DISTRIBUTION AND ABUNDANCE OF BIRDS ON WESTERN VICTORIA ISLAND, 2004

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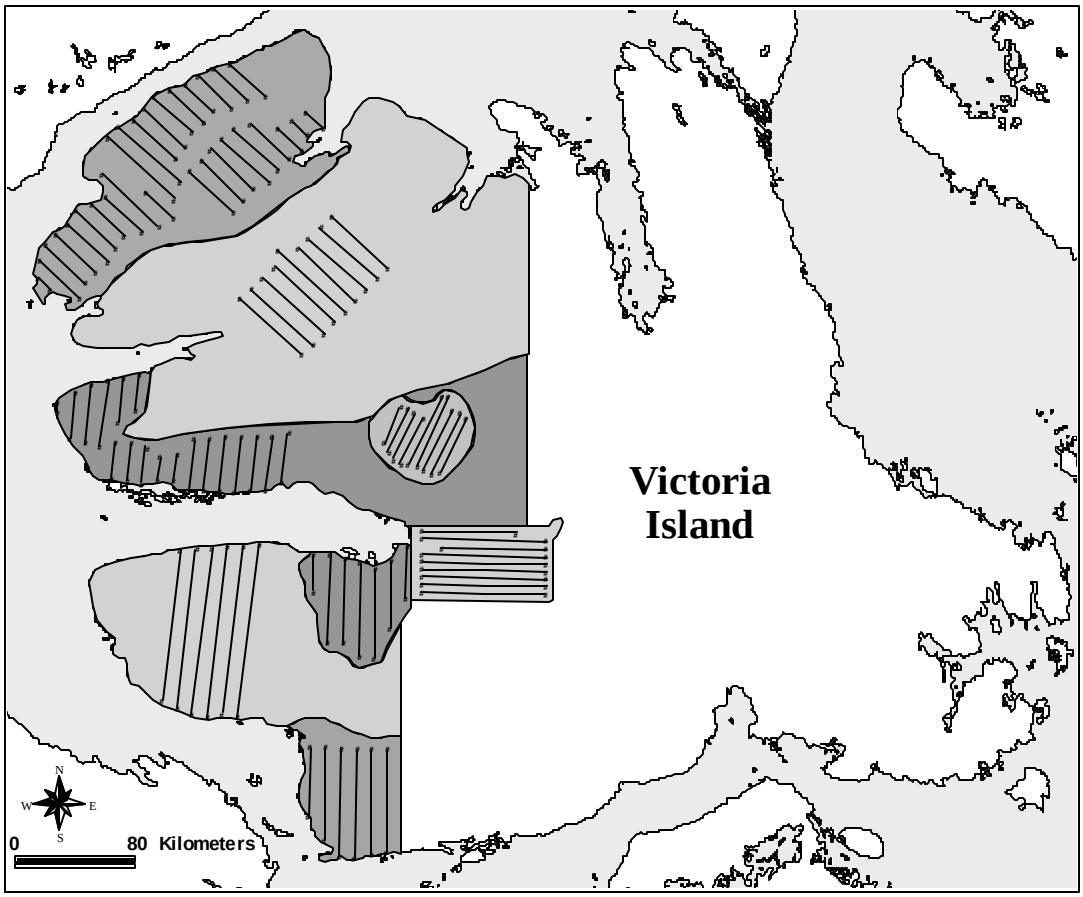

INTRODUCTION

Current North American waterfowl breeding population surveys do not adequately cover breeding grounds for King Eiders and Long-tailed Ducks within Canada. In recognition of this problem, as well as growing evidence that both species were in decline, breeding waterfowl surveys were conducted in a core area for King Eiders from 1992 to 1994 to establish a baseline for comparison in future years. These surveys were repeated in 2004 to allow comparisons among years and provide population trends for King Eiders, Long-tailed Ducks, Canada Geese, and other bird species nesting on western Victoria Island. This report summarizes those results as well as spatially quantifying bird densities, thus providing useful information on important areas and habitats.

METHODS

The study area for the 2004 aerial surveys was western Victoria Island and was divided into 8 different strata (Table 1; Fig. 1) based on physiographic and habitat similarities. Landsat Thematic Mapper satellite imagery was used to determine the boundaries of strata based on vegetation cover and moisture (Cornish and Dickson, 1996). Plots were surveyed within each stratum to represent each of the dominant habitat types.

To allow comparisons between these surveys and those conducted 1992 to 1994, the same methods were used (Cornish and Dickson, 1996). Due to the immense size of several strata, plots were used to sample areas within each stratum. Straight line transects were flown within plots for each of the strata at a spacing of 10 km (4% plot coverage), except in strata 2 and strata 3 where the spacing was 5 km (8% plot coverage). Transect spacing within stratum 8 was 5 km in 1993 and 10 km in 2004. Transect length varied between 6 and 116 km while between 6 and 29 transects were flown per stratum (Fig. 2).

The surveys were conducted from a Bell 206B helicopter flown at a height of 30 m above ground and at a speed of 145 kph. In addition to the pilot there were two observers, one in the left front seat and one in the rear right seat. Each observer recorded all birds within 200 m of their side of the helicopter. Species, number, and when possible, sex of birds were recorded as well as the time of the observation. By recording observations on a cassette tape recorder observers never had to look away from transects. FUGAWI GIS mapping software (Northport Systems Inc., Toronto, Ontario, Canada) logged all aircraft movements and provided real time locations at 2 second intervals, which could later be merged with observations. At the beginning of each day and at intervals throughout the day survey conditions (snow cover, percentage of open water) and weather (temperature, wind speed and direction, cloud cover, precipitation) were recorded. Dates of surveys in 2004 were 18 to 28 June.

Population estimates for King Eider and Canada Geese were based on total indicated birds, whereas all other population estimates were based on the observed number of birds. The standard operating procedure for waterfowl breeding population surveys, developed by the U.S. Fish and Wildlife Service and the Canadian Wildlife Service (Anonymous 1997), was used to calculate the indicated breeding population of King Eiders. King Eider observations were divided into the following categories: lone males, flocks of two to four males, pairs, and groups of five or more birds. Observations of one hen and two drakes were treated as a pair and a lone

drake. Likewise, a hen and three drakes were treated as a pair and two drakes. The number of indicated breeding pairs was calculated by adding together the number of lone males, males in flocks of two to four, and pairs. Total indicated birds was calculated by multiplying the number of indicated breeding pairs by two and adding the number of grouped birds. Observations of one to four females were not included in the calculations.

For all species, the population index, density, and standard error for each stratum were calculated using the ratio method (Jolly 1969:48; Cochran 1977:155). Where only a portion of a stratum was surveyed, we assumed that the density and variance within the survey plot was representative of the entire stratum. The total population of a species within a stratum was calculated by multiplying the density by the stratum area. The population variance was calculated by multiplying the density variance by the square of the area (Beyer 1968:15). The total population for numerous strata was calculated by taking the sum of the population estimates for each stratum. Likewise, the variance for more than one stratum was calculated by summing the variances of each included stratum (Caughley 1977:614), and the standard error was calculated by taking the square root of the sum of the variances.

Locations and numbers of certain species observed were imported into ArcView 3.1 (Environmental Systems Research Institute, Inc., Redlands, California, U.S.A.). Observed numbers (indicated numbers for King Eiders and Canada Geese) were divided by the proportion of the plot that was surveyed to represent assumed observations given entire survey coverage. For example, values were divided by 0.04 for plots where transects were flown every 10 km and values were divided by 0.08 for plots where transects were flown every 5 km (strata 2 and 3). Density was calculated and mapped using these location values and a 10 km search radius. Five strata were defined for each mapped species according to density of birds within the search radius.

RESULTS

King Eider

Western Victoria Island density indices for King Eider in 2004 were lower in nearly all strata than were observed in 1992 – 1994 (Table 2). Population indices for both northwestern and southwestern portions of the island were approximately half of those indicated in the previous surveys (Table 3). Highest densities occurred in the Kagloryuak River valley (stratum 2), around Tahiruak Lake (stratum 3), and in northeastern portions of Prince Albert Peninsula (stratum 6: Fig. 3).

Canada Goose

Density (Table 2) and population indices (Table 3) for Canada Geese were very comparable to those observed in the 1992 - 1994 surveys. Highest densities (1.5-2.1/km^2) were found near Tassijuak Lake (stratum 8) in southwestern Victoria Island (Fig. 4). The southern portion of Wollaston Peninsula (stratum 7) and western portions of the Kagloryuak River valley (stratum 2) also had densities > 1/km^2.

Long-tailed Duck

Densities of Long-tailed Ducks in 2004 were similar to previous surveys in most strata (Table 2). Population indices for 2004 were below those observed in 1992 and 1993 but very similar to those from 1994 (Table 3). Distribution of Long-tailed Ducks was scattered and widespread but highest densities (0.25-0.5/km^2) were found in the southern portion of stratum 8, the western portion of stratum 2, and the northern portion of stratum 3 (Fig. 5).

