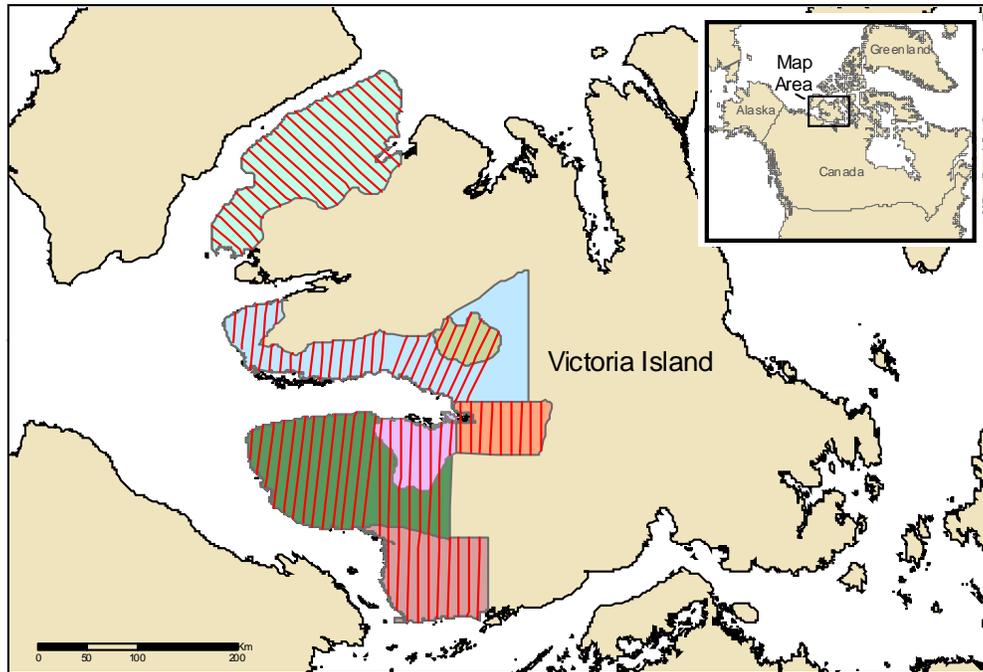


MIGRATORY BIRD SURVEYS IN THE CANADIAN ARCTIC
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ABSTRACT: We conducted a fixed-wing aerial survey for waterfowl and other migratory birds on western Victoria Island, Northwest Territories, Canada. The survey was conducted from 19 June to 1 July 2008. The survey area included Prince Albert Peninsula, Diamond Jenness Peninsula, Wollaston Peninsula, and wetland areas adjacent to these peninsulas. The survey design consisted of 400-m-wide transects spaced systematically at 10-km intervals (approximately 4% sample) within 7 areas of known or suspected high densities of waterfowl. Most of the area boundaries and transects had been established previously for helicopter surveys conducted by the Canadian Wildlife Service. The results from this survey are presented by area. This is the fourth consecutive year that we have successfully flown fixed-winged waterfowl surveys in Canada's central Arctic. We believe fixed-wing aircraft offer a safe and cost-efficient alternative to the use of helicopters for conducting surveys in the region. We recommend the establishment of a long-term annual survey to monitor the status and trends of migratory birds nesting in the Canadian Arctic.

Key words: aerial survey, Canadian Arctic, Victoria Island, waterfowl, migratory birds, Canada goose, cackling goose, greater white-fronted goose, tundra swan, king eider, long-tailed duck.

INTRODUCTION

Many important nesting areas of North American waterfowl lie outside the range of the existing Waterfowl Breeding Population and Habitat Survey (U.S. Fish and Wildlife Service 2008) and other cooperative waterfowl survey efforts. For example, portions of the central and western Canadian Arctic are recognized as important nesting areas of waterfowl and other waterbirds but due to their remoteness have been surveyed only periodically or not at all. Cooperating agencies of the Arctic Goose Joint Venture and Sea Duck Joint Venture recently initiated efforts to assess bird abundance and distribution in these areas to improve status information and harvest management for several species of sea ducks, geese, swans, and other waterbirds. As part of these efforts, the Canadian Wildlife Service (CWS) conducted systematic transect surveys by helicopter in 2002-2006 (Alisauskas 2003, Alisauskas 2005, Alisauskas 2006, Raven and Dickson 2006, Alisauskas unpubl. data). Also in 2005-2007, the Waterfowl Management Branch of the U.S. Fish and Wildlife Service (USFWS) flew transect surveys using a single-engine, turbine-powered, fixed-wing aircraft to gather additional data and to explore the logistic feasibility of using this more cost-effective survey aircraft for regular surveys in the region (Conant et al. 2006, Conant et al. 2007, Groves et al. 2009). The fixed-wing surveys in 2005-2007 were conducted on southern Victoria Island and on the mainland and islands between Kugluktuk and Gjoa Haven. In 2008 we shifted our geographic focus and conducted the survey

on western Victoria Island. This report summarizes the results from our fixed-wing survey in 2008.

STUDY AREA AND METHODS

Survey Design

The survey in 2008 consisted of seven areas on western Victoria Island (Figure 1, Table 1). These areas were previously delineated by CWS for bird surveys they conducted by helicopter in 1992-1994 and 2004-2005 (Cornish and Dickson 1996, Raven and Dickson 2006). Delineation of the area boundaries was based on physiographic and habitat similarities as determined from Landsat Thematic Mapper satellite imagery (Cornish and Dickson 1996). We extended the eastern boundary of one area (Tassijuak Lake) eastward to make it contiguous to another area surveyed previously by CWS and USFWS (Byron Bay; Alisauskas 2005, Groves et al. 2009). We omitted one area from the 1992-1994 and 2004-2005 surveys (Minto Inlet to Wynniatt Bay) due to very low bird densities observed there (Raven and Dickson 2006). The total survey area in 2008 was 68,617 km² (Table 1).

Transects from the 1992-1994 and 2004-2005 helicopter surveys were established within plots and were spaced at 5-km or 10-km intervals depending on the area (Cornish and Dickson 1996). We repeated most of these transects but at 10-km spacing for all areas (Figure 1, Table 1). Because our fixed-wing aircraft had greater survey range than the helicopter, we modified the transects and added new ones so that they extended systematically across the entire survey area (except for the eastern portion of Diamond Jenness Peninsula). We also replaced the previous east/west transects in the Kagloryuak River area with north/south transects to increase survey efficiency. The final survey design consisted of variable-length transects spaced systematically at 10-km intervals (Figure 1, Table 1). The width of each transect strip was 400m (200m on each side of the aircraft). Slightly less than 4% of the total survey area was sampled.

Although we originally intended to sample all parts of the Diamond Jenness Peninsula area, time constraints prohibited us from surveying a portion at the eastern end. (This portion was also not surveyed in 1992-1994 or 2004-2005.) The transects not flown were omitted from the final survey design presented in this report.

Data Collection and Analyses

The 2008 survey was flown 19 June-1 July. The survey timing was intended to coincide with the mid-incubation period for geese, as well as the period when the peak number of paired male king eiders was present (Cotter et al. 1997). A total of 72.1 hours of flight time was spent on survey (surveying transects and flying to/from transects). An additional 18.5 hours of flight time was spent flying the survey airplane from and to our home base in Alaska. The survey was primarily based from Ulukhaktok, NT, with three days based from Kugluktuk, NU. We used the specially modified de Havilland Turbine Beaver (N754) as our fixed-wing survey platform. This aircraft has been used for waterfowl surveys in Alaska since 1977 (Mallek and Groves 2008). Two observers participated in the survey, one left-seat pilot/observer and one right-seat observer (Ed Mallek and Debbie Groves, respectively).

Survey procedures followed established USFWS and CWS protocol for aerial waterfowl breeding population surveys (USFWS and CWS 1987). The centerline of each transect strip was flown at a height of 30-45 m (100-150 feet) above ground level and at a ground speed of 145-170 km/hr (90-105 miles/hr). Aircraft navigation to transect “start” and “end” waypoints and along the transect centerline was maintained using the aircraft Global Positioning System (GPS). The pilot and right-seat observer each recorded observations by species (or species group) within 200 m of the flight path on their side of the aircraft. Marks on the windows and wing struts were used to delineate the outer edges of transects. All birds (except shorebirds and small passerines) and large mammals observed within the transect strip were recorded. Each observation was recorded vocally to a sound file (.wav format), linked with simultaneous GPS coordinates, and saved to separate on-board computers for each observer, via custom software developed by John I. Hodges (USFWS, Migratory Bird Management, Juneau, AK). After the flight, a transcription program, also developed by John Hodges, was used to replay the sound files and combine the transcribed observation data with the geographic coordinates to produce a text data file. The transcribed text file was then used for data analyses.

Observations of waterfowl were recorded and summarized according to established survey protocol (USFWS and CWS 1987). For duck species, observations were recorded by the following categories: lone drakes, pairs, flocked drakes, and mixed-sex groups of five or more birds. Observations of one hen and two drakes were recorded as a pair and a lone drake. A hen and three drakes were recorded as a pair and two drakes. Observations of one to four hens were not recorded. Geese, swans, loons, and cranes were recorded as singles, pairs, or groups (flocks). The remaining bird and mammal species were recorded by number, and we differentiated between adults and calves for caribou and muskoxen.

The number of total indicated ducks was calculated for each species or species group by multiplying two times the sum of the number of lone drakes, drakes in flocks of two to four, and pairs, and adding this to the total number of grouped birds [i.e. $2 * (\text{drakes} \leq 4 + \text{pairs}) + \text{grouped birds}$]. For geese, the number of total indicated birds was calculated by multiplying the number of singles and pairs by two and adding the number of grouped birds. For the remaining bird species, the number of total indicated birds was simply the number of birds observed. Using the number of total indicated birds for each species or species group, densities, population indices, and variances were estimated with the ratio method (Cochran 1977, Smith 1995). To calculate population indices for species in the Diamond Jenness Peninsula area, we assumed that the densities and variances throughout the area were similar to those found within the sampled portion.

Population indices of northern pintail, long-tailed duck, red-breasted merganser, and green-winged teal were adjusted for incomplete detection using visibility correction factors (VCFs) that were developed for tundra habitats, derived from a 3-year helicopter/fixed-wing study on the Yukon-Kuskokwim Delta, Alaska in 1989-1991 (Conant et al. 1991, Smith 1995). These VCFs have been used in Alaska as constant adjustments to annually-obtained breeding population indices (Mallek and Groves 2008). King and common eider indices were not adjusted for incomplete detection because we do not have reliable VCFs for these species. The remaining bird and mammal indices were also not adjusted for incomplete detection.

RESULTS AND DISCUSSION

Population indices (adjusted by standard Alaska VCFs for a few species only) are presented by species and area in Tables 2 and 3. Population densities of total indicated birds and mammals (not adjusted for incomplete detection) are presented in Tables 4 and 5. Distributions of selected species within the survey area, displayed as locations of observations along the survey transects, are illustrated in Figures 2-5 and 7-17.

Canada/Cackling Goose

Canada/cackling geese breeding in the survey area are defined as belonging to the Short Grass Prairie Population (SGPP), based on banding work conducted on wintering, breeding, and staging areas (Arctic Goose Joint Venture 2008). The SGPP is composed of unknown proportions of lesser Canada geese (*Branta canadensis parvipes*) and Richardson's cackling geese (*B. hutchinsii hutchinsii*) (Arctic Goose Joint Venture 2008). The majority of these geese breeding in the survey area are likely *B. h. hutchinsii*.

Canada/cackling geese were widely distributed throughout the survey area and were the most abundant bird species (Figure 2, Table 2). The population index was 113,312 (Table 2). Densities were highest on the Tassijuak Lake (2.90/km²) and Kagloryuak River (2.68/km²) areas (Figure 2, Table 4). Of the total number of Canada/cackling geese observed, 14% were singles, 54% were paired, and 32% were in flocks (≥ 3 unpaired birds). Assuming a single bird represented a pair with an undetected mate on a nest, indicated pairs comprised 72% of the total indicated birds observed.

White-fronted Goose

The population index for greater white-fronted geese (*Anser albifrons*) was 9,543 (Table 2). White-fronted geese were found in small to moderate numbers in all surveyed areas with the exception of Tahiryuak Lake area, where we did not observe any in the sample area. Densities were highest in the Tassijuak Lake (0.59/km²) and Kagloryuak River (0.20/km²) areas (Figure 3, Table 4). Of the total number of white-fronted geese observed, 9% were singles, 38% were paired, and 53% were in flocks (≥ 3 unpaired birds). Assuming a single bird represented a pair with an undetected mate on a nest, indicated pairs comprised 51% of the total indicated birds observed.

