Changes in Distribution and Abundance of Birds on Western Victoria Island from 1992-1994 to 2004-2005

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ABSTRACT

Annual waterfowl breeding population surveys do not adequately cover breeding grounds for many species nesting in the Canadian arctic. Baseline surveys were conducted on western Victoria Island 1992-1994. In 2004 and 2005 we resurveyed western Victoria Island to obtain current population estimates and determine trends for bird species since the 1992-1994 surveys.

We calculated visibility correction factors (VCF) for the three main species encountered during the 2004-2005 surveys using a double-count method. The VCF for King Eiders (*Somateria spectabilis*) was 1.435, for Canada Geese (*Branta hutchinsii*) was 1.617, and for Long-tailed Duck (*Clangula hyemalis*) was 1.833.

The mean breeding population estimate for King Eiders on western Victoria Island in 2004-2005 was 33 199, which is 54% below the mean estimate from the 1992-1994 surveys. Proportional population decreases occurred throughout western Victoria Island for King Eiders except on Diamond Jenness Peninsula where estimates decreased by 92%.

Long-tailed Duck densities remained low throughout western Victoria Island and population estimates were slightly below those from the 1992-1994 surveys.

The mean breeding population estimate for Canada Geese on western Victoria Island was 80 092; an increase of 18% over the 1992-1994 mean estimate. Mean estimates for Canada Geese on Prince Albert Peninsula increased by 244% between the two survey periods indicating the breeding range is expanding northward. White-fronted Geese (*Anser albifrons*) were common in the southwest but rare on northwestern Victoria Island, and showed no change in number between survey periods. Lesser Snow Geese (*Chen caerulescens caerulescens*) numbers more than doubled on southwestern Victoria Island between the two survey periods. Most observations were small flocks of non-breeders. Black Brant (*Branta bernicla nigricans*) were very rare on western Victoria Island and numbers have continued to decrease since the surveys were last completed.

Estimates of Tundra Swans *(Cygnus columbianus*) were low in 2004 but rebounded in 2005. A late spring occurred on western Victoria Island in 2004 and likely affected estimates. More typical spring conditions were observed in 2005. Highest densities on Tundra Swans occurred in the Kagloryuak River valley and southwestern Victoria Island. Few swans were seen north of Prince Albert Sound. Sandhill Crane (*Grus canadensis*) observations on northwestern Victoria Island were low in 2004 but similar to swans they rebounded in 2005 to numbers more representative of the earlier surveys.

Three species of loons (*Gavia spp.*) were observed on western Victoria Island: Yellow-billed Loons (*G. adamsii*), Red-throated Loons (*G. stellata*), and Pacific Loons (*G. pacifica*). Loons were distributed throughout western Victoria Island. Population indices for northwestern Victoria Island were lower than those observed in the previous surveys but numbers were stable in southwestern Victoria Island.

Three species of jaegers (*Stercorarisu spp.*) were observed on western Victoria Island: Pomarine Jaegers (*S. pomarinus*), Parasitic Jaegers (*S. parasiticus*), and Long-tailed Jaegers (*S. longicaudus*). Jaeger numbers decreased since the 1992-1994 surveys, although a rebound occurred in 2005, largely due to an increasing number of Pomarine and Long-tailed Jaegers. The population rebound of Pomarine and Long-tailed Jaegers occurred in conjunction with a rebound

in Snowy Owl (*Bubo scandiacus*) numbers, another predator of lemmings. Other raptors observed on western Victoria Island were Rough-legged Hawks (*Buteo lagopus*), Peregrine Falcons (*Falco peregrinus*), and Short-eared Owls (*Asio flammeus*).

Glaucous Gulls (*Larus hyperboreus*) were widespread throughout western Victoria Island with a distribution similar to that observed during the 1992-1994 surveys. Although numbers were low in 2004 compared to the earlier surveys, they appeared to recover in 2005.

RÉSUMÉ

Les relevés annuels de la sauvagine nicheuse ne couvrent pas adéquatement les lieux de reproduction de bon nombre d'espèces nichant dans l'Arctique canadien. Des relevés de référence ont été effectués dans l'ouest de l'île Victoria dans la période 1992-1994. En 2004 et 2005, nous avons effectué de nouveaux relevés dans cette même région pour obtenir des estimations à jour des populations d'oiseaux, et dégager les tendances des effectifs depuis les relevés de 1992-1994.

En utilisant une méthode de double comptage, nous avons calculé des facteurs de correction pour la visibilité (FCV) pour les trois principales espèces observées durant les relevés de 2004-2005. Le FCV était de 1,435 pour l'Eider à tête grise (*Somateria spectabilis*), de 1,617 pour la Bernache de Hutchins (*Branta hutchinsii*) et de 1,833 pour le Harelde kakawi (*Clangula hyemalis*).

La population estimative moyenne d'Eiders à tête grise nicheurs dans l'ouest de l'île Victoria pour 2004 et 2005 était de 33 199 oiseaux, ce qui correspond à une baisse de 54 % par rapport à l'effectif estimatif moyen obtenu lors des relevés de 1992-1994. Des baisses proportionnelles des effectifs de l'espèce ont eu lieu dans tout l'ouest de l'île Victoria, sauf dans la péninsule Diamond-Jenness, où les baisses estimatives ont été de 92 %.

Les densités de Harelde kakawi sont demeurées faibles dans tout l'ouest de l'île Victoria, et les effectifs estimatifs ont été légèrement inférieurs à ceux obtenus lors des relevés de 1992-1994.

La population estimative moyenne de Bernache de Hutchins nicheuses dans l'ouest de l'île Victoria était de 80 092, ce qui représente un accroissement de 18 % par rapport à l'effectif estimatif moyen de 1992-1994. L'effectif estimatif moyen de l'espèce dans la péninsule Prince-Albert s'est accru de 244 % entre les deux périodes de relevés, ce qui indique une expansion de l'aire de répartition de l'oiseau vers le nord. L'Oie rieuse (*Anser albifrons*) était commune dans le sud-ouest de l'île Victoria mais rare dans le nord-ouest, et ses effectifs étaient similaires dans les deux périodes de relevés. Les effectifs de Petite Oie des neiges (*Chen caerulescens caerulescens*) ont plus que doublé dans le sud-ouest de l'île Victoria entre les deux périodes de relevés; la plupart des observations ont consisté en de petits groupes de non-nicheurs. La Bernache noire (*Branta bernicla nigricans*) était très rare dans l'ouest de l'île Victoria, et ses effectifs y sont à la baisse.

Les effectifs estimatifs de Cygne siffleur *(Cygnus columbianus*) étaient faibles en 2004 mais se sont accrus en 2005. Le printemps a été tardif dans l'ouest de l'île Victoria en 2004, ce qui a probablement eu une incidence sur les effectifs. Les conditions printanières ont été plus normales en 2005. Les plus fortes densités de Cygne siffleur ont été observées dans la vallée de la rivière Kagloryuak et dans le sud-ouest de l'île Victoria. Peu de cygnes ont été vus au nord de la baie Prince-Albert. Les effectifs de Grue du Canada (*Grus canadensis*) dans le nord-ouest de l'île Victoria étaient faibles en 2004, mais comme dans le cas des cygnes, ils se sont accrus en 2005 pour revenir au niveau observé lors des relevés antérieurs.

Trois espèces de plongeons (*Gavia* spp.) ont été observés dans l'ouest de l'île Victoria: le Plongeon à bec blanc (*G. adamsii*), le Plongeon catmarin (*G. stellata*) et le Plongeon du Pacifique (*G. pacifica*). Ces oiseaux étaient répartis dans l'ensemble de l'ouest de l'île. Les

indices de population pour le nord-ouest de l'île étaient inférieurs à ceux obtenus lors des relevés antérieurs, mais les effectifs se sont révélés stables dans le sud-ouest de l'île.

Trois espèces de labbes (*Stercorarius* spp.) ont aussi été observées dans l'ouest de l'île Victoria: le Labbe pomarin (*S. pomarinus*), le Labbe parasite (*S. parasiticus*) et le Labbe à longue queue (*S. longicaudus*). Globalement, les effectifs de labbes ont diminué depuis les relevés de 1992-1994, une hausse largement attribuable à un accroissement des effectifs de Labbe pomarin et de Labbe à longue queue ayant toutefois été observée en 2005. La hausse des effectifs de ces deux labbes s'est produite en même temps qu'une hausse des effectifs de Harfang des neiges (*Bubo scandiacus*), tous prédateurs de lemmings. Les autres rapaces qui ont été observés dans l'ouest de l'île Victoria sont la Buse pattue (*Buteo lagopus*), le Faucon pèlerin (*Falco peregrinus*) et le Hibou des marais (*Asio flammeus*).

Le Goéland bourgmestre (*Larus hyperboreus*) était largement répandu dans l'ensemble de l'ouest de l'île Victoria, avec une répartition semblable à celle observée lors des relevés de 1992-1994. En 2004, ses effectifs étaient faibles par rapport à ceux observés lors des relevés antérieurs, mais ils ont semblé s'être rétablis en 2005.

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INTRODUCTION

Current North American Waterfowl Breeding Population Surveys (Anonymous 2005) do not adequately cover breeding grounds for King Eiders (*Somateria spectabilis*), small Canada Geese (*Branta hutchinsii*, also known as Cackling Goose), and Long-tailed Ducks (*Clangula hyemalis*) within Canada. Additionally, information on the abundance and distribution of birds in general has been very limited on western Victoria Island. Several studies provided bird species accounts in certain areas of the island, (Porsild 1951, Barry 1960, Smith 1973) but there is no quantitative data for the region.

The settlement of the Inuvialuit land claim in the Canadian western Arctic brought the need to improve our understanding of harvested bird species within the Inuvialuit Settlement Region. Specified in the Inuvialuit Final Agreement were the preferential hunting rights of the Inuvialuit within their settlement region. Waterfowl surveys were required in order to set harvest limits that would ensure sustainable populations. In recognition of the lack of bird knowledge for western Victoria Island and in the interest of acquiring data needed to better manage harvested species, the Canadian Wildlife Service, in cooperation with the Inuvialuit, conducted breeding waterfowl surveys from 1992 to 1994 (Cornish and Dickson 1996). Primary objectives were to determine the abundance and distribution of King Eiders, and to establish baseline population estimates for monitoring breeding population trends in future years. Western Victoria Island was selected for monitoring based on reconnaissance surveys by Barry (1960) that indicated it was a core breeding area for King Eiders in western arctic Canada.

The western Victoria Island aerial surveys were repeated in 2004 and 2005 to allow comparisons among years and provide population trends for King Eiders, Canada Geese, Long-tailed Ducks, and other bird species nesting on western Victoria Island. This report summarizes the historical survey data originally presented in Cornish and Dickson (1996) as well as the more recently collected data. Comparisons between the two survey periods allow identification of species population trends and changes in distributions. Advancements in survey technology have allowed past and present observations to be spatially quantified and mapped according to population density, further showing potential changes to distribution.

METHODS

Aerial surveys in 2004-2005 were designed and conducted in the same way as surveys in 1992-1994 to allow direct comparison of results (Cornish and Dickson 1996, Dickson et al. 1997). As in previous surveys, the western half of Victoria Island (a total area of approximately 105 000 km^2) was divided into eight different strata (Table 1; Fig. 1) based on physiographic and habitat similarities. Landsat Thematic Mapper satellite imagery was used to determine 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. 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 the Kagloryuak River valley (stratum 2) and near Tahiryuak Lake (stratum 3) where the spacing was 5 km (8% plot coverage). Transect spacing near Tassijuak Lake at the extreme southwest of Victoria Island (stratum 8) was 5 km in 1993 and 10 km in 2004 and 2005. Transect length varied between 6 and 116 km while between 6 and 29 transects were flown per stratum (Fig. 2; Appendix D).

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. These locations were later 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. Dates in 2005 were 18 to 26 June.

Population indices for the King Eider, Long-tailed Duck and Canada Goose were based on total indicated birds, whereas all other population indices 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 1987), was used to calculate the indicated breeding population of King Eiders and Canada Geese. 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. Due to the inability to reliably differentiate between male and female Long-tailed Ducks we used the same technique used for Canada Geese for calculating the Indicated Breeding Population. To calculate Long-tailed Duck and Canada Goose Indicated Breeding Population, observations of single birds or pairs were multiplied by two, whereas groups of more than two birds were multiplied by one. Tundra Swans were highly visible and not likely missed during surveys. Consequently, the breeding population estimate was calculated using the number of swans actually observed during the surveys.

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):

$$\hat{R} = \sum y_i / \sum x_i$$

where:

$\hat{R}$ = population density (number of birds/km^2);

y_i = total indicated birds on transect *i*

x_i = area of transect *i*; and

and

$$s^2 = 1 - n/N\left[\sum_{i=1}^{n}(y_i - \widehat{R}x_i)^2\right]/(n-1)n\overline{x}^2$$

where:

s^2 = variance of $\widehat{R}$;
n = number of transects in stratum that were sampled;

N = number of possible transects; and

$1 – n/N$ = finite population correction factor.

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). 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), and the standard error was calculated by taking the square root of the sum of the variances. Population estimates for 1992-1994, and 2004-2005 were averaged to calculate the mean number per period. The standard error (SE) of the mean population estimate was calculated as:

$$SE = \frac{\sqrt{\sum S_i}}{n}$$

where:

S_i = variance of the population estimate in year i;

n = number of survey years.

Not all animals on transect are observed and counted during aerial surveys. Consequently, these surveys typically underestimate the number of animals actually present in an area (Pollock and Kendall 1987). For the three species of waterfowl most commonly encountered during our helicopter surveys on western Victoria Island, we developed visibility correction factors (*VCFs*) by using a “double-counting” or “mark-recapture” approach (Caughley and Grice 1982, Pollock and Kendall 1987, Anthony et al. 1992, Hines and Kay 2006). Data for developing the VCFs were collected while ferrying to or from transect starting points or fuel caches during the 2004 and 2005 surveys. Both observers were seated on the left side of the aircraft which was flown at the same elevation (30 m) and ground speed (145 kph) as during the regular surveys. Each observer recorded the number of each species they observed within 200 m of the left side of the aircraft and the time of each observation (to the nearest second). Sightings made by both observers of the same species and number of birds within the same 10 second interval were treated as duplicate observations. Sightings which did not meet these criteria were considered non-duplicate observations. The number of birds present in the area of observation was then calculated using the Petersen-Lincoln method for mark-recapture data (Krebs 1989, Pollock et al. 1990):

$$\widehat{N} = \frac{n_{front} n_{back}}{m}$$

$$SE_{\widehat{N}} = \sqrt{\frac{(n_{front}+1)(n_{back}+1)(n_{front}-m)(n_{back}-m)}{(m+1)^2(m+2)}}$$

$\widehat{N}$ = estimated number of birds of a given species present

n_{front} = number of birds seen by front-seat observer

n_{back} = number of birds seen by back-seat observer

m = number of duplicate observations

$SE_{\widehat{N}}$ = standard error of estimated number of birds present

For each species, the visibility correction factor (*VCF*) and its standard error (SE_{VCF}) was calculated using the following formulas:

$$VCF = \frac{\widehat{N}}{n_{front}}$$

$$SE_{VCF} = \frac{SE_{\widehat{N}}}{n_{front}}$$

To correct for visibility bias, we multiplied the population estimate by the visibility correction factor for that species. The variance of the adjusted population estimate was calculated by combining the variance of the population estimate with that of the visibility correction factor (Gasaway et al. 1986:39):

$$V(\hat{T}_a) = VCF^2\left[V(\hat{T}_o)\right] + \hat{T}_o^{\,2}\left[V(VCF)\right] - V(VCF)\left[V(\hat{T}_o)\right]$$

where:

$\hat{T}_o$ = population estimate unadjusted for visibility;

$V(\hat{T}_o)$ = variance of population estimate unadjusted for visibility;

VCF = visibility correction factor;

V(*VCF*) = variance of visibility correction factor;

$\hat{T}_a$ = population estimate adjusted with visibility correction factor; and

$V(\hat{T}_a)$ = variance of adjusted population estimate.

Density and distribution of certain species observed during surveys were mapped using ArcView 3.1 (Environmental Systems Research Institute, Inc., Redlands, California, U.S.A.). Observed numbers (visibility adjusted indicated numbers for King Eiders, Long-tailed Ducks and Canada Geese), at specific locations, were divided by the proportion of the plot that was surveyed to represent assumed observations given entire survey coverage. For example, survey 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). For multiple years of surveys, the mean number of birds observed at each location was calculated. Values were then divided according to transect spacing.

Density was calculated and mapped using these location values and a 10 km search radius. Strata were defined for each mapped species according to density of birds within the search radius. For mapping of the 1992-1994 surveys only data from transects that were also flown during the 2004-2005 surveys were used.

RESULTS

Northwest Victoria Island (strata 1 to 6 in Fig. 1) was surveyed in all five years (1992-1994 and 2004-2005), whereas southwest Victoria Island (strata 7 and 8) was surveyed only in 1993, 2004, and 2005. Table 2 shows annual density of birds observed during the surveys in each of the strata. Annual population indices for birds observed during the five years of surveys are presented in Table 3. Population estimates adjusted for visibility (Appendix A) are presented in Table 4 for King Eiders, Canada Geese, and Long-tailed Ducks. Mean population estimates of the two survey periods (1992-1994 and 2004-2005) for selected species are summarized in Table 5.

King Eider

King Eider population estimates for northwestern Victoria Island in 2004 and 2005 were 25 863 (±4806) and 23 860 (±3312) respectively (Table 4). Estimates for southwestern Victoria Island were 7647 (±1758) and 9026 (±1577) for 2004 and 2005 respectively (Table 4). These estimates were substantially lower than those from the earlier surveys suggesting King Eiders declined in number by about 50% on western Victoria Island between the two survey periods (Table 4; Fig 4). The mean population estimate dropped from 71848 for the 1992-1994 survey period to 33 199 for 2004-2005 (Table 5; Fig 13).

Highest densities of King Eiders in 2004 and 2005 occurred in the Kagloryuak River valley (stratum 2) and near Tahiryuak Lake (stratum 3; Table 2; Fig. 3). In general, distribution was similar to that observed for the 1992-1994 survey period, but with a 40-55% decline in number in most areas (Fig 3; Appendix B1). The exception was Diamond Jenness Peninsula where the King Eider had declined by 92% (Appendix B1; Fig 3).

The overall ratio of lone males (males without females) to total males (lone males + paired males) for the 2004 survey was 0.29 while for the 2005 survey was 0.61 (Appendix C). This compares with values of 0.45, 0.49, and 0.31 for 1992, 1993, and 1994 respectively (Dickson et al. 1997).

Canada Goose

Canada Geese were the most abundant species in both northwest and southwest Victoria Island during the 2004-2005 surveys. Canada Goose population estimates for northwestern Victoria Island in 2004 and 2005 were 29 748 (±3031) and 49 920 (±4773) respectively (Table 4). Southwestern estimates were 30 757 (±3290) and 49 758 (±6287) for 2004 and 2005 respectively (Table 4). The 2004 estimate was similar to those from the 1992-1994 surveys, while the 2005 estimate showed an increase over the earlier surveys (Table 4; Fig 4). The mean population estimate was 66 040 for the 1992-1994 survey period and 80 092 for 2004-2005 (Table 5; Fig 13).

Highest densities of Canada Geese in 2004 and 2005 occurred in the Kagloryuak River valley (stratum 2) and southwest Victoria Island (strata 7 and 8; Table 2; Fig 5). This distribution closely resembled that which was observed during the 1992-1994 surveys (Fig 5). Interestingly, the greatest increase in Canada Goose density was on Prince Albert Peninsula, which is the northern-most stratum (Table 2; Fig 5; Appendix B2).

Long-tailed Duck

Long-tailed Duck population estimates for northwestern Victoria Island in 2004 and 2005 were 9275 (±2649) and 13264 (±3808) respectively (Table 4). Southwestern estimates were 3411 (±962) and 3761 (±1473) for 2004 and 2005 respectively (Table 4). Estimates were slightly lower than those from the 1992 and 1993 surveys but 95% confidence intervals show considerable overlap (Table 4; Fig 4). The mean population estimate was 20 107 for the 1992-1994 survey period and 14 856 for 2004-2005 (Table 5; Fig 13).

