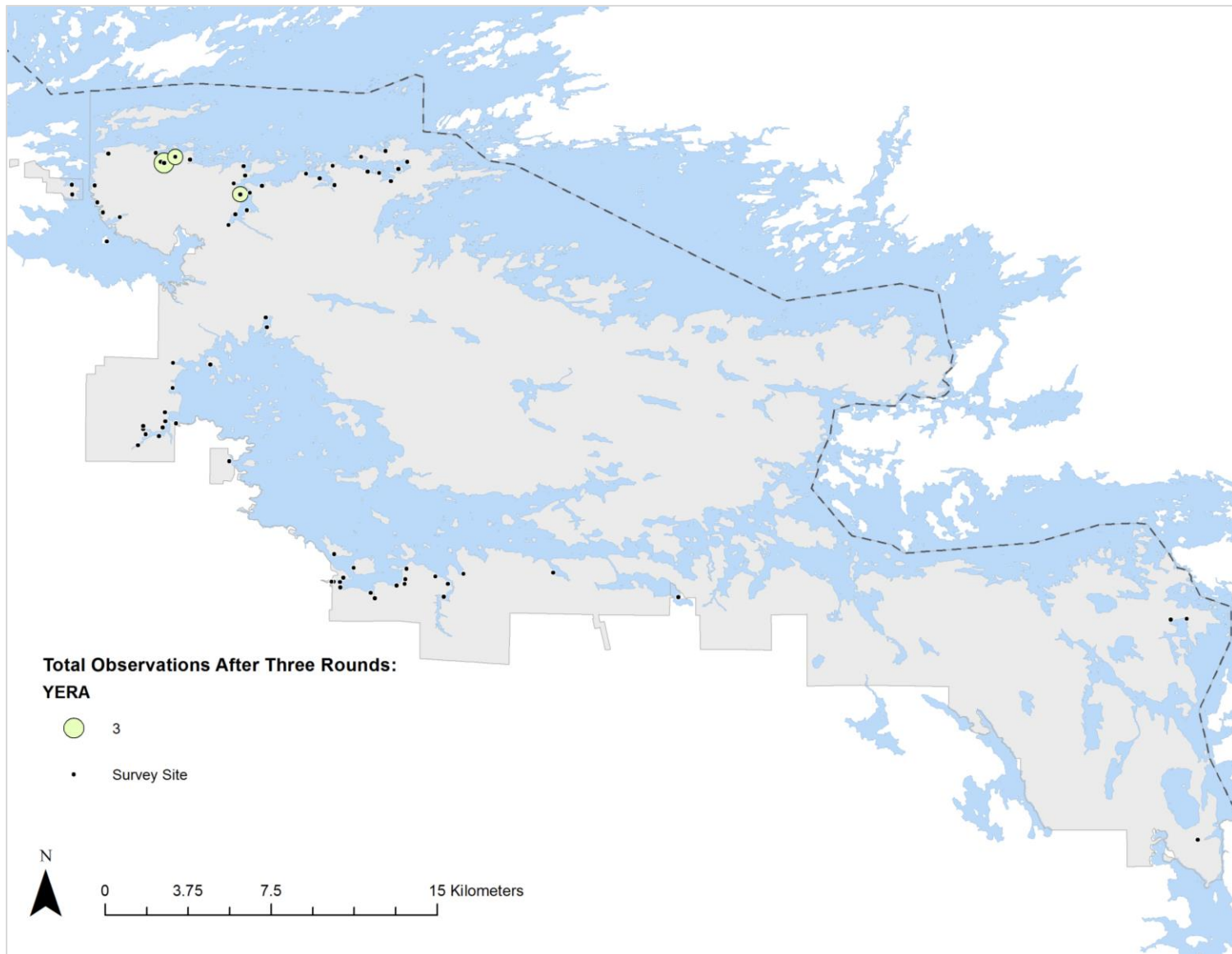


Figure C8. Yellow Rail. Marker size is proportional to the number of observations.

Appendix D. Secondary species observed during marsh bird surveys in Voyageurs National Park, Minnesota.

Species	Observations	Species	Observations
Red-winged blackbird	3,714	American robin	19
Black-capped chickadee	553	Bald eagle	16
Common loon	284	American white Pelican	15
Canada goose	260	Common Raven	14
Woodpecker species	184	Bufflehead	14
Duck species	173	Common Grackle	13
Mallard	160	Herring gull	9
American crow	142	Great crested flycatcher	8
Ring-billed gull	108	Common merganser	10
Trumpeter Swan	103	Hooded merganser	6
Song sparrow	100	Common tern	5
Wilson's snipe	89	Tree swallow	4
White-throated sparrow	88	Swallow species	4
Blue jay	82	Sparrow species	4
Red-breasted nuthatch	77	Sandhill crane	4
Ruffed grouse	73	Red-head duck	4
Ring-necked duck	69	Cooper's hawk	4
Ovenbird	59	Common yellowthroat	5
Sedge wren	56	Osprey	3
Red-eyed vireo	56	Blue-headed vireo	3
Veery	55	Turkey vulture	2
Common Goldeneye	51	Ruby-throated hummingbird	2
Pileated woodpecker	40	Gadwall	2
Gull species	38	Franklin's gull	2
Marsh wren	31	Barred owl	2
Swainson's thrush	27	Wood thrush	1
Great blue heron	22	Northern harrier	1
Double-crested cormorant	20	Northern flicker	1

The Department of the Interior protects and manages the nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors its special responsibilities to American Indians, Alaska Natives, and affiliated Island Communities.

NPS 172/145034, May 2018

National Park Service
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