Snow and Ross's Geese

This survey was not expected to provide an accurate population estimate of snow and Ross's geese (*Chen caerulescens*, *C. rossii*), due to their clumped distribution. However, we recorded these species when encountered, because the data may be useful for documenting changes in the distribution of colonies. We were not able to differentiate between the two species during the survey. Snow and Ross's geese were found in small numbers in all surveyed areas with the exception of Tahiryuak Lake area, where we did not observe any in the sample area (Table 2). The distribution of our observations is illustrated in Figure 4.

King Eider

The population index for king eiders (*Somateria spectabilis*) was 24,728 (Table 2). Densities were highest on the Tahiryuak Lake (0.78/km²) and Kagloryuak River (0.77/km²) areas (Figure 5, Table 4). Of the total number of king eiders observed, 19% were single drakes, 70% were paired, 5% were flocked drakes, and 6% were in mixed-sex groups of ≥ 5 birds. The overall ratio of lone drakes (drakes not associated with females) to total drakes (lone and paired drakes) was 0.41; the daily ratio fluctuated between 0.29 and 0.58 (Figure 6).

Long-tailed Duck

The unadjusted population index for long-tailed ducks (*Clangula hyemalis*) was 32,684, and the index adjusted with the standard Alaska VCF (1.87) was 61,121 (Table 2). The highest densities were found on the Tassijuak Lake (0.97/km²), Kagloryuak River (0.67/km²), and Diamond Jenness Peninsula (0.62/km²) areas (Figure 7, Table 4).

Tundra Swan

The population index for tundra swans (*Cygnus columbianus*) was 10,003 (Table 2). Densities were highest on the Kagloryuak River (0.47/km²) and Tassijuak Lake (0.36/km²) areas (Figure 8, Table 4). The nest index for tundra swans was 1,039 (Table 2). The highest nest densities were also on the Kagloryuak River (0.05/km²) and Tassijuak Lake (0.05/km²) areas (Table 4).

Northern Pintail

The unadjusted population index for northern pintails (*Anas acuta*) was 4,547, and the index adjusted with the standard Alaska VCF (3.05) was 13,869 (Table 2). The majority of pintails (89%) and the highest densities were observed on the Tassijuak Lake area (0.25/km²) and the Wollaston Peninsula (0.11/km²) (Figure 9, Table 4). Indicated breeding pairs comprised 63% of the total number of indicated birds observed.

Sandhill Crane

The population index for sandhill cranes (*Grus canadensis*) was 4,220 (Table 3). Densities were highest on the Tassijuak Lake area (0.23/km²), followed by the Wollaston Peninsula (0.08/km²) (Figure 10, Table 5).

Loons

Pacific loons (*Gavia pacifica*), red-throated loons (*G. stellata*), and yellow-billed loons (*G. adamsii*) were observed in the survey area. Population indices were 4,979 Pacific loons, 1,568 red-throated loons, and 2,671 yellow-billed loons (Table 3). Densities of Pacific loons were highest on the Tassijuak Lake area (0.18/km²), while the highest densities of red-throated loons were on the Tassijuak Lake (0.05/km²) and Quunnguq Lake (0.05/km²) areas (Figures 11 and 12, Table 5). Yellow-billed loon densities were similar (0.04-0.05/km²) in most areas, with a lower

density observed on the Kagloryuak River area (0.02/km²) and none observed on the Tahiryuak Lake area (Figure 13, Table 5).

Gulls/Arctic Tern/Jaegers

We had difficulty consistently identifying gulls to species, specifically when we were concentrating on waterfowl observations. Due to these inconsistencies we grouped gulls into three categories: unidentified large gulls, unidentified small gulls, and Sabine's gull (*Xema sabini*). Large gulls and Sabine's gulls were observed in most or all areas, while only a few small gulls were observed in the Kagloryuak River and Tassijuak Lake areas (Figures 14 and 15, Tables 3 and 5). Arctic terns (*Sterna paradisaea*) were observed in low numbers throughout the survey area (Figure 16, Tables 3 and 5). Jaegers (*Stercorarius* spp.), also grouped to minimize diversion from our focal species, were encountered in low numbers in all areas (Figure 17, Tables 3 and 5).

Ptarmigan/Common Raven/Raptors

Ptarmigan (*Lagopus* spp.), common ravens (*Corvus corax*), and raptors were observed throughout the survey area (Tables 3 and 5). The highest diversity of raptors was observed on the Tassijuak Lake area followed by the Wollaston Peninsula (Table 3).

Caribou/Muskox

Caribou (*Rangifer tarandus*) were observed throughout the survey area. Caribou indices were 9,103 adults and 1,279 calves (Table 3). Muskoxen (*Ovibos moschatus*) were observed throughout the survey area with the exception of the Tahiryuak Lake area, where we did not observe any within the sample area. Muskoxen indices were 19,037 adults and 1,554 calves (Table 3).

Miscellaneous

We had several observations of arctic foxes (*Vulpes lagopus*) and two observations of wolves (*Canis lupis*) in the survey area (Table 3). We observed one grizzly bear (*Ursus arctos*) on the Wollaston Peninsula that was outside our sampling transect.

RECOMMENDATIONS

The results obtained from this fourth consecutive year conducting fixed-wing aerial surveys in the central Canadian Arctic are encouraging. The terrain and flying-weather conditions we encountered in all four years were manageable. The remoteness and high latitude of the region did provide certain logistic challenges, including:

- 1) Extreme distances between airports
- 2) Lack of suitable off-airport landing surfaces (i.e., lakes that were large and deep enough to land on and take off from with a float-equipped aircraft were almost entirely ice-covered during the survey period)

3) Extremely sparse weather reporting and forecasting for the survey area

Given these characteristics of the region, we strongly recommend that single-engine fixed-wing aircraft surveying in this environment are turbine powered, equipped with amphibious floats, have an automated flight following (AFF) system on board, and have an installed aircraft satellite phone. The turbine engine delivers a significant increase in engine reliability over a piston engine, and the amphibious floats deliver increased safety (to the aircraft and occupants) in the unlikely event of a forced landing due to mechanical problems or weather. The AFF system allows real-time tracking of the aircraft (via a satellite phone data system), providing the aircraft's geographic location at all times. The aircraft satellite phone enables the pilot to call flight service in remote areas, allowing the pilot to get updated weather and forecasts and to update (shorten, extend, and close) flight plans.

ACKNOWLEDGEMENTS

This work was accomplished with the support of the Olokhaktomiut Hunters and Trappers Committee, Canadian Wildlife Service, U.S. Fish and Wildlife Service, Central Flyway Council, Seaduck Joint Venture, and Arctic Goose Joint Venture. We thank the Ulukhaktok Co-op Ltd. and the community of Ulukhaktok, especially Pat at the Ulukhaktok airport, Gary at Boaks Service, and folks at the Arctic Char Inn, for their kind and generous support during our stay. We also thank Lynne Dickson, Garnet Raven, Jim Hines, and Joel Ingram of CWS and Rob MacDonald of USFWS for their invaluable support and advice with survey design and logistics. This work was conducted under Northwest Territories Wildlife Research Permit WL005587 and Nunavut Wildlife Research Permit WL 2008-998.

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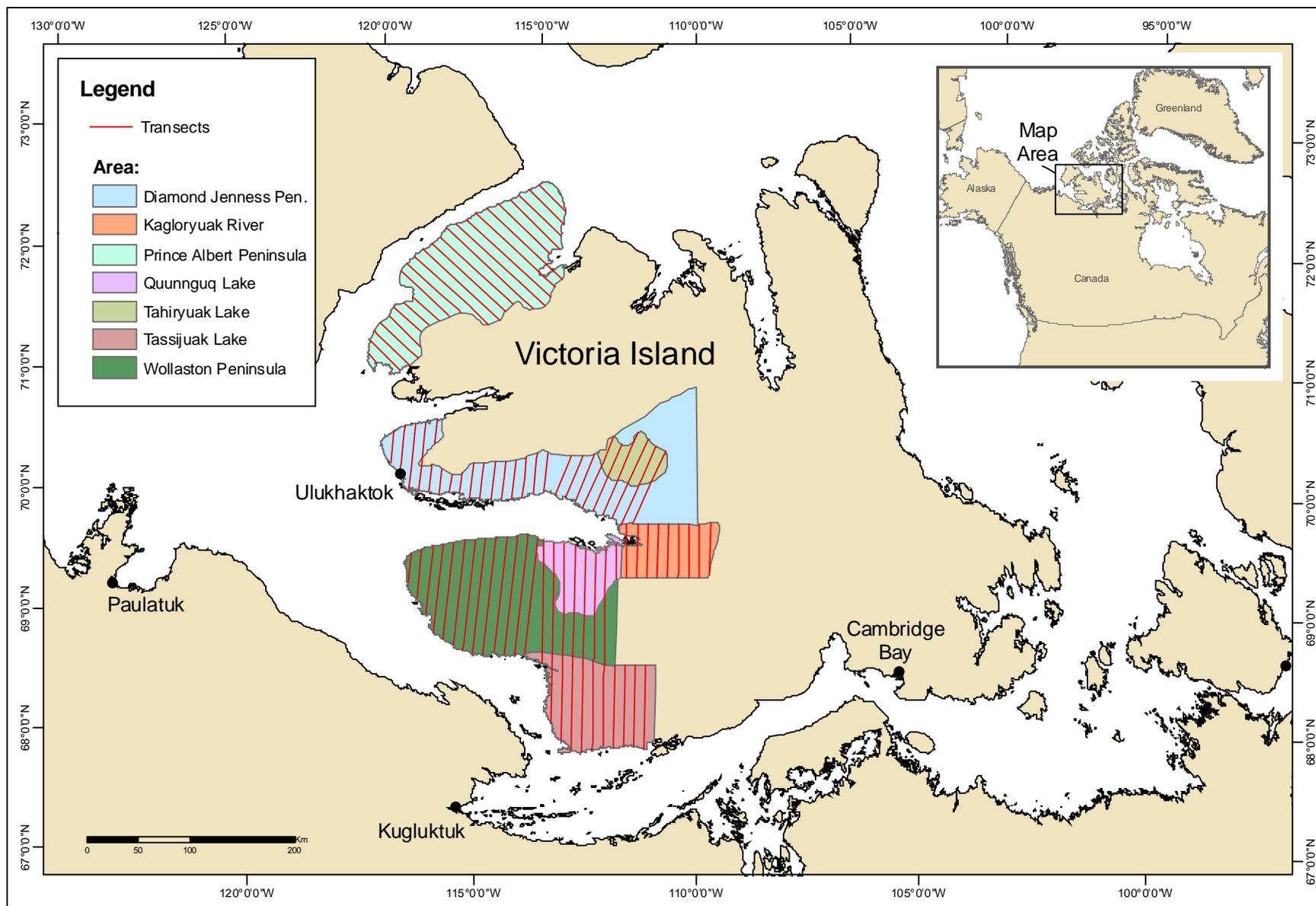


Figure 1. Transect lines within seven areas surveyed for wildlife by fixed-wing aircraft on western Victoria Island, Canada, 19 June-1 July 2008.