Densities of Long-tailed Ducks in 2004 and 2005 were generally low (< 0.5/km^2) with a scattered distribution throughout most of western Victoria Island (Table 2; Fig 6). Highest densities were found in the Kagloryuak River valley (stratum 2), near Tahiryuak Lake (stratum 3), and in the extreme southwest portion of the island (stratum 8). This distribution closely resembled that observed in the 1992-1994 surveys, although densities may have increased marginally in the southernmost stratum (Fig 6).

Tundra Swan

Population estimates for Tundra Swans (*Cygnus columbianis*) on northwestern Victoria Island in 2004 and 2005 were 1449 (±307) and 2842 (±385) respectively (Table 3). For southwestern Victoria Island estimates were 2024 (±648) and 5043 (±999) for 2004 and 2005 respectively (Table 3). Estimates from 2004 were below those observed in the earlier surveys, while 2005 estimates were quite similar (Table 3; Fig 4) to the 1992-1994 surveys. The mean population estimate for the 1992-1994 survey period was 7781, compared to 3473 in 2004 and 7885 in 2005 (Table 5; Fig 13).

Distribution was similar between the two survey periods with highest densities of Tundra Swans found in southwest Victoria Island (strata 7 and 8) and in the Kagloryuak River valley (stratum 2; table 2; Fig 7). Moderate densities were found around Quunguq Lake (stratum 1), but Tundra Swans were rarely seen north of Prince Albert Sound (Table 2; Fig 7).

Loons

As in the 1992-1994 survey period, three species of loons (*Gavia spp.*) were observed on western Victoria Island during the 2004-2005 surveys: Yellow-billed Loon (*G. adamsii*), Red-throated Loon (*G. stellata*), and Pacific Loon (*G. pacifica*). Yellow-billed Loons were most numerous in northwestern Victoria Island for both 2004 and 2005, followed by Pacific Loons and Red-throated Loons (Table 3). In southwestern Victoria Island, Yellow-billed Loons were most numerous in 2004, while Pacific Loons were more numerous in 2005 (Table 3). By contrast, during the 1992-1994 surveys, the Pacific Loon was most numerous for both areas in all three years.

Population indices for all loon species combined indicated nearly a 50% decline in number on northwestern Victoria Island, but no change in the southern part of the study area (Table 3; Fig. 9). The mean population indices for northwestern Victoria Island declined from 7115 for the 1992-1994 surveys to 3799 for the 2004-2005 surveys, whereas the population indices for southwestern Victoria Island remained stable at about 1500 loons (Table 5; Fig 14). The survey results suggest the decline was primarily due to fewer Pacific Loons, although there is some uncertainty to this given up to 47% of loons were unidentified to species. By applying the proportion that were Pacific Loons (obtained from loons identified to species) to the population index for total loons, the Pacific Loon population index for northwestern Victoria Island dropped from an average of 5350 in 1992-1994 to only 1245 in 2004-2005.

In all years, loons were widespread throughout western Victoria Island (Table 2; Fig 8). Highest densities for the 2004-2005 surveys were found around Quunguq Lake (stratum 1; Table 2; Fig 8), while highest densities from the earlier surveys were found in the Kagloryuak River valley (stratum 2; Table 2; Fig 8).

Jaegers

Three species of jaegers (*Stercorarius spp*.) were seen on western Victoria Island during all five years of survey: Pomarine Jaeger *(S. pomarinus*), Parasitic Jaeger (*S. parasiticus*), and Long-tailed Jaeger (*S. longicaudus*).

Although population indices for all three species were low in 2004 relative to numbers observed 1992-1994, indices for Pomarine and Long-tailed Jaegers rebounded in 2005 (Table 3). The rebound is reflected in population indices for all jaeger species combined and shows that although numbers were low in 2004, 2005 indices surpassed those observed in 1994. Nevertheless, 2005 indices remain well below those for 1992 and 1993 (Table 3; Fig. 9). The mean population indices for jaegers on western Victoria Island declined from 11 948 for the 1992-1994 surveys to 6668 for the 2004-2005 surveys (Table 5; Fig 14). The survey results suggest the declines were a result of much lower numbers of both Pomarine and Parasitic jaegers, although up to 56% were unidentified to species lending uncertainty to our analysis of trends at the species level. By applying the proportion that were Pomarine Jaegers (obtained from jaegers identified to species) to the population index for total jaegers, the Pomarine Jaeger population index for western Victoria Island dropped from an average of 5905 in 1992-1994 to only 2475 in 2004-2005. By applying the proportion that were Parasitic Jaegers to the population index for total jaegers the Parasitic Jaeger index for western Victoria Island dropped from an average of 3842 in 1992-1994 to only 1517 in 2004-2005.

Jaegers were distributed throughout western Victoria Island during the 2004-2005 surveys (Table 2; Fig 10). Highest densities, especially for Pomarine and Parasitic jaegers, were observed in the Kagloryuak River valley (stratum 2) and in northern portions of the Prince Albert Peninsula (stratum 6; Table 2; Fig 10). Though higher densities were observed during the 1992-1994 surveys, the overall distribution of jaegers for the two survey periods was very similar (Fig 10).

Gulls

Population indices for Glaucous Gulls (*Larus hyperboreus*) in 2004 were 2612 (±590) in northwestern Victoria Island and 231 (±140) for southwestern Victoria Island (Table 3; Fig 9). Although 2004 indices were well below those observed in the 1992-1994 surveys, numbers rebounded in 2005 with population indices of 6048 (±1149) and 2563 (±468) for northwestern and southwestern Victoria Island respectively (Table 3; Fig 9). Mean population indices for the two survey periods indicated Glaucous Gull numbers for western Victoria Island dropped by about 50% (Table 5; Fig 14). However, the large fluctuation in number of gulls among all five years lends uncertainty to whether they have actually declined in number (Fig. 9).

Glaucous Gulls were fairly evenly distributed throughout western Victoria Island during the 2004-2005 surveys (Table 2; Fig 11), though somewhat higher concentrations were observed on the western portion of Diamond Jenness Peninsula (stratum 4) and the southern portion of Prince Albert Peninsula (stratum 6; Fig 11). Distribution was similar during the 1992-1994 surveys, but with additional high densities south of Prince Albert Sound on the Wollaston Peninsula (stratum 7), in the extreme southwest of the island (stratum 8) and in northern areas of Prince Albert Peninsula (stratum 6; Fig 11).

Few Sabine's Gulls (*Xema sabini*) were observed during the 2004-2005 surveys (total of 59 observations). The numbers were more than 50% below those observed during the 1992-1994 surveys (Table 3). Similar to the earlier surveys, over 90% of observations occurred in the Kagloryuak River valley (stratum 2) and at Tahiryuak Lake (stratum 3).

A total of 14 Thayer's Gulls (*L. thayeri*) were observed during the 2004-2005 surveys: 11 in the Kagloryuak River valley (stratum 2); 2 near the cliffs of Diamond Jenness Peninsula (stratum 4); and 1 near Quunguq Lake (stratum 1; Table 2). Like Sabine's Gulls, numbers are well below those observed during the 1992-1994 surveys (Table 3).

Sandhill Crane

Sandhill Crane (*Grus canadensis*) population indices varied considerably among years, with no discernable trend: 500-2600 cranes in the northwest, and 300-700 in the southwest (Table 3). Although Sandhill Cranes occurred throughout western Victoria Island, highest densities were found in the southernmost stratum (stratum 8; Table 2).

Other Geese

Two pairs of Black Brant (*Branta bernicla nigricans*) were observed during the 2004-2005 surveys: one pair in the Kagloryuak River valley (stratum 2) in 2004, and the other northeast of the Minto Inlet (stratum 5) in 2005 (Table 2). Though rare, Brant were more plentiful during the 1992-1994 surveys (Table 2; Table 3).

Greater White-fronted Geese (*Anser albifrons*) were found primarily in the southern portion of the study area (stratum 8) during the 2004-2005 surveys (Table 2; Fig. 12). Although densities were very low, numbers were similar both years (Table 2; Table 3; Fig 9) and similar to past surveys (Table 3; Fig 14).

Lesser Snow Geese (*Chen caerulescens caerulescens*) occurred in low densities throughout much of western Victoria Island (Table 2; Table 3). Observations typically were of small flocks (< 20) of non-breeders. Numbers on northwestern Victoria Island were similar between the two survey periods, but in the most southern strata they increased, especially in 2005 (Table 2; Table 3). An incidental observation of an apparent nesting pair was observed on a coastal cliff near the north end of Prince Albert Peninsula.

Raptors

Only one Snowy Owl (*Bubo scandiacus*) was observed during the 2004 surveys and was located northwest of Minto Inlet (stratum 5). Observations were much more common during the 2005 surveys when 43 owls were seen distributed throughout northwest Victoria Island (Table 2). There was only one observation in southwestern Victoria Island and occurred south of

Tassijuak Lake (stratum 8). The northwest Victoria Island population index of 1849 (±391) Snowy Owls for 2005 was above that observed in 1994, but below indices from 1992 and 1993 (Table 3).

One observation of a Short-eared Owl (*Asio flammeus*) was made in 2004 at the southwest portion of Prince Albert Peninsula (stratum 6). Two observations were made in 2005: one in the Kagloryuak River valley (stratum 2), and the other south of Tassijuak Lake (stratum 8) in the southern part of the island. Likewise, there were few observations of Short-eared Owls in the 1992-1994 surveys.

Two Peregrine Falcons (*Falco peregrinus*) were observed in 2004. One was in the northeast portion of Prince Albert Peninsula (stratum 6) and the other was on the east-central portion of the Wollaston Peninsula (stratum 7). Similarly, two observations of Peregrine Falcons were made in 2005. One was south of Tassijuak Lake (stratum 8) in southern Victoria Island, while the other was east of Minto Inlet (stratum 5).

Rough-legged Hawks (*Buteo lagopus*) were observed throughout western Victoria Island during the 2004-2005 surveys with the exception of the area around Tahiryuak Lake (stratum 3) and the inland area northeast of Minto Inlet (stratum 5; Table 2). In general, Rough-legged Hawk numbers were lower than those observed during the 1992-1994 surveys for northwestern Victoria Island but higher for southwestern Victoria Island (Table 3).

Ptarmigan

Rock (*Lagopus mutus*) and Willow Ptarmigan (*L. lagopus*) could not reliably be distinguished from the aircraft, so the two species were combined. They were observed in low numbers throughout western Victoria Island (Table 2). Highest densities were observed in the Kagloryuak River valley (stratum 2), near Tahiryuak Lake (stratum 3), and in southern Victoria Island (stratum 8). Population indices were very similar to those observed in previous surveys (Table 3).

Arctic Tern

Observations of Arctic Terns (*Sterna paridisaea*) were widely distributed throughout western Victoria Island during the 2004-2005 surveys with the exception of the inland area northeast of Minto Inlet (stratum 5) where none were seen (Table 2). Compared to the 1992-1994 surveys, population indices were very low in 2004. Although they rebounded in 2005, they were still >50% below indices from the earlier surveys (Table 3).

Common Eider

Common Eiders (*Somateria mollissima v-nigra*) were seldom observed inland, where our surveys took place. Rare observations were made near the coast in strata 1, 6, 7, and 8 (Table 2).

DISCUSSION

Unlike earlier accounts indicating the King Eider was the most abundant waterfowl species on western Victoria Island (Smith 1973, McLaren and Alliston 1981, Allen 1982, Cornish and Dickson 1996), we found it was now second to the Canada Goose. Our results show >50% decrease since the surveys were last conducted during 1992 to 1994. Several studies have documented a general decline of King Eider numbers in the western Canadian arctic since the mid 1970's (Dickson et al. 1997, Suydam et al. 1997, Suydam et al 2000), and it appears this trend has continued on western Victoria Island since the surveys were last conducted. In contrast, migration counts at Point Barrow, Alaska, in 2003 and 2004 show the western arctic population of King Eiders as a whole may have rebounded in recent years (R. Suydam, North Slope Borough Dept. Wildlife Management pers. comm.), and survey data from the Alaskan North Slope show a slightly increasing trend (Larned et al. 2005).

Information on breeding population trends is difficult to ascertain when surveys are not conducted on an annual basis. The natural annual variability in breeding effort and success of arctic nesting birds is high (Barry 1968, Lamothe 1973, Pehrsson 1986, Dickson 1992). As witnessed by the 1992-1994 surveys (Cornish and Dickson 1996), King Eider breeding population estimates can fluctuate greatly on an annual basis. Nevertheless, estimated numbers of King Eiders in both 2004 and 2005 fell well below estimates for all three of the earlier surveys. Furthermore, the differences were so large that none of the 95% confidence intervals overlapped suggesting there was a significant population decline (van Belle 2002).

Timing surveys to coincide with presence of male King Eiders on the nesting grounds is critical if counts are to include all breeding pairs for the area. If the survey is conducted too early, not all of the pairs will have arrived on the breeding grounds, and if surveys are too late, many of the males will have departed on moult migration (Lamothe 1973, Dickson et al. 1997). In either situation, the population estimates are biased low. The ratio of lone males to total males (lone plus paired males) can be a good indicator of relative survey timing for ducks (Anonymous 1987, Larned and Balogh 1997). However, male King Eiders tend to leave the nesting grounds shortly after the onset of incubation (Lamothe 1973, Dickson et al. 1998, Dickson et al. 1999) making the index less useful for this species. Nevertheless, an extreme value (either very low or very high) would be an indication of problems with timing of the survey. The overall ratio of 0.29 for the 2004 survey suggests that survey was conducted earlier relative to nest initiation than the 2005 survey, which had a ratio of 0.61 lone males to total males. Comparing our 2004 and 2005 ratios with those observed in 1992, 1993 and 1994 (0.45, 0.49, and 0.31 respectively) on western Victoria Island, it appears the latter two years of surveys fall at opposite extremes.

Our surveys indicate King Eiders declined by about 50% throughout western Victoria Island, except on Diamond Jenness Peninsula where they declined by over 90%. A disproportionate population decrease in a specific area like this points to a different circumstance or cause in this region. Abundance of predators or alternative prey can affect the reproductive success and ultimately the distribution of arctic nesting birds (Bowman et al. 1997, Kellett and Alisauskas 1997). Holman, which is the only community on western Victoria Island, is located on the far western edge of Diamond Jenness Peninsula (Fig 1). The permanent community of Holman was established circa 1940 as a Hudson Bay Company trading post. Since that time the local human population has increased greatly. Concurrent with the increase in population has been an increase in human refuse from the community. Human caused refuse has provided a new food source for Glaucous Gulls around communities in the north (Gilchrist 2001), likely leading to greater survival of juveniles and sub-adults (Day 1998) and resulting in higher numbers of Glaucous Gulls around communities than were historically present. The suspected change in distribution of Glaucous Gulls on western Victoria Island is reinforced by our survey results from both the 1992-1994 surveys and the 2004-2005 surveys. In fact, higher densities of Glaucous Gulls surrounding the community of Holman (Fig. 11) closely contrast the decreased densities observed for King Eiders during the 2004-2005 surveys (Fig. 3). Glaucous Gulls are a known predator of King Eider ducklings and eggs (Kellett and Alisauskas 1997, Gilchrist 2001, Kellett et al. 2003) and may be influencing the reproductive success and consequent breeding distribution of King Eiders around the community of Holman. Although the King Eider – Glaucous Gull relationship was not obvious from the 1992-1994 surveys, perhaps the impact on the long-lived King Eiders was delayed and is just now affecting the breeding population as the unsuccessful eiders fail to replace themselves. It is possible that other predators of King Eider ducklings and eggs such as Arctic Fox and Common Ravens have also become more abundant on Diamond Jenness Peninsula due to the influence of the community on the local environment.

In contrast to the 1992-1994 surveys (Cornish and Dickson 1996) when the King Eider was more numerous, the Canada Goose has become the most abundant species of waterfowl observed during our surveys on western Victoria Island in 2004-2005. Although Canada Geese were more prevalent in the southern portion of our study area, they still outnumbered King Eiders throughout western Victoria Island. No Canada Geese were observed north of the Kuujuua River in 1980 (McLaren and Alliston 1981; Allen 1982). Based on the 1992-1994 survey results, Cornish and Dickson (1996) suggested Canada Geese may be expanding their breeding range northward. Hines et al. (2000) reported the range expansion was accompanied by an increase in population size and our data support this theory. After applying our visibility correction factor to the 1992-1994 data we estimated a mean of 2885 Canada Geese nesting on Prince Albert Peninsula (stratum 6) in the extreme northwest of Victoria Island. By 2004-2005, there had been a three-fold increase to an estimated 9927 Canada Geese.

Interestingly, King Eider breeding populations appear to be decreasing while Canada Goose numbers are increasing in the same breeding area. To understand why this may be occurring we can focus our attention on the differences between the two species. King Eiders and Canada Geese nesting on western Victoria Island differ in relation to their wintering area and migration route to the breeding grounds. King Eiders winter in the Bering Sea and migrate eastward through the Beaufort Sea along open water leads during the spring (Barry 1986, Dickson et al. 2001). Canada Geese nesting on western Victoria Island winter primarily in the northern panhandle of Texas, Colorado, and Nebraska and migrate northward through the prairies and the boreal forest (Hines et al. 2000, Bellrose 1976). Vastly different environmental conditions on the wintering area and migration route could result in differences in nutritional status of the two species upon arrival on the breeding grounds, and ultimately affect breeding effort and success. Alternatively, different survival rates on the wintering area and migration route between the two species could similarly affect resulting breeding populations. Increased survival rates coupled with a decrease in harvest rate have likely contributed to the increasing population of Canada Geese on western Victoria Island (Hines et al. 2000). Unfortunately the harvest rate for King Eiders is poorly understood, particularly in Russia where many western Victoria Island King Eiders moult and winter (Dickson et al. 2001).

Population estimates for Canada Geese on western Victoria Island increased substantially from 2004 to 2005, while population estimates for King Eiders were relatively consistent between the two years. Canada Geese nesting on western Victoria Island arrive and begin their nesting activities approximately three to four weeks earlier than King Eiders (Parmalee et al. 1967, Kay et al. 2006). Due to their long migration and small body size they rely heavily on exogenous reserves during nesting (Thompson and Raveling 1987, Jarvis and Bromley 2000). A favorable spring phenology, such as was observed on western Victoria Island in 2005, would allow Canada Geese to readily restore reserves while foraging near the nest and would result in a productive nesting season. A late spring would require increased foraging likely resulting in an increase in nest predation or abandonment. Furthermore, a late spring may force many geese to forgo nesting completely and retreat to more southerly areas with a viable food supply (Barry 1962, Ganter and Boyd 2000). Since our surveys are timed to maximize the number of King Eider males on the breeding grounds, nesting Canada Geese are typically at an advanced stage of incubation by the time of our counts. Consequently, non-nesters or unsuccessful nesting Canada Geese may have left the breeding grounds, resulting in a biased low breeding population estimate in years of a late spring phenology, like 2004. The count for the later arriving King Eiders would not be affected in the same fashion, and our consistent breeding population estimates for King Eiders support this.

The decline in number of Long-tailed Ducks on western Victoria Island that was first noted by Cornish and Dickson (1996) may be continuing. Although densities were low and confidence intervals overlapped among surveys, a general decline in number appears to have occurred. Waterfowl breeding population surveys in Alaska and northern Canada during the same time period as our surveys support the decline in overall Long-tailed Duck numbers (Mallek et al. 2004, Larned et al. 2005, Anonymous 2005).

Distribution of Tundra Swans was similar between the two survey periods with few swans observed in the northern half of western Victoria Island. Although the number of swans observed in 2004 was much lower than in earlier surveys, numbers rebounded in 2005 suggesting a stable population on western Victoria Island. As with Canada Geese, the low number in 2004 was likely due to the late spring thaw. Tundra Swans usually arrive on the breeding grounds in late May on western Victoria Island (Kay et al. 2006). A late arrival of spring, as occurred in 2004, can result in non-breeding of a substantial proportion of the population (McLaren and McLaren 1984) resulting in a low breeding population estimate.

Pacific Black Brant populations may have declined on western Victoria Island since the surveys were last completed but observations were so rare that conclusions can not be made in regards to their status. About 4% of geese identified during the 1992-1994 surveys were Brant (Cornish and Dickson 1996) compared to <1% during the 2004-2005 surveys. Indeed, only 5 observations of Brant were made on transect during our surveys.

