# AN ESTIMATE OF HERD SIZE FOR THE MIGRATORY DOLPHIN AND UNION CARIBOU HERD DURING THE RUT (17 - 22 OCTOBER 1997)

JOHN S. NISHI[1]

AND

ANNE GUNN[2]

DEPARTMENT OF RESOURCES, WILDLIFE
AND ECONOMIC DEVELOPMENT

GOVERNMENT OF THE NORTHWEST TERRITORIES

[1]KUGLUKTUK, NU
(Now in Fort Smith, NT)

[2]YELLOWKNIFE, NT

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## ABSTRACT

Based on various observations of caribou staging along the southern coastline of Victoria Island during the fall rut including i) annual fall sightings by Inuit hunters, ii) previous aerial reconnaissance along the coastline in October 1994 and 1996, and iii) the distribution of VHF radio-collared cows along southern Victoria Island in October 1994 and 1997, we surveyed the coastline to determine relative distribution and abundance during the rut. Our first objective was to document relative caribou densities and distributions through a non-systematic reconnaissance and provide a basis for subsequent stratification and survey. Our second objective was to derive a precise estimate of caribou numbers along the southern coast within a strip transect aerial survey design. On 17 and 18 of October 1998, we flew along the southern coastline of Victoria Island from Lady Franklin Point to Parker Bay. During the reconnaissance survey, we counted 10 379 caribou and found that most were either in the area between Cape Colborne and Anderson Bay or between Cape Peel and Nakyoktok (Richardson Islands). Most groups of caribou were within 10 km of the coast. From those observations, we designed a survey to estimate the number of caribou that were along the southern coastline. We stratified the coastline into eight different survey strata to get a precise estimate of caribou numbers. From 19 to 22 October, we surveyed each stratum. We counted a total of 5087 caribou on *ca.* 1047 km of line transects and estimated that there were 27 948 ± 3367 (Standard Error) caribou in the surveyed area. We suggest that an aerial survey during the fall rut is a useful technique to estimate size of the migratory Dolphin and Union caribou herd and recommend that additional work should build on this survey design. Replication and independent validation of this survey technique would be best achieved though the inclusion of satellite telemetry and aerial surveys.

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# INTRODUCTION

## History of Dolphin and Union caribou

There are two discrete caribou (*Rangifer tarandus)* herds on Victoria Island – the Minto Inlet herd and the Dolphin and Union herd (Gunn and Fournier 2000, Gunn *et al.* 2000). The annual range of the Minto Inlet herd is on northwest Victoria Island, while the Dolphin and Union herd summer on southern and central Victoria Island and spend the winter on the adjacent mainland.

Manning (1960) first described the Dolphin and Union herd as a migratory herd that historically summered on Victoria Island, migrated over the frozen Dolphin and Union Strait (Figure 1) – hence its name – and overwintered on the mainland. Manning (1960) guessed that the Dolphin and Union herd numbered *ca.* 100 000 caribou in the late 1800s based on explorers' accounts of caribou densities during spring and fall migrations and his extrapolation to the size of Victoria Island. This early abundance of the Dolphin and Union herd was short-lived, as a precipitous decline due to overhunting (Manning 1960) or possibly overhunting compounded by severe winters (Gunn 1990) in the early 1900s resulted in a near extirpation of the herd by the 1920s (Manning 1960, and see Condon and Ogina 1996).

However, by the 1970s and 1980s, hunters reported increased sightings of caribou on southern and central Victoria Island (Gunn 1990). During the 1980s, caribou were migrating in the fall from central and western Victoria Island to the

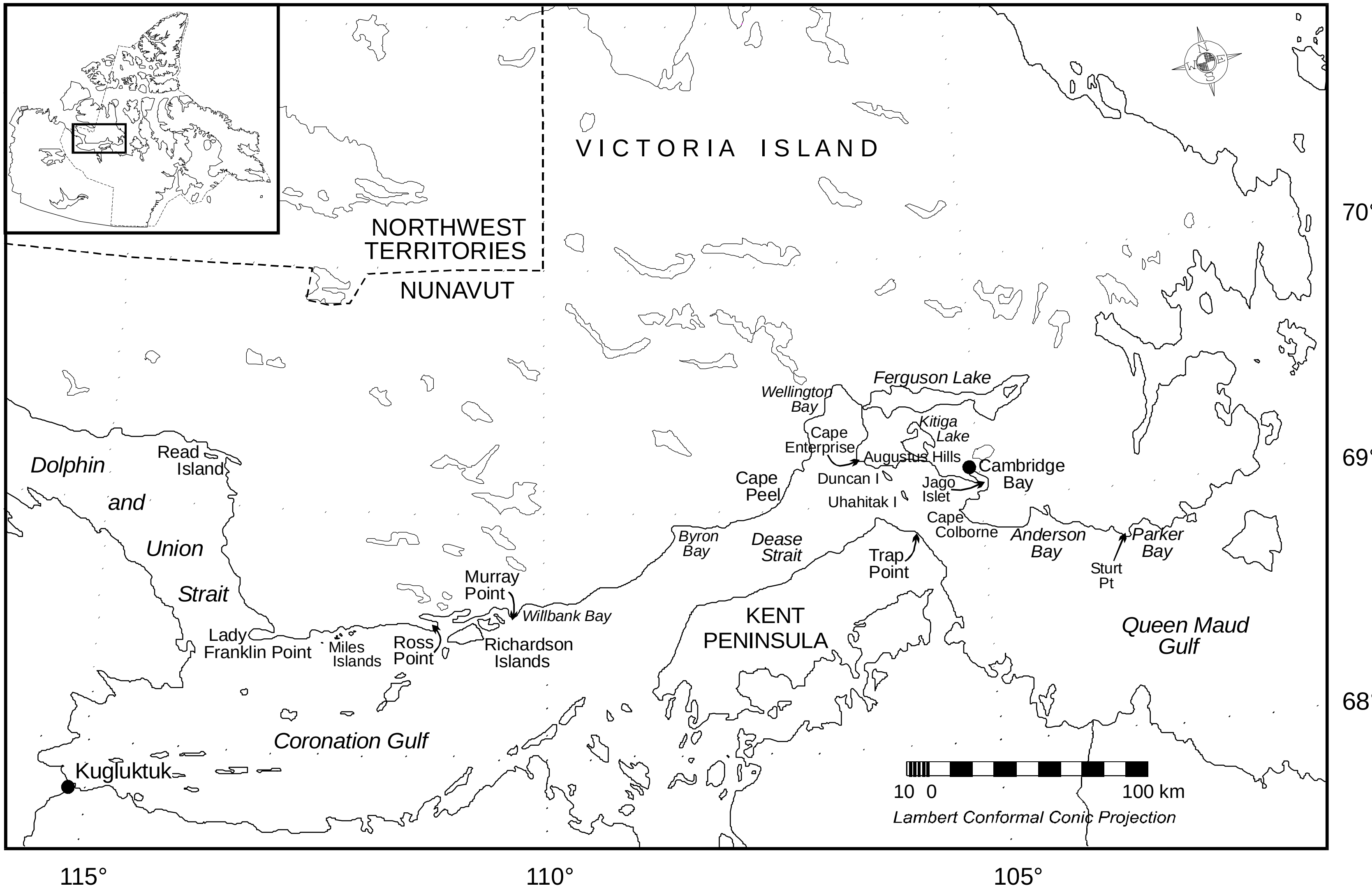


Figure 1. Place names and locations on southern Victoria Island.

southern part of the island. Hunters also reported seeing more caribou along the southern coast at this time. By the mid 1980s, the winter distribution of caribou was shifting progressively eastward towards Cambridge Bay. In 1987-89, Gunn and Fournier (2000) showed that while most caribou were wintering along the southern coast of Victoria Island, one of nine satellite-collared female caribou migrated to the mainland for the winter. By the early 1990s, the migratory movement of caribou between Victoria Island and the adjacent mainland had increased in magnitude; in May 1993, Gunn *et al.* (1997) documented over 7000 caribou had returned or were returning to Victoria Island after wintering on the mainland.

**Current status and trend of Dolphin and Union caribou**

Dolphin and Union caribou are currently listed as “special concern” by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 2004). The designation of “special concern” is assigned primarily because of apparently high levels of harvest, relative to incomplete data on population size (Miller 1990b , Gunn *et al.* 2000, Harding 2004).