Tundra Swan

Tundra Swan densities in 2004 were lower in most strata than those observed in 1992 – 1994 (Table 2). Of special note is the considerably lower density index of stratum 8 for 2004 compared to 1993 results. Population indices were less than half of previous estimates in both northwestern and southwestern Victoria Island (Table 3). Tundra swans were widely distributed over the southern half of Victoria Island but rare in the northern half (Fig. 6). Highest densities (> 0.25/km^2) were found in portions of the Kagloryuak River valley (stratum 2) and near Tassijuak Lake (stratum 8) in the southwestern extreme of Victoria Island (Fig. 6).

Sandhill Crane

Sandhill Crane population indices for 2004 were lower than those observed 1992 – 1994 for northwestern Victoria Island (Table 3). However, indices for southwestern Victoria Island in 2004 were very similar to those observed in 1993.

Common Eider

Common Eiders were observed in the coastal areas of strata 1,4,6,7, and 8. Highest densities in 2004 were observed in stratum 8 (Table 2). Population indices were much lower than those observed in 1992 but similar to those from 1993 and 1994 (Table 3).

Other Geese

Black Brant were observed only in stratum 2 in 2004 (Table 2). Though rare, Brant were more plentiful in previous surveys (Table 2; Table 3).

Greater White-fronted Geese were found primarily in the southern two strata (7 and 8) in 2004 at low densities and at numbers comparable to those observed in the previous surveys (Table 2; Table 3).

Snow Geese occurred in low densities throughout the southern half of Victoria Island in numbers similar to those observed in the previous surveys (Table 2; Table 3).

Ptarmigan

Rock and Willow Ptarmigan could not reliably be distinguished from the aircraft so the two species were combined. They were observed throughout western Victoria Island but in low densities (Table 2). Highest densities were observed in the Kagloryuak River valley (stratum 2). Population indices were slightly lower than those observed in previous surveys (Table 3).

Loons

Three species of loons were observed on western Victoria Island in 2004. Yellow-billed Loon was most numerous in 2004, followed by Pacific Loon, and Red-throated Loon (Table 3). Overall, population indices were very similar to those observed in 1992 but slightly lower than

those observed in 1993 and 1994. Highest densities of loons in general were found around Quunnguq Lake in stratum 1 (0.3-0.5/km^2) but strata 6 and 7 also had pockets of > 0.2 loons/km^2. Strata 2 and 3 had consistent densities of 0.025-0.2 loons/km^2 (Fig. 7).

Jaegers

Three species of jaegers were observed on western Victoria Island in 2004. Population indices were much lower than those observed in 1992 and 1993 but similar to those observed in 1994 (Table 3). Long-tailed Jaegers were observed throughout the study area (Table 2). Pomarine Jaegers were more prevalent in the southern half of Victoria Island while Parasitic Jaegers were observed more frequently in the northern half (Table 2). In general, jaegers were distributed throughout the study area with highest densities (0.3-0.5/km^2) observed in the northern portion of stratum 6 (Fig. 8).

Gulls

Population indices for Glaucous Gulls in 2004 were well below estimates from earlier surveys (Table 2; Table 3). Thayer's Gull observations were rare and limited to strata 2 and 4 (Table 2) in 2004. Sabine's Gull population indices for 2004 were 50 – 70% lower than in previous surveys (Table 3) but had a similar distribution (Table 2).

Arctic Tern

2004 population indices for Arctic Tern were below those of previous surveys (Table 2; Table 3). 2004 indices are approximately 10% of those observed in 1994 (Table 3).

Raptors

A single Snowy Owl was observed in 2004 in stratum 5. This is well below the number of Snowy Owls observed in previous surveys. A short-eared owl was observed in stratum 6 in 2004. Rough-legged Hawks were observed scattered throughout western Victoria Island in 2004 but less frequent in the northwest portion of the island than in previous surveys (Table 2; Table 3). Single observations of Peregrine Falcons were recorded in stratum 6 and stratum 7 in 2004.

DISCUSSION

Preliminary results from the 2004 aerial surveys on western Victoria Island show some species may have declined in numbers since the surveys were last performed in 1992, 1993, and 1994. In particular, population indices for both King Eiders and Tundra Swans are approximately half of what was observed previously. It was a late spring on western Victoria Island in 2004 and this may have affected the results observed for earlier nesting species like the Tundra Swan that may have been unable to nest due to late snow cover. Timing of the surveys attempts to capture the majority of male King Eiders on the breeding grounds. However, due to the late spring, surveys may have occurred prior to arrival of some King Eiders on their breeding areas. A second year of surveys is recommended to help determine whether the count obtained in 2004 is representative of the current number breeding on western Victoria Island.

ACKNOWLEDGEMENTS

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Table 1. Extent of aerial surveys for breeding populations of birds on western Victoria Island, 1992 – 1994, and 2004.

Stratum			Transects surveyed							
			2004		1992		1993		1994	
No.	Location	Area (km^2)	No.	Length (km)	No.	Length (km)	No.	Length (km)	No.	Length (km)
1	Quunnguq Lake	3971	7	324	7	172	7	324	7	324
2	Kagloryuak River Valley	4573	9	688	8	608	9	688	9	688
3	Tahiryuak Lake	2298	9	322	8	282	9	322	9	322
4	Diamond Jenness Peninsula	15866	18	527	24	817	18	527	21	709
5	Minto Inlet to Wynniatt Bay	39676	9	476	16	690	6	338	9	476
6	Prince Albert Peninsula	16365	29	983	29	964	26	914	29	983
7*	Wollaston Peninsula	16596	6	662	-	-	6	662	-	-
8*	Tassijuak Lake	5508	6	392	-	-	12	799	-	-

* surveyed only in 1993 and 2004

Table 2. Density (number per 100 sq km) of birds observed in each stratum during aerial surveys on Victoria Island, 1992 – 1994, and 2004. Numbers in brackets represent standard errors.

		Stratum							
SPECIES	Year	1	2	3	4	5	6	7	8
Pacific Loon	2004	3.1 (2.0)	3.3 (1.4)	3.9 (2.1)	1.4 (1.0)	0.5 (0.5)	2.5 (1.0)	0.0 (0.0)	1.9 (1.4)
	1992	2.9 (1.7)	9.0 (2.7)	8.0 (4.5)	1.8 (1.0)	1.2 (1.6)	5.9 (4.7)	ns -	ns -
	1993	11.6 (3.3)	9.8 (2.1)	8.5 (5.1)	5.2 (1.5)	3.0 (2.8)	6.9 (6.1)	4.5 (1.7)	8.4 (1.9)
	1994	2.3 (1.5)	17.4 (2.3)	10.9 (5.1)	12.3 (3.0)	3.2 (1.6)	5.8 (2.5)	ns -	ns -
Red-throated Loon	2004	3.1 (2.1)	4.4 (1.9)	0.8 (0.7)	0.0 (0.0)	0.5 (0.5)	2.0 (0.9)	0.8 (0.5)	0.0 (0.0)
	1992	0.0 (0.0)	3.3 (1.9)	1.8 (1.2)	0.9 (0.5)	0.0 (0.0)	0.9 (1.3)	ns -	ns -
	1993	0.0 (0.0)	0.7 (0.5)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.9 (1.0)	0.0 (0.0)	0.9 (0.6)
	1994	1.5 (1.5)	2.5 (1.6)	0.0 (0.0)	1.4 (1.4)	0.0 (0.0)	1.1 (1.2)	ns -	ns -
Yellow-billed Loon	2004	8.5 (2.0)	0.4 (0.3)	3.1 (3.0)	0.9 (0.6)	2.1 (1.1)	2.3 (1.1)	1.1 (0.8)	1.3 (1.2)
	1992	0.0 (0.0)	0.0 (0.0)	0.9 (0.9)	0.6 (0.6)	0.8 (1.6)	3.1 (2.7)	ns -	ns -
	1993	0.0 (0.0)	2.2 (1.7)	0.8 (0.8)	1.4 (0.7)	0.7 (0.7)	3.7 (1.6)	0.8 (0.5)	1.3 (0.7)
	1994	1.5 (0.9)	0.4 (0.3)	0.0 (0.0)	0.7 (0.7)	0.5 (0.5)	1.6 (1.7)	ns -	ns -
All Loon sp.	2004	17.0 (4.3)	9.8 (2.6)	8.5 (3.1)	2.8 (1.1)	3.7 (1.3)	7.4 (1.6)	6.4 (1.8)	3.2 (1.6)
	1992	2.9 (1.7)	16.9 (3.0)	13.3 (5.1)	4.0 (1.2)	2.5 (2.8)	10.5 (6.6)	ns -	ns -
	1993	13.1 (4.2)	14.2 (2.1)	9.3 (5.3)	8.5 (1.6)	5.2 (3.1)	15.2 (6.5)	5.3 (1.5)	11.9 (2.0)
	1994	8.5 (3.3)	24.3 (4.6)	11.6 (5.2)	17.3 (3.5)	6.3 (2.3)	11.8 (2.4)	ns -	ns -
Tundra Swan	2004	8.5 (1.1)	16.0 (5.4)	3.1 (1.8)	1.4 (1.0)	0.0 (0.0)	0.5 (0.3)	9.4 (3.7)	8.3 (3.8)
	1992	5.8 (5.7)	34.5 (6.5)	5.3 (4.3)	5.5 (1.2)	1.1 (1.8)	2.0 (1.9)	ns -	ns -
	1993	10.8 (6.1)	28.3 (3.1)	7.0 (1.7)	6.6 (2.4)	0.0 (0.0)	1.3 (1.2)	13.2 (4.1)	37.5 (5.7)
	1994	13.9 (3.0)	41.4 (4.2)	4.7 (2.5)	5.3 (2.0)	1.1 (1.0)	0.2 (0.4)	ns -	ns -
Canada Goose*	2004	55.6 (11.2)	86.8 (14.5)	29.5 (7.7)	36.5 (7.0)	4.2 (1.7)	24.9 (3.9)	74.4 (7.3)	121.2 (24.4)
	1992	23.3 (9.8)	153.4 (24.6)	38.1 (11.6)	58.1 (7.7)	10.9 (7.9)	10.9 (5.1)	ns -	ns -
	1993	94.9 (18.1)	151.2 (28.6)	29.5 (5.6)	19.4 (6.3)	1.5 (1.5)	6.5 (3.4)	65.7 (3.9)	148.3 (14.0)
	1994	66.4 (6.2)	187.1 (12.9)	48.1 (8.8)	45.5 (8.8)	7.4 (3.1)	16.0 (6.4)	ns -	ns -