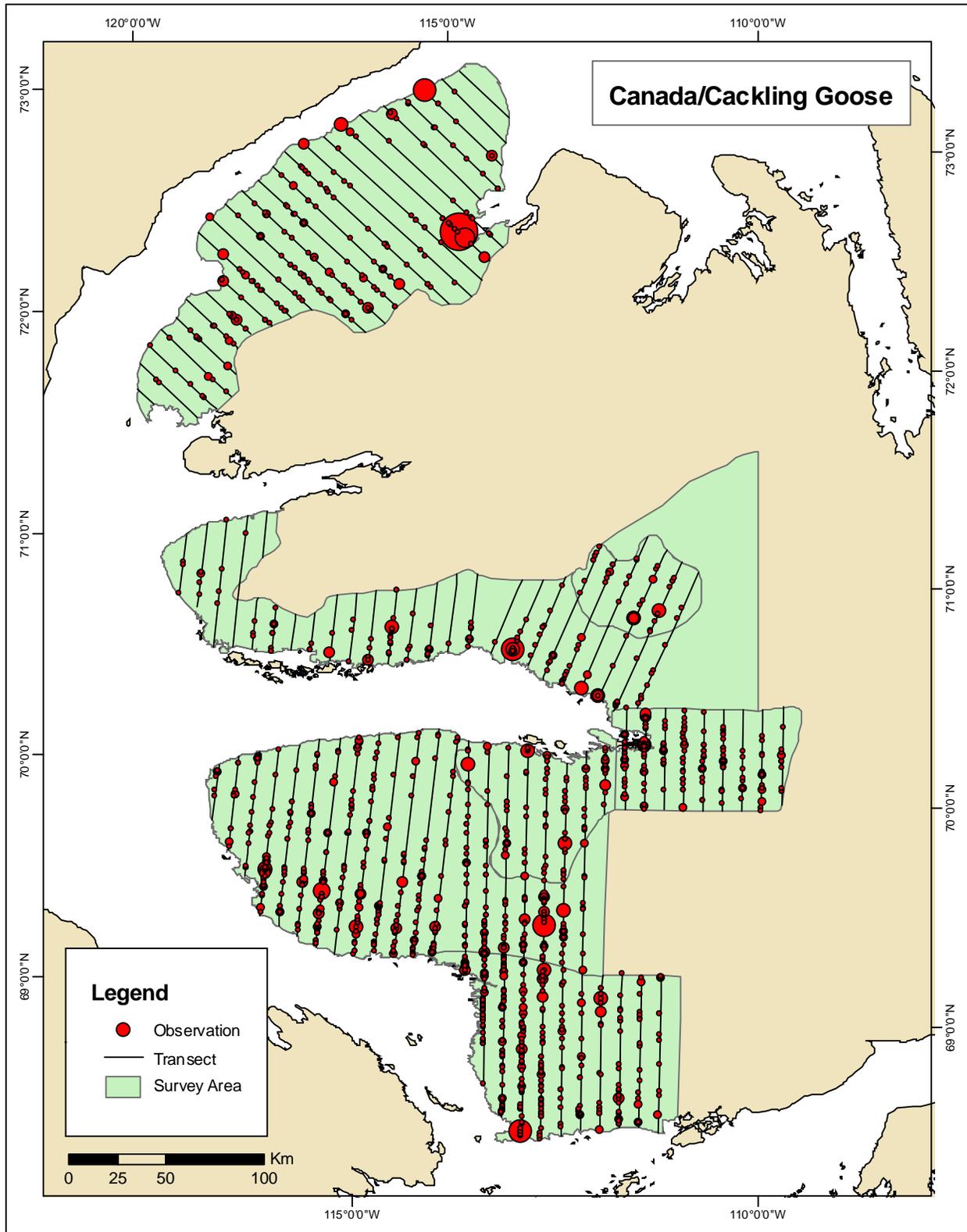


Figure 2. Locations of Canada/cackling goose observations in 2008. Symbol size is proportional to the number of birds observed.

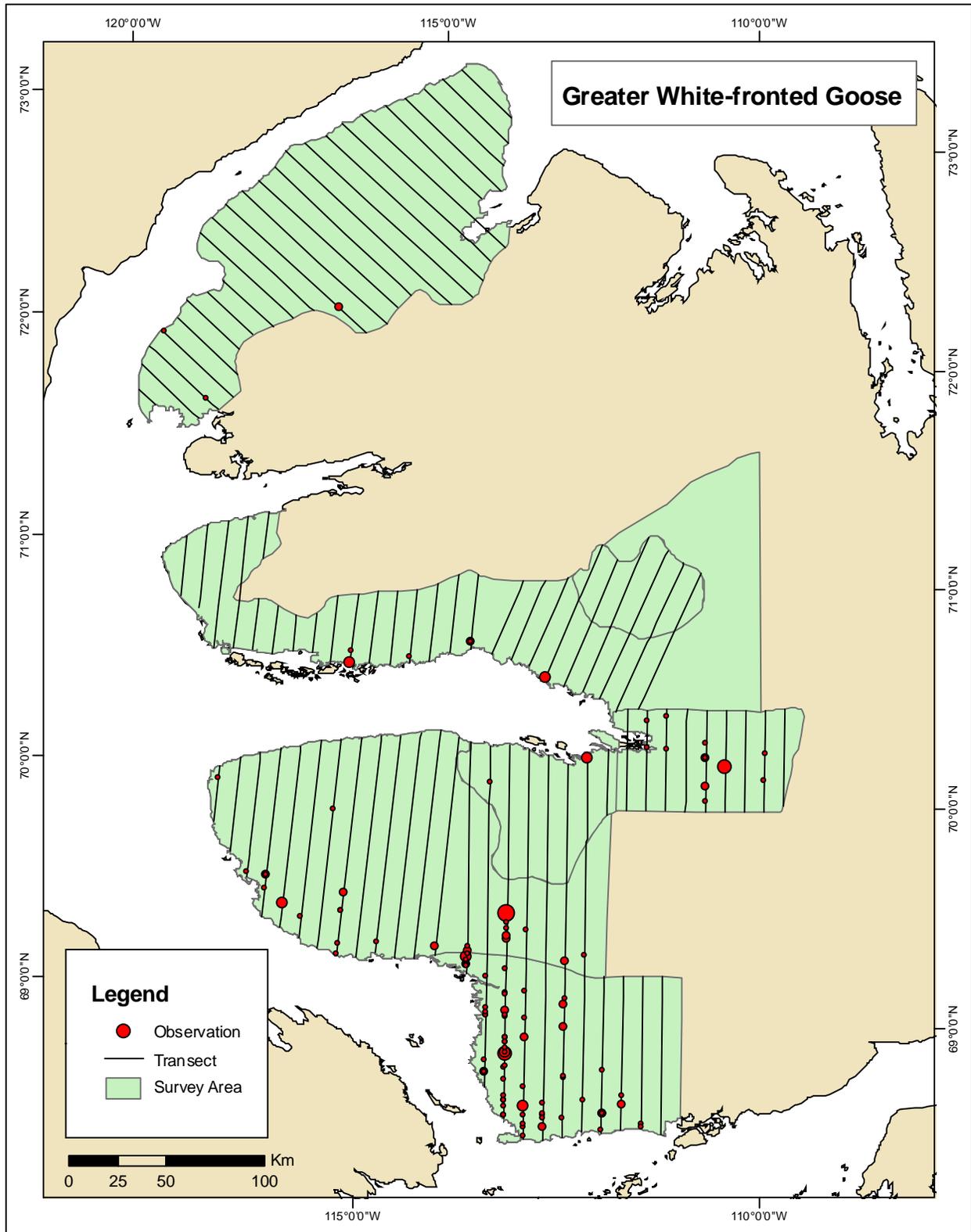


Figure 3. Locations of greater white-fronted goose observations in 2008. Symbol size is proportional to the number of birds observed.

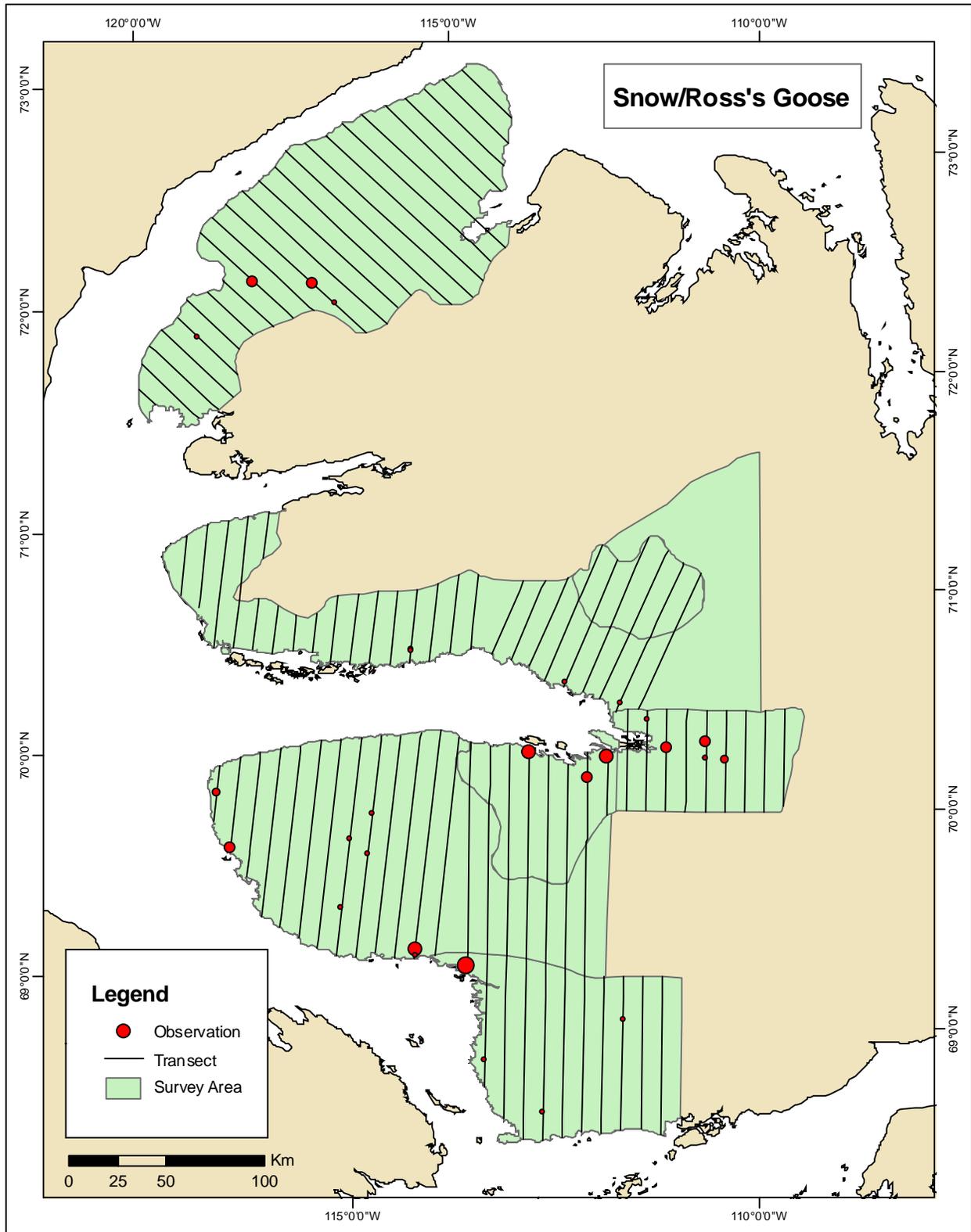


Figure 4. Locations of snow/Ross's goose observations in 2008. Symbol size is proportional to the number of birds observed.