Estimating abundance of caribou on Victoria Island has proved difficult. The conventional approach to caribou on islands is to survey the entire island. But flying an island-wide survey (see Jakimchuk and Carruthers 1980) is not practical given the large size of Victoria Island (*ca.* 220 574 $km^2$). In addition, without being able to distinguish the spatial distribution and seasonal movements of the two herds on Victoria Island, it is difficult to ascribe herd-specific rates of increase (see discussion in Nishi and Buckland 2000). Although the calving ground survey technique has worked relatively well in providing a repeatable index of herd abundance for mainland caribou herds (Heard 1985, Williams 1994), the technique has not been as useful an approach for estimating caribou herd sizes on Victoria Island despite a concerted effort (see Gunn and Fournier 2000, Nishi and Buckland 2000). A large part of the difficulty is related to low densities of caribou in an extensive area.

An alternative approach to an island-wide survey and a calving ground survey technique must be logistically feasible and biologically relevant. In order to accurately determine trend, the population of inference for the survey results must be a functionally discrete demographic unit and a meaningful biological population, *i.e.,* a caribou herd. We designed this aerial survey on the premise that a large majority of the migratory Dolphin and Union caribou herd congregated along the southern coastline of Victoria Island during the rut and prior to their fall migration to the mainland. Since there was still mostly open water between Victoria Island and the mainland and the caribou could not migrate across Dease Strait and Coronation Gulf, we thought that a census of this fall distribution should provide a reliable and repeatable technique to estimate herd size.

Our premise was based on hunters' reports and observations, and observations recorded during previous aerial surveys of the caribou distribution along the southern coastline of Victoria Island during the rut and prior to freeze-up of the sea ice (Nishi 2000). Hunters based out of the outpost camps near Read Island (J. Atatahak pers. comm.) and Ross Point (Nakyoktok) (C. Bolt pers. comm.) (Figure 1), and Cambridge Bay (G. Angohiatok and D. Kaomayok pers. comm.), had been consistently observing the fall migratory movement of caribou towards and along the coast through the early and mid 1990s. These observations by hunters of caribou numbers and movements at distant locations along the coast during the fall – a time of the year when snowmobile travel may be limited because of a lack of continuous snow cover and potential hazards of thin ice – suggested that the annual fall migration was consistent and extensive. Also, previous observations of radio-collared (VHF collars) cows in October 1994, 1996, and 1997 suggested that a majority of the migratory caribou herd used the southern coastline as a staging area where they would wait for the sea ice to form before crossing over to the mainland (Nishi 2000). Radio-telemetry flights in October 1994 showed that 13 of 20 collared cows were located along the southern coastline (Figure 12 in Nishi 2000) - the other collars were not located when poor weather ended the flying.  A low level (150 m agl) reconnaissance of the southern coastline of Victoria Island on 11 October 1996, resulted in a total of 6172 caribou and 272 muskoxen observed (Appendix D in Nishi 2000). And during the flight, the radio signals of 5 radio-collared cows were opportunistically detected along the southern coastline out of a maximum of 14 collared caribou presumed alive at the time (Appendix C in Nishi 2000). Similarly from 8-17 October 1997, of the remaining 12 radio-collared caribou that were presumed to be alive at the time (Appendix C in Nishi 2000), nine cows were found and collected in association with high densities of caribou along the southern coastline (Figure 13 in Nishi 2000). The three cows that were not found in October 1997 had not been found during two previous radio-telemetry flights in June 1997 (Appendix C in Nishi 2000).

Therefore, immediately following the collection of radio-collared caribou in October 1997, we surveyed the southern coastline of Victoria Island to determine distribution and abundance of caribou during the rut. Our goal was to estimate herd size by conducting an aerial survey of the fall rut distribution when we expected most of the migratory Dolphin and Union caribou herd to be aggregated along the southern coastline of Victoria Island. Our specific objectives were twofold:

1. to document relative caribou densities and distributions through a non-systematic reconnaissance and provide a basis for subsequent stratification and survey; and
2. to derive a precise estimate of caribou numbers along the southern coast within a stratified strip transect aerial survey design.

## METHODS

We used a Helio-Courier H-295 on wheel skis to conduct the aerial reconnaissance. Survey altitude was 100 metres above ground level with an airspeed of 160 km / hr. In addition to the pilot, the survey crew consisted of a left and right observer. The right observer recorded group sizes for each caribou observation and also assisted with navigation during the reconnaissance. The pilot marked all caribou observations on 1:250 000 scale National Topographic Series (NTS) maps. From the reconnaissance, we determined relative abundance and distribution of arctic-island caribou along the coastline.

To precisely estimate caribou numbers, we used the observed distribution and density of caribou relative to landmarks along the coastline to delineate six survey strata – Lady Franklin, Richardson, Byron, Wellington, Kitiga, and Anderson South. We designed the coastline strata to provide an estimate of caribou within 10 km of the coastline, as it was clear from the reconnaissance survey that caribou densities declined substantially after *ca.* 5-8 km inland. However, we also plotted transects on survey maps for adjacent northern strata that would extend an additional 10 km inland for each of the six coastline strata. Our rationale was to provide an adaptive approach to confirm and sample the northern extents of the coastal caribou distribution that may have shifted northward since completion of the reconnaissance or that we may have missed during the initial reconnaissance. Sampling effort for adjacent northern strata was contingent on field observations of caribou within the coastline strata and remaining air charter time.

Following completion of the reconnaissance, we were notified that Holman hunters were still seeing caribou in the Prince Albert Sound area (J. Kuneyuna pers. comm.). Consequently, we added one additional coastline stratum west of Read Island (Figure 1) to determine whether large numbers of caribou were moving south along the coastline of the Dolphin and Union Strait.

Because caribou were distributed along the shore, we oriented transects perpendicular to the main axis of the coastline to reduce potential bias. As observed densities of caribou during the reconnaissance were greatest in the eastern part of the survey area, we surveyed the eastern-most stratum first with a comparatively higher rate of coverage and progressively worked west along the coastline. We established survey effort at 20% for high-density strata and 10% for lower density strata. We decided not to exceed 20% survey coverage so as to minimize the number of overflights and potential disturbance to caribou.

We programmed all transect endpoints into a Global Positioning System (GPS) to assist the pilot in navigating transects. A front seat navigator recorded all wildlife sightings called out by left and right observers and recorded observations on 1:250 000 NTS maps. The pilot frequently checked ground elevation from the NTS maps and maintained survey altitude at 100 metres above ground level and a constant airspeed of *ca.* 140 – 160 km / hour. Strip width was 500 metres per side. Prior to flying the strip-transect survey, we verified transect width by having the pilot fly the Helio-Courier perpendicular to the Cambridge Bay airport runway at survey altitude while observers checked the location of strip markers[1] against a pickup truck that was temporarily parked 500 metres from the end of the runway.

We used Jolly's (1969) Method 2 to calculate a population estimate of caribou in the surveyed area based on observations from unequal sized transects. We used the program Aerial (Krebs 1992, Program 3.5) for all calculations of population estimates and variances for each stratum.

We used a two-tailed Wilcoxon signed ranks test on observation data from the stratified strip-transect survey to test for differences between numbers of caribou counted by left and right observers on each transect. We adjusted sample sizes for occurrences when there was no difference between observers, and used the large sample test statistic adjusted for tied ranks (Siegel and Castellan 1988, pp. 91–94). Statistical significance was arbitrarily set at $p \leq 0.05$.

Because of the north-south axis of the transects and the predominant north winds on the 19 and 20 October, we used a one-way ANOVA to test whether the number of caribou counted on transect while the aircraft was flying north into a headwind was greater than when the aircraft heading was south with a tailwind. We log-transformed caribou count data for each transect flown on those days to normalise the data. For this analysis, we ignored transects in which we observed no caribou.

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[1] On each side of the aircraft, we tied a nylon cord from a bracket on the fuselage to an anchor attachment on the underside of the corresponding wing. We determined a strip width on the ground that would correspond to a 500-metre-wide transect at survey altitude (see Norton-Griffiths 1978), and used a length of flagging tape wrapped and attached to the nylon cord to serve as the outside strip markers.

# RESULTS

## Reconnaissance survey

On 17 and 18 October 1997, we flew a total of 8.8 hours and covered the entire southern coastline of Victoria Island from Lady Franklin Point to Parker Bay (Figure 2, Appendix A). At the time of our reconnaissance survey, the sea ice was at early stages of formation and continuous thin ice pans did not extend more than a few hundred metres beyond the shoreline.

On 17 October, we flew from Cambridge Bay and flew south and east to Parker Bay. Approximately 10 km southeast of the airport, we observed caribou tracks heading off Jago Islet (Figure 1) on newly frozen pan ice[2] and passed by a herd of 102 caribou strung out in single file on the ice with lead animals on the opposite shore. We saw few caribou on the flight leg to Parker Bay, but observed progressively greater numbers of caribou (an increase in group size and numbers of groups) along the coastline to the west. There were moderately high densities of caribou between Sturt Point and Anderson Bay, with very high densities as we proceeded to Cape Colburne (Figures 1 & 2).