Table 2. (continued)

SPECIES	Year	Stratum 1	2	3	4	5	6	7	8
Brant	2004	0.0 (0.0)	1.1 (1.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
	1992	0.0 (0.0)	4.5 (4.3)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	6.1 (7.1)	ns -	ns -
	1993	0.0 (0.0)	1.5 (0.9)	0.0 (0.0)	1.9 (1.9)	0.0 (0.0)	3.3 (3.1)	1.1 (1.1)	0.3 (0.3)
	1994	0.8 (0.8)	11.3 (8.7)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	2.6 (5.0)	ns -	ns -
Greater White	2004	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.5 (0.5)	0.0 (0.0)	0.0 (0.0)	1.5 (0.5)	8.3 (3.7)
-fronted Goose	1992	1.5 (1.3)	0.0 (0.0)	0.0 (0.0)	1.2 (1.2)	0.0 (0.0)	0.0 (0.0)	ns -	ns -
	1993	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	1.9 (1.4)	12.8 (6.4)
	1994	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	ns -	ns -
Snow Goose	2004	1.5 (1.5)	8.4 (4.2)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	1.0 (1.0)	1.9 (1.2)	3.8 (4.0)
	1992	1.5 (1.3)	1.6 (0.8)	0.0 (0.0)	0.3 (0.3)	0.0 (0.0)	3.4 (6.3)	ns -	ns -
	1993	3.1 (3.2)	1.1 (1.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	3.8 (6.1)	0.0 (0.0)	5.0 (3.3)
	1994	9.3 (8.6)	20.0 (11.2)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	3.8 (6.7)	ns -	ns -
Northern Pintail	2004	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	1.1 (0.8)	12.1 (7.2)
	1992	0.0 (0.0)	1.6 (1.2)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	ns -	ns -
	1993	0.0 (0.0)	0.7 (0.7)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	1.5 (1.5)	1.6 (1.2)
	1994	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	ns -	ns -
Common Eider	2004	0.8 (0.7)	0.0 (0.0)	0.0 (0.0)	0.9 (1.0)	0.0 (0.0)	3.3 (1.2)	1.5 (1.0)	6.4 (6.6)
	1992	39.2 (26.4)	0.0 (0.0)	0.0 (0.0)	33.0 (19.5)	7.8 (14.0)	5.4 (5.9)	ns -	ns -
	1993	6.2 (6.1)	1.5 (1.4)	0.0 (0.0)	0.9 (0.6)	0.0 (0.0)	0.7 (0.8)	0.0 (0.0)	0.6 (0.4)
	1994	1.5 (1.5)	0.7 (0.7)	0.0 (0.0)	10.2 (3.7)	0.0 (0.0)	3.6 (3.9)	ns -	ns -
King Eider*	2004	20.1 (7.3)	66.9 (11.5)	92.4 (22.6)	1.9 (1.3)	13.7 (6.9)	38.7 (7.4)	21.5 (6.3)	31.9 (9.6)
	1992	81.4 (18.2)	135.7 (19.6)	140.1 (25.7)	41.0 (6.8)	9.7 (7.1)	60.4 (11.1)	ns -	ns -
	1993	84.1 (19.4)	130.1 (12.4)	132.8 (21.1)	38.9 (9.3)	17.8 (4.9)	47.5 (18.1)	38.5 (9.8)	86.4 (10.2)
	1994	79.5 (15.4)	186.0 (23.1)	166.1 (22.6)	49.4 (10.2)	37.8 (9.2)	74.8 (20.4)	ns -	ns -

Table 2. (continued)

		Stratum							
SPECIES	Year	1	2	3	4	5	6	7	8
Long-tailed	2004	7.7 (2.8)	12.0 (2.3)	13.2 (5.4)	4.3 (1.9)	3.7 (2.4)	6.1 (1.6)	4.9 (1.2)	12.8 (4.6)
Duck	1992	10.2 (3.6)	15.2 (3.6)	52.3 (23.3)	11.9 (3.3)	8.0 (5.4)	2.5 (1.9)	ns -	ns -
	1993	4.6 (2.2)	16.7 (3.1)	5.4 (2.4)	7.6 (2.5)	11.1 (6.0)	4.8 (4.8)	8.3 (1.1)	7.2 (1.9)
	1994	5.4 (4.3)	9.4 (2.8)	10.1 (3.3)	13.8 (4.1)	1.6 (1.5)	2.9 (2.0)	ns -	ns -
Falcon sp.	2004	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.3 (0.3)	0.4 (0.4)	0.0 (0.0)
	1992	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	1.1 (0.3)	0.2 (0.4)	ns -	ns -
	1993	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.9 (0.6)	0.0 (0.0)	0.0 (0.0)	0.4 (0.4)	0.3 (0.3)
	1994	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.4 (0.4)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Rough-legged	2004	2.3 (1.2)	1.1 (0.5)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.3 (0.2)	0.8 (0.5)	1.3 (1.2)
Hawk	1992	1.5 (1.5)	1.2 (0.8)	0.0 (0.0)	0.9 (0.5)	3.3 (3.7)	2.4 (1.3)	ns -	ns -
	1993	0.8 (0.8)	0.4 (0.4)	0.8 (0.8)	2.4 (1.2)	0.0 (0.0)	2.2 (1.2)	0.4 (0.4)	0.6 (0.4)
	1994	1.5 (1.0)	0.4 (0.4)	1.6 (1.0)	0.0 (0.0)	1.1 (0.7)	3.2 (1.2)	ns -	ns -
Ptarmigan sp.	2004	0.8 (0.8)	2.9 (0.6)	1.6 (1.6)	0.5 (0.5)	0.5 (0.5)	0.8 (0.4)	0.4 (0.4)	0.0 (0.0)
	1992	0.0 (0.0)	2.5 (1.0)	4.4 (1.8)	0.3 (0.3)	1.3 (0.6)	2.7 (2.1)	ns -	ns -
	1993	0.0 (0.0)	4.0 (1.3)	0.8 (0.7)	0.5 (0.4)	0.0 (0.0)	2.1 (1.8)	1.1 (0.8)	4.7 (1.2)
	1994	0.8 (0.8)	2.5 (0.8)	3.1 (1.9)	0.7 (0.5)	1.6 (1.1)	5.7 (2.5)	ns -	ns -
Sandhill Crane	2004	0.0 (0.0)	0.4 (0.3)	0.0 (0.0)	1.9 (1.2)	0.0 (0.0)	1.0 (0.4)	1.1 (1.1)	1.9 (1.3)
	1992	0.0 (0.0)	4.9 (1.4)	0.0 (0.0)	0.6 (0.4)	4.8 (2.6)	2.2 (1.8)	ns -	ns -
	1993	0.0 (0.0)	1.8 (1.0)	0.8 (0.8)	0.5 (0.5)	0.7 (0.7)	2.0 (1.7)	0.0 (0.0)	5.6 (1.4)
	1994	3.9 (3.6)	1.5 (0.9)	1.6 (1.4)	3.2 (1.1)	0.0 (0.0)	2.3 (1.8)	ns -	ns -
Shorebird sp.	2004	30.9 (6.5)	74.1 (13.4)	51.2 (8.2)	5.2 (2.0)	2.1 (1.1)	16.5 (3.1)	32.5 (3.7)	44.6 (5.8)
	1992	61.0 (10.4)	90.9 (16.7)	88.7 (14.0)	25.4 (4.1)	22.0 (6.1)	74.4 (17.8)	ns -	ns -
	1993	10.8 (2.3)	28.7 (3.6)	33.4 (6.6)	7.6 (2.5)	12.6 (3.4)	22.4 (9.2)	10.6 (2.9)	41.9 (5.4)
	1994	17.7 (5.2)	32.3 (7.4)	40.4 (10.4)	14.5 (3.6)	7.4 (2.2)	18.8 (6.6)	ns -	ns -