Greater White-fronted Geese occurred primarily in the southern most portion of Victoria Island during our surveys, although observations were also made on the Wollaston Peninsula (stratum 7), Diamond Jenness Peninsula (stratum 4), and in the Kagloryuak River valley (stratum 2). This distribution supports previously documented observations from the area (Cornish and

Dickson 1996). Likewise, there was no change in abundance of Greater White-fronted Geese between the two survey periods.

Historically, few Lesser Snow Geese have been observed on western Victoria Island (McLaren and Alliston 1981, Allen 1982, Cornish and Dickson 1996, Kay et al. 2006). A few pairs, presumably breeding, were observed throughout western Victoria Island during the 2004-2005 surveys but most observations were small flocks and assumed to be failed or non-breeding birds. Two large and recently expanding breeding colonies are located nearby on Banks Island and south of Queen Maud Gulf (Alisauskas and Boyd 1994, Kerbes et al. 1999, Mowbray et al. 2000, Wiebe and Hines 2006) and could be why observed numbers are increasing on southwestern Victoria Island.

Our surveys indicate loon numbers decreased by about 50% on northwestern Victoria Island since the surveys were last completed, but remained stable in the southern part of the study area. The decline on northwestern Victoria Island appears to be primarily due to decreased numbers of Pacific Loons. During the same time period, both Pacific and Red-throated loons declined in mainland western arctic Canada (Jim Hines pers. comm.). Annual surveys on the Arctic Coastal Plain of Alaska indicate Yellow-billed Loon and Pacific Loon populations have been stable since surveys were begun in 1986; however Red-throated Loons have declined (Groves et al. 1996; Larned et al. 2005).

Sandhill Cranes nest in low densities throughout western Victoria Island (Cornish and Dickson 1996, this study). Like Canada Geese and Tundra Swans, Sandhill Cranes are early nesters on western Victoria Island (Kay et al. 2006). Thus the lower numbers observed in 2004 was likely a reflection of lower breeding effort/success due to a late spring thaw. Although numbers were low in 2004 compared with the previous surveys, 2005 numbers were consistent with those observed 1992-1994, suggesting a stable breeding population.

Jaegers were observed throughout western Victoria Island, but most commonly in areas associated with their main prey sources, small birds and lemmings (Maher 1974, Taylor 1974, Wiley and Lee 1998, 1999, 2000). Cornish and Dickson (1996) found Pomarine Jaegers to be the most numerous species during their surveys (1992-1994), except in 1994 which was preceded by a lemming (*Lemmus spp*.) crash in 1993. Pomarine and Long-tailed jaeger numbers were low in 2004, but rebounded in 2005 in relation to an observed increase in lemming numbers (G. Raven pers. obs.). Pomarine Jaegers, the largest of the three jaeger species found on western Victoria Island, are obligate predators of microtines and typically only breed in areas or years with an abundant supply (Maher 1974, Wiley and Lee 2000). Long-tailed Jaegers likewise rely on microtines as their primary prey when available but can take advantage of other prey sources such as birds and insects when microtines are rare (Maher 1974, Wiley and Lee 1998). We saw little change in Parasitic Jaeger numbers between 2004 and 2005. Unlike the other jaeger species, Parasitic Jaegers are a minor predator of lemmings and often rely on passerines, small shorebirds or eggs as their primary prey (Maher 1974, Wiley and Lee 1999).

Our survey data indicates jaegers as a group fluctuated in number in relation to lemming abundance on western Victoria Island. Although jaeger numbers were lower in 2004 than in all three of the earlier years, in 2005 the count was higher than in 1994. Given the large annual fluctuations in numbers, it would be risky to form conclusions concerning their population status based on only five years of surveys over a fourteen year span.

Glaucous Gull numbers were very low in 2004 in relation to the earlier surveys, while numbers observed in 2005 were more typical. The onset of nesting is strongly influenced by weather and snow melt for Glaucous Gulls, and this in turn can cause high annual variation in population estimates derived from poorly timed surveys (Barry and Barry 1990, Gilchrist 2001). The late spring on western Victoria Island in 2004 likely affected our survey counts, resulting in a lower population estimate. Many larger wetlands where Glaucous Gulls typically nest on Victoria Island (Parmelee et al. 1967) were ice covered during the 2004 surveys, so that many Glaucous Gulls may have still been on marine habitats when we surveyed (Alexander et al. 1993, Gilchrist 2001).

Like Pomarine Jaegers, Snowy Owl distribution on the breeding grounds is closely tied to the abundance of lemmings, which is the owl's primary prey item during nesting season (Parker 1974, Taylor 1974, Parmelee 1992). The extremely low number of Snowy Owls observed on northwestern Victoria Island in 2004 further suggests that lemmings were at a low point in their population cycle. Similar to Pomarine and Long-tailed Jaegers, Snowy Owls rebounded in 2005 in relation to an increase in lemmings on western Victoria Island.

RECOMMENDATIONS

The intent of our surveys was to determine population trends for several of the larger, more visible species of birds that inhabit western Victoria Island. Unfortunately, conducting these surveys at >10-year intervals makes any conclusions concerning population trends somewhat uncertain. As our 2004-2005 surveys attest, dramatic annual fluctuations can occur in breeding population numbers for many bird species. A number of factors such as timing of spring thaw, abundance of lemmings and abundance of predators of birds, eggs and their young affect the results of breeding bird surveys. A better understanding of actual population changes, as opposed to natural annual fluctuations in estimated numbers, could be achieved if surveys were completed on an annual basis or at least more frequently.

The remote location of Victoria Island makes it logistically difficult and expensive to survey. The cost of caching fuel combined with frequent ferrying to and from fuel caches while conducting surveys make the use of a helicopter very costly. Recent work on the cost effectiveness of using fixed wing aircraft, which can fly a much greater distance before refueling, is encouraging (B. Conant, USFWS, pers. comm.). However, work is needed to gauge the effectiveness and develop visibility correction factors for the use of fixed wing aircraft in the western and central Canadian arctic.

The use of different observers during aerial surveys introduces an observer bias and creates another source of uncertainty when comparing survey results. Observer bias can be eliminated by always using the same observers.

More intensive sampling during surveys of western Victoria Island would further improve confidence in population estimates. Our survey plots sample a relatively small portion (38%) of western Victoria Island. Again, cost is the limiting factor to increasing the intensiveness of surveys. However, results from our surveys could indicate specifically which areas may benefit from a more intensive sampling design. For example, the significant change in

King Eider density observed on Diamond Jenness Peninsula indicates it may be an area in need of further study.

LITERATURE CITED

Alexander, S. A., S. E. Westover, and D. L. Dickson. 1993. Spring migration of waterbirds in the Beaufort Sea, Amundsen Gulf and Lambert Channel Polynya. Canadian Wildlife Service Technical Report Series No. 171.

Alisauskas, R. T., H. Boyd. 1994. Previously unrecorded colonies of Ross' and Lesser Snow geese in the Queen Maud Gulf Bird Sanctuary. Arctic 47:69-73.

Allen, D. L. 1982. Bird migration and nesting observations, western Victoria Island, NWT, June, 1980. Unpublished report, Canadian Wildlife Service, Yellowknife. 61pp.

Anonymous. 1987. Standard operating procedures for aerial waterfowl breeding ground population and habitat surveys in North America. U.S. Fish and Wildlife Service, Washington, D.C., and Canadian Wildlife Service, Ottawa.

Anonymous. 2005. The Waterfowl Breeding Population and Habitat Survey for northern Alberta, northeastern British Columbia, and the Northwest Territories (Mackenzie District). U.S. Fish and Wildlife Service, Washington, D.C., and Canadian Wildlife Service, Ottawa.

Anthony, R. M., W. H. Anderson, J. S. Sedinger, and L. L. McDonald. 1992. Estimating populations of Black Brant on the Yukon-Kuskokwim delta with airborne video: 1991 progress report. Alaska Fish and Wildlife Research Center, Anchorage, Alaska. Unpublished Report. 30pp.

Barry, T. W. 1960. Waterfowl reconnaissance in the western Arctic. The Arctic Circle 13(4):51-58.

Barry, T. W. 1962. Effect of late season on Atlantic Brant reproduction. Journal of Wildlife Management 26:19-26.

Barry, T. W. 1968. Observations on natural mortality and native use of eider ducks along the Beaufort Sea coast. Canadian Field-Naturalist 82:140-146.

Barry, T. W. 1986. Eiders of the western Canadian Arctic. Pages 74-80 *in* A. Reed (ed.), Eider ducks in Canada. Canadian Wildlife Service Technical Report Series No. 47, Ottawa.

Barry, S. J., and T. W. Barry. 1990. Food habits of Glaucous Gulls in the Beaufort Sea. Arctic 43:43-49.

Bellrose, F. C. 1976. Ducks, geese, and swans of North America. Stackpole Books, Harrisburg, Pennsylvania. 544 pp.

Beyer, W. H. 1968. Handbook of tables for probability and statistics. 2nd edition. The Chemical Rubber Co., Cleveland, Ohio.

Bowman, T. D., R. A. Stehn, and K. T. Scribner. 1997. Glaucous Gull predation of goslings on the Yukon-Kuskokwim Delta, Alaska. Unpublished Report, U. S. Fish and Wildlife Service, Anchorage, AK. 59pp.

Caughley, G. 1977. Sampling in aerial survey. Journal of Wildlife Management 41(4):605-615.

Caughley, G. and D. Grice. 1982. A correction factor for counting Emus from the air, and its application to counts in western Australia. Australian Wildlife Research 9: 253-259.

Cochran, W. G. 1977. Sampling techniques. 3rd Edition. John Wiley and Sons, Toronto.

Cornish, B. J. and D. L. Dickson. 1996. Distribution and abundance of birds on western Victoria Island, 1992 to 1994. Canadian Wildlife Service Technical Report Series No. 253, Prairie and Northern Region, Edmonton. 78pp.

Day, R. H. 1998. Predator populations and predation intensity on tundra-nesting birds in relation to human development. Unpublished Report. U. S. Fish and Wildlife Service, Fairbanks, AK. 61pp.

Dickson, D. L. 1982. The Red-throated Loon as an indicator of environmental quality. Canadian Wildlife Service Occasional Paper No. 73, Ottawa. 17pp.

Dickson, D. L., R. C. Cotter, J. E. Hines, and M. F. Kay. 1997. Distribution and abundance of King Eiders in the western Canadian Arctic. Pages 29-39 in D. L. Dickson (ed.), King and Common Eiders of the western Canadian Arctic. Canadian Wildlife Service Occasional Paper No. 94. Ottawa, Ontario.

Dickson, D. L., R. S. Suydam, and J. Fadely. 1998. Tracking the movement of King Eiders from nesting grounds in western arctic Canada to their molting and wintering areas using satellite telemetry. 1997/1998 Progress Report. Unpublished Report, Canadian Wildlife Service, Edmonton. 7 pp.

Dickson, D. L., R. S. Suydam, and G. Balogh. 1999. Tracking the movement of King Eiders from nesting grounds in western arctic Canada to their molting and wintering areas using satellite telemetry. 1998/1999 Progress Report. Unpublished Report, Canadian Wildlife Service, Edmonton. 7 pp.

Dickson, D. L., G. Balogh, and S. Hanlan. 2001. Tracking the movement of King Eiders from nesting grounds on Banks Island, Northwest Territories to their molting and wintering areas using satellite telemetry. 2000/2001 Progress Report. Unpublished Report, Canadian Wildlife Service, Edmonton. 8 pp.

Fabijan, M., R. Brook, D. Kuptana, and J. E. Hines. 2000. The subsistence harvest of King and Common eiders in the Inuvialuit Settlement Region, 1988-1994. Pages 67-73 in D. L. Dickson (ed.), King and Common Eiders of the western Canadian Arctic. Canadian Wildlife Service, Occasional Paper No. 94. Ottawa, Ontario.

Ganter, B. and H. Boyd. 2000. A tropical volcano, high predation pressure, and the breeding biology of arctic waterbirds: a circumpolar review of breeding failure in the summer of 1992. Arctic 53:289-305.

Gasaway, W. C., S. D. Dubois, D. J. Reed, D. J. Reed, and S. J. Harbo. 1986. Estimating moose population parameters from aerial surveys. Biological Paper. Univ. Alaska No. 22, University of Alaska Press, Fairbanks. 108pp.

Gilchrist, H. G. 2001. Glaucous Gull (*Larus hyperboreus*). *In* The Birds of North America, No. 573 (A.F. Poole and F.B. Gill, eds). The Birds of North America, Inc., Philadelphia, PA.

Groves, D. J., B. Conant, R. J. King, J. I. Hodges, and J. G. King. 1996. Status and Trends of Loon populations summering in Alaska, 1971-1993. Condor 98:189-195.

Hines, J. E., D. L. Dickson, B. C. Turner, M. O. Wiebe, S. J. Barry, T. A. Barry, R. H. Kerbes, D. J. Nieman, M. F. Kay, M. A. Fournier, and R. C. Cotter. 2000. Population status, distribution, and survival of Shortgrass Prairie Canada Geese from the Inuvialuit Settlement Region, Western Canadian Arctic. Pages 27-58 in K. M. Dickson (ed.), Towards conservation of the diversity of Canada Geese (*Branta canadensis*). Canadian Wildlife Service Occasional Paper No. 103. Ottawa, Ontario.

Hines, J. E. and M. F. Kay. 2006. Minimum visibility correction factors for some species of waterfowl encountered in helicopter surveys in Arctic Canada. Pages 68-69 in Hines, J. E. and Wiebe, M. O (ed.). Surveys of geese and swans in the Inuvialuit settlement region, western Canadian arctic, 1989-2001. Canadian Wildlife Service Occasional Paper (draft). Ottawa, Ontario.

Jarvis, R. L. and R. G. Bromley. 2000. Incubation behaviour of Richardson's Canada Geese on Victoria Island, Nunavut, Canada. Pages 59-64 in K. M. Dickson (ed.), Towards conservation of the diversity of Canada Geese (*Branta canadensis*). Canadian Wildlife Service Occasional Paper No. 103. Ottawa, Ontario.

Jolly, G. M. 1969. Sampling methods for aerial censuses of wildlife populations. East African Agricultural and Forestry Journal 34:46-49.

Kay, D. G., D. Kuptana, G. Wolki, Sr., and J. E. Hines. 2006. Pages 44-57 in Hines, J. E. and Wiebe, M. O (ed.). Surveys of geese and swans in the Inuvialuit settlement region, western Canadian arctic, 1989-2001. Canadian Wildlife Service Occasional Paper (draft). Ottawa, Ontario.

Kellett, D. K., and R. T. Alisauskas. 1997. Breeding biology of King Eiders nesting on Karrak Lake, Northwest Territories. Arctic 50:47-54.

Kellett, D. K., R. T. Alisauskas, and K. R. Mehl. 2003. Nest-site selection, interspecific associations, and nest success of King Eiders. Condor 105(2):373–378.

Kerbes, R. H., K. M. Meeres, and J. E. Hines. 1999. Distribution, survival, and numbers of Lesser Snow Geese of the western Canadian Arctic and Wrangel Island, Russia. Canadian Wildlife Service Occasional Paper No. 98. Ottawa, Ontario.

Krebs, C. J. 1989. Ecological methodology. Harper and Row, Publishers. New York, N.Y.

Lamothe, P. 1973. Biology of King Eider (*Somateria spectabilis*) in a fresh water breeding area on Bathurst Island, Northwest Territories. MSc. Thesis, University of Alberta, Edmonton. 125pp.

Larned, W. W., and G. R. Balogh. 1997. Eider breeding population survey, arctic coastal plain, Alaska, 1992-1996. Unpublished Report, U. S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, AK. 51pp.

Larned, W. W., R. A. Stehn, and R. M. Platte. 2005. Eider breeding population survey, arctic coastal plain, Alaska. Unpublished Report, U. S. Fish and Wildlife Service, Migratory Bird Management, Anchorage, AK. 49pp.

Maher, W. J. 1974. Ecology of Pomarine, Parasitic, and Long-tailed Jaegers in Northern Alaska. Pacific Coast Avifauna: 37.

Mallek, E. J., R. M. Platte, and R. A. Stehn. 2004. Aerial breeding pair surveys of the Arctic coastal plain of Alaska – 2004. Unpublished Report, U. S. Fish and Wildlife Service, Migratory Bird Management, Fairbanks, AK. 25 pp.

McLaren, M. A. and W. G. Alliston. 1981. Summer bird populations on western Victoria Island, NWT, July 1980. Unpublished Report by LGL Ltd. for Polar Gas Project. 147pp. (Available from LGL Ltd., 22 Fisher Street, P.O. Box 280, King City ON L7B 1A6.)

McLaren, M. A. and P. L. McLaren. 1984. Tundra Swans in Northeastern Keewatin District, N.W.T. Wilson Bulletin 96(1):6-11.

Mowbray, T. B., F. Cooke, and B. Ganter. 2000. Snow Goose (*Chen caerulescens*). *In* The Birds of North America, No. 514 (A.F. Poole and F.B. Gill, eds). The Birds of North America, Inc., Philadelphia, PA.

Parker, G. R. 1974. A population peak and crash of lemmings and snowy owls on Southampton Island, N.W.T. Canadian Field-Naturalist 88:151-156.

Parmelee, D. F., H. A. Stephens, and R. H. Schmidt. 1967. The birds of southeastern Victoria Island and adjacent small islands. National Museum of Canada Bulletin. No. 222, Biological Series No. 78, Ottawa. 229 pp.

Paramelee, D. F. 1992. Snowy Owl (*Bubo scandiacus*). *In* The Birds of North America, No. 10 (A.F. Poole and F.B. Gill, eds). The Birds of North America, Inc., Philadelphia, PA.

Pehrsson, O. 1986. Duckling production of the Oldsquaw in relation to spring weather and small-rodent fluctuations. Canadian Journal of Zoology 64:1835-1841.

Pollock, K. H. and W. L. Kendall. 1987. Visibility bias in aerial surveys: a review of estimation procedures. Journal of Wildlife Management 51: 502-510.

Pollock, K. H., J. D. Nichols, C. Brownie, and J. E. Hines. 1990. Statistical inference for capture-recapture experiments. Wildlife Monographs No. 107. 97pp.

Porsild, A. E. 1951. Bird notes from Banks and Victoria Islands. Canadian Field-Naturalist 65:40-42.

Smith, T. W. 1973. The birds of Holman region, western Victoria Island. Canadian Field-Naturalist 87:35-42.

Suydam, R. S., D. L. Dickson, J. B. Fadely, and L. T. Quakenbush. 2000. Population declines of King and Common Eiders of the Beaufort Sea. Condor 102:219-222.

Suydam, R. S., L. Quakenbush, M. Johnson, J. C. George and J. Young. 1997. Migration of King and Common eiders past Point Barrow, Alaska, in spring 1987, spring 1994, and fall 1994. Pages 21-28 in D. L. Dickson (ed.), King and Common Eiders of the western Canadian Arctic. Canadian Wildlife Service Occasional Paper No. 94. Ottawa, Ontario.

Taylor, P. S. 1974. Summer population and food ecology of jaegers and snowy owls on Bathurst Island, N.W.T. emphasizing the long-tailed jaeger. M.Sc. thesis. Univ. of Alberta, Edmonton. 168 pp.

Thompson, S. C. and D. G. Raveling. 1987. Incubation behaviour of Emperor Geese compared with other geese: interactions of predation, body size, and energetics. Auk 104:707-716.

Van Belle, G. 2002. Statistical Rules of Thumb. John Wiley & Sons, Inc., New York, N.Y. 221pp.

Wiebe, M. O. and J. E. Hines. 2006. Aerial surveys of Lesser Snow Goose colonies at Anderson River and Kendall Island, Northwest Territories, 1996-2001. Pages 58-61 in Hines, J. E. and Wiebe, M. O (ed.). Surveys of geese and swans in the Inuvialuit settlement region, western Canadian arctic, 1989-2001. Canadian Wildlife Service Occasional Paper (draft). Ottawa, Ontario.

Wiley, R. H. and D. S. Lee. 1998. Long-tailed Jaeger (*Stercorarius longicaudus*). *In* The Birds of North America, No. 365 (A.F. Poole and F.B. Gill, eds). The Birds of North America, Inc., Philadelphia, PA.

Wiley, R. H. and D. S. Lee. 1999. Parasitic Jaeger (*Stercorarius parasiticus*). *In* The Birds of North America, No. 445 (A.F. Poole and F.B. Gill, eds). The Birds of North America, Inc., Philadelphia, PA.