On 18 October, we flew west along the coastline to Cape Enterprise and then around Wellington Bay (Figure 2) because of open water and risk of

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[2] The ice had formed overnight as P. Linton reported having seen no ice in the area when he flew over the day before.

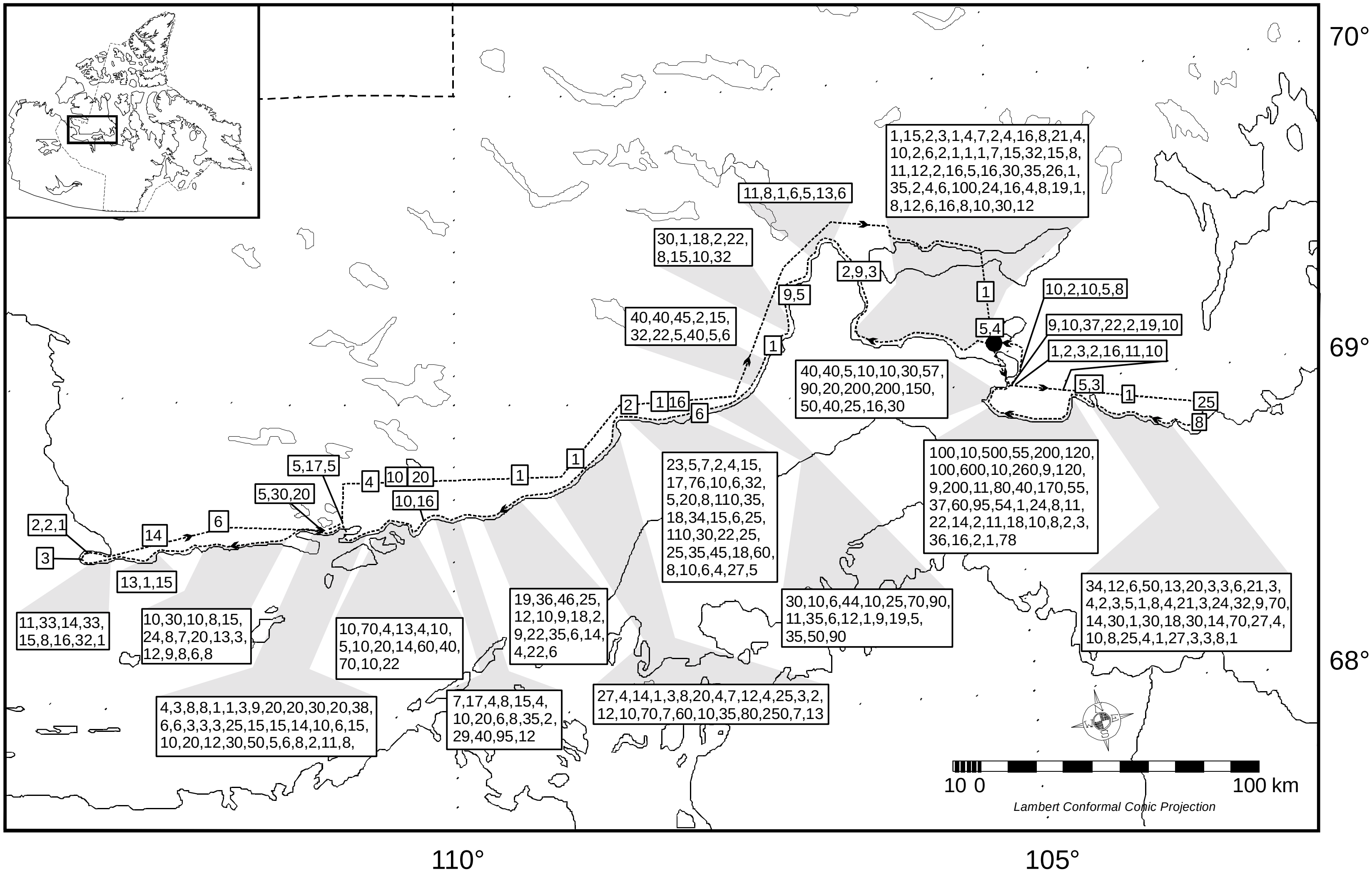


Figure 2. Flight lines and group sizes of caribou on transect during an aerial reconnaissance survey of the Dolphin and Union caribou herd on southern Victoria Island, 17-18 October 1997.

freezing drizzle (Appendix B). We saw moderate densities of caribou between the airport and Cape Enterprise. Newly formed sea ice out to Duncan and Unahitak Islands (Figure 1) was scattered with a few caribou tracks. Although we saw very few caribou around Wellington Bay, we observed recent and heavily used trails oriented on a west – east axis at the north end of the bay. These tracks would have been formed following a recent 3-day blizzard occurring from 13-15 October 1997. There were few caribou from Wellington Bay to Cape Peel (Figures 1 & 2), with scattered groups of animals walking east and north along the coastline. There were moderately high densities of caribou from Cape Peel to Byron Bay with many groups walking in single file and heading eastward along the coast. Other groups were bedded and feeding, with a few groups of caribou bedded on the sea ice within a km of the shoreline.

There were numbers of caribou distributed continuously along the coast from Byron Bay to Nakyoktok River (Ross Point) (Figures 1 & 2). At Wilbank Bay we saw a few caribou travelling west towards Murray Point, but the majority were bedded, feeding, and walking slowly – often in single file – to the east. Within the narrows between the Richardson Islands and Victoria Island, we observed 19 caribou that had broken through an area of noticeably thinner sea ice. Most of the caribou were at the ends of broken ice trails attempting to swim to thicker ice: we saw some getting out and onto thicker ice, and observed a few animals breaking through.

As we proceeded west of Ross Point, we continued to observe caribou along the coastline up to the Miles Islands. There were substantially fewer caribou along the coastline towards Lady Franklin Point, although there were several groups along the southern shoreline (Figure 2).

On the return flight back to Cambridge Bay, we headed eastward at varying distances from the coastline to determine whether the distribution of caribou extended further north in the higher density areas (Figure 2). We saw very few caribou during the return trip to the north end of Wellington Bay. We proceeded east to follow the northern shoreline of Ferguson Lake to determine whether there were any fresh tracks or caribou, which would have suggested that the unfrozen waters of Ferguson were funneling animals east and away from the coast, outside of our planned survey area. We continued along the north shore halfway down the length of Ferguson Lake and saw no caribou or tracks. We observed only 10 caribou between Ferguson Lake and the airport (Figure 2).

During the initial two-day reconnaissance survey we counted 10 379 caribou (Appendix C) and observed that most were distributed along the coastline either in the area between Cape Colborne and Anderson Bay or between Cape Peel and Nakyoktok (Richardson Islands) (Figures 1 and 2). Caribou densities were concentrated within a narrow band along the shoreline, estimated to be less than 10 kilometres inland from the coast (Figure 2).

**Stratified strip-transect survey**

From 19-22 October 1997, we flew a total of 26.8 hours (Appendix A) and surveyed eight strata (Figure 3). We flew 1047 km of strip transects, counted a total of 5087 caribou on transect and estimated that there were 27 948 ± 3367 (Standard Error) caribou in the surveyed area (Table 1).