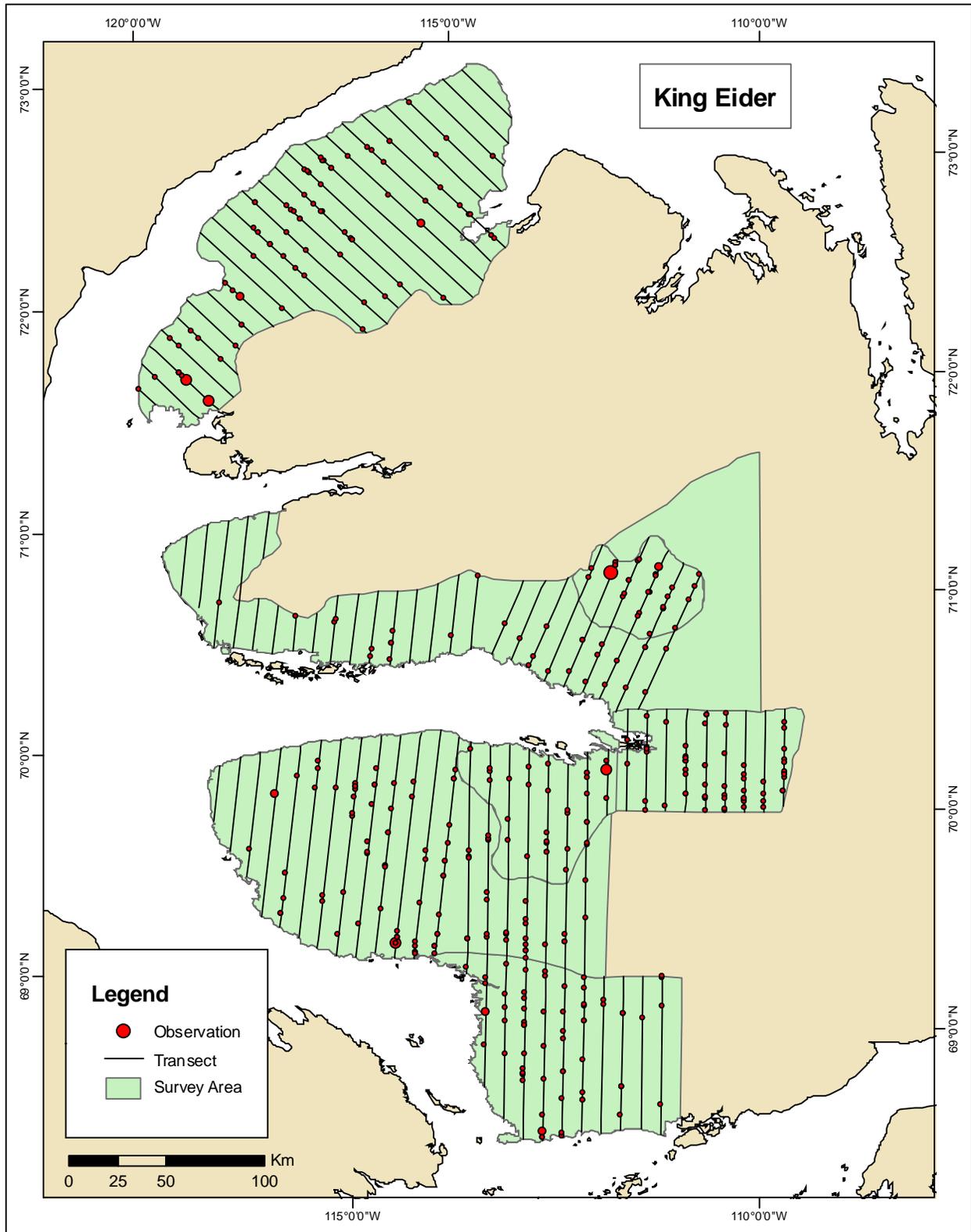


Figure 5. Locations of king eider observations in 2008. Symbol size is proportional to the number of birds observed.

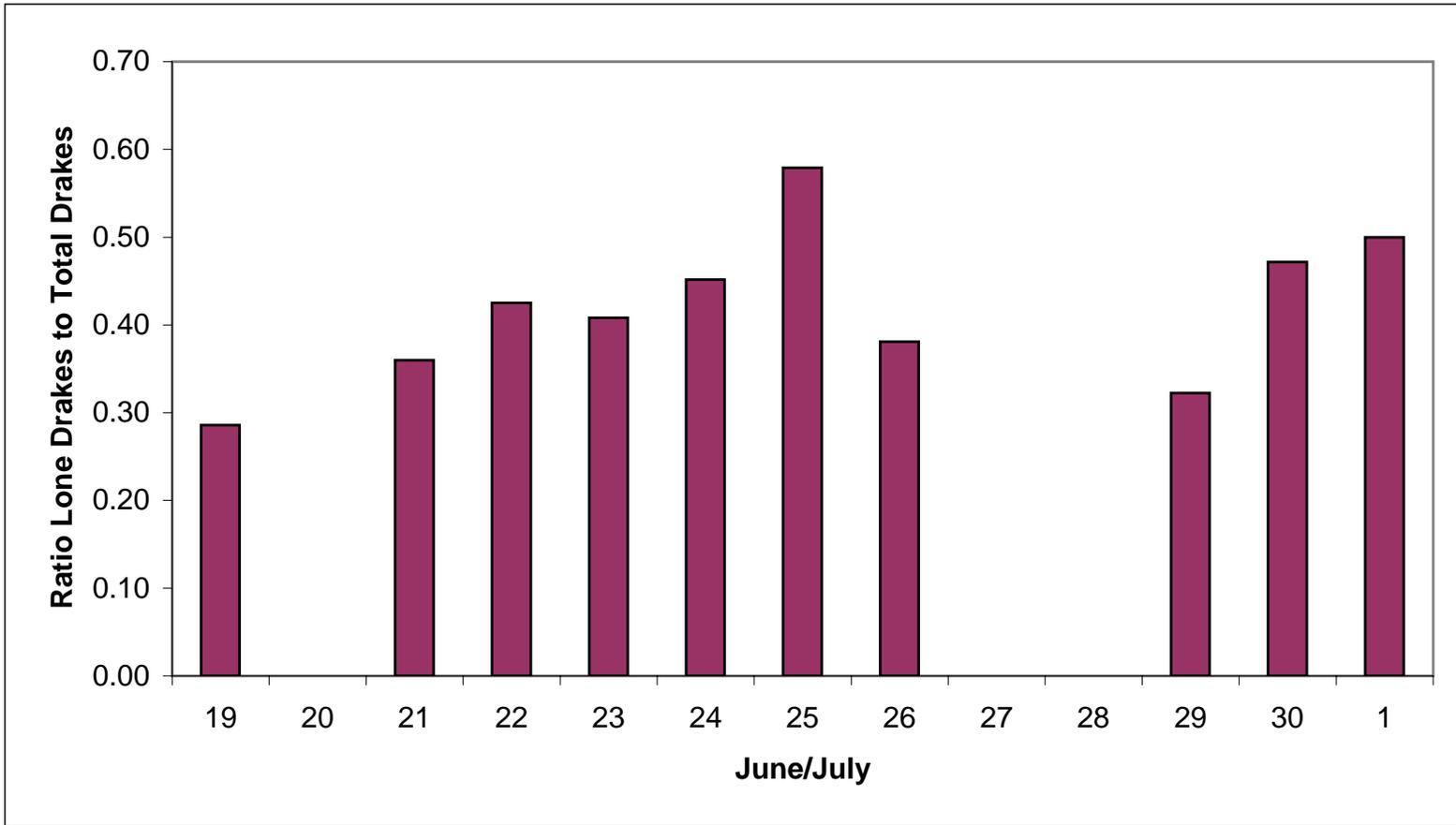


Figure 6. Daily ratios of lone drakes (drakes not associated with females) to total drakes for king eiders observed during the fixed-wing survey on western Victoria Island, Canada 19 June-1 July 2008. No survey was flown on 20, 27, or 28 June.

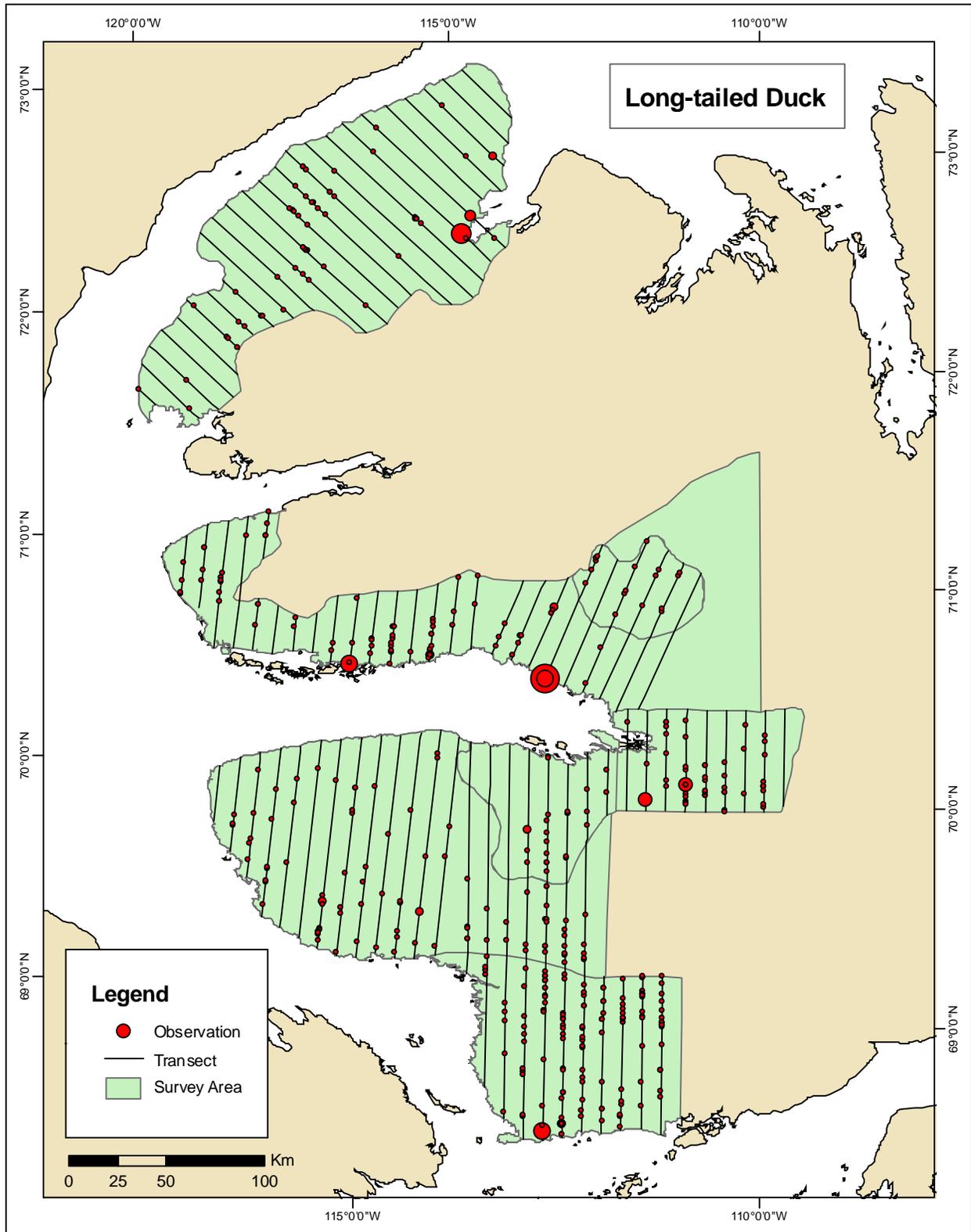


Figure 7. Locations of long-tailed duck observations in 2008. Symbol size is proportional to the number of birds observed.

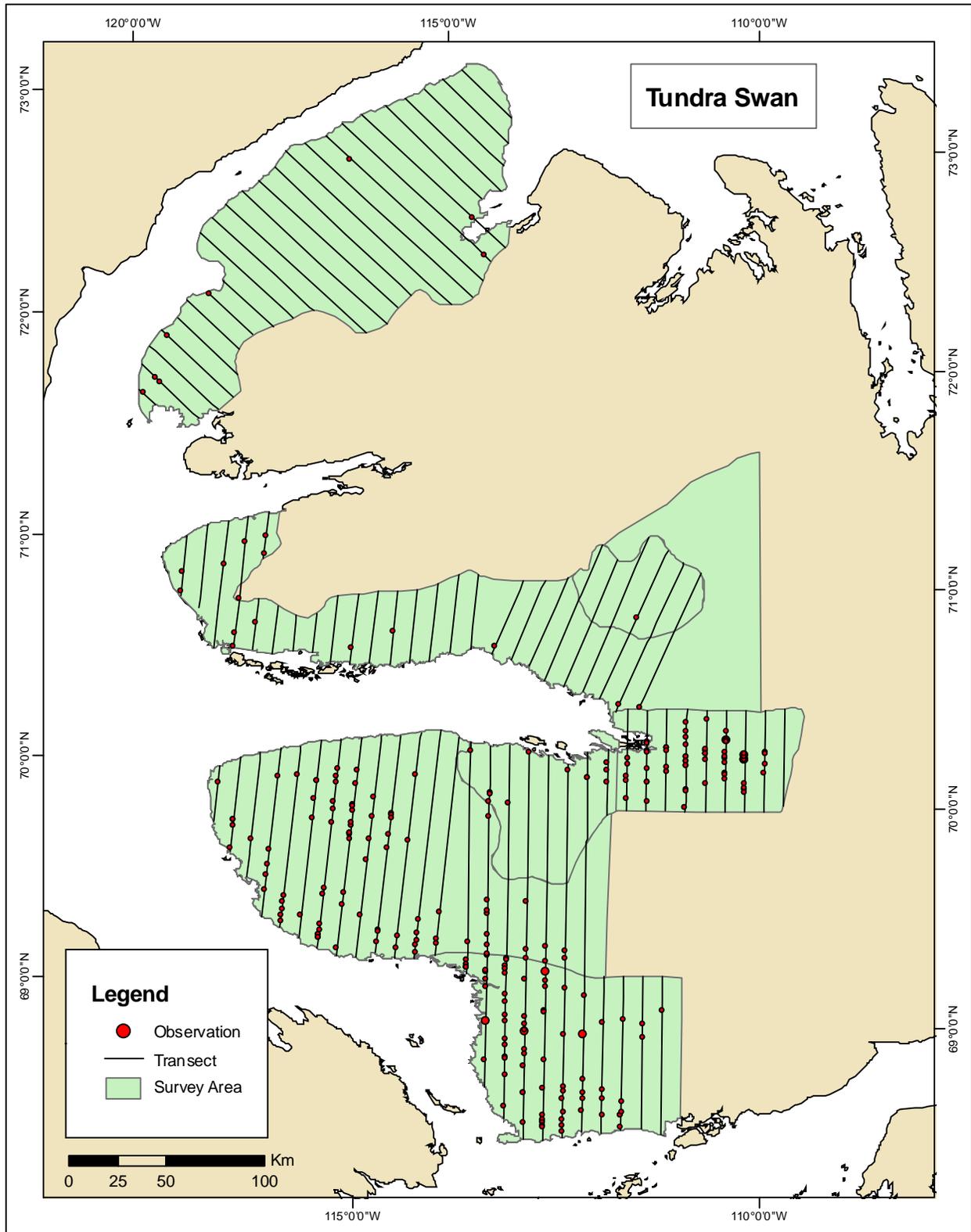


Figure 8. Locations of tundra swan observations in 2008. Symbol size is proportional to the number of birds observed.