Wiley, R. H. and D. S. Lee. 2000. Pomarine Jaeger (*Stercorarius pomarinus*). *In* The Birds of North America, No. 483 (A.F. Poole and F.B. Gill, eds). The Birds of North America, Inc., Philadelphia, PA.

Table 1. Extent of aerial surveys for breeding bird populations on western Victoria Island, 1992-1994 and 2004-2005.

Stratum			Transects surveyed									
			1992		1993		1994		2004		2005	
No.	Location	Area (km^2)	No.	Length (km)	No.	Length (km)	No.	Length (km)	No.	Length (km)	No.	Length (km)
1	Quunnguq Lake	3971	7	172	7	324	7	324	7	324	7	324
2	Kagloryuak River Valley	4573	8	608	9	688	9	688	9	688	9	688
3	Tahiryuak Lake	2298	8	282	9	322	9	322	9	322	9	322
4	Diamond Jenness Peninsula	15866	26	817	18	527	23	709	18	527	23	709
5	Minto Inlet to Wynniatt Bay	39676	16	690	6	338	9	476	9	476	9	476
6	Prince Albert Peninsula	16365	29	964	26	914	29	983	29	983	29	983
7*	Wollaston Peninsula	16596	-	-	6	662	-	-	6	662	6	662
8*	Tassijuak Lake	5508	-	-	12	799	-	-	6	392	6	392

* surveyed only in 1993, 2004 and 2005

Table 2. Density (number per 100 sq km) of birds observed in each stratum during aerial surveys on Victoria Island, 1992-1994 and 2004-2005. Numbers in brackets represent standard errors.

		Stratum							
SPECIES	Year	1	2	3	4	5	6	7	8
Pacific Loon	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 -
	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)
	2005	4.6 (1.9)	2.9 (1.1)	1.6 (1.5)	1.4 (0.8)	0.0 (0.0)	0.5 (0.3)	3.8 (0.4)	4.5 (1.9)
Red-throated Loon	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 -
	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)
	2005	0.8 (0.7)	1.8 (1.0)	3.1 (1.6)	0.0 (0.0)	0.0 (0.0)	1.0 (0.7)	0.0 (0.0)	0.0 (0.0)
Yellow-billed Loon	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 -
	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)
	2005	3.1 (1.8)	1.8 (1.4)	0.0 (0.0)	2.1 (1.2)	0.5 (0.5)	0.8 (0.4)	0.4 (0.4)	0.6 (0.6)
All Loons[a]	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 -
	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)
	2005	13.1 (3.1)	8.4 (2.7)	8.5 (2.9)	6.7 (1.4)	0.5 (0.5)	4.8 (1.3)	7.9 (1.6)	9.6 (4.3)
Tundra Swan	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 -
	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)
	2005	8.5 (3.5)	30.9 (4.3)	3.9 (1.5)	3.2 (1.0)	0.5 (0.5)	1.8 (0.8)	20.0 (5.6)	31.3 (6.5)

Table 2. (continued)

SPECIES	Year	Stratum 1	2	3	4	5	6	7	8
Canada Goose[b]	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 -
	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)
	2005	84.9 (12.5)	160.6 (23.5)	45.0 (7.8)	55.7 (13.0)	5.3 (2.3)	50.1 (7.3)	105.0 (19.1)	242.3 (30.4)
Brant	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 -
	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)
	2005	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	1.1 (1.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Greater White -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 -
	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)
	2005	0.0 (0.0)	2.5 (1.8)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.4 (0.4)	12.1 (4.6)
Lesser Snow Goose	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 -
	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)
	2005	3.1 (1.7)	26.5 (16.5)	0.8 (0.7)	1.1 (0.8)	0.0 (0.0)	4.1 (1.5)	3.0 (2.9)	20.4 (8.0)
Northern Pintail	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 -
	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)
	2005	0.0 (0.0)	0.7 (0.7)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	3.2 (2.0)

Table 2. (continued)

SPECIES	Year	Stratum 1	2	3	4	5	6	7	8
Common Eider	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 -
	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)
	2005	3.9 (2.2)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	1.3 (1.2)	0.8 (0.7)	1.9 (1.3)
King Eider[b]	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 -
	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)
	2005	53.2 (14.1)	82.1 (14.0)	63.7 (15.1)	6.3 (2.2)	9.5 (3.4)	27.7 (6.7)	22.7 (5.7)	45.9 (6.2)
Long-tailed Duck[b]	1992	11.6 (3.6)	18.1 (4.6)	61.2 (22.8)	14.4 (3.8)	10.1 (6.7)	4.0 (2.4)	ns -	ns -
	1993	7.7 (3.6)	25.1 (3.7)	6.2 (2.5)	13.3 (4.1)	14.8 (7.7)	7.3 (7.8)	11.3 (1.4)	11.3 (3.0)
	1994	6.9 (5.1)	11.6 (3.9)	12.4 (4.0)	16.2 (4.4)	1.6 (1.5)	4.3 (2.3)	ns -	ns -
	2004	7.7 (2.8)	14.9 (2.8)	14.0 (5.9)	4.7 (2.0)	4.2 (2.7)	8.1 (2.0)	5.3 (1.3)	17.9 (6.7)
	2005	9.3 (2.2)	21.1 (6.7)	20.2 (6.0)	9.9 (2.6)	7.4 (4.0)	5.8 (1.9)	4.5 (2.8)	23.6 (10.4)
Peregrine Falcon	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)
	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)
	2005	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)	0.6 (0.6)
Rough-legged 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 -
	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)
	2005	0.8 (0.7)	1.8 (0.8)	0.0 (0.0)	1.4 (0.6)	0.0 (0.0)	0.8 (0.4)	1.9 (0.4)	2.6 (2.5)

Table 2. (continued)

SPECIES	Year	Stratum 1	2	3	4	5	6	7	8
Ptarmigan	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 -
	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)
	2005	1.5 (1.0)	4.7 (1.6)	3.1 (2.2)	0.4 (0.8)	1.6 (1.1)	2.0 (0.6)	0.8 (0.5)	3.8 (2.5)
Sandhill Crane	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 -
	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)
	2005	1.5 (1.5)	2.2 (0.8)	0.0 (0.0)	1.4 (1.1)	0.0 (0.0)	3.3 (1.0)	1.1 (0.8)	8.9 (1.1)
Shorebird sp.	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 -
	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)
	2005	20.1 (7.3)	30.2 (7.1)	19.4 (6.3)	2.5 (1.8)	1.6 (0.8)	10.9 (2.5)	12.8 (4.6)	14.7 (1.3)
Pomarine 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 -
	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)
	2005	5.4 (1.5)	12.7 (1.8)	3.1 (2.0)	0.7 (0.5)	0.0 (0.0)	4.3 (0.9)	1.5 (0.7)	1.3 (0.8)
Parasitic 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 -
	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)
	2005	2.3 (1.1)	8.4 (1.7)	0.8 (0.8)	0.4 (0.8)	0.0 (0.0)	1.3 (0.5)	0.4 (0.4)	1.9 (0.8)

Table 2. (continued)

SPECIES	Year	Stratum 1	2	3	4	5	6	7	8
Long-tailed 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 -
	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)
	2005	6.2 (1.7)	4.4 (0.8)	3.9 (2.9)	2.5 (0.8)	0.0 (0.0)	4.8 (1.1)	0.8 (0.5)	2.6 (1.3)
All Jaegers[c]	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 -
	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)
	2005	20.1 (4.6)	55.2 (6.8)	14.8 (3.3)	6.0 (1.7)	0.0 (0.0)	20.3 (3.1)	6.4 (2.1)	11.5 (1.1)
Glaucous Gull	1992	16.0 (6.3)	4.1 (1.3)	14.2 (5.8)	18.7 (6.6)	16.2 (1.5)	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 -
	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)
	2005	10.8 (2.7)	10.5 (2.8)	18.6 (7.7)	14.5 (5.2)	1.6 (0.8)	10.9 (4.3)	10.6 (2.6)	14.7 (3.0)
Thayer's Gull	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 -
	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)
	2005	0.8 (0.7)	2.9 (2.8)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)
Sabine's Gull	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 -
	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)
	2005	0.0 (0.0)	4.4 (1.7)	9.3 (4.4)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.6 (0.6)

Table 2. (continued)

		Stratum							
SPECIES	Year	1	2	3	4	5	6	7	8
Arctic Tern	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 -
	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)
	2005	8.5 (2.9)	7.3 (2.9)	7.8 (2.9)	0.7 (0.5)	0.0 (0.0)	2.0 (0.8)	0.4 (0.4)	7.7 (2.6)
Snowy Owl	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 -
	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)
	2005	2.3 (0.9)	2.9 (1.3)	2.3 (1.2)	1.8 (0.8)	1.1 (0.7)	5.3 (1.5)	0.0 (0.0)	0.6 (0.6)
Short-eared 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 -
	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)
	2005	0.0 (0.0)	0.4 (0.3)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.0 (0.0)	0.6 (0.6)
Common Raven	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 -
	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)
	2005	0.0 (0.0)	0.7 (0.7)	0.8 (0.7)	2.5 (1.2)	0.0 (0.0)	0.0 (0.0)	0.4 (0.4)	0.0 (0.0)
Passerine sp.	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 -
	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)
	2005	6.9 (3.8)	8.7 (2.1)	3.1 (1.2)	6.3 (2.4)	6.3 (1.9)	8.9 (1.7)	7.9 (2.6)	14.0 (3.6)

[a] including loons that were not identified to species
[b] based on indicated number
[c] including jaegers that were not identified to species
ns – not surveyed

Table 3. Population indices for birds observed during aerial surveys on western Victoria Island, 1992-1994 and 2004-2005. Numbers in brackets represent standard errors.

	NW Victoria Island[a]					SW Victoria Island[b]		
SPECIES	1992	1993	1994	2004	2005	1993	2004	2005
Pacific Loon	2453 (1041)	4235 (1520)	5292 (898)	1212 (323)	659 (173)	1217 (296)	105 (75)	873 (128)
Red-throated Loon	463 (235)	179 (169)	575 (310)	881 (277)	316 (129)	52 (35)	125 (77)	0 (0)
Yellow-billed Loon	941 (797)	1237 (415)	659 (359)	1784 (502)	875 (300)	194 (86)	258 (146)	98 (70)
Unidentified Loon sp.	697 (126)	1632 (630)	2927 (561)	560 (245)	1312 (290)	69 (27)	752 (303)	873 (286)
All loons[d]	4553 (1173)	7284 (1653)	9509 (1258)	4436 (642)	3161 (418)	1532 (275)	1241 (314)	1843 (362)
Tundra Swan	3575 (885)	3144 (511)	3838 (570)	1449 (307)	2842 (385)	4262 (745)	2024 (648)	5043 (999)
Canada Goose[c]	24146 (2602)	16100 (1972)	24938 (2240)	18397 (1647)	30872 (2540)	19074 (1011)	19021 (1812)	30772 (3590)
Brant	1205 (1176)	904 (600)	978 (915)	50 (48)	417 (407)	205 (188)	0 (0)	0 (0)
Greater White-fronted Goose	252 (193)	0 (0)	0 (0)	75 (74)	116 (81)	707 (352)	707 (219)	730 (263)
Lesser Snow Goose	737 (1042)	786 (1003)	1909 (629)	610 (259)	2187 (803)	276 (182)	524 (298)	1625 (656)

Table 3. (continued)

SPECIES	NW Victoria Island[a]					SW Victoria Island[b]		
	1992	1993	1994	2004	2005	1993	2004	2005
Northern Pintail	75 (54)	33 (31)	0 (0)	0 (0)	33 (32)	337 (259)	855 (415)	176 (109)
Common Eider	10789 (6515)	579 (298)	2301 (578)	722 (244)	361 (222)	34 (22)	602 (397)	231 (141)
King Eider[c]	32875 (3266)	33321 (3996)	50561 (5369)	18023 (3112)	16627 (2001)	11149 (1728)	5329 (1170)	6290 (1010)
Long-tailed Duck[c]	9653 (2769)	10762 (3383)	4991 (1035)	5060 (1189)	7236 (1714)	2501 (284)	1861 (429)	2052 (737)
Peregrine Falcon	215 (106)	151 (96)	56 (56)	42 (41)	208 (204)	230 (115)	63 (61)	35 (34)
Falcon sp.	459 (140)	151 (96)	56 (56)	42 (41)	208 (204)	230 (115)	63 (61)	35 (34)
Rough-legged Hawk	1963 (1472)	800 (282)	1226 (461)	183 (65)	462 (128)	97 (65)	196 (103)	454 (149)
Ptarmigan sp.	1215 (425)	627 (313)	1896 (599)	608 (236)	1363 (470)	447 (143)	133 (92)	336 (158)
Sandhill Crane	2588 (1078)	791 (402)	1139 (233)	484 (208)	926 (247)	310 (78)	293 (196)	680 (139)
Shorebird sp.	33544 (3950)	12364 (2058)	11396 (1578)	10160 (1020)	5428 (749)	4064 (563)	7849 (692)	2939 (260)

Table 3. (continued)

SPECIES	NW Victoria Island[a]					SW Victoria Island[b]		
	1992	1993	1994	2004	2005	1993	2004	2005
Pomarine Jaeger	3857 (937)	7340 (1816)	1236 (308)	305 (136)	1687 (205)	1164 (253)	329 (141)	321 (129)
Parasitic Jaeger	4639 (965)	2948 (787)	813 (164)	700 (297)	756 (173)	650 (204)	0 (0)	168 (76)
Long-tailed Jaeger	2624 (861)	936 (260)	1564 (611)	620 (235)	1716 (246)	274 (87)	98 (71)	266 (107)
Unidentified Jaeger sp.	1265 (239)	1146 (691)	337 (151)	1191 (246)	3671 (416)	291 (134)	454 (123)	943 (245)
All jaegers[e]	12385 (1644)	12370 (2276)	3949 (703)	2816 (485)	7942 (676)	2380 (304)	880 (173)	1698 (352)
Glaucous Gull	11525 (1300)	7644 (1540)	5794 (802)	2612 (590)	6048 (1149)	2156 (506)	231 (140)	2563 (468)
Thayer’s Gull	1293 (945)	857 (536)	839 (733)	200 (157)	164 (130)	0 (0)	0 (0)	0 (0)
Sabine’s Gull	1469 (779)	1386 (464)	1662 (646)	571 (336)	414 (128)	160 (128)	70 (46)	35 (34)
Arctic Tern	2400 (597)	2340 (674)	3732 (1580)	384 (118)	1293 (238)	975 (295)	211 (151)	484 (155)
Snowy Owl	2802 (927)	5577 (1412)	944 (405)	208 (206)	1849 (391)	354 (140)	0 (0)	35 (34)
Short-eared Owl	0 (0)	0 (0)	34 (23)	42 (41)	17 (16)	0 (0)	0 (0)	52 (38)

Table 3. (continued)

Common Raven	230 (288)	0 (0)	238 (204)	0 (0)	443 (201)	80 (63)	0 (0)	505 (210)
Passerine sp.	9507 (2263)	2499 (688)	6429 (1194)	14362 (2392)	5710 (911)	595 (158)	2076 (484)	2089 (479)

[a] Strata 1 to 6
[b] Strata 7 and 8
[c] based on indicated number
[d] including loons that were not identified to species
[e] including jaegers that were not identified to species

Table 4. Adjusted population estimates for King Eider, Canada Goose, and Long-tailed Duck observed during aerial surveys on western Victoria Island, 1992-1994 and 2004-2005. Numbers in brackets represent standard errors.

	NW Victoria Island[a]					SW Victoria Island[b]		
SPECIES	1992	1993	1994	2004	2005	1993	2004	2005
King Eider[c]	47176 (5715)	47815 (6620)	72555 (9200)	25863 (4806)	23860 (3312)	15999 (2713)	7647 (1758)	9026 (1577)
Canada Goose[d]	39044 (4615)	26034 (3429)	40325 (4119)	29748 (3031)	49920 (4773)	30843 (2222)	30757 (3290)	49758 (6287)
Long-tailed Duck[e]	17694 (5811)	19727 (6945)	9149 (2415)	9275 (2649)	13264 (3808)	4584 (921)	3411 (962)	3761 (1473)

[a] Strata 1 to 6
[b] Strata 7 and 8
[c] adjusted with a visibility correction factor of 1.435 ± 0.100 (SE)
[d] adjusted with a visibility correction factor of 1.617 ± 0.079 (SE)
[e] adjusted with a visibility correction factor of 1.833 ± 0.306 (SE)

Table 5. Mean population estimates for selected bird species observed during aerial surveys on western Victoria Island for the periods 1992-1994 and 2004-2005. Numbers in brackets represent 95% confidence intervals.

	NW Victoria Island[a]		SW Victoria Island[b]	
SPECIES	1992 - 1994	2004 - 2005	1993	2004 - 2005
King Eider[c]	55849 (8293)	24862 (5720)	15999 (5318)	8337 (2314)
Canada Goose[d]	35135 (4621)	39834 (5541)	30843 (4355)	40258 (6954)
Long-tailed Duck[e]	15523 (6123)	11270 (4545)	4584 (1806)	3586 (1724)
Tundra Swan	3519 (765)	2146 (482)	4262 (1461)	3534 (1167)
All loons[f]	7115 (1559)	3799 (751)	1532 (539)	1542 (470)
All jaegers[g]	9568 (1891)	5379 (815)	2380 (596)	1289 (385)
Glaucous Gull	8321 (3599)	4330 (1265)	2156 (992)	1397 (479)
Greater White-fronted Goose	84 (126)	96 (108)	707 (690)	719 (335)

[a] Strata 1 to 6
[b] Strata 7 and 8
[c] indicated breeding population adjusted with a visibility correction factor of 1.435 ± 0.100 (SE)
[d] indicated breeding population adjusted with a visibility correction factor of 1.617 ± 0.079 (SE)
[e] indicated breeding population adjusted with a visibility correction factor of 1.833 ± 0.306 (SE)
[f] including loons that were not identified to species
[g] including jaegers that were not identified to species

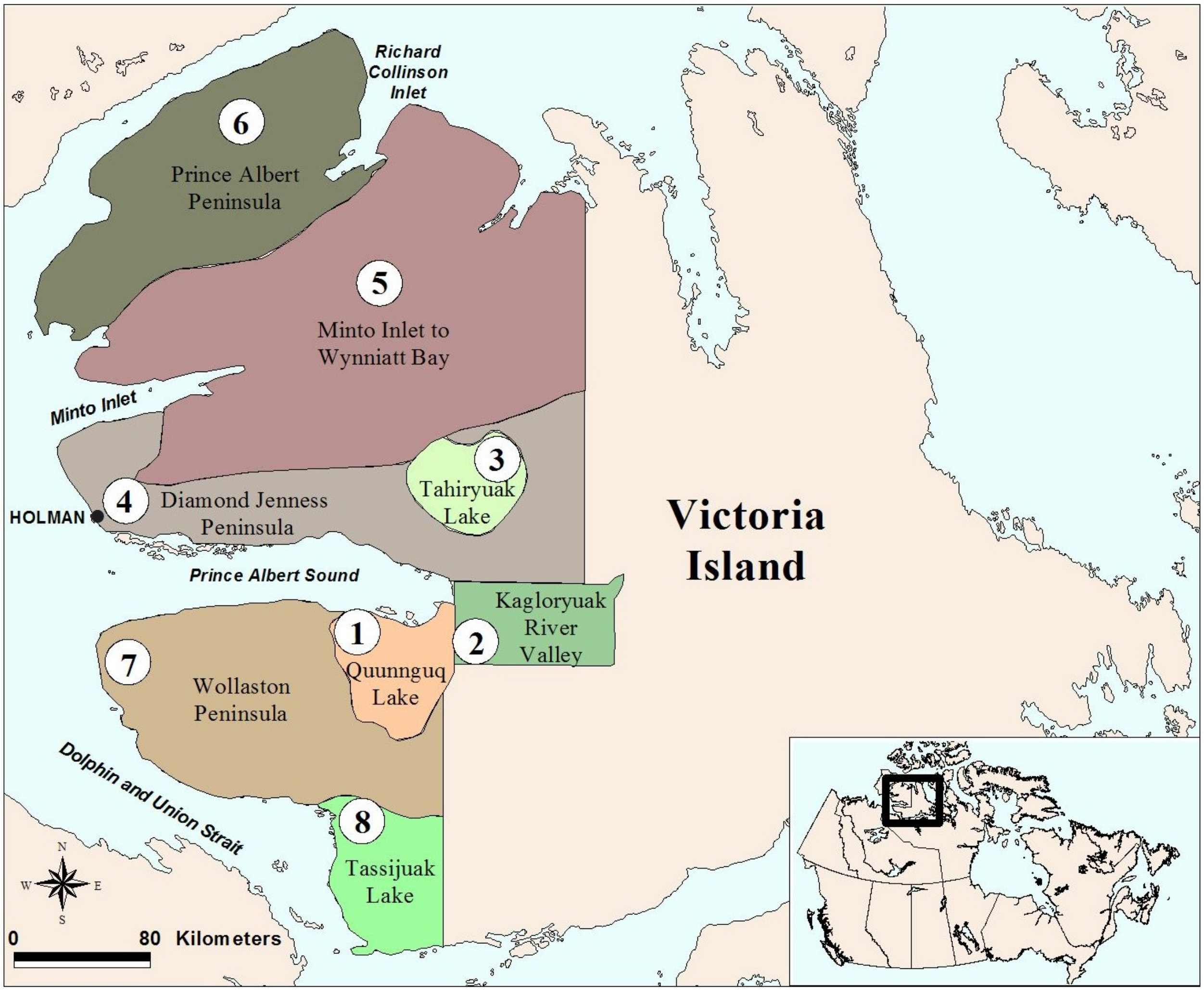


Figure 1. Location of the study area and boundaries of the strata used to estimate bird populations on western Victoria Island, 1992-1994 and 2004-2005.