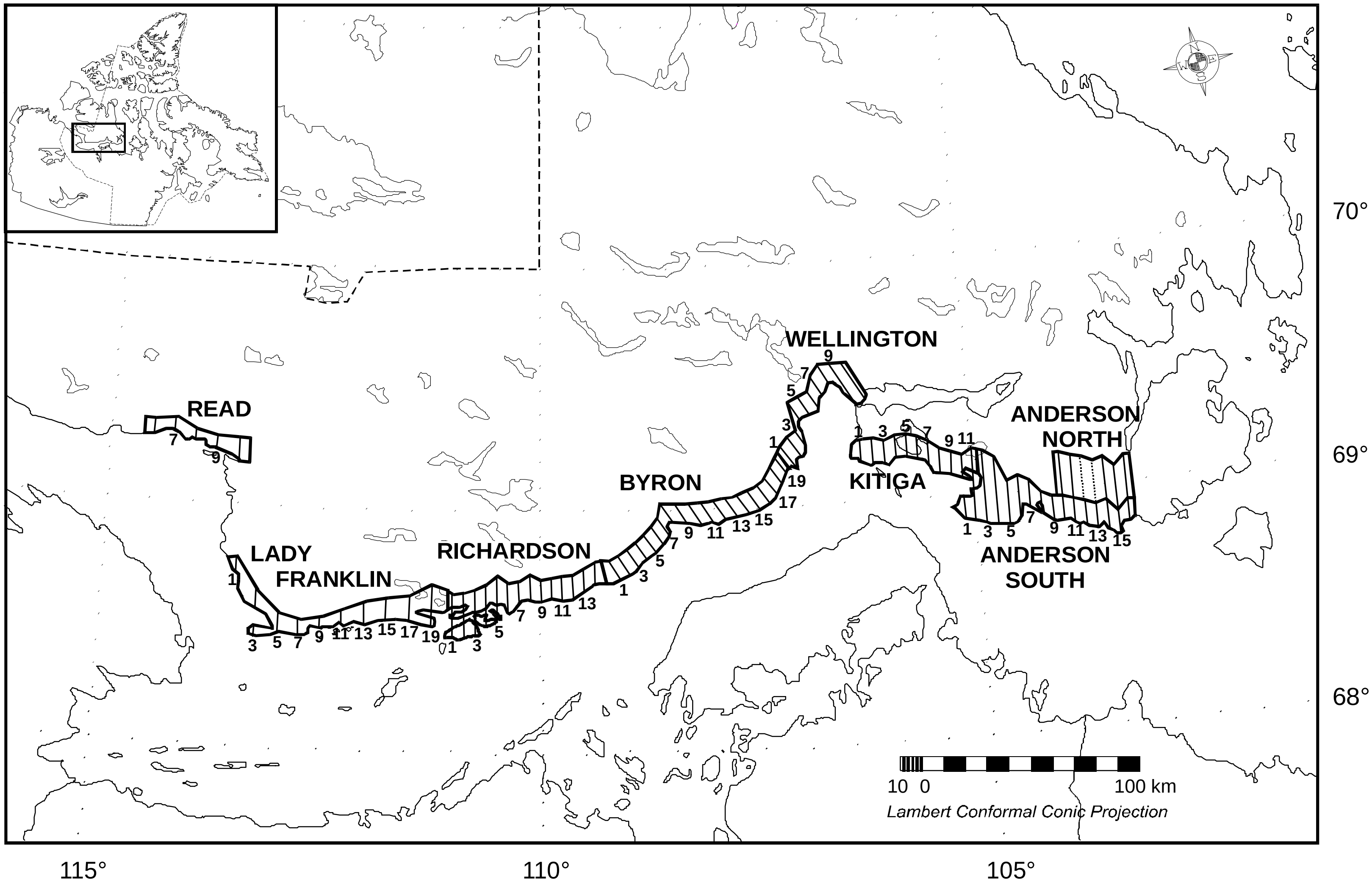


Figure 3. Strata and transects flown during a systematic aerial survey of the Dolphin and Union caribou herd on southern Victoria Island, 19-22 October 1997.

Table 1. Analysis of data from an aerial survey of Dolphin and Union caribou (*Rangifer tarandus*) on southern Victoria Island, 19-22 October 1997.

| | STRATA | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Read | Lady Franklin | Richardson | Byron | Wellington | Kitiga | Anderson South | Anderson North | Total |
| Maximum number of transects (N) | 50 | 101 | 71 | 96 | 50 | 57 | 82 | 48 | |
| Number of transects surveyed (n) | 5 | 10 | 14 | 19 | 10 | 11 | 16 | 5 | |
| Stratum area, $km^2$ (Z) | 333.3 | 992.5 | 913.0 | 999.8 | 587.5 | 623.1 | 1189.6 | 705.8 | |
| Transect area, $km^2$ (z) | 30.3 | 89.8 | 172.0 | 191.5 | 120.0 | 112.3 | 230.3 | 100.5 | |
| Number of caribou counted (y) | 38 | 159 | 1065 | 833 | 20 | 696 | 2253 | 23 | |
| Caribou density, caribou/$km^2$ (R) | 1.256 | 1.772 | 6.192 | 4.350 | 0.167 | 6.200 | 9.785 | 0.229 | |
| Population estimate (Y) | 419 | 1758 | 5658 | 4349 | 98 | 3864 | 11 640 | 162 | 27 948 |
| Population variance (Var Y) | 37 369 | 548 029 | 1 956 951 | 1 394 622 | 3625 | 851 938 | 6 540 674 | 6207 | 11 339 415 |
| Standard error (SE Y) | 193 | 740 | 1399 | 1181 | 60 | 923 | 2557 | 79 | 3367 |
| Coefficient of variation (CV) | 0.461 | 0.421 | 0.247 | 0.272 | 0.615 | 0.239 | 0.220 | 0.488 | 0.120 |
| 95% Confidence inverval | 537 | 1674 | 3022 | 2481 | 136 | 2056 | 5550 | 218 | |
| % Coverage | 9.1 | 9.0 | 18.8 | 19.2 | 20.4 | 18.0 | 19.4 | 14.2 | |

The summed estimates of four out of eight strata represented 91.3% of the total estimate (Table 1). We observed the greatest densities of caribou - *ca.* 9.79 caribou / $km^2$ - east of Cambridge Bay in the stratum Anderson South (Table 1, Figure 4). Immediately west of Cambridge Bay, we observed a density of 6.20 caribou / $km^2$ in Kitiga stratum. The combined estimates for Anderson South and Kitiga comprised 55.5% of the total estimate. The Richardson and Byron strata together comprised 35.8% of the population estimate with observed densities of 6.19 and 4.35 caribou / $km^2$ respectively (Table 1, Figure 4).

Numbers of caribou counted on transect by the left (AG, 19 and 20 Oct.; and DP, 22 Oct.) and right (JN) observers during the strip-transect survey were not significantly different ($P = 0.569$, $T^+ = 1178.5$, $n = 71$). Despite the early winter weather conditions along the coast, we were able to fly strip-transects under conditions of good visibility for the duration of the survey. A 3-day blizzard preceding the survey also presented a fresh cover of snow that allowed us to see caribou tracks well.

Although variable cloud conditions and some ground drifting affected visibility at times (Appendix B), those conditions did not reduce visibility within the transect nor did they persist for any length of time during the survey. Nevertheless, open water along the coastline combined with light precipitation resulted in occasional but patchy fog and risk of freezing rain. With deteriorating weather and associated light conditions typical of late afternoons and extensive

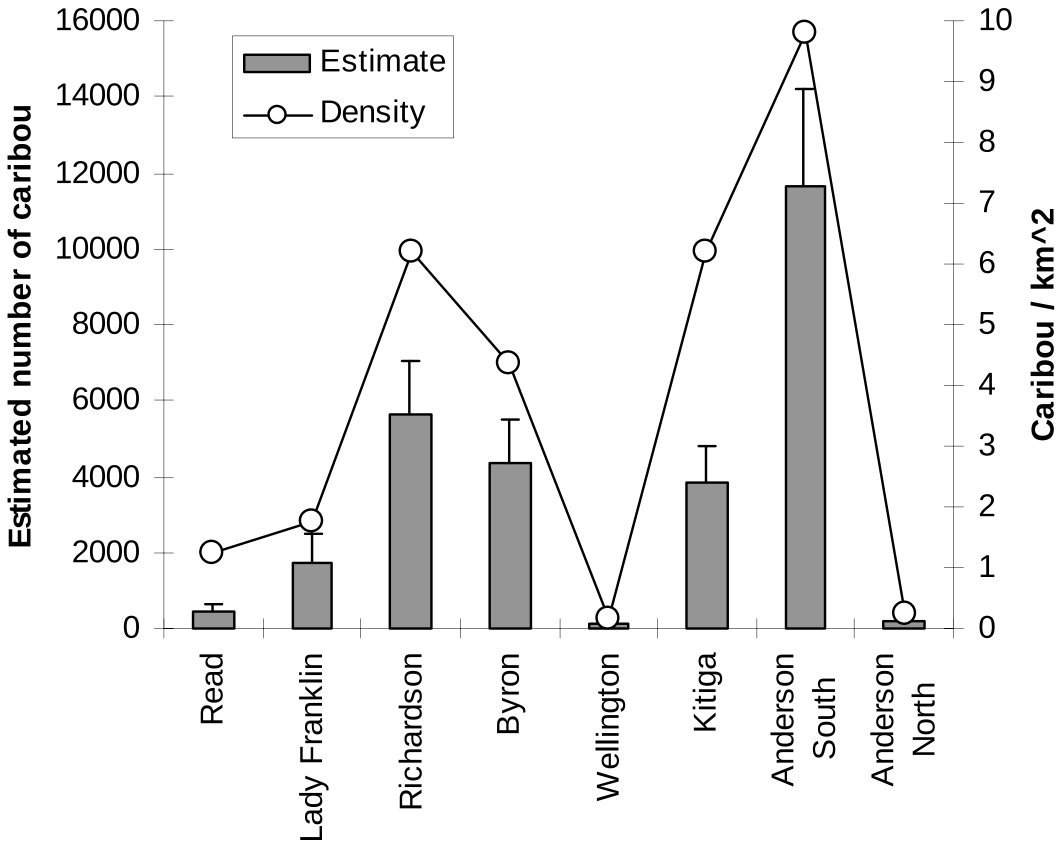


Figure 4. Estimated abundance (±1 SE) and observed densities in survey strata along southern coastline of Victoria Island, 19-22 October 1997.