Table 2. (continued)

SPECIES	Year	Stratum 1	2	3	4	5	6	7	8
Pomarine	2004	0.8 (0.7)	1.5 (0.8)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	1.3 (0.8)	1.1 (0.7)	2.6 (1.2)
Jaeger	1992	4.4 (3.0)	16.9 (1.2)	10.6 (3.9)	2.1 (1.1)	1.0 (1.8)	11.8 (3.5)	ns -	ns -
	1993	3.9 (2.1)	14.5 (2.7)	42.7 (6.3)	1.4 (0.8)	5.2 (2.5)	19.9 (9.1)	5.7 (1.5)	4.1 (0.6)
	1994	0.0 (0.0)	4.0 (1.5)	4.7 (2.4)	1.8 (1.1)	0.0 (0.0)	4.1 (1.5)	ns -	ns -
Parasitic	2004	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.5 (0.5)	1.1 (0.7)	1.3 (0.6)	0.0 (0.0)	0.0 (0.0)
Jaeger	1992	7.3 (3.8)	25.1 (3.6)	3.5 (1.5)	4.6 (1.7)	1.1 (1.5)	11.9 (4.1)	ns -	ns -
	1993	2.3 (1.3)	5.8 (1.2)	3.9 (1.9)	1.4 (0.7)	2.2 (1.5)	8.5 (2.9)	3.4 (1.2)	1.6 (0.7)
	1994	1.5 (1.6)	2.2 (1.2)	2.3 (1.2)	0.0 (0.0)	0.0 (0.0)	3.7 (2.4)	ns -	ns -
Long-tailed	2004	1.5 (0.9)	1.8 (0.9)	0.8 (0.8)	0.0 (0.0)	0.5 (0.5)	1.5 (0.7)	0.4 (0.4)	0.6 (0.7)
Jaeger	1992	2.9 (2.9)	6.2 (1.2)	0.9 (0.9)	0.9 (0.5)	2.5 (2.1)	6.4 (2.3)	ns -	ns -
	1993	1.5 (1.0)	2.2 (0.9)	2.3 (2.2)	0.9 (0.6)	0.0 (0.0)	3.5 (1.4)	1.1 (0.5)	1.6 (0.5)
	1994	3.1 (2.4)	2.5 (0.9)	3.1 (1.6)	0.4 (0.3)	1.1 (1.0)	4.8 (2.7)	ns -	ns -
All Jaeger sp.	2004	3.1 (1.5)	6.5 (1.7)	2.3 (1.2)	1.9 (1.1)	1.6 (0.7)	8.6 (2.0)	3.4 (0.9)	5.7 (1.5)
	1992	16.0 (6.0)	53.9 (5.3)	16.8 (5.3)	8.0 (2.8)	5.2 (2.7)	34.0 (6.7)	ns -	ns -
	1993	7.7 (2.4)	23.6 (3.0)	49.7 (7.4)	3.8 (1.1)	8.9 (4.1)	19.6 (9.7)	11.3 (1.7)	9.1 (1.7)
	1994	4.6 (2.8)	9.4 (1.6)	10.1 (3.6)	2.5 (1.1)	1.1 (1.0)	14.0 (3.2)	ns -	ns -
Glaucous Gull	2004	6.9 (3.7)	5.5 (2.1)	0.8 (0.8)	5.7 (1.8)	1.6 (1.1)	3.3 (1.4)	0.8 (0.7)	1.9 (1.2)
	1992	16.0 (6.3)	4.1 (1.3)	14.2 (5.8)	18.7 (6.6)	16.2 (12.9)	6.1 (2.4)	ns -	ns -
	1993	6.9 (2.1)	10.2 (3.2)	3.9 (2.1)	11.4 (3.7)	8.1 (3.2)	10.9 (3.9)	7.2 (2.8)	17.5 (3.8)
	1994	10.0 (1.6)	14.5 (2.7)	8.5 (4.7)	12.3 (2.7)	3.7 (1.3)	6.8 (2.5)	ns -	ns -
Thayer's Gull	2004	0.0 (0.0)	1.1 (1.0)	0.0 (0.0)	0.9 (0.9)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
	1992	0.0 (0.0)	0.0 (0.0)	0.9 (1.0)	7.6 (5.9)	0.0 (0.0)	0.4 (0.5)	ns -	ns -
	1993	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	5.2 (3.4)	0.0 (0.0)	0.2 (0.4)	0.0 (0.0)	0.0 (0.0)
	1994	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	5.3 (4.6)	0.0 (0.0)	0.0 (0.0)	ns -	ns -

Table 2. (continued)

SPECIES	Year	Stratum 1	2	3	4	5	6	7	8
Sabine's Gull	2004	0.8 (0.7)	10.9 (7.3)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.3 (0.2)	0.0 (0.0)	1.3 (0.8)
	1992	7.3 (7.5)	12.7 (7.8)	4.4 (2.5)	0.6 (0.6)	0.6 (1.4)	1.1 (1.8)	ns -	ns -
	1993	0.0 (0.0)	17.4 (7.2)	20.2 (11.8)	0.0 (0.0)	0.0 (0.0)	0.8 (1.1)	0.8 (0.7)	0.6 (0.6)
	1994	0.0 (0.0)	18.5 (8.9)	24.1 (19.1)	0.0 (0.0)	0.0 (0.0)	1.6 (1.7)	ns -	ns -
Arctic Tern	2004	0.8 (0.8)	2.9 (1.2)	2.3 (1.5)	0.0 (0.0)	0.0 (0.0)	1.0 (0.6)	0.0 (0.0)	3.8 (2.7)
	1992	5.8 (3.4)	6.2 (2.7)	5.3 (2.5)	4.0 (1.9)	0.2 (0.6)	6.4 (2.5)	ns -	ns -
	1993	9.3 (3.8)	7.6 (3.0)	14.8 (5.4)	0.0 (0.0)	0.7 (0.7)	6.1 (3.4)	1.5 (1.5)	13.1 (3.0)
	1994	17.0 (7.7)	8.0 (3.6)	11.6 (4.7)	1.4 (1.0)	2.6 (1.8)	7.1 (8.3)	ns -	ns -
Snowy Owl	2004	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.5 (0.5)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
	1992	1.5 (1.4)	10.3 (2.6)	0.0 (0.0)	2.1 (0.9)	1.1 (2.0)	9.1 (2.5)	-	-
	1993	0.0 (0.0)	2.5 (0.8)	3.1 (1.3)	0.9 (0.6)	8.1 (3.8)	8.2 (3.9)	1.5 (0.8)	1.9 (1.1)
	1994	0.8 (0.8)	0.7 (0.5)	1.6 (1.1)	1.8 (0.7)	0.0 (0.0)	3.5 (2.4)	ns -	ns -
Short-eared	2004	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.3 (0.2)	0.0 (0.0)	0.0 (0.0)
Owl	1992	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	ns -	ns -
	1993	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
	1994	0.0 (0.0)	0.4 (0.3)	0.8 (0.7)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	ns -	ns -
Common Raven	2004	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
	1992	0.0 (0.0)	0.4 (0.4)	0.0 (0.0)	0.3 (0.3)	0.2 (0.6)	0.5 (0.9)	ns -	ns -
	1993	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.4 (0.4)	0.3 (0.3)
	1994	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.5 (0.5)	0.2 (0.4)	ns -	ns -
Passerine sp.	2004	7.7 (4.8)	5.1 (1.7)	45.0 (7.8)	12.3 (4.8)	17.9 (5.4)	22.9 (4.4)	12.1 (2.9)	1.3 (1.2)
	1992	20.3 (4.0)	9.0 (2.6)	8.0 (3.5)	10.7 (3.1)	10.4 (5.3)	14.0 (3.6)	ns -	ns -
	1993	3.1 (2.9)	0.0 (0.0)	0.8 (0.7)	2.8 (1.2)	3.0 (1.5)	4.5 (1.6)	1.5 (0.5)	6.3 (2.5)
	1994	3.1 (1.4)	2.9 (0.8)	3.9 (2.1)	11.6 (2.6)	6.3 (2.0)	10.6 (4.8)	ns -	ns -

* based on indicated number

ns – not surveyed

Table 3. Population estimates for birds observed during aerial surveys on western Victoria Island, 1992 – 1994, and 2004.

Numbers in brackets represent standard errors.