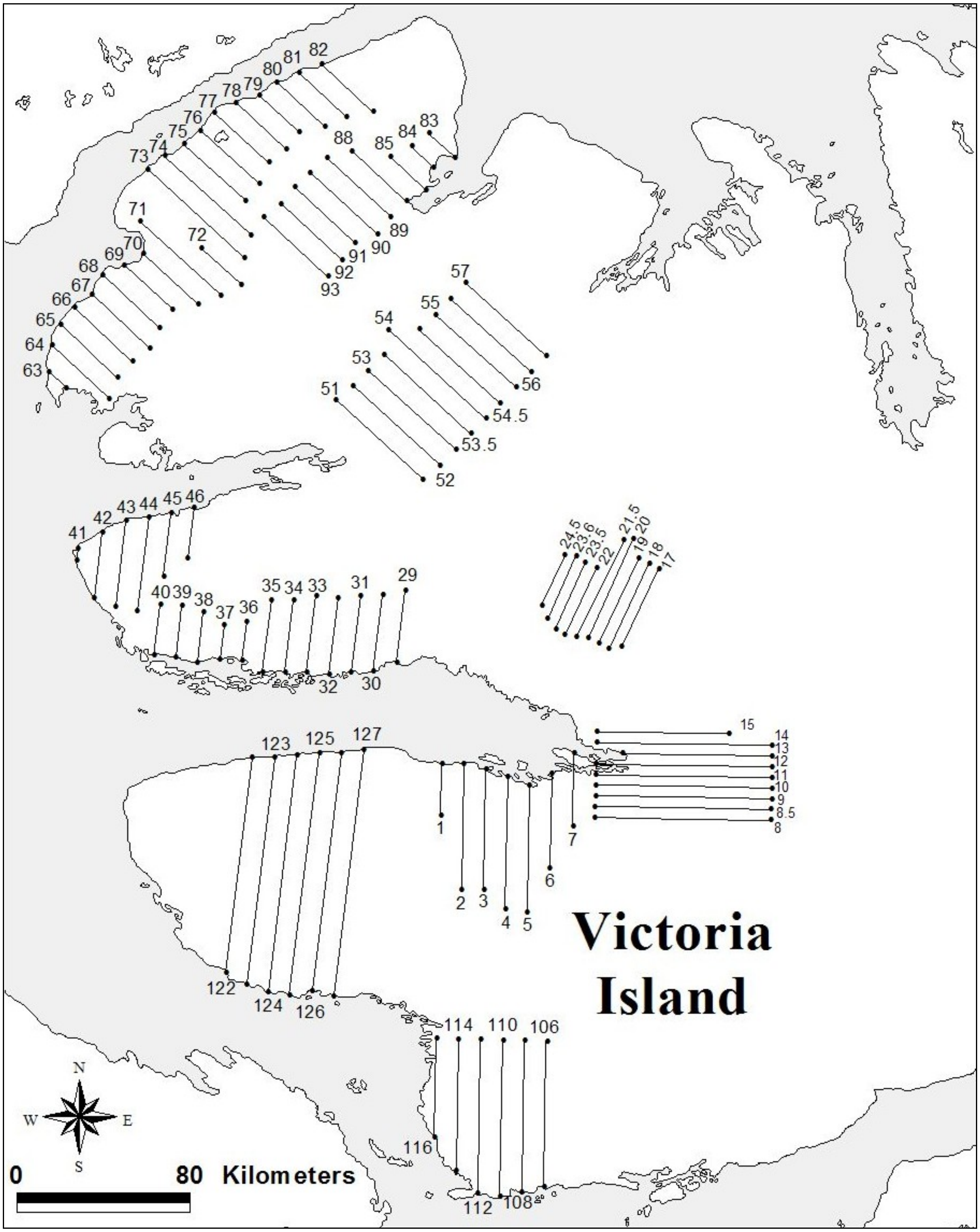
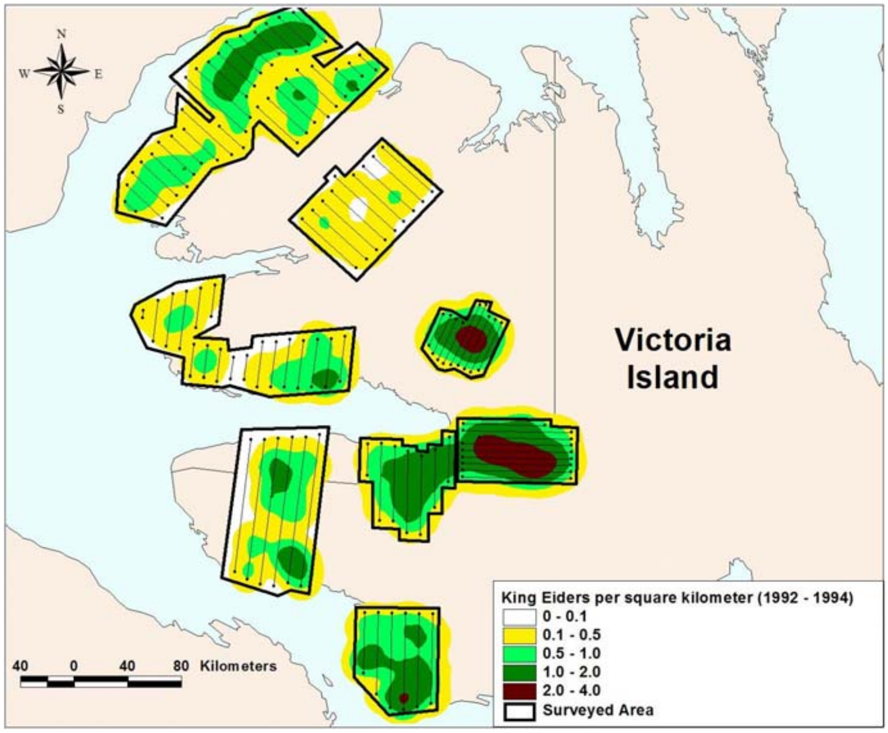


Figure 2. Locations of transects surveyed by helicopter on western Victoria Island in June 2004 and 2005.

A)



B)

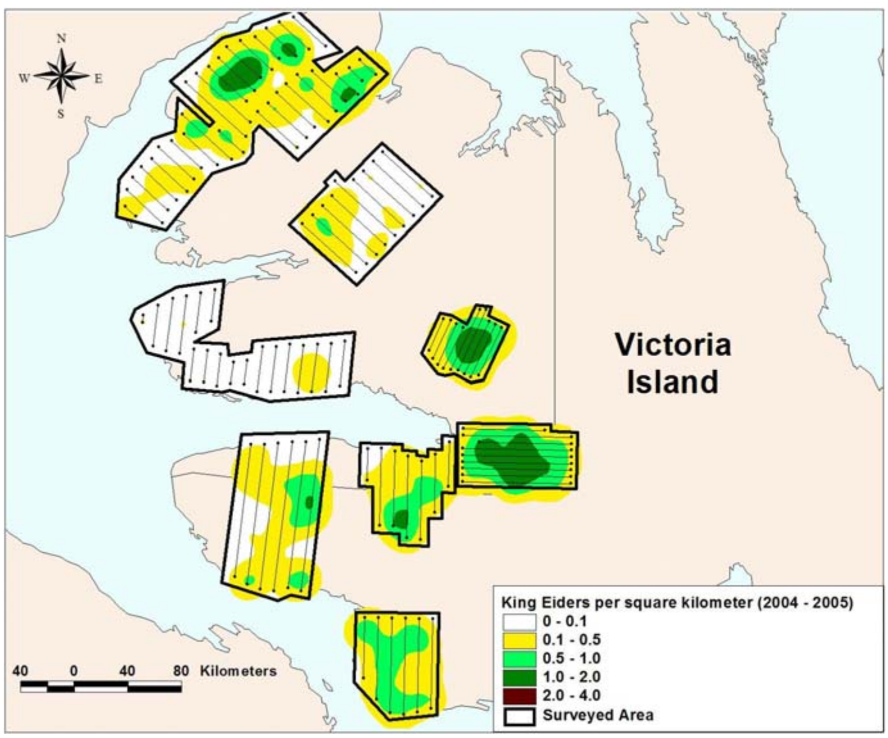


Figure 3. Distribution of indicated King Eiders recorded during aerial surveys on western Victoria Island. A) 1992-1994. B) 2004-2005. Densities are adjusted with a visibility correction factor of 1.435.

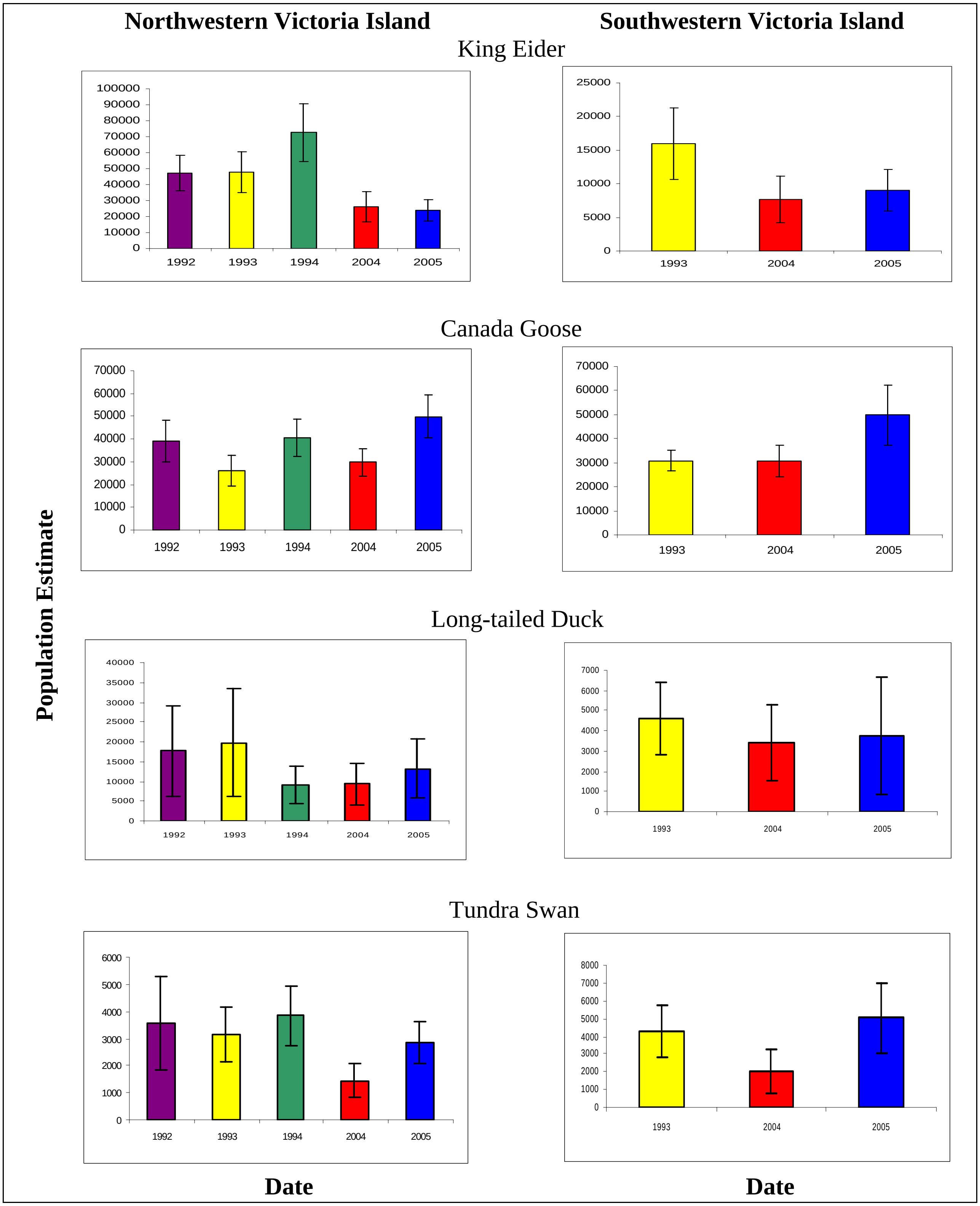
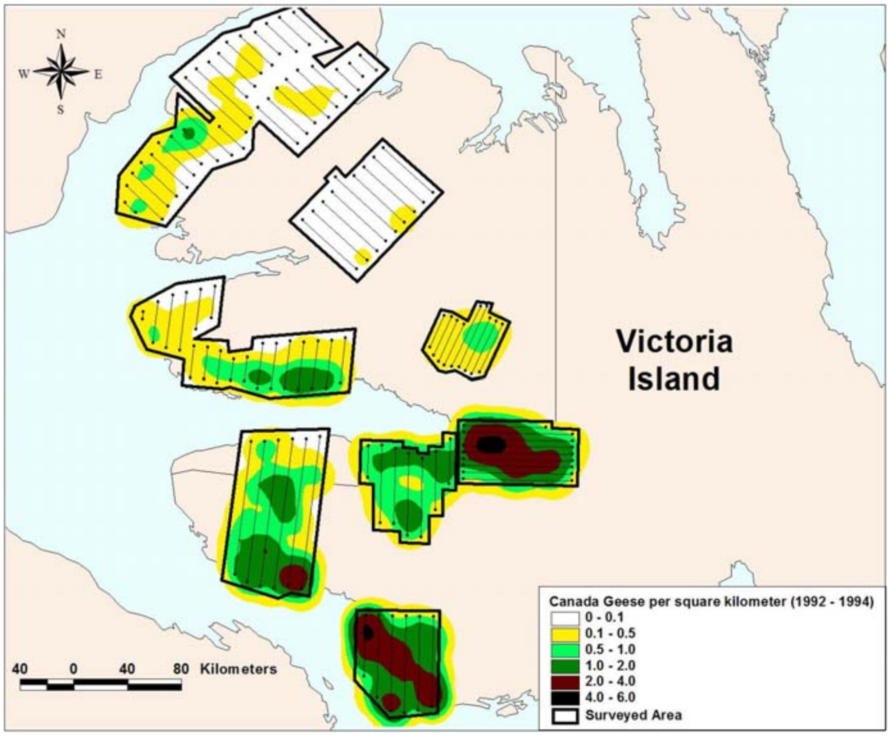


Figure 4. Population estimates with 95% confidence intervals for King Eiders, Canada Geese, Long-tailed Ducks, and Tundra Swans on western Victoria Island generated from aerial surveys completed in 1992-1994 and 2004-2005.

A)



B)

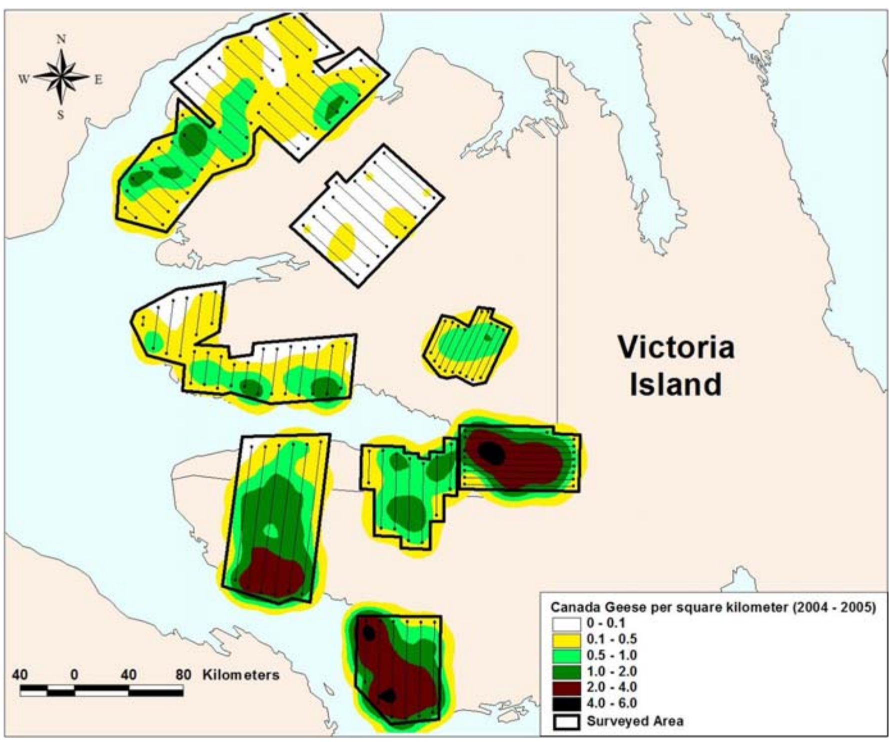
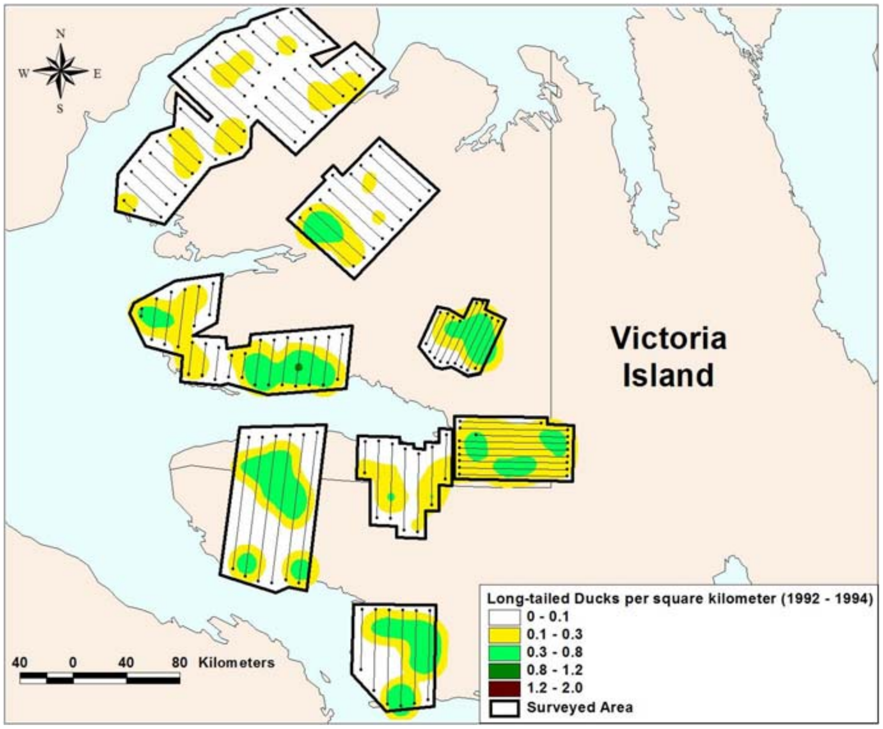


Figure 5. Distribution of indicated Canada Geese recorded during aerial surveys on western Victoria Island. A) 1992-1994. B) 2004-2005. Densities are adjusted with a visibility correction factor of 1.617.