ferrying to distant strata, it was necessary to conduct the actual survey within a relatively short working day (Appendix A). Winds for most of the strip-transect survey were predominantly from the north – northwest and ranged from 5 to 16 knots (Appendix B). A comparison of transects where the aircraft was flying into a headwind, *i.e.,* a northerly heading (n = 32), versus flying with a tailwind, *i.e.,* a southerly heading (n = 36), did not reveal a significant difference in number of caribou observed (p = 0.582).

The 5087 caribou we observed on transect occurred in 322 groups (Figure 5.). Group size ranged from 1 to 477, with a median of 8 and mean of 15.8 ± 34.4 (Standard Deviation). Approximately 50% of the total number of caribou counted on transect occurred in group sizes of 30 or less, while 80% of the total number counted occurred in group sizes of 110 or less (Figure 5). Typical group size (calculated according to Jarman 1982) was 90.5 caribou. Regressions of typical group size and mean group size with density across the eight survey strata were significant (Figure 6, Tables 2 and 3). In the regression between typical group size and density, the intercept was not significantly different from zero (p = 0.574, Table 2); in the regression between mean group size and density the intercept was significantly greater than zero (p = 0.011, Table 3).

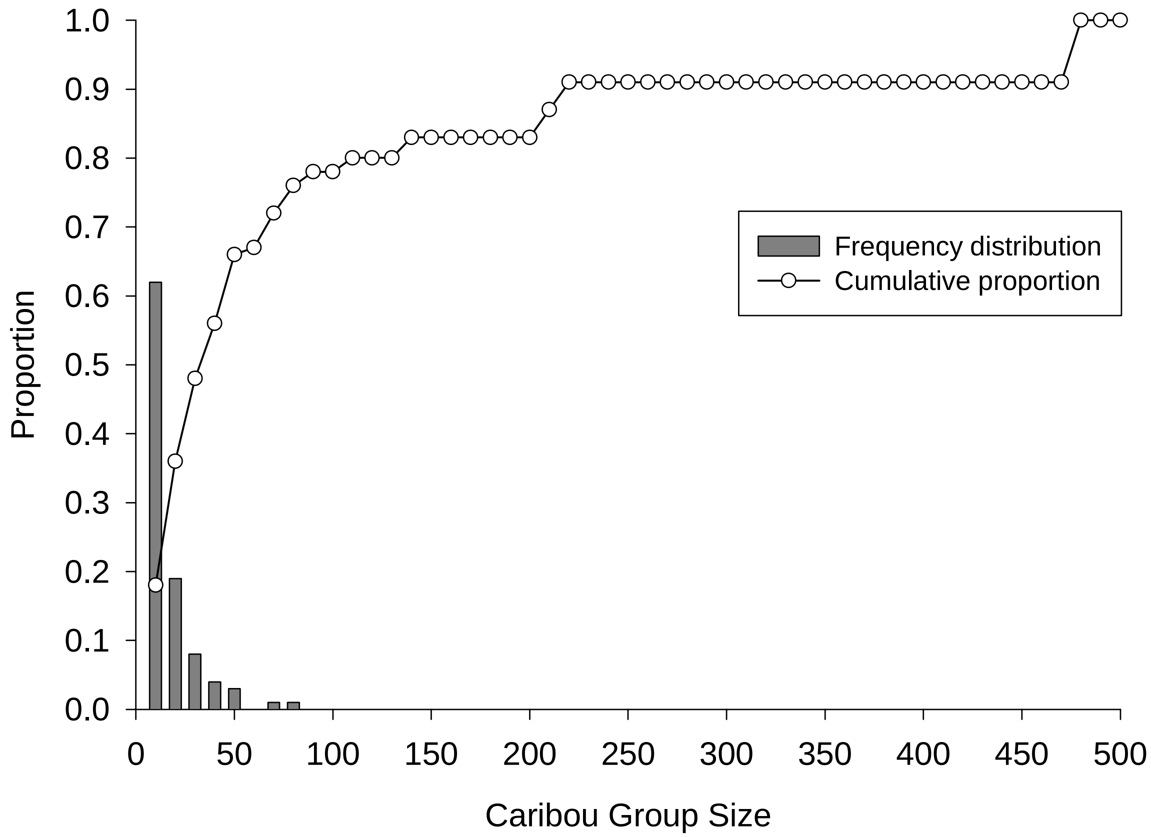


Figure 5. Frequency distribution of caribou group sizes (n = 322) observed on transect (group sizes are shown at intervals of 10) during an aerial survey of the southern coastline of Victoria Island, October 1997. The line graph represents the associated cumulative proportion of the total number of caribou observed (n = 5087) for each of the group size intervals.

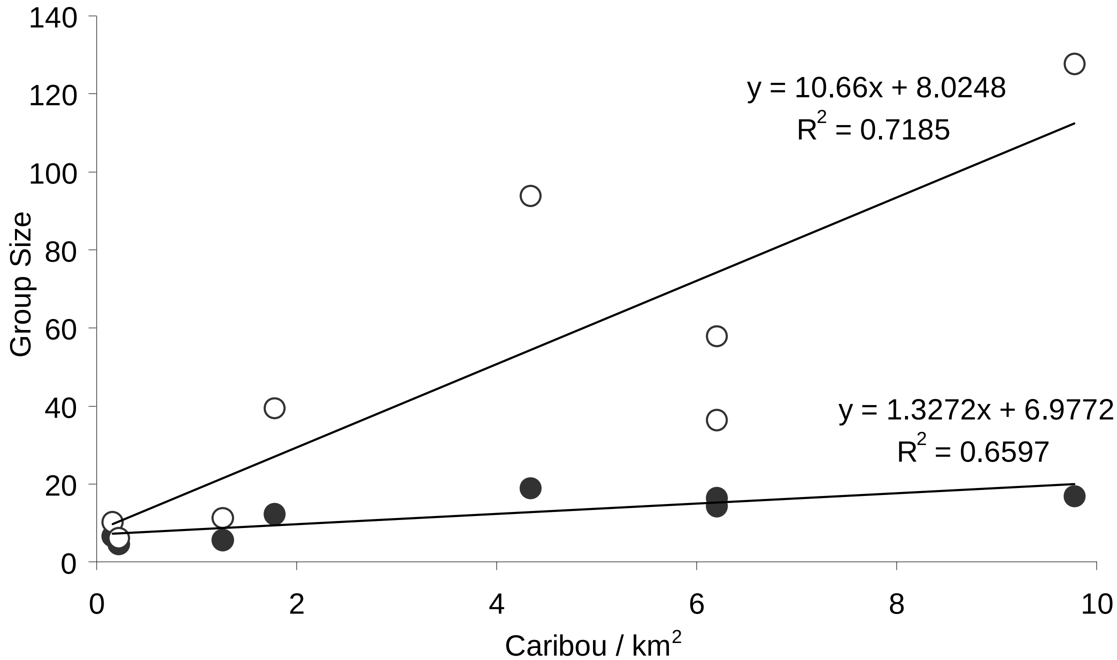


Figure 6. Relationship between group size and density observed in eight survey strata on southern Victoria Island, October 1997. Typical group size is represented by open circles and mean group size is shown by black circles.