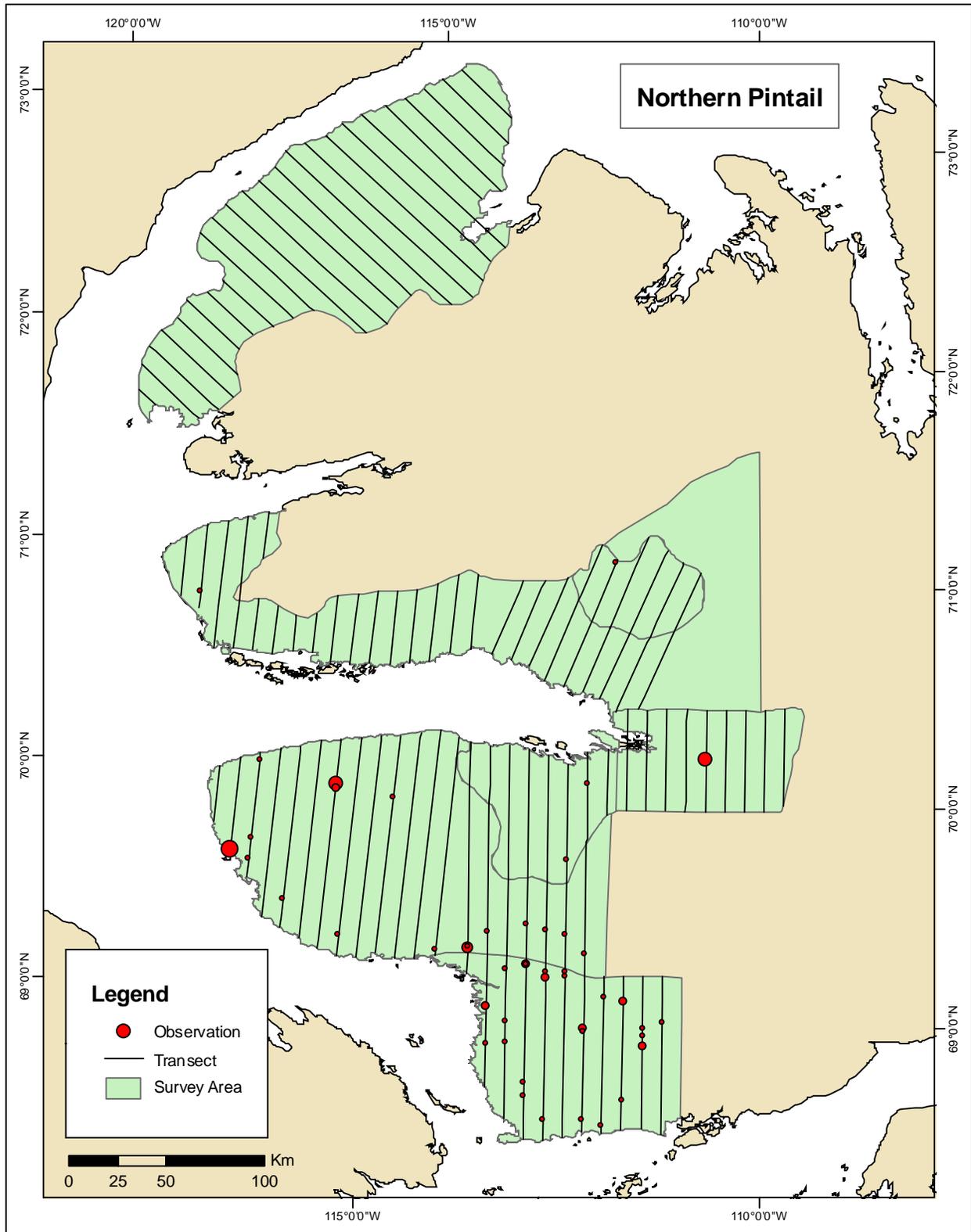


Figure 9. Locations of northern pintail observations in 2008. Symbol size is proportional to the number of birds observed.

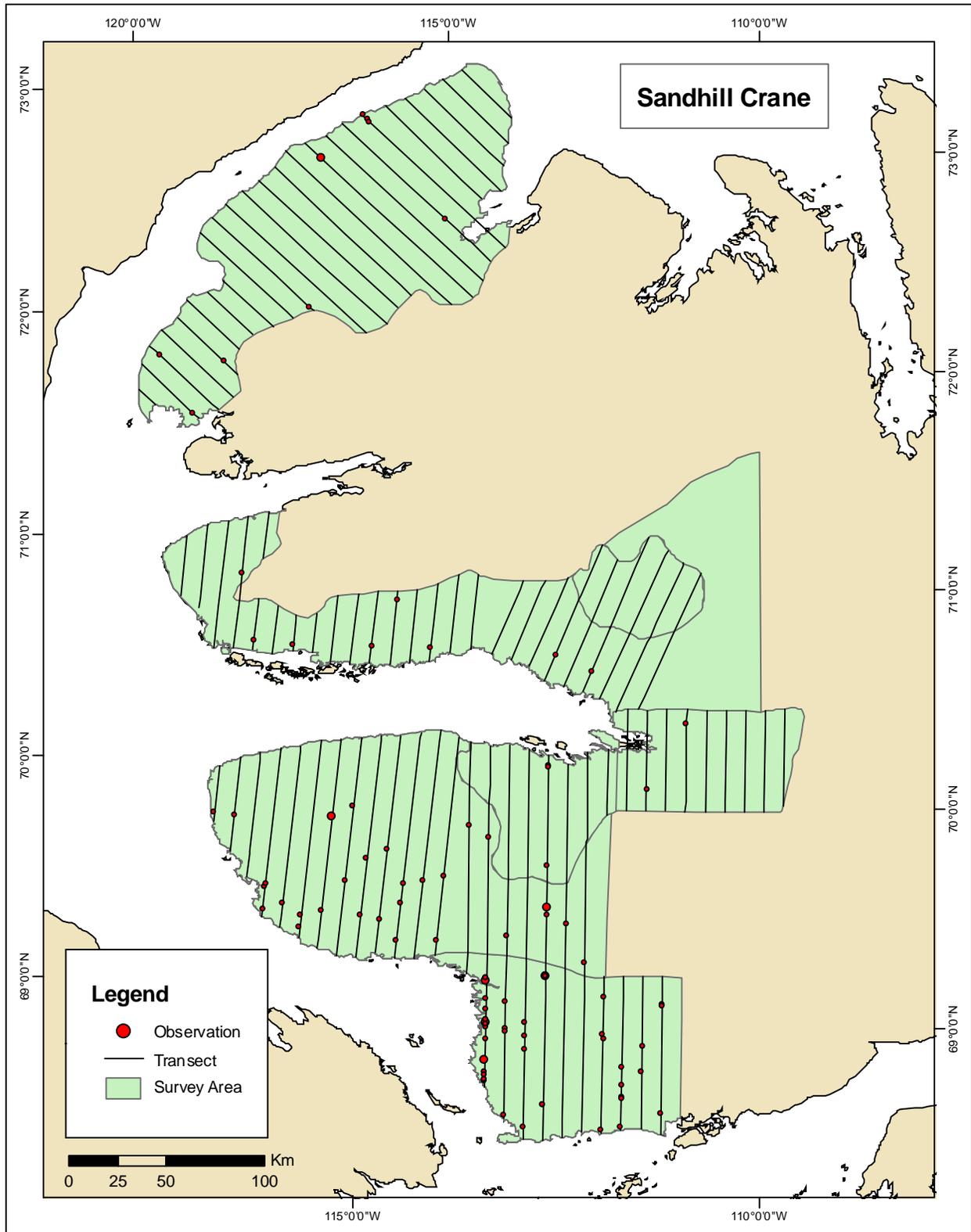


Figure 10. Locations of sandhill crane observations in 2008. Symbol size is proportional to the number of birds observed.

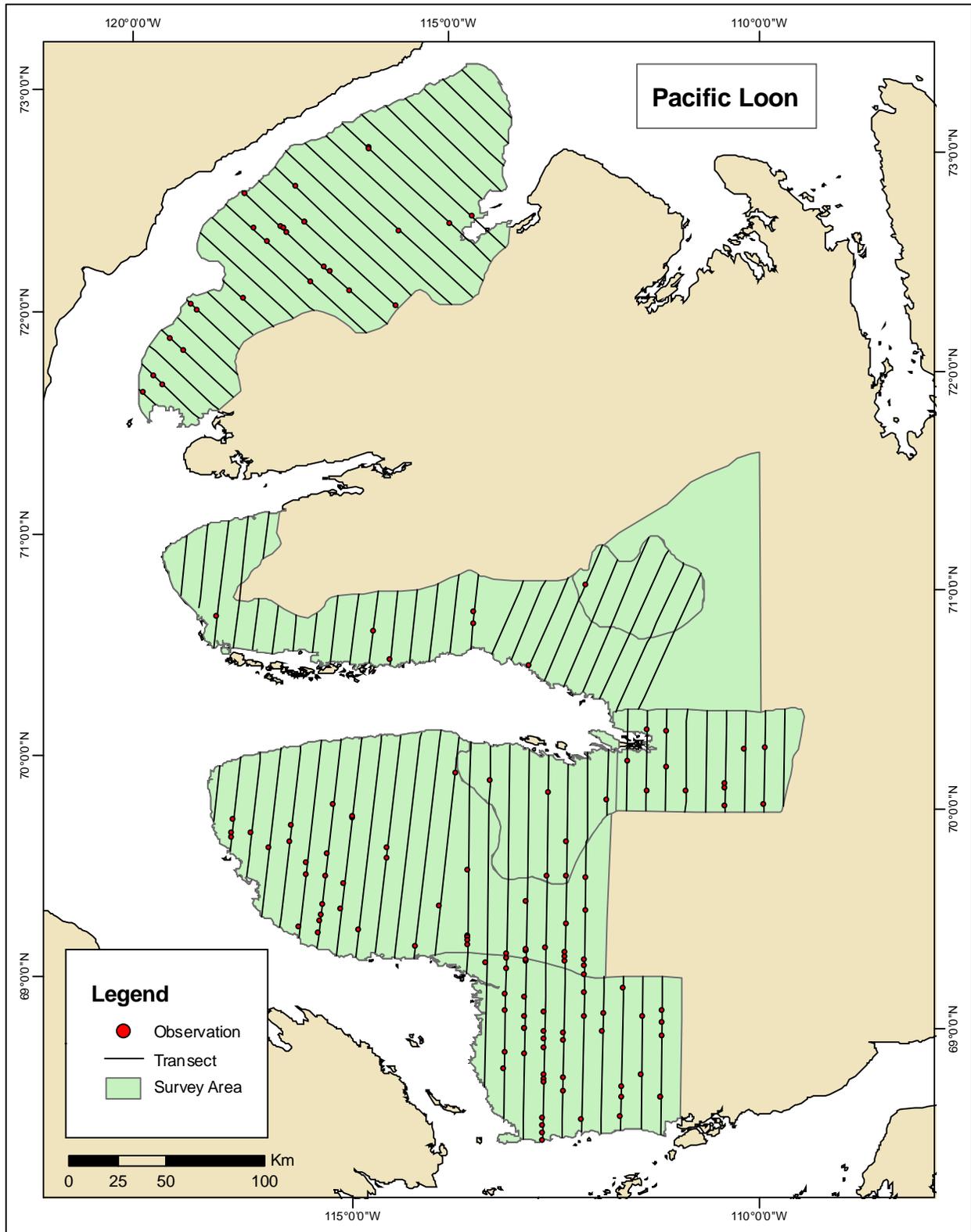


Figure 11. Locations of Pacific loon observations in 2008. Symbol size is proportional to the number of birds observed.