	NW Victoria Island[a]				SW Victoria Island[b]	
SPECIES	2004	1992	1993	1994	2004	1993
Pacific Loon	1212 (323)	2453 (1041)	4235 (1520)	5292 (898)	105 (75)	1217 (296)
Red-throated Loon	881 (277)	483 (236)	179 (169)	575 (310)	125 (77)	52 (35)
Yellow-billed Loon	1784 (502)	941 (797)	1237 (415)	659 (359)	258 (146)	194 (86)
All Loon sp.	4436 (642)	4553 (1173)	7284 (1653)	9509 (1258)	1241 (314)	1532 (1676)
Tundra Swan	1449 (307)	3575 (885)	3144 (511)	3838 (570)	2024 (648)	4262 (745)
Canada Goose[c]	18397 (1647)	24146 (2602)	16100 (1972)	25055 (2232)	19021 (1812)	19074 (1011)
Brant	50 (48)	1205 (1176)	904 (600)	978 (915)	0 (0)	205 (188)
Greater White-fronted Goose	75 (74)	252 (193)	0 (0)	0 (0)	707 (219)	1020 (427)
Snow Goose	610 (259)	737 (1042)	786 (1003)	1909 (629)	524 (298)	276 (182)
Northern Pintail	0 (0)	75 (54)	33 (31)	0 (0)	855 (415)	337 (259)
Common Eider	722 (244)	10789 (6515)	579 (298)	2301 (578)	602 (397)	34 (22)
King Eider[c]	18023 (3112)	32875 (3266)	33321 (3996)	50561 (5369)	5329 (1170)	11149 (1728)

Table 3. (continued)

	NW Victoria Island[a]				SW Victoria Island[b]	
SPECIES	2004	1992	1993	1994	2004	1993
Long-tailed Duck	4293 (1052)	7763 (2314)	7457 (2532)	4167 (969)	1517 (318)	1775 (211)
Peregrine Falcon	42 (41)	215 (106)	151 (96)	56 (56)	63 (61)	230 (115)
Falcon sp.	-	459 (140)	-	-	-	-
Rough-legged Hawk	183 (65)	1963 (1472)	800 (282)	1226 (461)	196 (103)	97 (65)
Ptarmigan sp.	608 (236)	1215 (425)	627 (313)	1896 (599)	133 (92)	447 (143)
Sandhill Crane	484 (208)	2588 (1078)	791 (402)	1139 (233)	293 (196)	310 (78)
Shorebird sp.	10160 (1020)	33544 (3950)	12364 (2058)	11396 (1578)	7849 (692)	4064 (563)
Pomarine Jaeger	305 (136)	3857 (937)	7340 (1816)	1236 (308)	329 (141)	1164 (253)
Parasitic Jaeger	700 (297)	4639 (965)	2948 (787)	813 (164)	0 (0)	650 (204)
Long-tailed Jaeger	620 (235)	2624 (861)	936 (260)	1564 (611)	98 (71)	274 (87)
All Jaeger sp.	2816 (485)	12385 (1644)	12370 (2276)	3949 (703)	880 (173)	2380 (304)
Glaucous Gull	2612 (590)	11525 (5228)	7644 (1540)	5794 (802)	231 (140)	2156 (506)
Thayer’s Gull	200 (157)	1293 (945)	857 (536)	839 (733)	0 (0)	0 (0)
Sabine’s Gull	571 (336)	1469 (779)	1386 (464)	1662 (646)	70 (46)	160 (128)

Table 3. (continued)

	NW Victoria Island[a]				SW Victoria Island[b]	
SPECIES	2004	1992	1993	1994	2004	1993
Arctic Tern	384 (118)	2400 (597)	2340 (674)	3732 (1580)	211 (151)	975 (295)
Snowy Owl	208 (206)	2802 (927)	5577 (1412)	944 (405)	0 (0)	354 (140)
Short-eared Owl	42 (41)	0 (0)	0 (0)	34 (23)	0 (0)	0 (0)
Common Raven	0 (0)	230 (288)	0 (0)	238 (204)	0 (0)	80 (63)
Passerine sp.	14362 (2392)	9507 (2263)	2499 (688)	6429 (1194)	2076 (484)	595 (158)

[a] Strata 1 to 6

[b] Strata 7 and 8

[c] based on indicated number

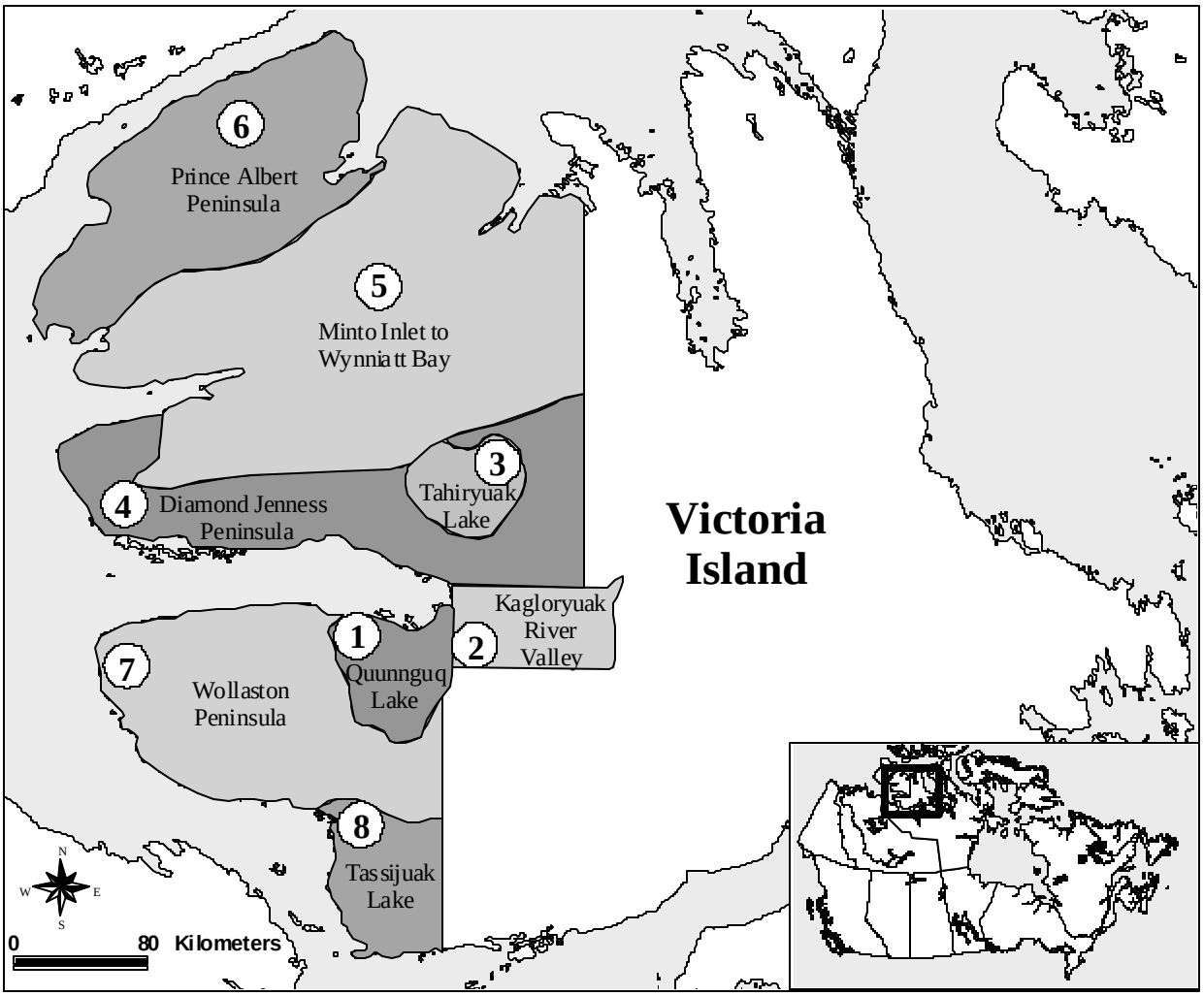

Figure 1. Location of the study area and boundaries of the strata used to estimate bird populations on western Victoria Island, 1992 to 1994, and 2004.