A)



B)

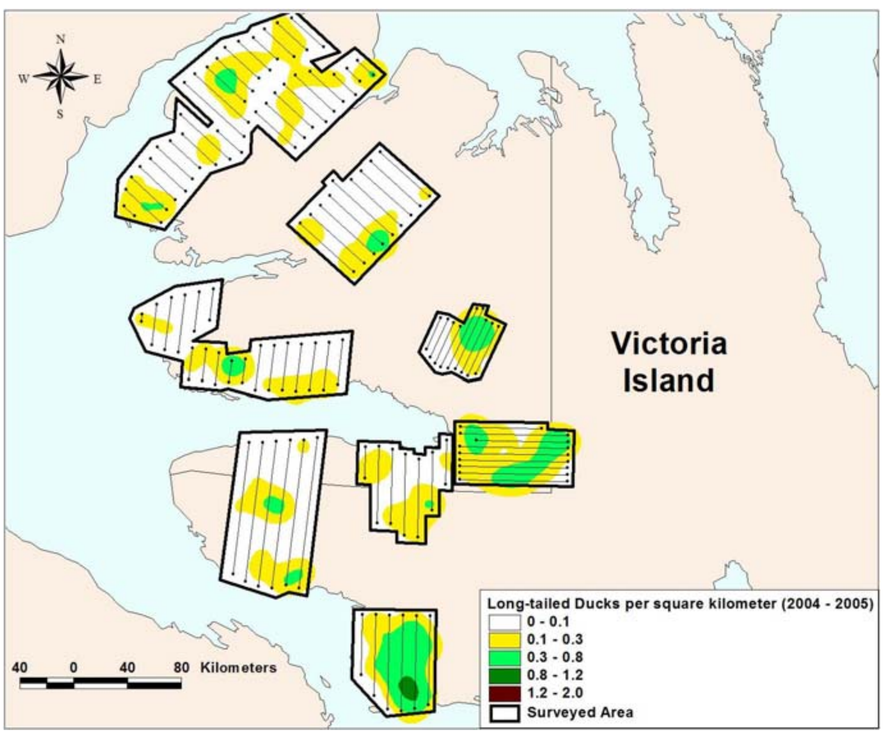
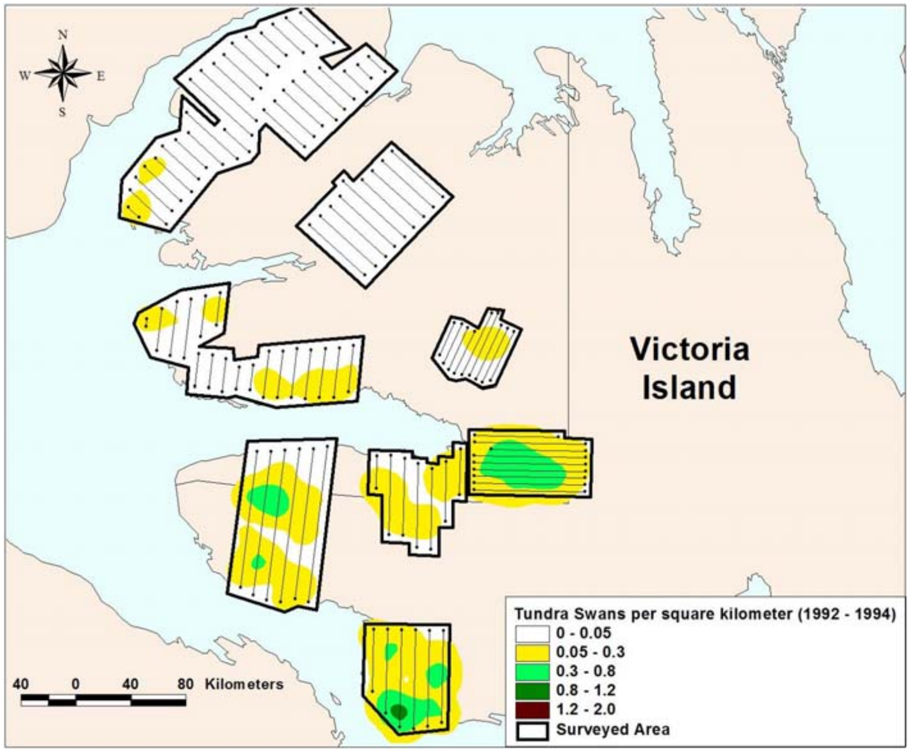


Figure 6. Distribution of indicated Long-tailed Ducks recorded during aerial surveys on western Victoria Island. A) 1992-1994. B) 2004-2005. Densities are adjusted with a visibility correction factor of 1.833.

A)



B)

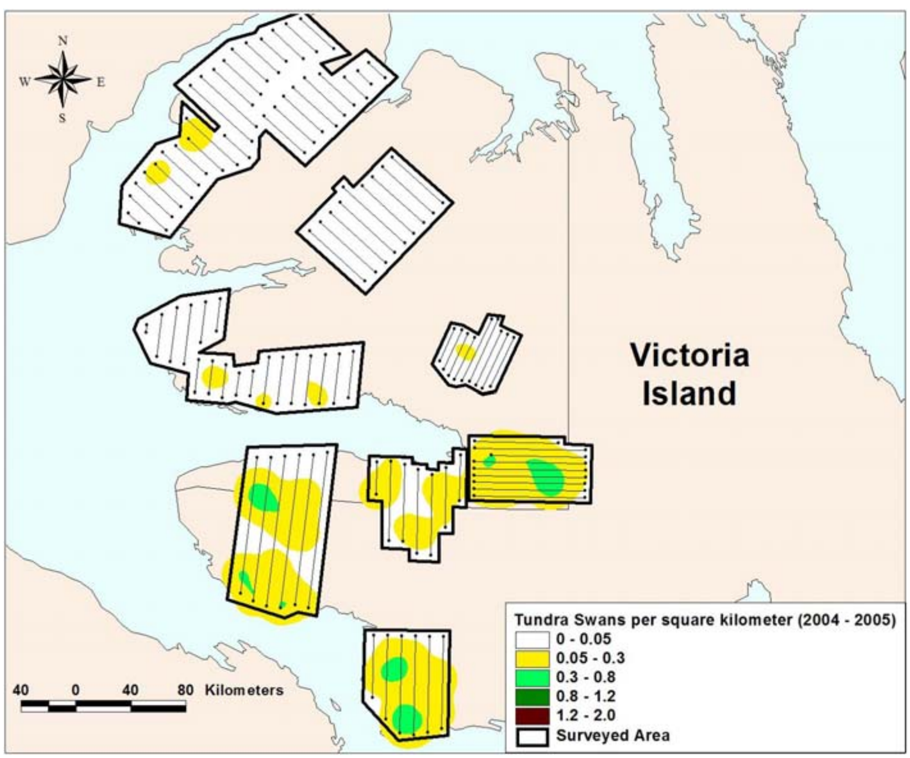
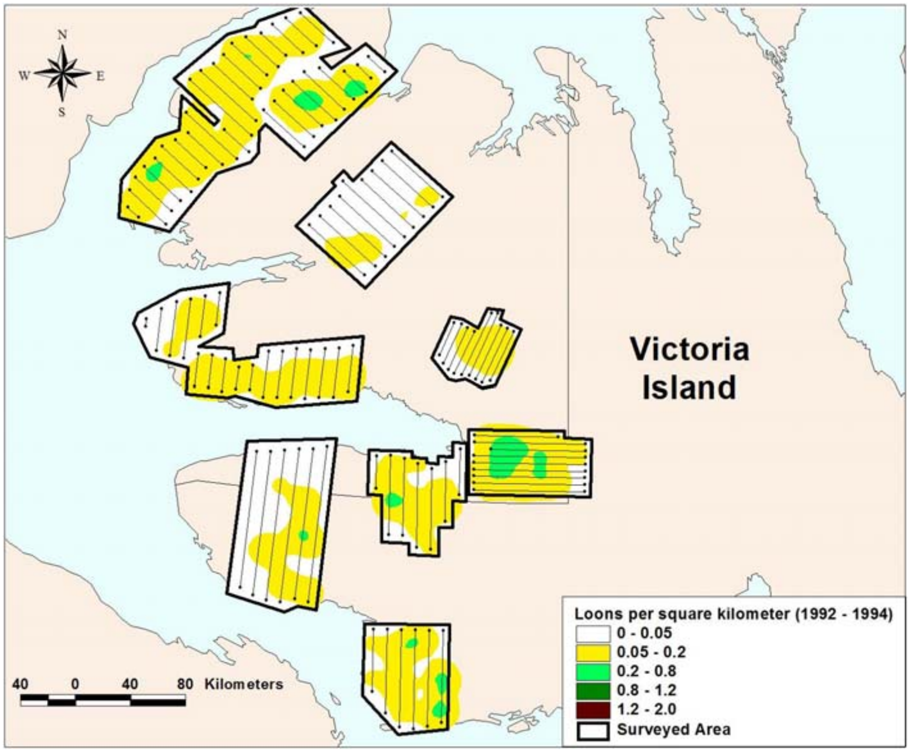


Figure 7. Distribution of observed Tundra Swans recorded during aerial surveys on western Victoria Island. A) 1992-1994. B) 2004-2005.

A)



B)

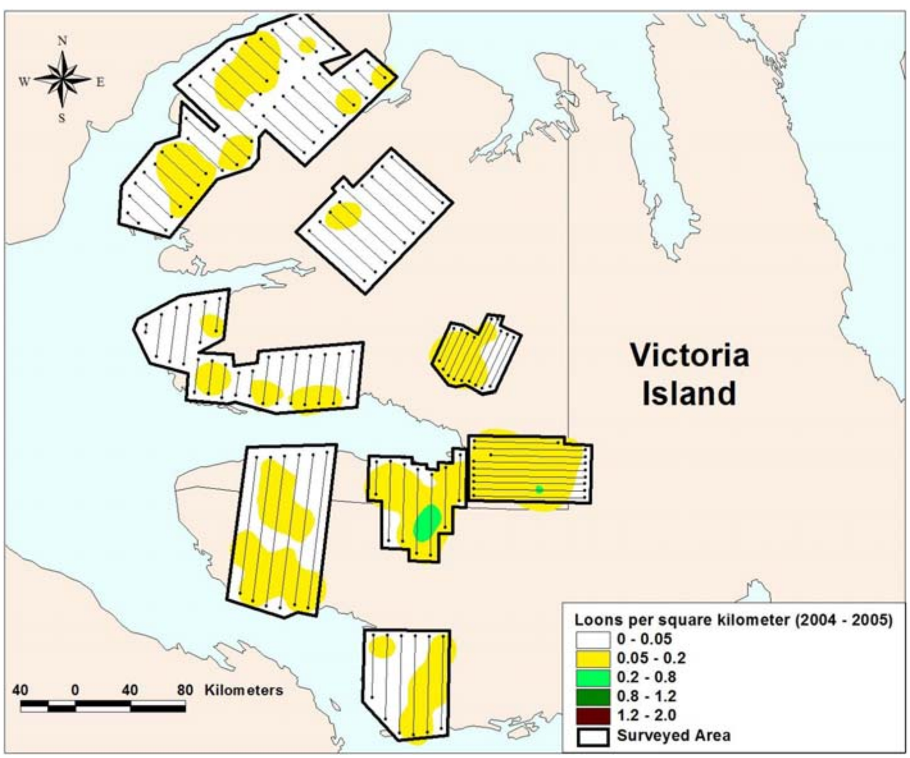


Figure 8. Distribution of observed loons recorded during aerial surveys on western Victoria Island. A) 1992-1994. B) 2004-2005.

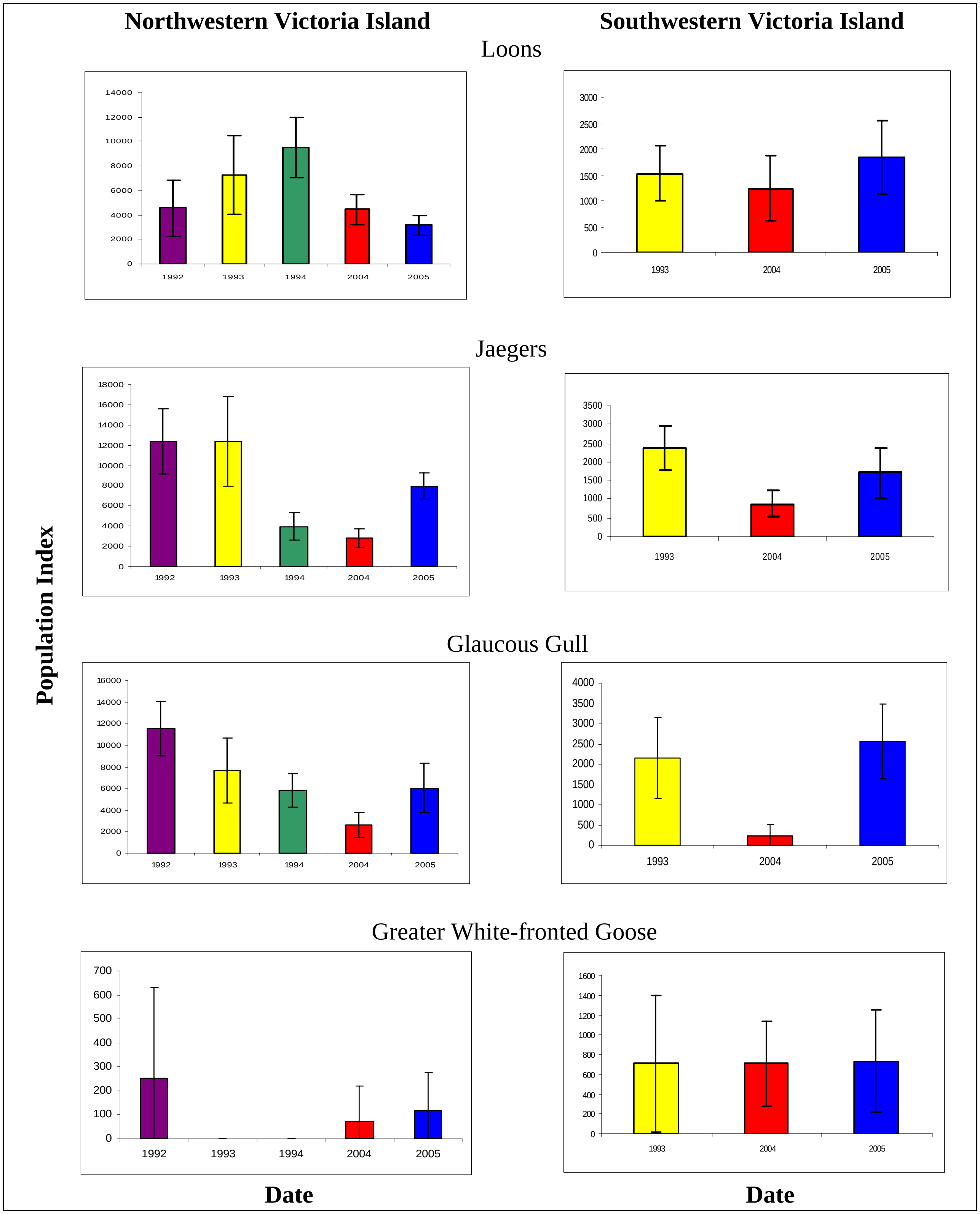
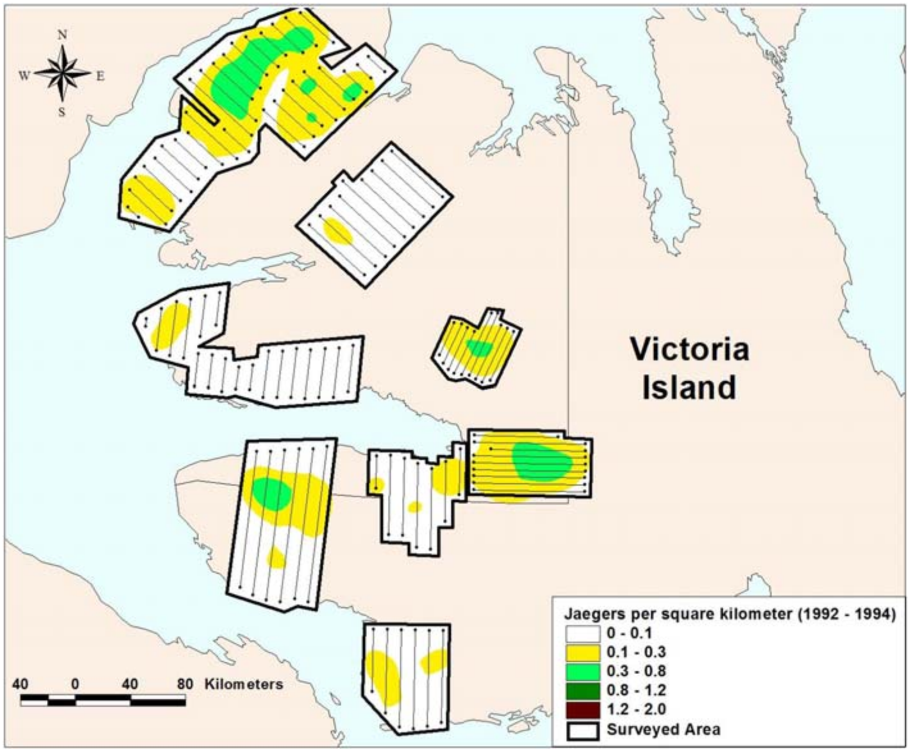


Figure 9. Population indices with 95% confidence intervals for loons, jaegers, Glaucous Gulls, and Greater White-fronted Geese on western Victoria Island generated from aerial surveys completed in 1992-1994 and 2004-2005.

A)



B)

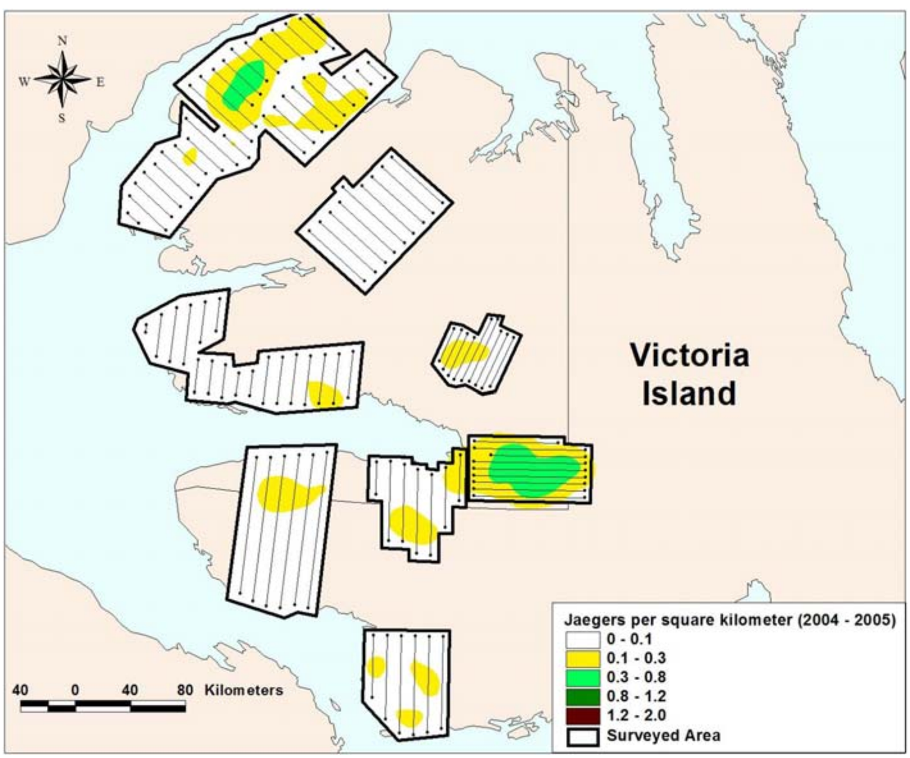
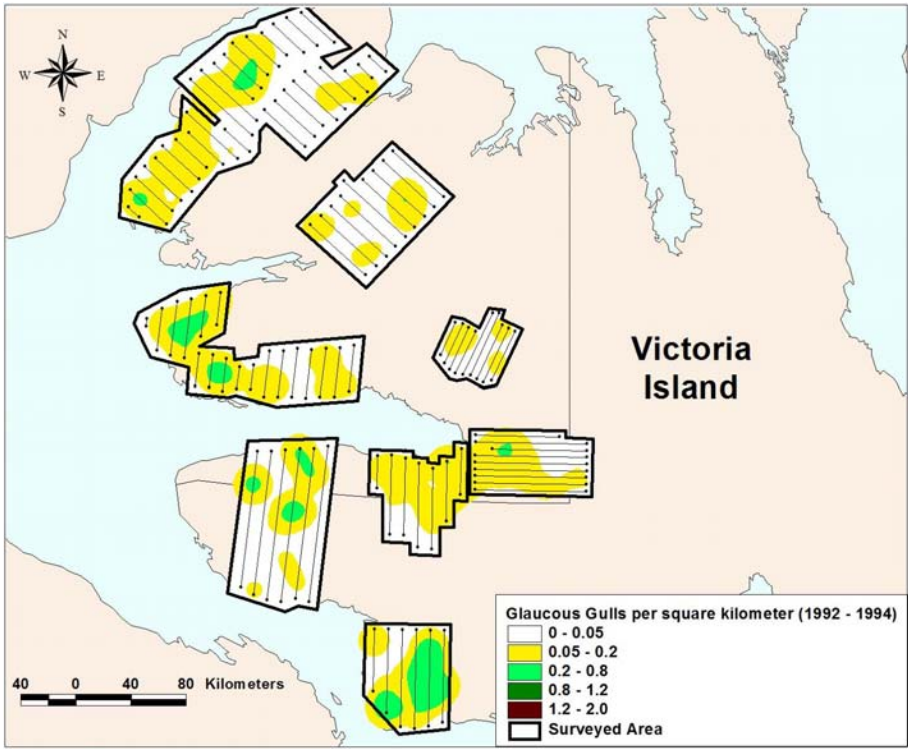


Figure 10. Distribution of observed jaegers recorded during aerial surveys on western Victoria Island. A) 1992-1994. B) 2004-2005.