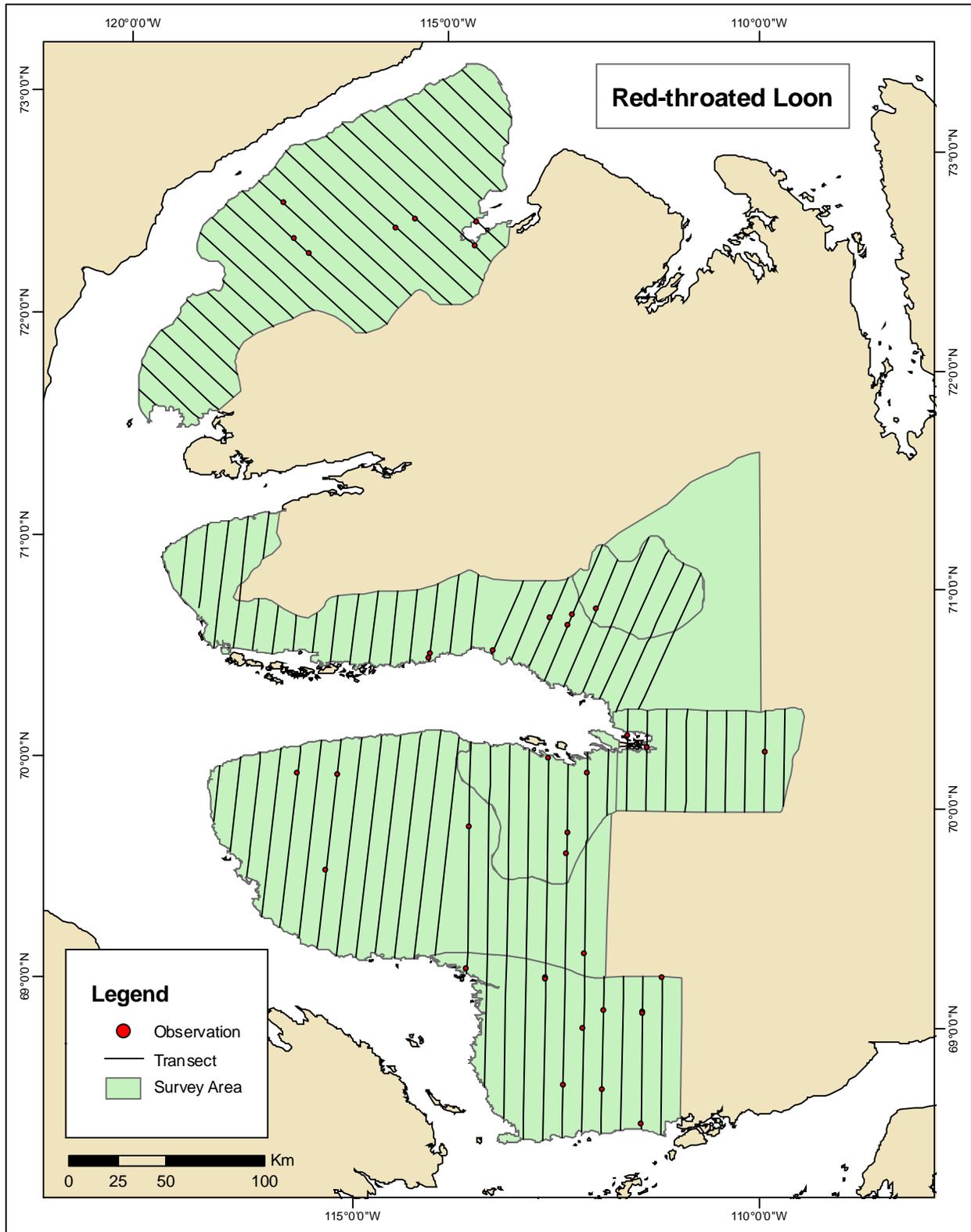


Figure 12. Locations of red-throated loon observations in 2008. Symbol size is proportional to the number of birds observed.

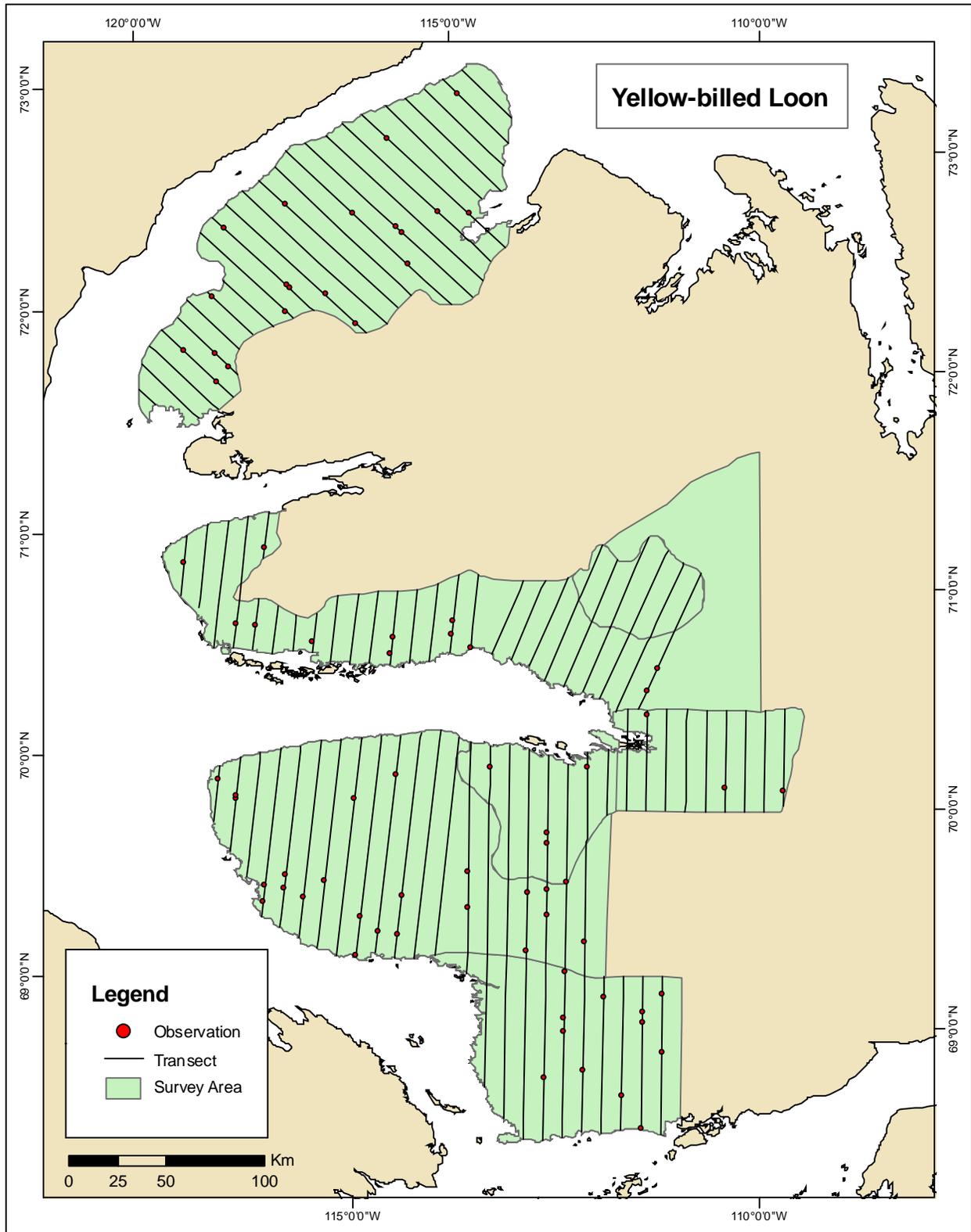


Figure 13. Locations of yellow-billed loon observations in 2008. Symbol size is proportional to the number of birds observed.

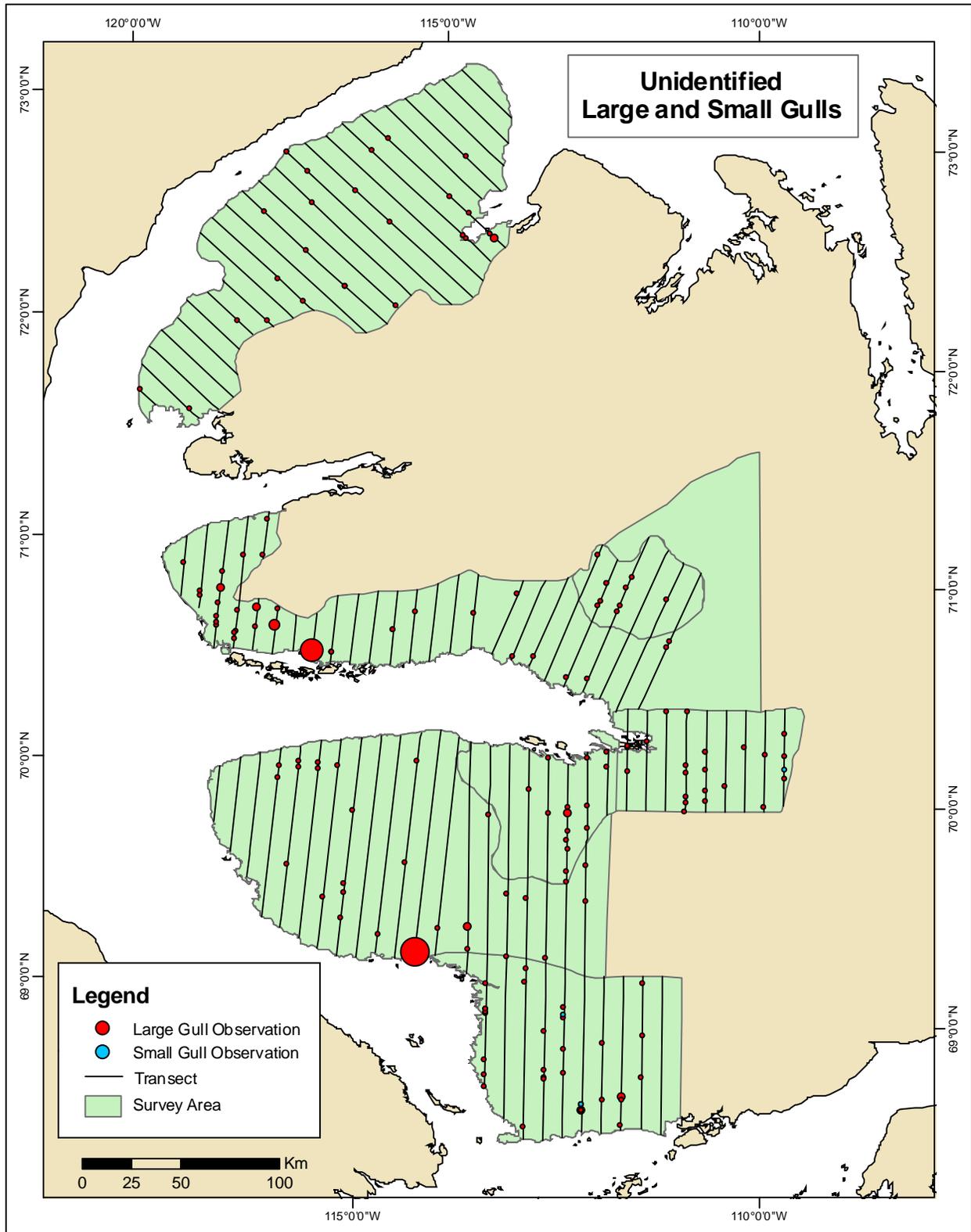


Figure 14. Locations of large and small gull observations (not identified to species) in 2008. Symbol size is proportional to the number of birds observed.