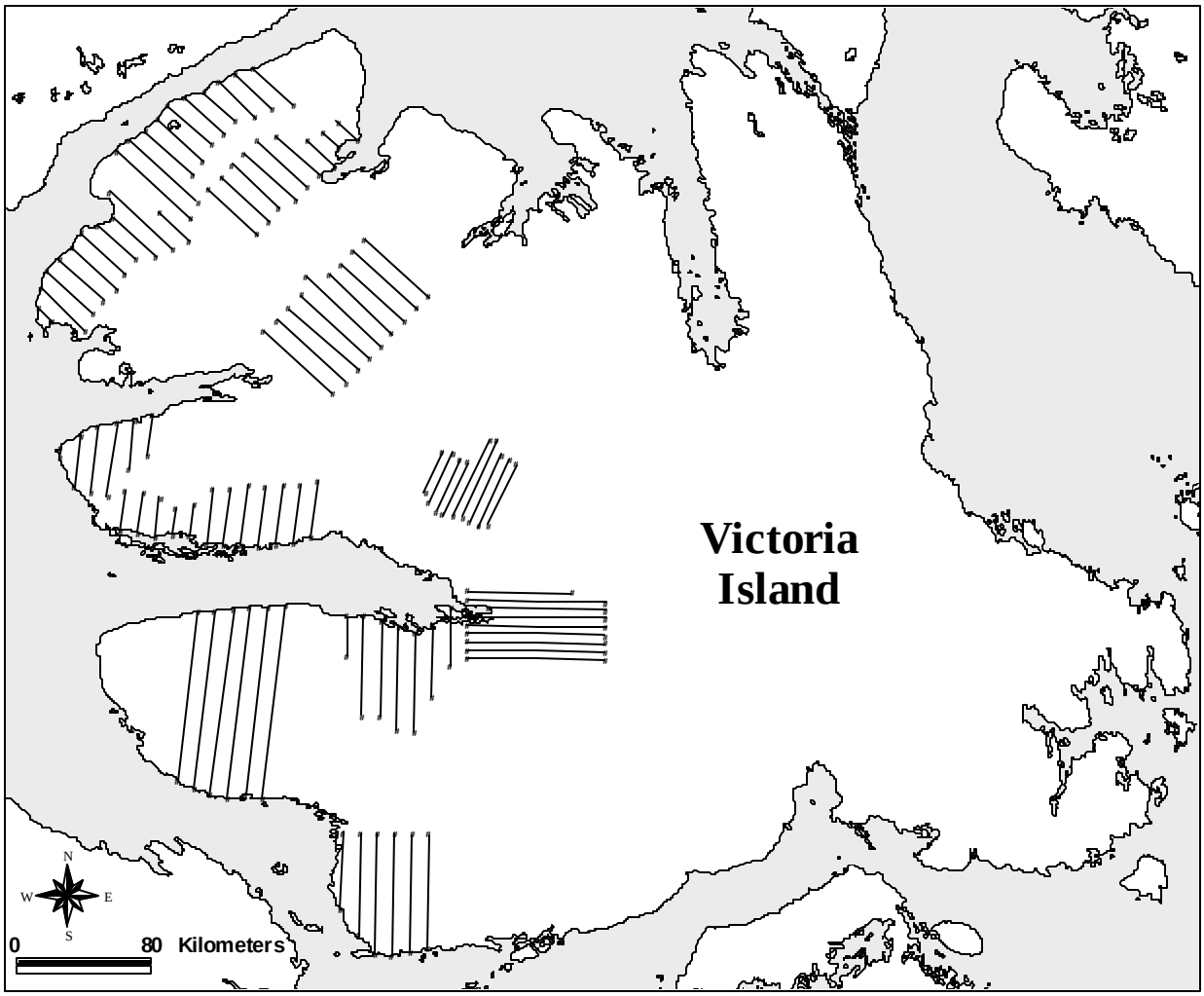

Figure 2. Location of the transects surveyed by helicopter on western Victoria Island in June 2004.

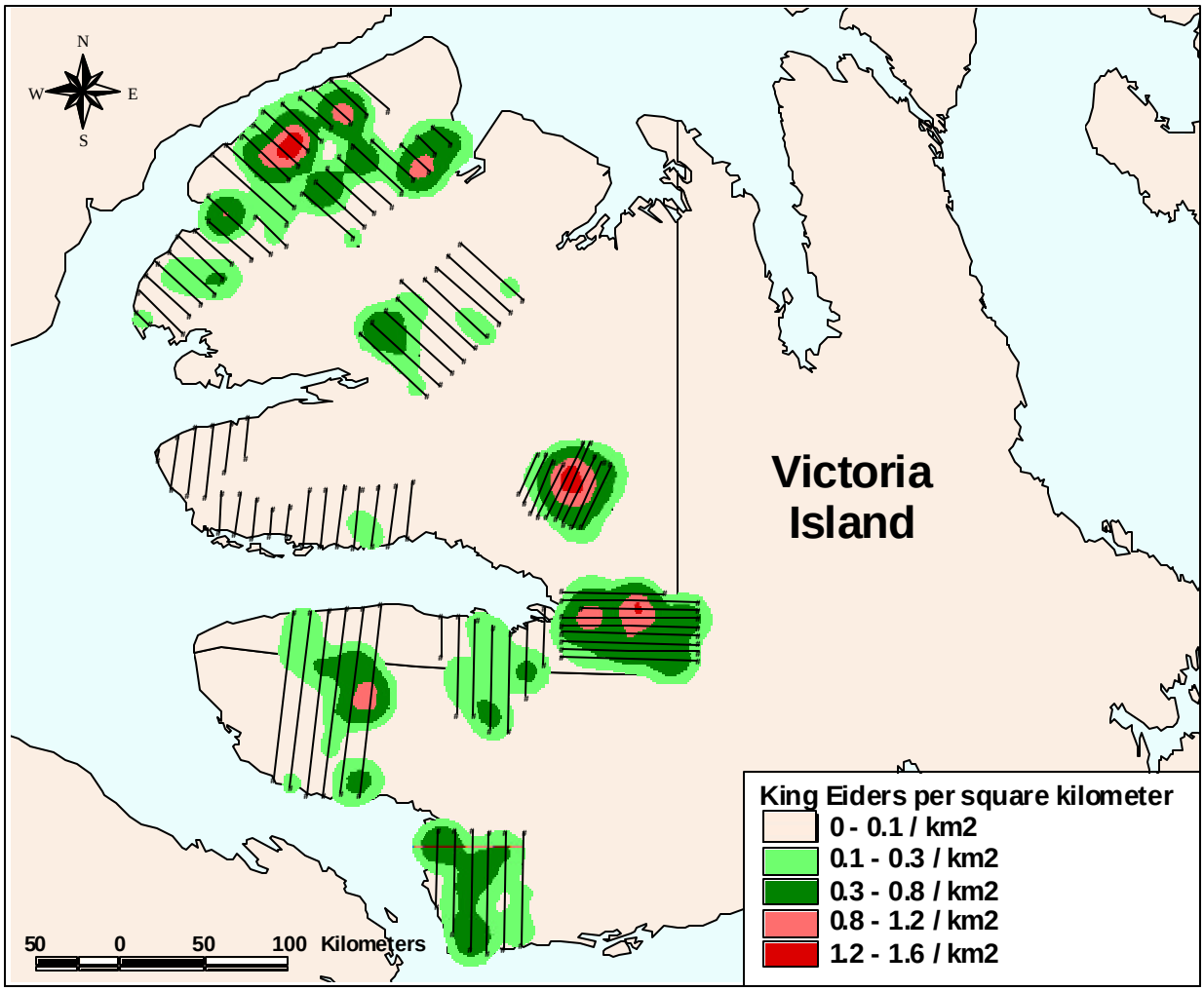

Figure 3. Distribution of King Eiders recorded during aerial surveys on western Victoria Island in 2004.