A)



B)

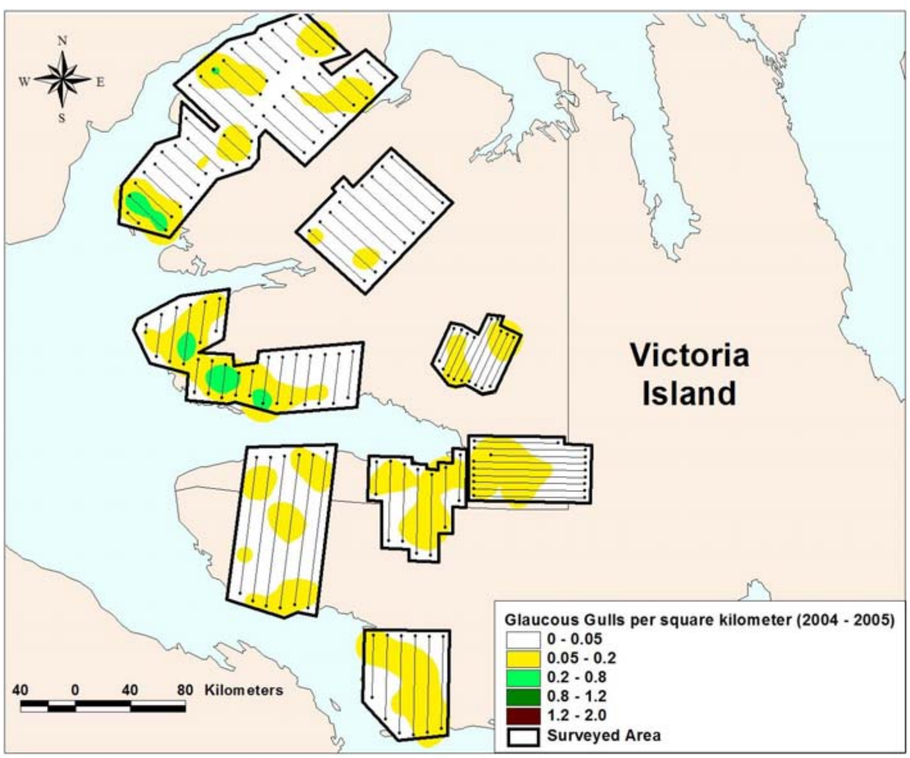
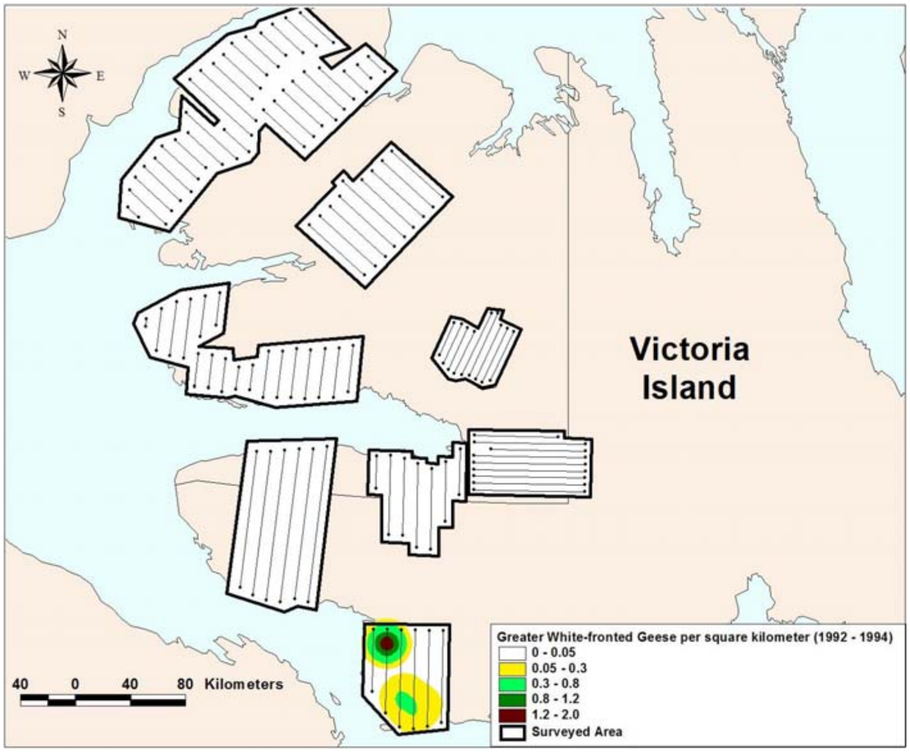


Figure 11. Distribution of observed Glaucous Gulls recorded during aerial surveys on western Victoria Island. A) 1992-1994. B) 2004-2005.

A)



B)

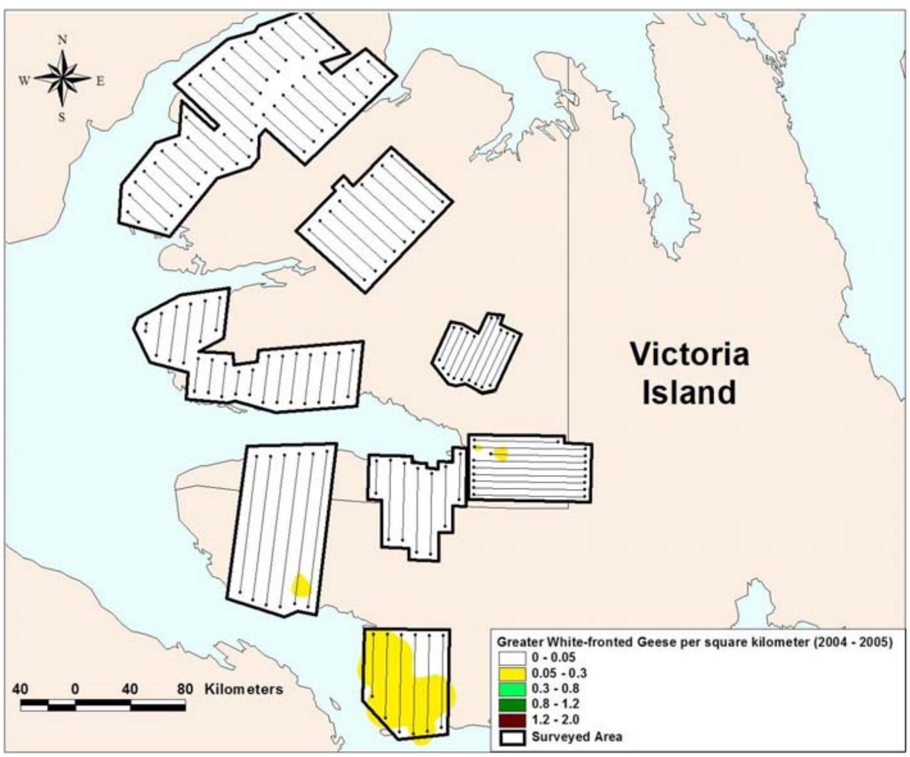


Figure 12. Distribution of observed Greater White-fronted Geese recorded during aerial surveys on western Victoria Island. A) 1992-1994. B) 2004-2005.

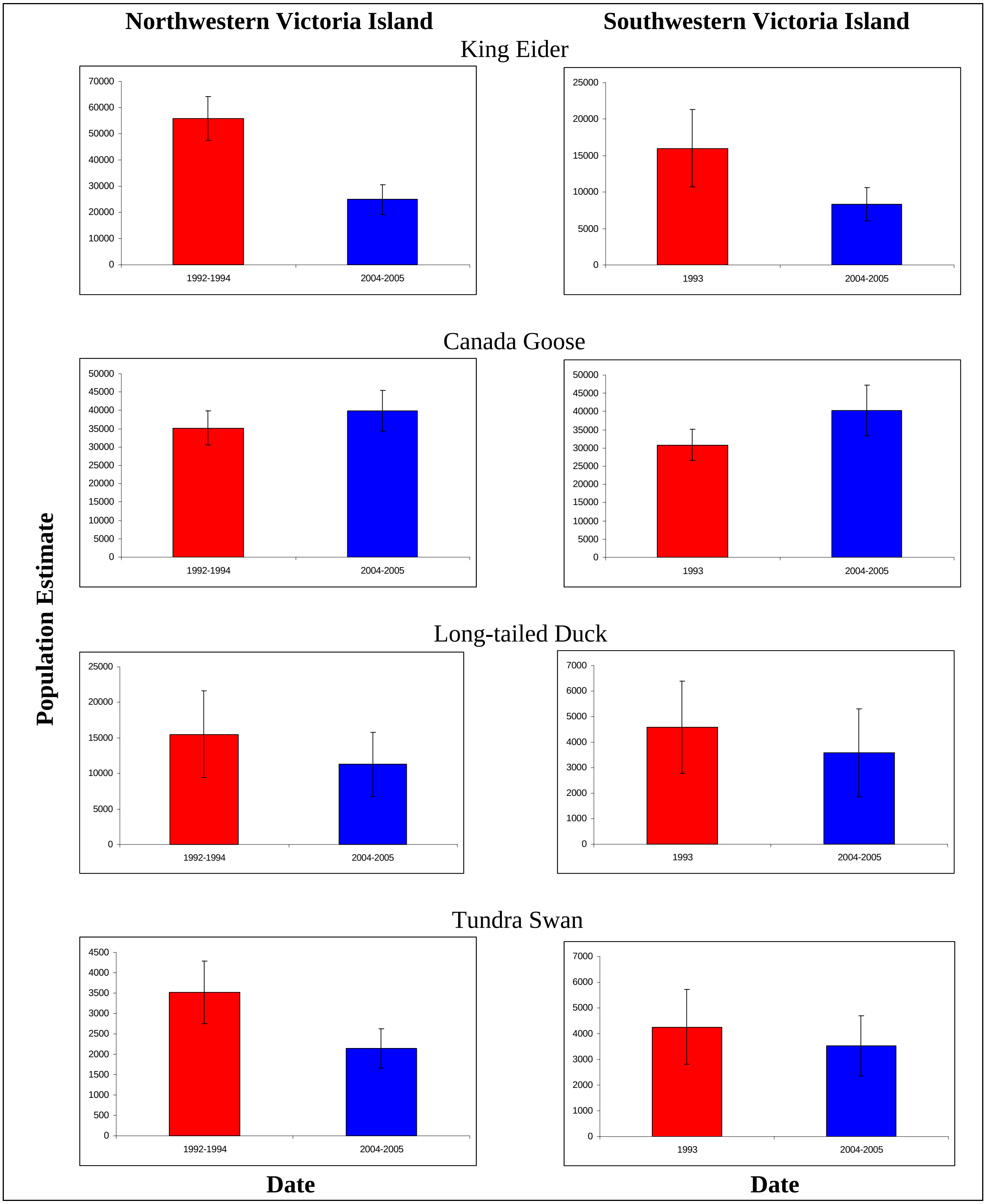


Figure 13. Mean population estimates with 95% confidence intervals for King Eiders, Canada Geese, Long-tailed Ducks, and Tundra Swans on western Victoria Island for the periods 1992-1994 and 2004-2005.

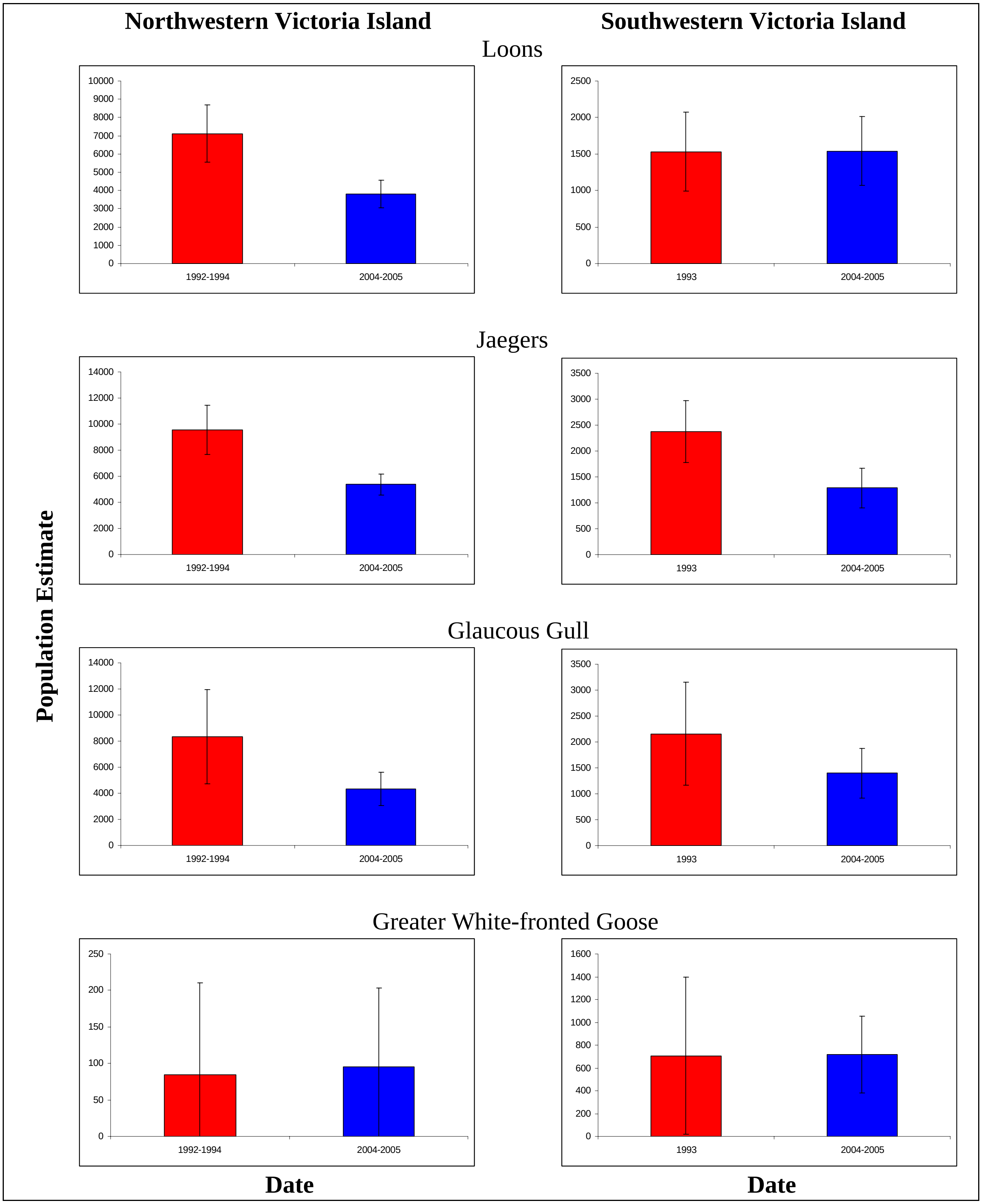


Figure 14. Mean population indices with 95% confidence intervals for loons, jaegers, Glaucous Gulls, and Greater White-fronted Geese on western Victoria Island for the periods 1992-1994 and 2004-2005.

Appendix A. Visibility Correction Factors developed for helicopter transect surveys of waterfowl on western Victoria Island.

Species	Number seen by front observer	Number seen by rear observer	Number seen by both observers	Estimated number present ± SE	% of total estimated number present sighted by front seat observer	Visibility Correction Factor ± SE
King Eider	39	33	23	56.0 ± 3.9	69.6	1.435 ± 0.100
Canada Goose	68	76	47	110.0 ± 5.4	61.8	1.617 ± 0.079
Long-tailed Duck	14	11	6	25.7 ± 4.3	54.5	1.833 ± 0.306

Appendix B. Percent change of King Eider, Canada Goose, and Long-tailed Duck populations between 1992-1994 surveys and 2004-2005 surveys for each of the eight strata surveyed on western Victoria Island.

Appendix B1. Percent change of King Eider populations between 1992-1994 surveys and 2004-2005 surveys for each of the eight strata surveyed on western Victoria Island.

Stratum	Population Mean (1992-1994)	Population Mean (2004-2005)	Percent Change
1 (Quunguq Lake)	4653	2089	-55.1
2 (Kagloryuak River valley)	9883	4888	-50.5
3 (Tahiryuak Lake)	4825	2573	-46.7
4 (Diamond Jenness Peninsula)	9810	756	-92.3
5 (Northeast of Minto Inlet)	12379	6579	-46.9
6 (Prince Albert Peninsula)	14297	7794	-45.5
7 (Wollaston Peninsula)	9174	5261	-42.6
8 (Tassijuak Lake)	6826	3075	-55.0

Appendix B. (continued)

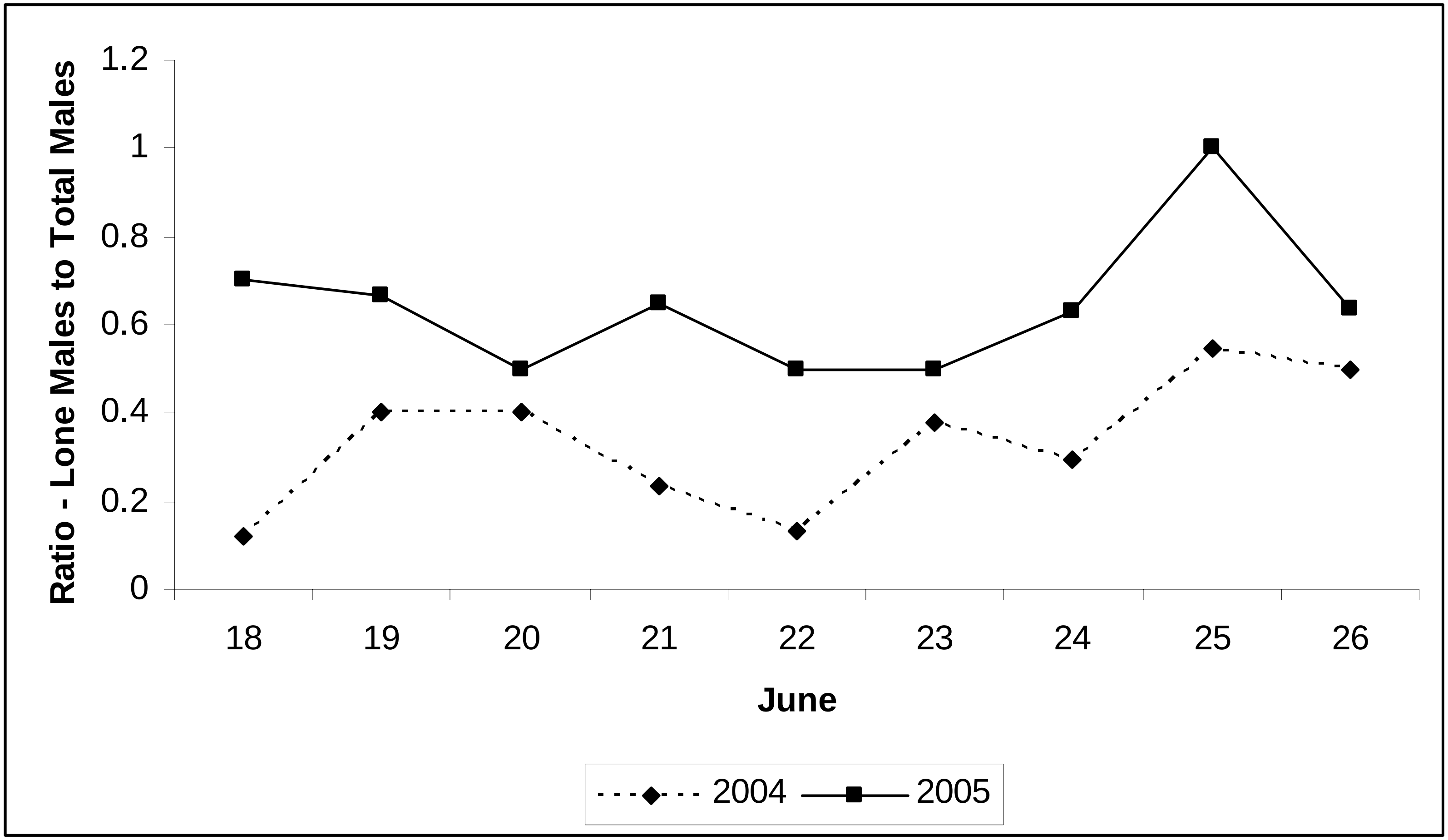
Appendix B2. Percent change of Canada Goose populations between 1992-1994 surveys and 2004-2005 surveys for each of the eight strata surveyed on western Victoria Island.