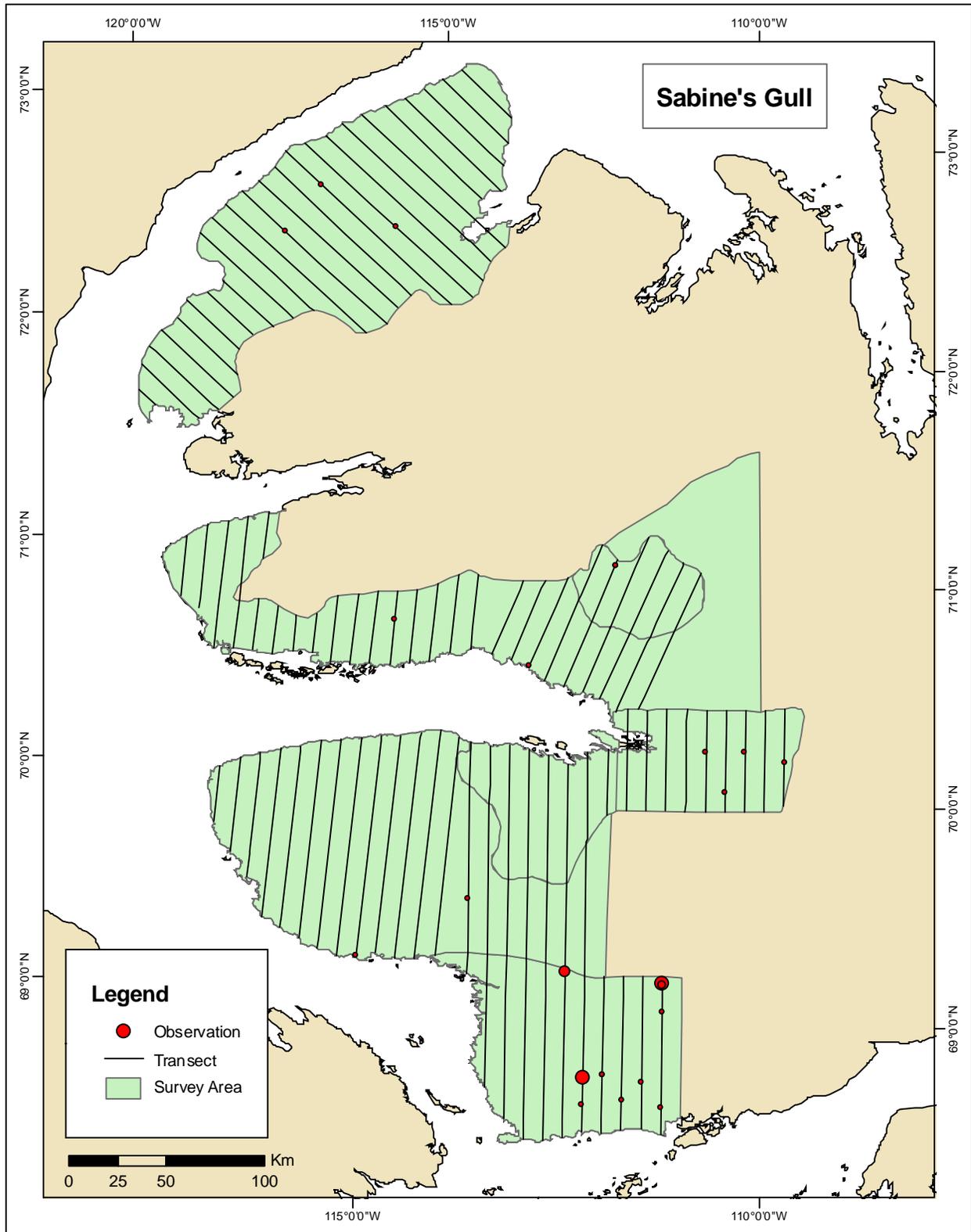


Figure 15. Locations of Sabine's gull observations in 2008. Symbol size is proportional to the number of birds observed.

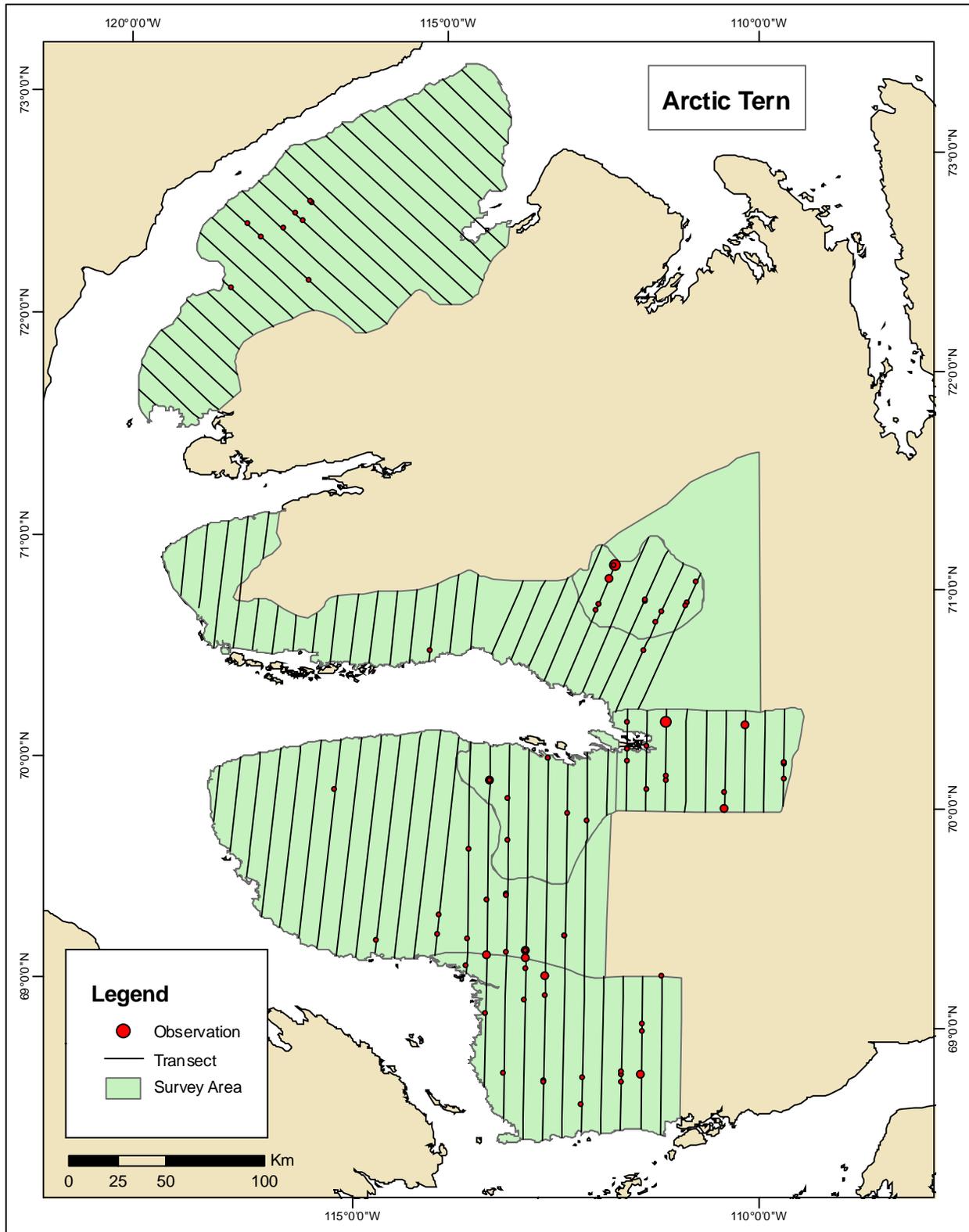


Figure 16. Locations of arctic tern observations in 2008. Symbol size is proportional to the number of birds observed.

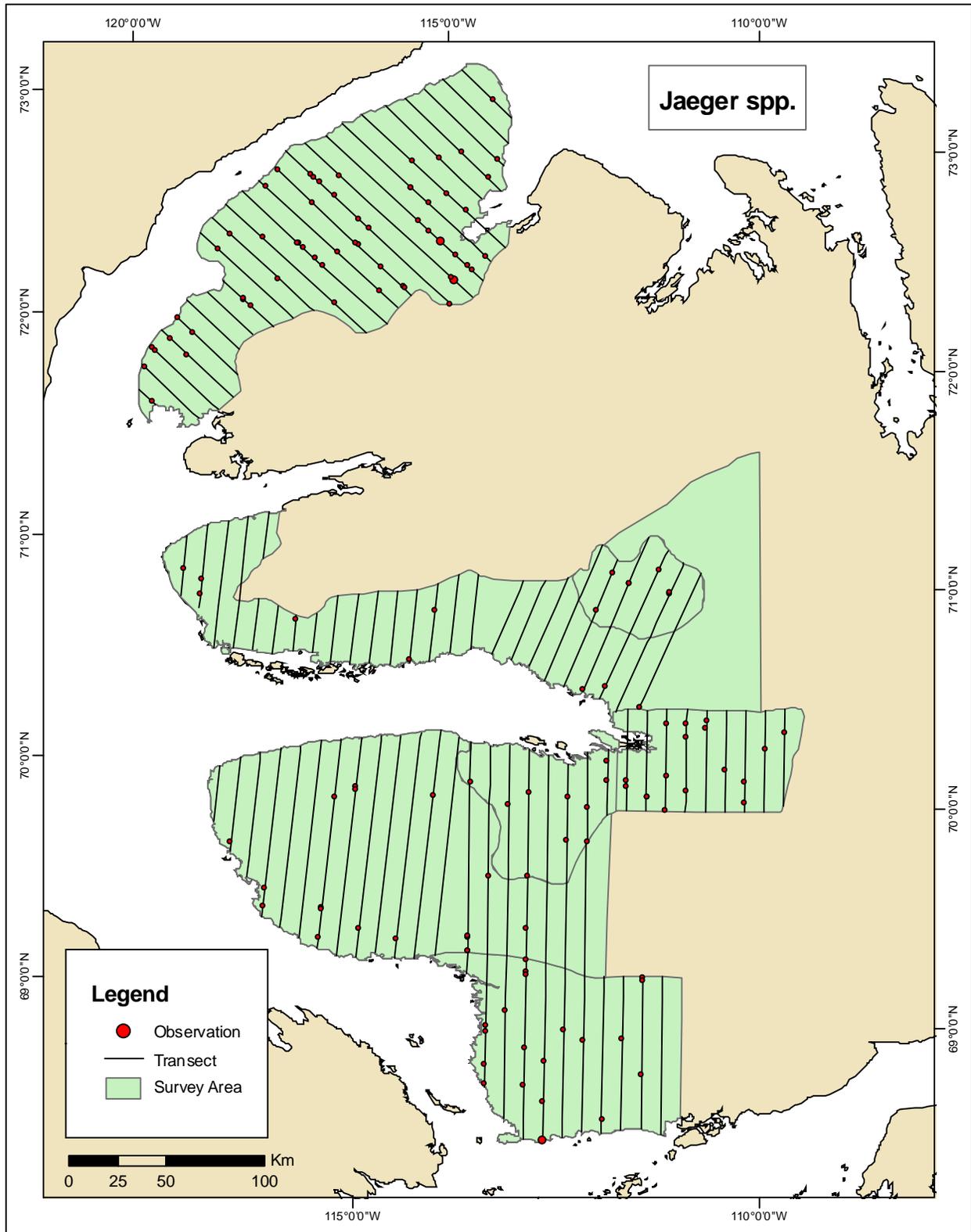


Figure 17. Locations of jaeger observations in 2008. Symbol size is proportional to the number of birds observed.

Table 1. Survey design used for fixed-wing aerial surveys of western Victoria Island, Canada in June 2008.