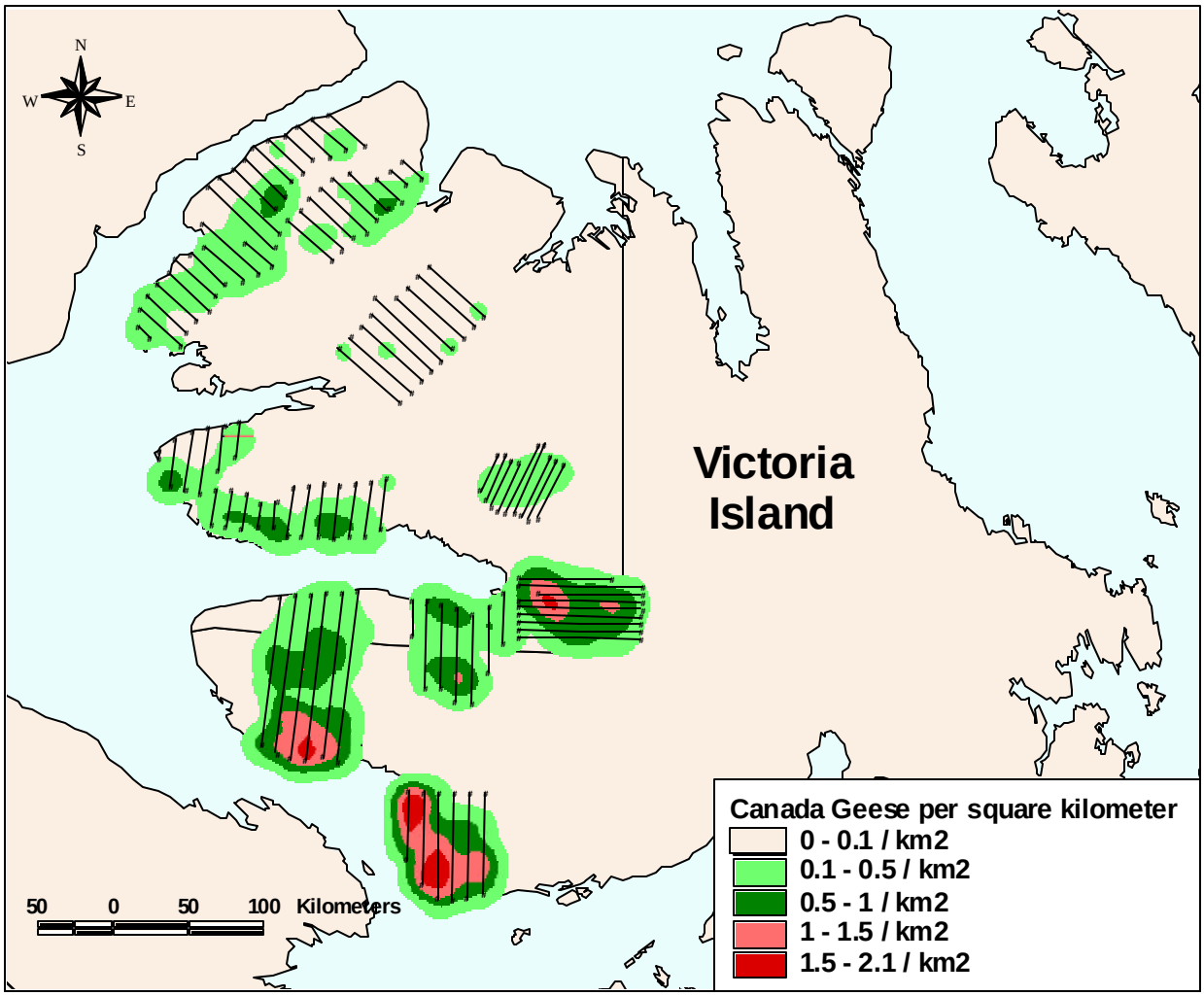

Figure 4. Distribution of Canada Geese recorded during aerial surveys on western Victoria Island in 2004.

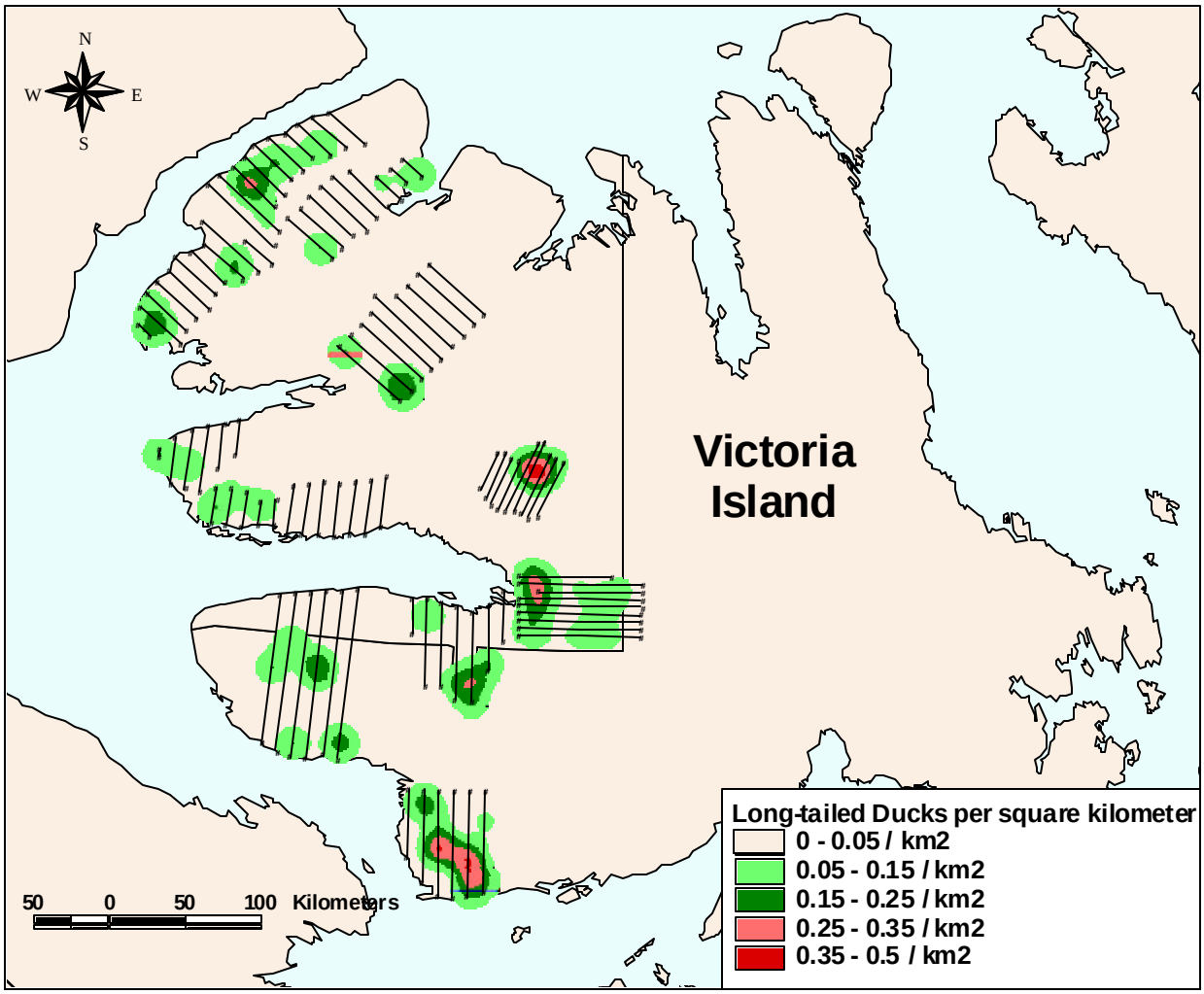

Figure 5. Distribution of Long-tailed Ducks recorded during aerial surveys on western Victoria Island in 2004.

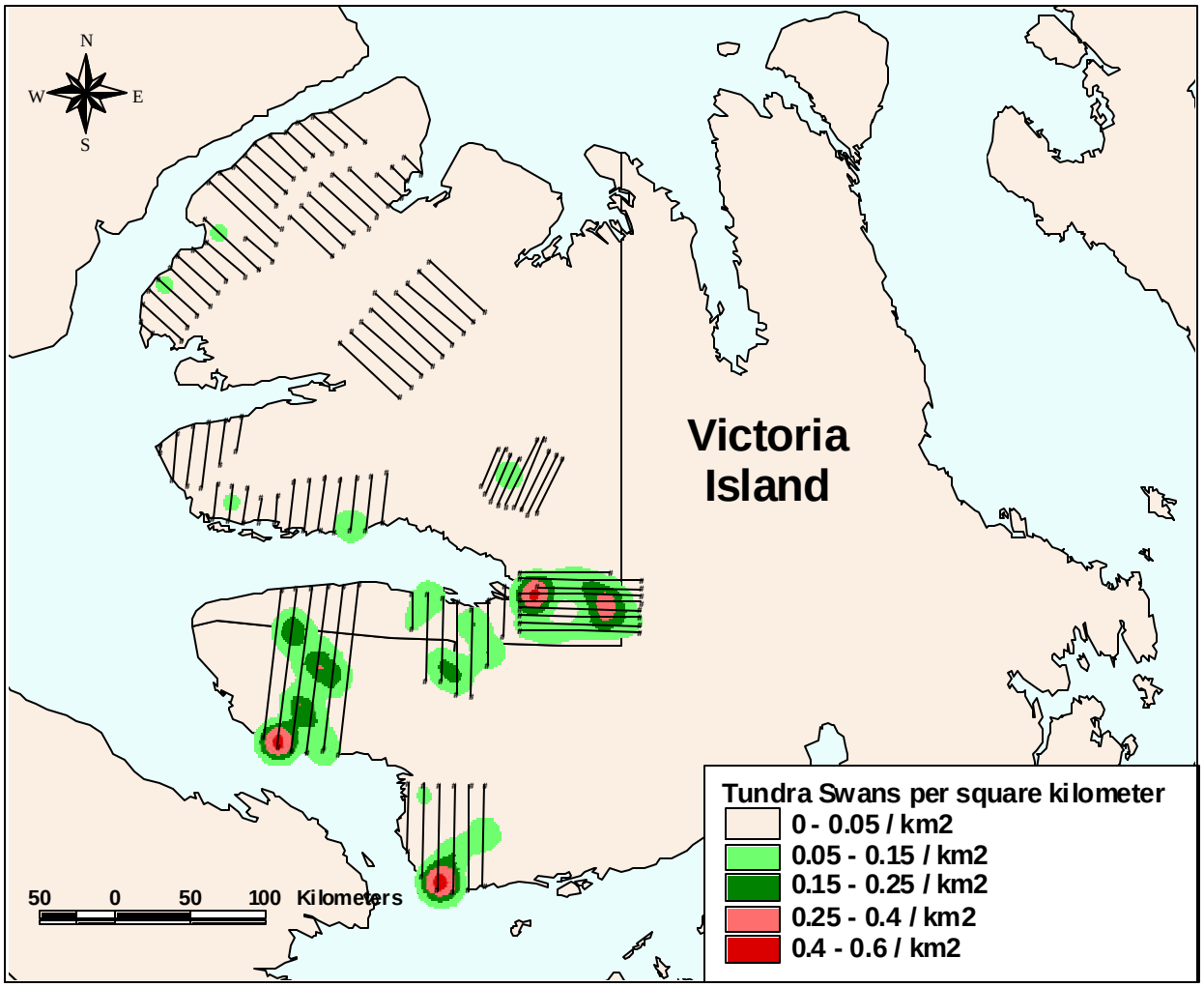

Figure 6. Distribution of Tundra Swans recorded during aerial surveys on western Victoria Island in 2004.