Table 2. Summary statistics for regression analysis of typical group size and density in eight survey strata. Typical group size = 8.013 + (10.659 x Density), n = 8, R = 0.848, $R^2$ = 0.719, Adj $R^2$ =0.672

| | Coefficient | Std. Error | t | P |
|---|---|---|---|---|
| Constant | 8.013 | 13.490 | 0.594 | 0.574 |
| Density | 10.659 | 2.723 | 3.914 | 0.008 |

Analysis of Variance:

| | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Regression | 1 | 9558.353 | 9558.353 | 15.322 | 0.008 |
| Residual | 6 | 3743.037 | 623.839 | | |
| Total | 7 | 13301.390 | 1900.199 | | |

Normality Test: Passed (P = 0.795)
Constant Variance Test: Failed (P = 0.015)

Table 3. Summary statistics for regression analysis of mean group size and density in eight survey strata. Mean group size = 6.979 + (1.326 x Density), n = 8, R = 0.812, $R^2$ = 0.659, Adj $R^2$ = 0.603

| | Coefficient | Std. Error | t | P |
|---|---|---|---|---|
| Constant | 6.979 | 1.928 | 3.619 | 0.011 |
| Density | 1.326 | 0.389 | 3.408 | 0.014 |

Analysis of Variance:

| | DF | SS | MS | F | P |
|---|---|---|---|---|---|
| Regression | 1 | 148.025 | 148.025 | 11.611 | 0.014 |
| Residual | 6 | 76.492 | 12.749 | | |
| Total | 7 | 224.517 | 32.074 | | |

Normality Test: Passed (P = 0.485)
Constant Variance Test: Passed (P = 0.578)

## DISCUSSION

In October 1997, we found that caribou were distributed in high densities along the southern coast of Victoria Island during the fall because the waters (including Dolphin and Union Strait, Coronation Gulf, Dease Strait, and the western extent of Queen Maud Gulf) between Victoria Island and the adjacent mainland had not yet frozen over completely, and the animals require weight-bearing ice to successfully cross the sea and migrate to their winter range on the mainland. Our rationale for flying the southern coastline during the rut was that the distribution and density of caribou staging along the coast served to concentrate the majority of this migratory population into a well-circumscribed area, making a population estimate logistically feasible and biologically meaningful.

### Interpretation of survey results

Despite a higher likelihood for marginal weather conditions and reduced visibility, logistic feasibility of a fall survey on southern Victoria Island is relatively good because the survey area is comparatively small and discrete. Following an initial reconnaissance of the southern coastline, we designed and flew a stratified strip-transect survey and estimated that there were 27 948 ± 3367 (SE) caribou.

As this was a visual survey, we recognize that undercounting was a likely source of bias (Caughley 1974, Norton-Griffiths 1978). It is also important to note that undercounting was probably a greater source of bias in high-density strata (*i.e.,* Anderson South) compared to those strata where we observed lower densities of caribou. Although, another important potential source of bias in winter surveys is reduced visibility due to blowing snow and ground-drift, we do not think these obscuring phenomena undermined our survey results because observers were able to visually cover their entire strip widths for the duration of the survey. Because transect lengths were short, *ca.* 10 km, observers had frequent short breaks which helped maintain their alertness. Despite strong winds affecting actual ground speed of the survey aircraft, we were unable to detect any differences in observer counts when either a head or tail wind affected the aircraft. Despite the potential problems associated with visibility bias, the population estimate was relatively precise (Coefficient of Variation = 0.12).

However, the issue of survey accuracy is somewhat more difficult to evaluate and will require additional follow-up work. For this survey, the issue of accuracy is linked directly to the question of “how many animals from this migratory herd were missed because they were outside of the survey area?” Whether this fall survey technique provides a direct and reliable estimate of the Dolphin and Union herd depends on whether the vast majority of the migratory herd occurred in the survey area during the time of survey.

We outlined several lines of supporting evidence (see Introduction) including hunters’ observations, previous aerial surveys of the southern coastline, radio-telemetry studies of Dolphin and Union caribou cows, and provide additional observations from this survey that are consistent with the assumption that the majority of the herd stages along the southern coastline in wait of freeze-up. We observed caribou and recent caribou sign (*i.e.,* tracks and trails) distributed within a narrow band along the entire coastline suggesting that pre-migration staging was both extensive and substantial. The high densities of caribou within specific survey strata, (*i.e.,* Anderson South, Richardson and Byron), corroborate well with local hunters' contention that caribou aggregate along certain sections of the southern coastline that are adjacent to where most of the animals will cross once the sea ice is formed sufficiently to support the animals' weight. Once the new sea ice is frozen sufficiently, thousands of caribou will cross from the Cape Colborne area to Kent Peninsula (south of Trap Point) within a matter of a few days (G. Angohiatok pers. comm.). The instinct to migrate is powerful as we observed several caribou herds bedded down on newly formed sea ice and walking out onto progressively weaker ice, with animals breaking through in some cases. Indeed, local trappers are known to search out caribou that have died during the fall ice crossing and set fox traps in the vicinity of these partially entombed carcasses (D. Kaomayok pers. comm.).

Although, Holman hunters had indicated that they were still seeing caribou along the northern shoreline of Prince Albert Sound[3] at the time of our survey, we do not know enough about the distribution or abundance of those caribou to

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[3] It is interesting to note that the Kunana site – a recent post-Thule site located near the mouth of the Kuuk River – was used between A.D. 1800 – 1900 primarily for fall caribou hunting (McGhee 1972 in Condon and Ogina 1996).

determine whether they overwinter on Victoria Island or whether they continue to migrate east and then south to the mainland. These possible explanations should be explored further with satellite collars placed on a sample of those female caribou during the fall rut with co-ordinated aerial surveys to determine distribution of caribou

Our observations during both the reconnaissance and stratified strip transect survey clearly showed that caribou were concentrated along the southern coastline. Greatest densities occurred in the eastern part of the survey area in the Anderson South and Kitiga strata. In the western part of the survey area, the Richardson and Byron strata had the highest caribou densities. Caribou density was the lowest in the Wellington strata and it appeared to show a separation between the western and eastern distributions of caribou along the southern coastline. However, the occurrence of heavily used trails around the northern periphery of Wellington Bay and the presence of small bands of caribou travelling these trails suggests that these eastern and western distributions are neither isolated nor distinct and there is likely substantial movement and interchange of caribou during the rut[4].

That we delineated a discrete distribution of Dolphin and Union caribou during the fall rut lends greater weight to the survey results as being representative of the entire migratory population. Since the staging of caribou

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[4] The location of Paleoeskimo (the first people to live year round in the Canadian Arctic) sites near Wellington Bay provide evidence of cooperative hunting where stone markers appear to have been used to funnel caribou toward a kill site (p. 6 in Condon and Ogina 1996). This points to the importance and past extent of this caribou migration.

along the coastline occurs during the rut, the composition of caribou is likely well representative of the population and there is no reason to suggest that any age / sex class would be under or over represented during this time of the year. Here again independent confirmation of these assertions is required in order to validate this survey method.

Characteristics of the fall migration to the mainland are in contrast to the spring migration when Dolphin and Union caribou return to Victoria Island and cross the sea ice from the adjacent mainland (see Manning 1960, Gunn *et al.* 1997). We suspect that the timing of the spring migration occurs over a longer period and may start as early as April and extend well in to June (depending on ice conditions). Typically, cows and yearlings precede the bulls in the spring migration to calving grounds on Victoria Island (Gunn *et al.* 1997, Nishi 2000, Nishi and Buckland 2000, Nishi unpublished data). In contrast, the fall migration consists of a representative mix of all age and sex classes crossing over to the mainland within a much shorter timeframe, where the caribou first cross over in mid to late October with the majority of animals on the adjacent mainland after 3-4 weeks (B. Patterson unpub. data). The unfrozen sea that lies between the southern coastline and the adjacent mainland acts as barrier to migrating caribou. And during the early freeze-up period, the open water and newly forming sea ice imparts a marked fencing effect on the caribou migration – essentially caribou cannot leave the southern coastline of Victoria Island until the sea ice has frozen sufficiently and until it does, the animals congregate and wait. This presents obvious advantages for survey design as relatively high densities of caribou are distributed within well-defined spatial boundaries.

Prior attempts to estimate the number of caribou on Victoria Island have been challenged by the vast areas and relatively low densities encountered on extensive surveys flown during the calving period or during late summer. The most recent surveys of the southern calving areas on Victoria Island flown by Gunn in 1987 and 1988 (Gunn and Fournier 2000), and Nishi and Buckland in 1994 (Nishi and Buckland 2000) were unable to delineate the entire calving distribution and generate a clear and defensible herd estimate. The overall densities observed on Wollaston Peninsula during those June surveys in the late 1980s and early 1990s were *ca.* 0.47 and 0.24 caribou / $km^2$ respectively. In their extensive survey of Victoria Island in August 1980, Jakimchuk and Carruthers (1980) observed caribou densities ranging from 0.01 – 0.13 caribou / $km^2$. In contrast, we observed an overall density of 4.41 and a range of 0.17 to 9.79 caribou / $km^2$ along the southern coast in late October 1997. Clearly, the clumped distribution of caribou during the fall rut presents a useful and biologically relevant opportunity to census this migratory population.