Stratum	Population Mean (1992-1994)	Population Mean (2004-2005)	Percent Change
1 (Quunguq Lake)	3949	4509	14.2
2 (Kagloryuak River valley)	12119	9149	-24.5
3 (Tahiryuak Lake)	1434	1385	-3.4
4 (Diamond Jenness Peninsula)	10525	11832	12.4
5 (Northeast of Minto Inlet)	4222	3033	-28.2
6 (Prince Albert Peninsula)	2885	9927	244.0
7 (Wollaston Peninsula)	17634	24069	36.5
8 (Tassijuak Lake)	13209	16188	22.6

Appendix B. (continued)

Appendix B3. Percent change of Long-tailed Duck populations between 1992-1994 surveys and 2004-2005 surveys for each of the eight strata surveyed on western Victoria Island.

Stratum	Population Mean (1992-1994)	Population Mean (2004-2005)	Percent Change
1 (Quunguq Lake)	563	545	-3.1
2 (Kagloryuak River valley)	1351	1330	-1.5
3 (Tahiryuak Lake)	988	635	-35.8
4 (Diamond Jenness Peninsula)	3753	1875	-50.0
5 (Northeast of Minto Inlet)	5665	3706	-34.6
6 (Prince Albert Peninsula)	1374	1851	34.7
7 (Wollaston Peninsula)	3040	1317	-56.7
8 (Tassijuak Lake)	1003	1846	84.0



Appendix C. Daily ratios of lone males (males not associated with females) to total males for King Eiders observed during aerial surveys on western Victoria Island in 2004 and 2005 (see Dickson et al. 1997 for daily ratios 1992-1994).

Appendix D. End-points of breeding waterfowl aerial survey transects flown on western Victoria Island in 2004 and 2005 using datum NAD27. Points are given in both decimal degrees and degrees, minutes, seconds format.

Transect	End Point	Stratum	Latitude	Longitude	Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
1	1	1	70.27232776	-113.65505539	70	16	20	-113	-39	-18
1	2	1	70.05735495	-113.62758373	70	3	26	-113	-37	-39
2	1	1	69.75416477	-113.33075350	69	45	14	-113	-19	-50
2	2	1	70.28052189	-113.39037745	70	16	49	-113	-23	-25
3	1	1	69.75739645	-113.07200638	69	45	26	-113	-4	-19
3	2	1	70.26413410	-113.12298653	70	15	50	-113	-7	-22
4	1	1	69.68182472	-112.80647866	69	40	54	-112	-48	-23
4	2	1	70.23749111	-112.85513296	70	14	14	-112	-51	-18
5	1	1	69.67308152	-112.54772115	69	40	23	-112	-32	-51
5	2	1	70.20641587	-112.58766188	70	12	23	-112	-35	-15
6	1	1	69.86342523	-112.30140180	69	51	48	-112	-18	-5
6	2	1	70.25786220	-112.32631929	70	15	28	-112	-19	-34
7	1	1	70.34702958	-112.06564845	70	20	49	-112	-3	-56
7	2	1	70.04221385	-112.05003178	70	2	31	-112	-3	0
8	1	2	70.08167080	-111.78900442	70	4	54	-111	-47	-20
8	2	2	70.07857536	-109.68513181	70	4	42	-109	-41	-6
8.5	1	2	70.12650048	-111.79071078	70	7	35	-111	-47	-26
8.5	2	2	70.12339749	-109.68228882	70	7	24	-109	-40	-56
9	1	2	70.17132992	-111.79242502	70	10	16	-111	-47	-32
9	2	2	70.16821934	-109.67943270	70	10	5	-109	-40	-45
10	1	2	70.21615911	-111.79414720	70	12	58	-111	-47	-38
10	2	2	70.21304091	-109.67656336	70	12	46	-109	-40	-35
11	1	2	70.26098806	-111.79587737	70	15	39	-111	-47	-45
11	2	2	70.25786220	-109.67368071	70	15	28	-109	-40	-25
12	1	2	70.30581675	-111.79761558	70	18	20	-111	-47	-51
12	2	2	70.30268321	-109.67078467	70	18	9	-109	-40	-14
13	1	2	70.35177620	-111.47963593	70	21	6	-111	-28	-46
13	2	2	70.34750394	-109.66787514	70	20	51	-109	-40	-4
14	1	2	70.39547341	-111.80111636	70	23	43	-111	-48	-4
14	2	2	70.39232439	-109.66495202	70	23	32	-109	-39	-53
15	1	2	70.44030137	-111.80287903	70	26	25	-111	-48	-10

Transect	End Point	Stratum	Latitude	Longitude	Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
15	2	2	70.44030137	-110.19712097	70	26	25	-110	-11	-49
17	1	3	70.79998586	-111.52308086	70	47	59	-111	-31	-23
17	2	3	71.12796517	-111.08448178	71	7	40	-111	-5	-4
18	1	3	70.78893035	-111.68208461	70	47	20	-111	-40	-55
18	2	3	71.15028467	-111.20659271	71	9	1	-111	-12	-23
19	1	3	70.80881400	-111.80951092	70	48	31	-111	-48	-34
19	2	3	71.17027305	-111.33449584	71	10	12	-111	-20	-4
20	1	3	70.83309167	-111.93740129	70	49	59	-111	-56	-14
20	2	3	71.24856592	-111.41387970	71	14	54	-111	-24	-49
21.5	1	3	70.83519011	-112.08625758	70	50	6	-112	-5	-10
21.5	2	3	71.24557051	-111.53503733	71	14	44	-111	-32	-6
22	1	3	70.84053911	-112.23398734	70	50	25	-112	-14	-2
22	2	3	71.12307460	-111.86401714	71	7	23	-111	-51	-50
23.5	1	3	70.86215135	-112.34944750	70	51	43	-112	-20	-58
23.5	2	3	71.14496653	-112.01331694	71	8	41	-112	0	-47
23.6	1	3	71.17120884	-112.12850966	71	10	16	-112	-7	-42
23.6	2	3	70.90347465	-112.45840061	70	54	12	-112	-27	-30
24	1	4	70.59241657	-112.96862861	70	35	32	-112	-58	-7
24	2	4	70.95910752	-112.53804304	70	57	32	-112	-32	-16
24.5	1	3	70.95910752	-112.53804304	70	57	32	-112	-32	-16
24.5	2	3	71.17563397	-112.27734181	71	10	32	-112	-16	-38
25	1	4	70.64411510	-113.19478811	70	38	38	-113	-11	-41
25	2	4	70.94580289	-112.84174243	70	56	44	-112	-50	-30
26	1	4	70.68947475	-113.43899922	70	41	22	-113	-26	-20
26	2	4	70.95553442	-113.12696788	70	57	19	-113	-7	-37
27	1	4	70.69587357	-113.71779486	70	41	45	-113	-43	-4
27	2	4	70.98241957	-113.40498094	70	58	56	-113	-24	-17
28	1	4	70.71527901	-113.99876329	70	42	55	-113	-59	-55
28	2	4	71.01479047	-113.66318218	71	0	53	-113	-39	-47
29	1	4	70.68433074	-114.29054493	70	41	3	-114	-17	-25
29	2	4	70.98883043	-114.24878981	70	59	19	-114	-14	-55
30	1	4	70.63886137	-114.56713227	70	38	19	-114	-34	-1
30	2	4	70.96134483	-114.52749523	70	57	40	-114	-31	-38
31	1	4	70.62881325	-114.83863574	70	37	43	-114	-50	-19

Transect	End Point	Stratum	Latitude	Longitude	Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
31	2	4	70.95135938	-114.80343980	70	57	4	-114	-48	-12
32	1	4	70.61164112	-115.11049829	70	36	41	-115	-6	-37
32	2	4	70.93424288	-115.07975746	70	56	3	-115	-4	-47
33	1	4	70.61154203	-115.38049580	70	36	41	-115	-22	-49
33	2	4	70.93419112	-115.35414644	70	56	3	-115	-21	-14
34	1	4	70.60387314	-115.65096875	70	36	13	-115	-39	-3
34	2	4	70.90863581	-115.63026731	70	54	31	-115	-37	-48
35	1	4	70.59356290	-115.92135391	70	35	36	-115	-55	-16
35	2	4	70.89835686	-115.90481070	70	53	54	-115	-54	-17
36	1	4	70.63530014	-116.18935639	70	38	7	-116	-11	-21
36	2	4	70.79667494	-116.18280884	70	47	48	-116	-10	-58
37	1	4	70.62957309	-116.45973228	70	37	46	-116	-27	-35
37	2	4	70.77302564	-116.45585827	70	46	22	-116	-27	-21
38	1	4	70.81845861	-116.72731192	70	49	6	-116	-43	-38
38	2	4	70.60327279	-116.73022042	70	36	11	-116	-43	-48
39	1	4	70.61692131	-117.00000000	70	37	0	-117	0	0
39	2	4	70.83210922	-117.00000000	70	49	55	-117	0	0
40	1	4	70.61223897	-117.26989945	70	36	44	-117	-16	-11
40	2	4	70.82742458	-117.27281072	70	49	38	-117	-16	-22
41	1	4	70.95927894	-118.37323828	70	57	33	-118	-22	-23
41	2	4	71.01305887	-118.37698190	71	0	47	-118	-22	-37
42	1	4	70.81543616	-118.09063548	70	48	55	-118	-5	-26
42	2	4	71.09332908	-118.10605743	71	5	35	-118	-6	-21
43	1	4	70.79443365	-117.81709945	70	47	39	-117	-49	-1
43	2	4	71.15303315	-117.83205551	71	9	10	-117	-49	-55
44	1	4	70.78871562	-117.54456903	70	47	19	-117	-32	-40
44	2	4	71.18319723	-117.55555144	71	10	59	-117	-33	-19
45	1	4	70.94398128	-117.27441566	70	56	38	-117	-16	-27
45	2	4	71.21295255	-117.27819686	71	12	46	-117	-16	-41
46	1	4	71.03160177	-117.00000000	71	1	53	-117	0	0
46	2	4	71.24677986	-117.00000000	71	14	48	-117	0	0
51	1	5	71.45642060	-114.12836723	71	27	23	-114	-7	-42
51	2	5	71.75846582	-115.33619241	71	45	30	-115	-20	-10
52	1	5	71.52026867	-113.91940865	71	31	12	-113	-55	-9

Transect	End Point	Stratum	Latitude	Longitude	Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
52	2	5	71.82271387	-115.12940261	71	49	21	-115	-7	-45
53	1	5	71.59031097	-113.73490233	71	35	25	-113	-44	-5
53	2	5	71.89148559	-114.94590674	71	53	29	-114	-56	-45
53.5	1	5	71.66008070	-113.55615053	71	39	36	-113	-33	-22
53.5	2	5	71.96227815	-114.75717782	71	57	44	-114	-45	-25
54	1	5	71.72748867	-113.37223416	71	43	38	-113	-22	-20
54	2	5	72.06728175	-114.72264543	72	4	2	-114	-43	-21
54.5	1	5	71.79419148	-113.19411741	71	47	39	-113	-11	-38
54.5	2	5	72.08236174	-114.32007285	72	4	56	-114	-19	-12
55	1	5	71.86513481	-113.00081205	71	51	54	-113	0	-2
55	2	5	72.14688308	-114.12423017	72	8	48	-114	-7	-27
56	1	5	71.93312930	-112.81300210	71	55	59	-112	-48	-46
56	2	5	72.21780605	-113.93458927	72	13	4	-113	-56	-4
57	1	5	72.00206188	-112.62392163	72	0	7	-112	-37	-26
57	2	5	72.28781490	-113.74684573	72	17	16	-113	-44	-48
63	1	6	71.66723183	-118.83390393	71	40	2	-118	-50	-2
63	2	6	71.72292235	-119.08938383	71	43	22	-119	-5	-21
64	1	6	71.65054600	-118.26294711	71	39	1	-118	-15	-46
64	2	6	71.83599240	-119.10553900	71	50	9	-119	-6	-19
65	1	6	71.74289737	-118.19402979	71	44	34	-118	-11	-38
65	2	6	71.92643098	-119.03626115	71	55	35	-119	-2	-10
66	1	6	71.81667720	-118.03360042	71	49	0	-118	-2	0
66	2	6	72.00419272	-118.88519571	72	0	15	-118	-53	-6
67	1	6	71.88375854	-117.83558704	71	53	1	-117	-50	-8
67	2	6	72.07101789	-118.68818490	72	4	15	-118	-41	-17
68	1	6	71.97270292	-117.73461827	71	58	21	-117	-44	-4
68	2	6	72.15821273	-118.58281663	72	9	29	-118	-34	-58
69	1	6	72.05496270	-117.60337871	72	3	17	-117	-36	-12
69	2	6	72.20950009	-118.31592827	72	12	34	-118	-18	-57
70	1	6	72.09156840	-117.26950420	72	5	29	-117	-16	-10
70	2	6	72.26808858	-118.08108681	72	16	5	-118	-4	-51
71	1	6	72.13881898	-116.98904625	72	8	19	-116	-59	-20
71	2	6	72.39974186	-118.18521972	72	23	59	-118	-11	-6
72	1	6	72.19468203	-116.74363645	72	11	40	-116	-44	-37

Transect	End Point	Stratum	Latitude	Longitude	Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
72	2	6	72.32232981	-117.32453677	72	19	20	-117	-19	-28
73	1	6	72.30673958	-116.74206623	72	18	24	-116	-44	-31
73	2	6	72.61936809	-118.19221949	72	37	9	-118	-11	-31
74	1	6	72.40526294	-116.68139270	72	24	18	-116	-40	-53
74	2	6	72.68658813	-117.98970792	72	41	11	-117	-59	-22
75	1	6	72.54550138	-116.81332320	72	32	43	-116	-48	-47
75	2	6	72.74479709	-117.74374987	72	44	41	-117	-44	-37
76	1	6	72.62261652	-116.65878707	72	37	21	-116	-39	-31
76	2	6	72.81155249	-117.54190536	72	48	41	-117	-32	-30
77	1	6	72.71430876	-116.55904208	72	42	51	-116	-33	-32
77	2	6	72.89368937	-117.39594502	72	53	37	-117	-23	-45
78	1	6	72.77531300	-116.33061345	72	46	31	-116	-19	-50
78	2	6	72.94558767	-117.11073284	72	56	44	-117	-6	-38
79	1	6	72.85548669	-116.19080910	72	51	19	-116	-11	-26
79	2	6	72.98584763	-116.78950725	72	59	9	-116	-47	-22
80	1	6	72.88623995	-115.83163477	72	53	10	-115	-49	-53
80	2	6	73.05049414	-116.56977197	73	3	1	-116	-34	-11
81	1	6	72.93827795	-115.55712889	72	56	17	-115	-33	-25
81	2	6	73.10124051	-116.28342272	73	6	4	-116	-17	0
82	1	6	72.96895843	-115.18743286	72	58	8	-115	-11	-14
82	2	6	73.14474956	-115.97262712	73	8	41	-115	-58	-21
83	1	6	72.80698293	-114.00594057	72	48	25	-114	0	-21
83	2	6	72.89972594	-114.38665962	72	53	59	-114	-23	-11
84	1	6	72.75944064	-114.29383625	72	45	33	-114	-17	-37
84	2	6	72.83862477	-114.61598624	72	50	19	-114	-36	-57
85	1	6	72.66183569	-114.37630875	72	39	42	-114	-22	-34
85	2	6	72.78789909	-114.89545324	72	47	16	-114	-53	-43
88	1	6	72.60938352	-114.63146139	72	36	33	-114	-37	-53
88	2	6	72.79729579	-115.43830542	72	47	50	-115	-26	-17
89	1	6	72.53935401	-114.82366460	72	32	21	-114	-49	-25
89	2	6	72.75919513	-115.76364552	72	45	33	-115	-45	-49
90	1	6	72.46365178	-114.98151261	72	27	49	-114	-58	-53
90	2	6	72.69092330	-115.98068972	72	41	27	-115	-58	-50
91	1	6	72.62455859	-116.17123061	72	37	28	-116	-10	-16

Transect	End Point	Stratum	Latitude	Longitude	Degrees	Minutes	Seconds	Degrees	Minutes	Seconds
91	2	6	72.41637709	-115.27084685	72	24	58	-115	-16	-15
92	1	6	72.33985534	-115.42359177	72	20	23	-115	-25	-24
92	2	6	72.54782149	-116.32786535	72	32	52	-116	-19	-40
93	1	6	72.48330195	-116.54092888	72	28	59	-116	-32	-27
93	2	6	72.26717158	-115.59534612	72	16	1	-115	-35	-43
106	1	8	69.13724570	-112.25804837	69	8	14	-112	-15	-28
106	2	8	68.52755622	-112.22396951	68	31	39	-112	-13	-26
108	1	8	69.13522202	-112.50955808	69	8	6	-112	-30	-34
108	2	8	68.49869871	-112.46692261	68	29	55	-112	-28	0
110	1	8	69.13283069	-112.76101330	69	7	58	-112	-45	-39
110	2	8	68.47621457	-112.70975711	68	28	34	-112	-42	-35
112	1	8	69.13007186	-113.01240497	69	7	48	-113	0	-44
112	2	8	68.48475179	-112.95481120	68	29	5	-112	-57	-17
114	1	8	69.12694572	-113.26372407	69	7	37	-113	-15	-49
114	2	8	68.57358675	-113.20792830	68	34	24	-113	-12	-28
116	1	8	69.12345245	-113.51496158	69	7	24	-113	-30	-53
116	2	8	68.71131296	-113.46848138	68	42	40	-113	-28	-6
122	1	7	69.32831471	-115.98470019	69	19	41	-115	-59	-4
122	2	7	70.23272510	-115.94026544	70	13	57	-115	-56	-24
123	1	7	70.24441585	-115.67454691	70	14	39	-115	-40	-28
123	2	7	69.28741853	-115.73324164	69	17	14	-115	-43	-59
124	1	7	69.26184703	-115.48164001	69	15	42	-115	-28	-53
124	2	7	70.26131550	-115.40810136	70	15	40	-115	-24	-29
125	1	7	70.28006024	-115.14102394	70	16	48	-115	-8	-27
125	2	7	69.25831935	-115.22881175	69	15	29	-115	-13	-43
126	1	7	69.28690951	-114.97304099	69	17	12	-114	-58	-22
126	2	7	70.28832732	-114.87451242	70	17	17	-114	-52	-28
127	1	7	70.30963793	-114.60622914	70	18	34	-114	-36	-22
127	2	7	69.27210884	-114.72113255	69	16	19	-114	-43	-16