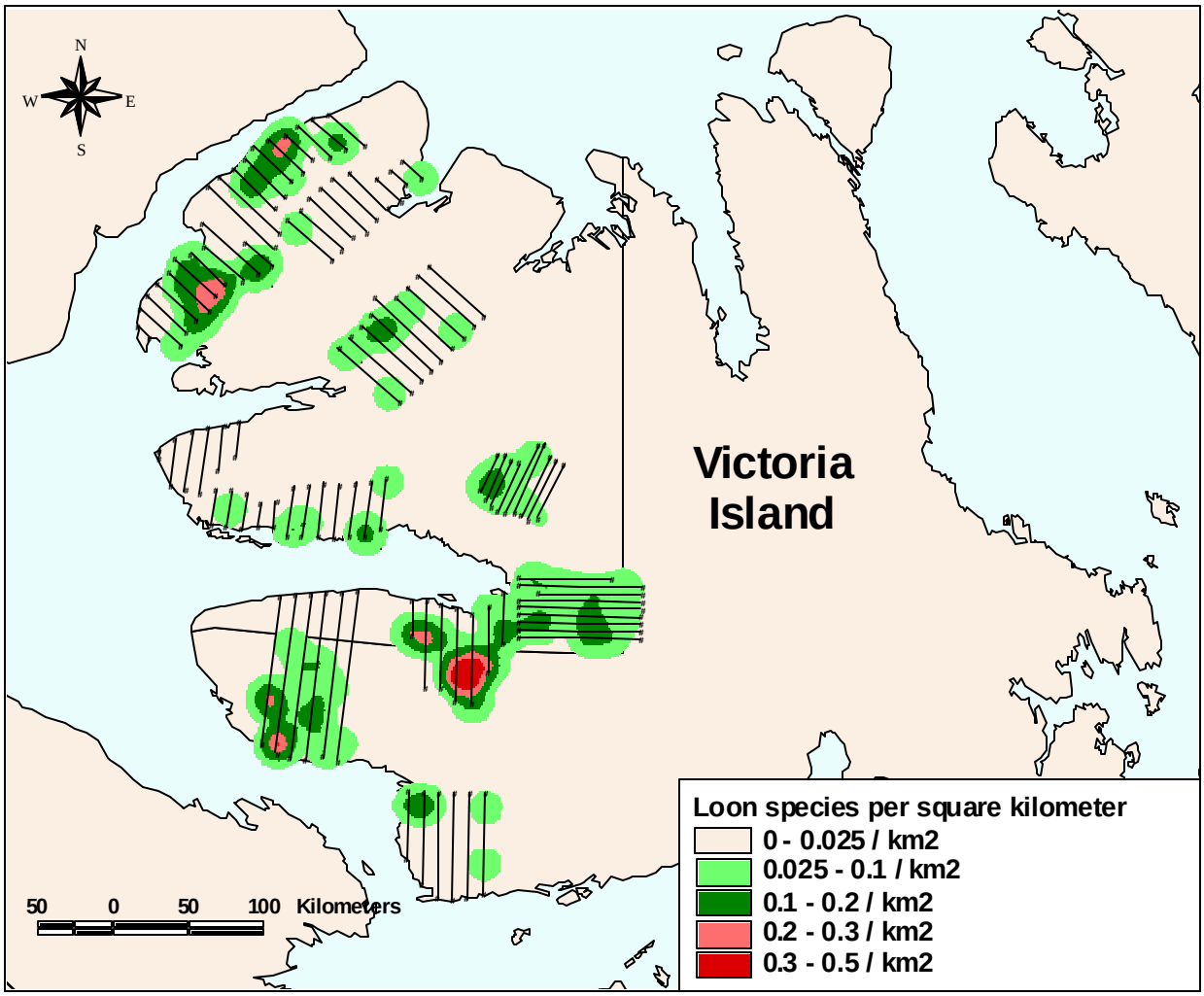

Figure 7. Distribution of Loons recorded during aerial surveys on western Victoria Island in 2004.

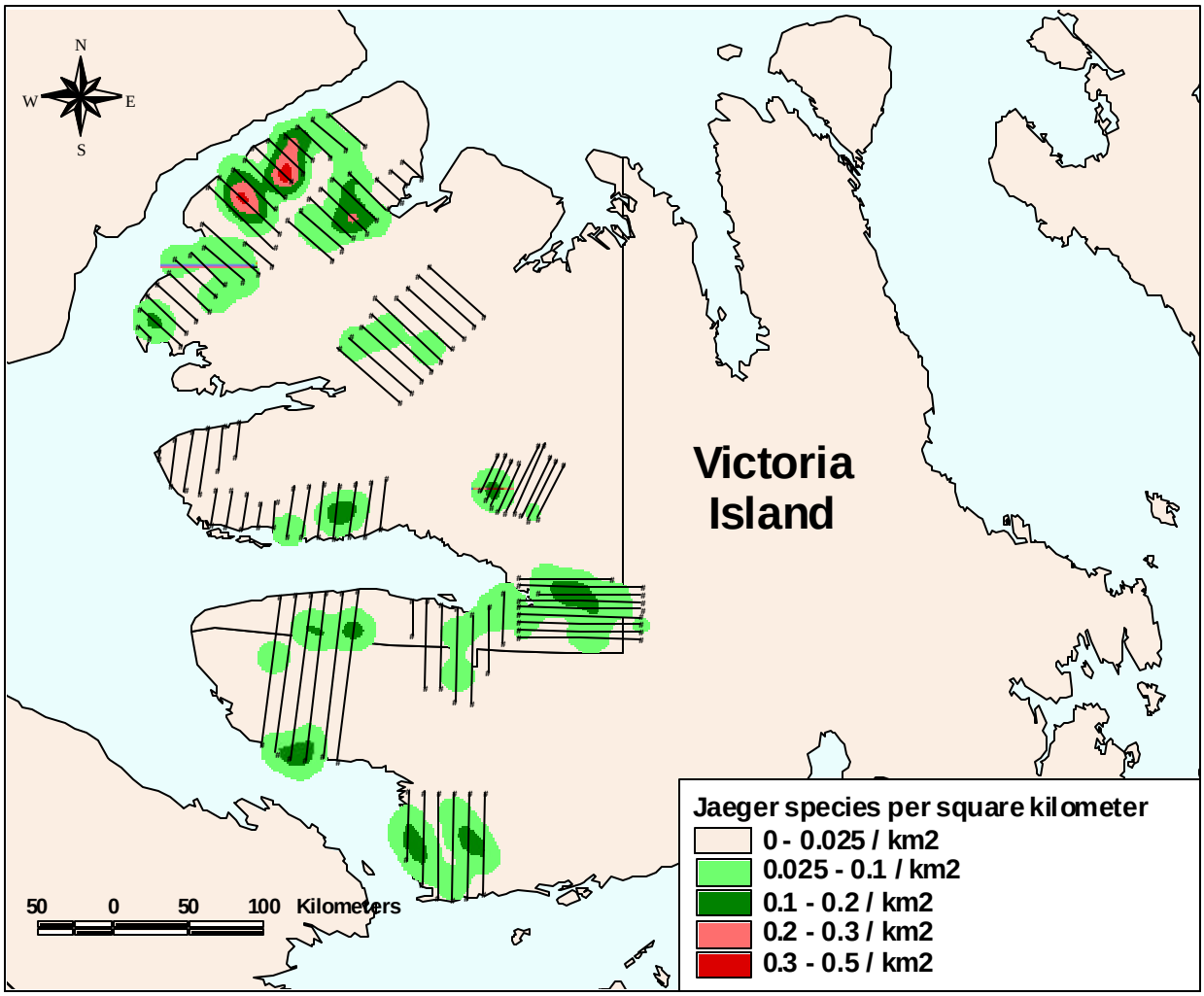

Figure 8. Distribution of Jaegers recorded during aerial surveys on western Victoria Island in 2004.