Although mean group size is conventionally reported in aerial surveys of ungulates, we think that typical group size is a more appropriate way of summarizing and comparing data on group sizes. Typical group size is an animal-centered measure that is considered more biologically relevant than mean group size because it better describes herding behaviour and the social environment experienced by the average individual (see Heard 1992 and Ruckstuhl and Festa-Bianchet 2001). Indeed our data showed that typical group size was a better correlate of caribou density than mean group size because the regression intercept of typical group size and stratum density passed through the origin. Also, since the distribution of observed group sizes clearly showed a non-normal distribution, the use of parametric descriptive statistics may be misleading because mean group size is greatly affected by the occurrence of single animal observations.

Although we contend that the survey results are a useful estimate for the migratory Dolphin and Union caribou herd, the critical assumption that a large majority of this migratory population stages along the southern coastline during freeze-up remains to be thoroughly tested. Though we argue that the assumption was reasonable given our information at the time, the survey technique should be repeated and validated by concomitant collection of additional data using satellite telemetry[5] on the timing and extent of migratory movements of Dolphin and Union caribou. The greatest potential source of error for accuracy of this survey technique is related to the timing of the fall migration and the possibility that an, as yet unknown and potentially variable proportion of the migratory herd, which may occur further north on Victoria Island during the fall rut and freeze-up period, move across to the mainland later in the winter.

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[5] In 1999, Nunavut Department of Sustainable Development initiated a multi-year study on the seasonal movements of Dolphin and Union caribou by deploying satellite collars on 25 adult cows (B. Patterson pers. comm., N. Griller pers. comm.).

**Management implications**

In addition to providing a potentially valid and repeatable technique for estimating abundance of the migratory Dolphin and Union caribou herd, we think these survey results highlight two important implications for management.

Firstly, the survey estimate does not ease ongoing concerns over the impact of current hunting levels on this migratory herd (see Gunn and Nishi 1998, Nishi and Buckland 2000, Gunn et al. 2000). Since the herd over-winters on the mainland, increased access by hunters from other communities including Kugluktuk (Coppermine), Umingmaktok (Bay Chimo), and Kingaok (Bathurst Inlet) contribute to the total harvest. With an extrapolated harvest of 2000-3000 caribou (based on the reported harvest from the Kitikmeot Harvest Study (Gunn *et al.* 1986), and the proportion of arctic island caribou reported in recent harvest studies (see Gunn and Nishi 1998), the current rate of harvest with respect to the October 1997 population estimate is high. Continued co-operative management efforts through the Kitikmeot Hunters and Trappers' Association and a conservative approach to managing harvest levels should be emphasised, along with a continued effort to collect information on the harvest of Dolphin and Union caribou and monitor herd trend.

Secondly, this survey demonstrates that timing and magnitude of the fall migration of Dolphin and Union caribou is an important and vulnerable aspect of their ecology because this population relies on formation of sea ice so that individual caribou can migrate to winter range on the mainland. Considering that the entire complement of caribou estimated during this survey was waiting to cross the sea ice, the fall migration imparts a potential vulnerability to this migratory herd through direct short-term impacts and indirect long-term effects.

A potential for increased mortality exists directly over the shorter term and may be triggered through behavioural disturbance of animals walking on thin ice (*i.e.,* harassment from snowmachines and/or low-flying aircraft) or physical disturbance of the newly forming sea ice (*i.e.,* ship traffic during the freeze-up period). Current drowning mortalities associated with this fall migration are likely a result of the caribou's strong instinctual drive to migrate to the mainland during the fall freeze-up period when sea ice is just forming. During early freeze-up, and depending on oceanographic and environmental conditions, such as ambient temperatures, ocean water temperature, salinity, and wind, sea ice conditions are likely marginal and highly variable in their ability to bear the weight of migrating caribou.

The timing and magnitude of the fall migration to the mainland imparts a potential vulnerability for longer-term indirect impacts on the Dolphin and Union herd. A mechanism for this long-term impact on the migration would be linked to the predicted impacts of climate warming (Wigley and Raper 2001) and its subsequent effects on the timing of formation and break-up of arctic sea ice (see Stirling *et al.* 1999, Stirling 2002). We suspect that a delay in timing of freeze-up rather than break-up would have the greater impact on Dolphin and Union caribou because a reduced rate of sea ice formation would prolong the period when caribou are walking over thin, weak ice thereby increasing the frequency of individual drownings. Since the spatio-temporal distribution of extreme events is often more ecologically important than changes in seasonal mean values (see Stenseth *et al.* 2002), we suggest that an increase in the variance of timing of freeze-up would likely have a greater impact on migrating caribou.

A delayed freeze-up in fall would also delay the caribou migration to the mainland and increase the time that animals stage along the southern coast of Victoria Island. Delay of the migration to the mainland may accelerate reduced fitness of the population over the longer-term because the migratory behaviour of caribou is tied to a strategy that allows the population to access better quality winter range (Miller 1990a) and possibly to ameliorate the impacts of grazing on vegetation. Consequently, disruption or delay of this fall caribou migration may magnify intra–specific competition for forage along the coastline and hasten impacts of grazing on plant communities.

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## PERSONAL COMMUNICATIONS

Angohiatok, G. Board Member, Ekaluktutiak HTO, Cambridge Bay, NU.

Atatahak, J. Hunter and owner of Outpost Camp at Read Island, Kugluktuk, NU.

Bolt, C. Hunter and owner of Outpost Camp at Nakayoktok (Ross Point), Kugluktuk, NU.

Griller, N. Regional Biologist (Former), Department of Sustainable Development, Government of Nunavut, Kitikmeot Region, Kugluktuk, NU.

Kaomayok, D. Renewable Resource Officer I (Retired), Department of Renewable Resources (now Nunavut Department of Sustainable Development), Kitikmeot Region, Cambridge Bay, NU.

Kuneyuna, J. Renewable Resource Officer (Former), Department of Sustainable Development, Government of Nunavut, Kitikmeot Region, Cambridge Bay, NU.

Patterson, B. Regional Biologist (Former), Department of Sustainable Development, Government of Nunavut, Kitikmeot Region, Kugluktuk, NU.

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**APPENDIX A.** Daily flight log during reconnaissance and systematic surveys of southern Victoria Island, 17–22 October 1997.

| Date | Purpose | Times | Hours flown |
|---|---|---|---|
| 17 October | Reconnaissance: YCB – Parker Bay – YCB | 1600h-1744h | 1.7 |
| 18 October | Reconnaissance: YCB – Ross Point | 0940h-1320h | 3.7 |
| | Ross Point – Lady Franklin Point – YCB | 1344h-1705h | 3.4 |
| 19 October | Ferry: YCB – ANDERSON | 0843h-0917h | 0.6 |
| | Systematic survey: | | |
| | ANDERSON North: 16–14, 11,10 and ANDERSON South: 16–1 | 0918h-1220h | 3.0 |
| | KITIGA: 11–1 | 1221h-1245h / 1305h-1429h | 1.8 |
| | WELLINGTON: 1–10 | 1430h-1542h | 1.2 |
| | BYRON: 19–10 | 1543h-1645h | 1.0 |
| | Ferry: BYRON – YCB | 1646h-1745h | 1.0 |
| 20 October | Ferry: YCB – BYRON | 0836h-0939h | 1.1 |
| | Systematic survey: BYRON: 13–1[a] | 0940h-1111h | 1.5 |
| | RICHARDSON: 14–1 | 1112h-1315h | 2.1 |
| | Ferry: RICHARDSON - Ross Point | 1316h-1330h | 0.2 |
| | Ferry: Ross Point – LADY FRANKLIN | 1355h-1359h | 0.1 |
| | Systematic survey: LADY FRANKLIN: 19–13 (odd- numbered transects only) | 1400h-1435h | 0.6 |
| | Ferry: LADY FRANKLIN – YCB | 1436h-1650h | 2.2 |
| 21 October | Ferry: YCB – YCO | 1300h-1602h | 3.0 |
| 22 October | Ferry: YCO – LADY FRANKLIN | 0958h-1049h | 0.9 |
| | Systematic survey: LADY FRANKLIN: 3,1 | 1050h-1124h | 0.6 |
| | READ: 10–6 | 1125h-1156h | 0.5 |
| | Ferry: READ – Lady Franklin Pt. | 1157h-1304h | 1.1 |
| | Systematic survey: LADY FRANKLIN: 5–11 (odd-numbered transects only) | 1315h-1335h | 0.3 |
| | Ferry: LADY FRANKLIN – Ross Pt. | 1336h-1355h | 0.3 |
| | Ferry: Ross Pt. – YCO | 1415h-1755h | 3.7 |
| TOTALS | 17 – 18 October 1997, Reconnaissance survey | | 8.8 |
| | 19 – 22 October 1997, Systematic survey: | | |
| | ANDERSON 3.0 | | |
| | KITIGA 1.8 | | |
| | WELLINGTON 1.2 | | |
| | BYRON 2.5 | | |
| | RICHARDSON 2.1 | | |
| | LADY FRANKLIN 1.5 | | |
| | READ 0.5 | | 12.6 |
| | Ferrying hours | | 14.2 |
| | TOTAL HOURS | | 35.6 |