	Diamond Jenness Peninsula	Kagloryuak River	Prince Albert Peninsula	Quunnguq Lake	Tahiryuak Lake	Tassijuak Lake	Wollaston Peninsula	All Strata
Stratum Area (km ²)	15,964	4,545	16,422	3,980	2,370	8,691	16,644	68,617
No. Transects	26	9	24	8	6	11	20	104
Total Transect Length (km)	992.7	465.1	1,634.3	389.8	235.9	827.4	1,605.8	6,151.0
Transect Coverage (km ²)	397.1	186.0	653.7	155.9	94.4	331.0	642.3	2,460.4
% Coverage of Stratum	2.5	4.1	4.0	3.9	4.0	3.8	3.9	3.6

Table 2. Population indices, by area, of waterfowl from the fixed-wing survey on western Victoria Island, Canada, 19 June-1 July 2008. Singles birds (except tundra swans) were doubled when calculating estimates. Indices of selected species are presented both with and without visibility correction factors (VCFs) applied to adjust for incomplete detection. VCFs are from 1989-1991 fixed-wing vs. helicopter comparison surveys in Alaska tundra habitats (Conant et al. 1991).

Species	VCF	Diamond Jenness Peninsula		Kagloryuak River		Prince Albert Peninsula		Quunnguq Lake		Tahiryuak Lake		Tassijuak Lake		Wollaston Peninsula		Total	SE
		Peninsula	SE	River	SE	Peninsula	SE	Lake	SE	Lake	SE	Lake	SE	Peninsula	SE		
Canada/Cackling Goose	---	16,685	3,237	12,167	2,067	16,103	3,420	6,229	707	2,612	569	25,182	4,760	34,334	3,344	113,312	7,817
White-fronted Goose	---	965	527	928	403	226	140	204	162	0	0	5,121	1,805	2,099	754	9,543	2,077
Brant	---	0	0	0	0	0	0	0	0	0	0	315	319	0	0	315	319
Snow/Ross's Goose	---	322	191	611	312	452	279	791	423	0	0	578	462	855	405	3,609	876
Am. Green-winged Teal	---	0	0	0	0	0	0	0	0	0	0	53	52	52	51	105	73
Am. Green-winged Teal	8.36	0	0	0	0	0	0	0	0	0	0	439	431	433	425	872	605
Northern Pintail	---	80	80	269	268	0	0	102	66	50	52	2,206	319	1,840	673	4,547	800
Northern Pintail	3.05	245	244	820	819	0	0	311	203	153	158	6,728	1,094	5,611	2,090	13,869	2,522
Common Eider	---	965	489	49	49	754	344	408	311	0	0	840	335	207	123	3,223	764
King Eider	---	2,814	592	3,518	659	4,773	664	1,838	324	1,859	239	4,044	713	5,882	713	24,728	1,551
Long-tailed Duck	---	9,890	2,760	3,029	763	3,819	708	1,353	451	904	294	8,429	1,304	5,260	804	32,684	3,367
Long-tailed Duck	1.87	18,495	5,771	5,665	1,635	7,141	1,672	2,530	912	1,691	596	15,762	3,328	9,837	2,064	61,121	7,436
Red-breasted Merganser	---	0	0	0	0	327	334	0	0	0	0	0	0	0	0	327	334
Red-breasted Merganser	1.27	0	0	0	0	415	423	0	0	0	0	0	0	0	0	415	423
Tundra Swan	---	884	319	2,125	454	352	130	408	137	50	48	3,099	576	3,084	475	10,003	950
Tundra Swan Nest	---	40	39	244	93	25	25	77	42	0	0	394	131	259	81	1,039	190

Table 3. Population indices, by area, of additional bird and mammal species from the fixed-wing survey on western Victoria Island, Canada, 19 June-1 July 2008. Indices were not adjusted to account for incomplete detection.

Species	Diamond Jenness		Kagloryuak		Prince Albert		Quunnguq		Tahiryuak		Tassijuak		Wollaston		Total	SE
	Peninsula	SE	River	SE	Peninsula	SE	Lake	SE	Lake	SE	Lake	SE	Peninsula	SE		
Sandhill Crane	402	129	49	32	377	133	128	123	0	0	1,969	783	1,296	269	4,220	858
Pacific Loon	322	149	391	102	804	227	179	79	50	53	1,523	238	1,710	333	4,979	510
Red-throated Loon	362	198	98	53	251	83	204	102	25	26	446	143	181	86	1,568	296
Yellow-billed Loon	643	212	73	37	578	137	153	86	0	0	420	136	803	148	2,671	335
Sabine's Gull	121	88	147	64	75	38	0	0	75	78	1,155	526	78	56	1,651	547
Unidentified Large Gull	3,216	1,280	806	212	955	259	485	235	276	113	1,313	303	2,125	1,214	9,176	1,840
Unidentified Small Gull	0	0	24	25	0	0	0	0	0	0	53	35	0	0	77	43
Arctic Tern	80	56	708	211	276	113	306	108	578	366	972	266	518	187	3,439	559
Jaeger spp.	402	146	440	62	1,859	274	281	83	176	53	630	177	518	144	4,306	402
Ptarmigan spp.	80	56	513	166	352	142	26	26	50	47	551	105	389	121	1,961	282
Common Raven	322	170	73	52	25	26	0	0	0	0	26	26	104	57	550	190
Rough-legged Hawk	201	83	73	37	100	72	77	35	0	0	105	42	259	92	816	158
Bald Eagle	0	0	0	0	0	0	0	0	0	0	26	26	0	0	26	26
Golden Eagle	0	0	0	0	0	0	0	0	0	0	26	26	0	0	26	26
Gyr Falcon	0	0	0	0	0	0	0	0	0	0	53	52	26	25	78	58
Merlin	0	0	0	0	0	0	0	0	0	0	26	26	0	0	26	26
Peregrine Falcon	0	0	0	0	0	0	0	0	0	0	0	0	52	35	52	35
Short-eared Owl	80	56	98	38	201	66	0	0	0	0	79	40	52	36	510	109
Snowy Owl	0	0	0	0	50	34	0	0	25	24	0	0	0	0	75	42
Muskox Adult	5,508	1,267	1,906	643	3,819	911	1,174	702	0	0	3,676	675	2,954	736	19,037	2,083
Muskox Calf	563	228	122	122	427	159	102	69	0	0	210	101	130	54	1,554	332
Caribou Adult	362	140	1,417	519	75	53	1,455	276	251	84	1,733	276	3,809	556	9,103	872
Caribou Calf	0	0	147	64	0	0	485	133	50	47	79	55	518	137	1,279	215
Arctic Fox	0	0	0	0	25	25	0	0	0	0	26	26	26	27	77	45
Wolf	0	0	0	0	0	0	0	0	0	0	53	35	0	0	53	35

Table 4. Population densities (number per km²), by area, of waterfowl from the fixed-wing survey on western Victoria Island, Canada, 19 June-1 July 2008. Densities were not adjusted to account for incomplete detection.

Species	Diamond Jenness Peninsula		Kagloryuak River		Prince Albert Peninsula		Quunnguq Lake		Tahiryuak Lake		Tassijuak Lake		Wollaston Peninsula	
		SE		SE		SE		SE		SE		SE		SE
Canada/Cackling Goose	1.045	0.203	2.677	0.455	0.981	0.208	1.565	0.178	1.102	0.240	2.897	0.548	2.063	0.201
White-fronted Goose	0.060	0.033	0.204	0.089	0.014	0.008	0.051	0.041	0.000	0.000	0.589	0.208	0.126	0.045
Brant	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.036	0.037	0.000	0.000
Snow/Ross's Goose	0.020	0.012	0.134	0.069	0.028	0.017	0.199	0.106	0.000	0.000	0.066	0.053	0.051	0.024
Am. Green-winged Teal	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.006	0.006	0.003	0.003
Northern Pintail	0.005	0.005	0.059	0.059	0.000	0.000	0.026	0.017	0.021	0.022	0.254	0.037	0.111	0.040
Common Eider	0.060	0.031	0.011	0.011	0.046	0.021	0.103	0.078	0.000	0.000	0.097	0.039	0.012	0.007
King Eider	0.176	0.037	0.774	0.145	0.291	0.040	0.462	0.081	0.784	0.101	0.465	0.082	0.353	0.043
Long-tailed Duck	0.620	0.173	0.667	0.168	0.233	0.043	0.340	0.113	0.381	0.124	0.970	0.150	0.316	0.048
Red-breasted Merganser	0.000	0.000	0.000	0.000	0.020	0.020	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Tundra Swan	0.055	0.020	0.468	0.100	0.002	0.002	0.103	0.034	0.021	0.020	0.357	0.066	0.185	0.029
Tundra Swan Nest	0.003	0.002	0.054	0.020	0.021	0.008	0.019	0.011	0.000	0.000	0.045	0.015	0.016	0.005

Table 5. Population densities (number per km²), by area, of additional bird and mammal species from the fixed-wing survey on western Victoria Island, Canada, 19 June-1 July 2008. Densities were not adjusted to account for incomplete detection.

Species	Diamond Jenness		Kagloryuak		Prince Albert		Quunnguq		Tahiryuak		Tassijuak		Wollaston	
	Peninsula	SE	River	SE	Peninsula	SE	Lake	SE	Lake	SE	Lake	SE	Peninsula	SE
Sandhill Crane	0.025	0.008	0.011	0.007	0.023	0.008	0.032	0.031	0.000	0.000	0.227	0.090	0.078	0.016
Pacific Loon	0.020	0.009	0.086	0.022	0.049	0.014	0.045	0.020	0.021	0.022	0.175	0.027	0.103	0.020
Red-throated Loon	0.023	0.012	0.022	0.012	0.015	0.005	0.051	0.026	0.011	0.011	0.051	0.016	0.011	0.005
Yellow-billed Loon	0.040	0.013	0.016	0.008	0.035	0.008	0.038	0.022	0.000	0.000	0.048	0.016	0.048	0.009
Sabine's Gull	0.008	0.005	0.032	0.014	0.005	0.002	0.000	0.000	0.032	0.033	0.133	0.061	0.005	0.003
Unidentified Large Gull	0.201	0.080	0.177	0.047	0.058	0.016	0.122	0.059	0.117	0.048	0.151	0.035	0.128	0.073
Unidentified Small Gull	0.000	0.000	0.005	0.005	0.000	0.000	0.000	0.000	0.000	0.000	0.006	0.004	0.000	0.000
Arctic Tern	0.005	0.003	0.156	0.046	0.017	0.007	0.077	0.027	0.244	0.154	0.112	0.031	0.031	0.011
Jaeger spp.	0.025	0.009	0.097	0.014	0.113	0.017	0.071	0.021	0.074	0.022	0.073	0.020	0.031	0.009
Ptarmigan spp.	0.005	0.003	0.113	0.036	0.021	0.009	0.006	0.007	0.021	0.020	0.063	0.012	0.023	0.007
Common Raven	0.020	0.011	0.016	0.011	0.002	0.002	0.000	0.000	0.000	0.000	0.003	0.003	0.006	0.003
Rough-legged Hawk	0.013	0.005	0.016	0.008	0.006	0.004	0.019	0.009	0.000	0.000	0.012	0.005	0.016	0.006
Bald Eagle	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.003	0.000	0.000
Golden Eagle	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.003	0.000	0.000
Gyr Falcon	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.006	0.006	0.002	0.002
Merlin	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.003	0.000	0.000
Peregrine Falcon	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.003	0.002
Short-eared Owl	0.005	0.004	0.022	0.008	0.012	0.004	0.000	0.000	0.000	0.000	0.009	0.005	0.003	0.002
Snowy Owl	0.000	0.000	0.000	0.000	0.003	0.002	0.000	0.000	0.011	0.010	0.000	0.000	0.000	0.000
Muskox Adult	0.345	0.079	0.419	0.142	0.233	0.055	0.295	0.176	0.000	0.000	0.423	0.078	0.177	0.044
Muskox Calf	0.035	0.014	0.027	0.027	0.026	0.010	0.026	0.017	0.000	0.000	0.024	0.012	0.008	0.003
Caribou Adult	0.023	0.009	0.312	0.114	0.005	0.003	0.366	0.069	0.106	0.035	0.199	0.032	0.229	0.033
Caribou Calf	0.000	0.000	0.032	0.014	0.000	0.000	0.122	0.034	0.021	0.020	0.009	0.006	0.031	0.008
Arctic Fox	0.000	0.000	0.000	0.000	0.002	0.002	0.000	0.000	0.000	0.000	0.003	0.003	0.002	0.002
Wolf	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.006	0.004	0.000	0.000