[a] BYRON: transects 13 to 10 reflown

**APPENDIX B.** Daily weather conditions for aerial survey of Victoria Island, 17–22 October 1997.

| Date | Time (location) – wind[a]; visibility, cloud cover; temperature/dewpoint |
|---|---|
| 17 October | 16:00 (Cambridge Bay) – wind 310°@15kts; scattered cloud, broken cloud layer @ 2000'; temp -21°C |
| 18 October | 08:20 (Cambridge Bay) – wind 320°@15kts; visibility 6 statute miles, scattered cloud @ 1500', broken @ 2500'; over water/onshore - visibility 6 statute miles, occasionally 3-5 statute miles in light snow with risk of freezing drizzle, broken cloud @ 1000-2000'; temp -15°C/ dewpoint -18°C |
| 19 October | 08:45 (Cambridge Bay) – wind 340°@15kts; visibility 9 statute miles, clouds scattered @ 1500', broken @ 3700'; over water/on shore – visibility patchy 3-5 statute miles in light snow with risk of freezing drizzle, local stratus ceiling south, visibility south 5-8 statute miles over water, few clouds; temp -14°C/ dewpoint -16°C |
| | 10:38 (Cambridge Bay) – wind 350°@8kts; visibility 15 statute miles, clouds broken @ 700', 1600', 3600'; blowing snow at north end of ANDERSON North stratum |
| | 13:07 (Cambridge Bay) – wind 360°@<10kts; clear skies, excellent visibility |
| 20 October | 08:40 (Cambridge Bay) – wind 300°@16kts; visibility $6^+$ statute miles, broken cloud layer @ 1500-2500', overcast @ 4000'; temp -14°C/ dewpoint -16°C |
| | 09:43 (Cambridge Bay) – wind 310°@9kts; visibility 9 statute miles in light snow, overcast with broken layers at 900, 2900, 4600, 5800'; (Lady Franklin Wx Station) – wind 170°@8kts; visibility 9 statute miles |
| | 09:44 (tr#12 BYRON) – estimated visibility $5^+$ miles in light snow, overcast and patchy at 1000-1500' |
| 21 October | 13:00 – wind 100°@15kts; clouds broken @ 1500', scattered @ 3000' |
| 22 October | 10:00 (Kugluktuk) – wind 210°@5kts; overcast @ 3000'; temp -5°C; (Lady Franklin) – wind 180°@8kts; visibility 9 statute miles, clouds broken @ 1500 & 3800'; temp -1°C |

[a] We report windspeed in knots (kts), visibility in statute miles, and estimated ceiling heights to the nearest 1000 feet as these are the standard units and nomenclatures used by Transport Canada for their Aviation Routine Weather Report (METAR) and International Aerodrome Forecast (TAF).

**APPENDIX C.** Caribou observed on and off transect during a reconnaissance survey of southern Victoria Island, 17–18 October 1997.

| | | Left observer | | Right observer | | Total | |
|---|---|---|---|---|---|---|---|
| Date | Obs # | On transect | Off transect | On transect | Off transect | On transect | Off transect |
| 17-Oct-97 | 1 | | | 1 | | 1 | 0 |
| 17-Oct-97 | 2 | | | 2 | | 2 | 0 |
| 17-Oct-97 | 3 | | | 3 | | 3 | 0 |
| 17-Oct-97 | 4 | | 16 | 2 | | 2 | 16 |
| 17-Oct-97 | 5 | 16 | 30 | | 24 | 16 | 54 |
| 17-Oct-97 | 6 | | | 11 | | 11 | 0 |
| 17-Oct-97 | 7 | 10 | | | | 10 | 0 |
| 17-Oct-97 | 12 | | | 5 | | 5 | 0 |
| 17-Oct-97 | 13 | 3 | | | | 3 | 0 |
| 17-Oct-97 | 15 | | | | 16 | 0 | 16 |
| 17-Oct-97 | 16 | | | | 8 | 0 | 8 |
| 17-Oct-97 | 18 | 1 | 3 | | | 1 | 3 |
| 17-Oct-97 | 22 | | | | 5 | 0 | 5 |
| 17-Oct-97 | 24 | | | 25 | | 25 | 0 |
| 17-Oct-97 | 27 | 8 | | | | 8 | 0 |
| 17-Oct-97 | 30 | 1 | | | | 1 | 0 |
| 17-Oct-97 | 31 | 8 | | | | 8 | 0 |
| 17-Oct-97 | 31 | 3 | | | | 3 | 0 |
| 17-Oct-97 | 32 | 3 | | | | 3 | 0 |
| 17-Oct-97 | 32 | 27 | | | | 27 | 0 |
| 17-Oct-97 | 32 | 4 | 50 | 1 | | 5 | 50 |
| 17-Oct-97 | 33 | 25 | | | 36 | 25 | 36 |
| 17-Oct-97 | 33 | | | | 12 | 0 | 12 |
| 17-Oct-97 | 34 | 10 | | 8 | | 18 | 0 |
| 17-Oct-97 | 34 | | | 4 | | 4 | 0 |
| 17-Oct-97 | 34 | | | 27 | | 27 | 0 |
| 17-Oct-97 | 35 | 14 | | 70 | | 84 | 0 |
| 17-Oct-97 | 35 | 18 | | 30 | | 48 | 0 |
| 17-Oct-97 | 35 | | | 30 | | 30 | 0 |
| 17-Oct-97 | 35 | | | 1 | | 1 | 0 |
| 17-Oct-97 | 36 | 14 | | 30 | | 44 | 0 |
| 17-Oct-97 | 37 | 70 | | | 12 | 70 | 12 |
| 17-Oct-97 | 37 | 9 | | | | 9 | 0 |
| 17-Oct-97 | 37 | 32 | | | | 32 | 0 |
| 17-Oct-97 | 38 | | | 24 | 25 | 24 | 25 |
| 17-Oct-97 | 39 | 21 | | 3 | | 24 | 0 |
| 17-Oct-97 | 39 | 8 | | 4 | | 12 | 0 |
| 17-Oct-97 | 39 | 5 | | 1 | | 6 | 0 |
| 17-Oct-97 | 39 | 2 | | 3 | 100 | 5 | 100 |
| 17-Oct-97 | 40 | 3 | | 4 | | 7 | 0 |
| 17-Oct-97 | 41 | 6 | | 21 | | 27 | 0 |
| 17-Oct-97 | 41 | 3 | | 3 | 2 | 6 | 2 |
| 17-Oct-97 | 41 | 13 | | 20 | | 33 | 0 |
| 17-Oct-97 | 41 | 6 | | 50 | | 56 | 0 |
| 17-Oct-97 | 41 | 34 | 40 | 12 | | 46 | 40 |
| 17-Oct-97 | 42 | 1 | | 78 | | 79 | 0 |
| 17-Oct-97 | 42 | 16 | | 2 | 10 | 18 | 10 |

**Appendix C**. *continued*

| Date | Obs # | Left observer | | Right observer | | Total | |
|---|---|---|---|---|---|---|---|
| | | On transect | Off transect | On transect | Off transect | On transect | Off transect |
| 17-Oct-97 | 42 | 36 | | | | 36 | 0 |
| 17-Oct-97 | 42 | 3 | | | | 3 | 0 |
| 17-Oct-97 | 43 | | | | 20 | 0 | 20 |
| 17-Oct-97 | 44 | | | 2 | | 2 | 0 |
| 17-Oct-97 | 46 | | | | 8 | 0 | 8 |
| 17-Oct-97 | 47 | 8 | | | 2 | 8 | 2 |
| 17-Oct-97 | 47 | 10 | | | 13 | 10 | 13 |
| 17-Oct-97 | 48 | 11 | | 18 | | 29 | 0 |
| 17-Oct-97 | 49 | 2 | | | | 2 | 0 |
| 17-Oct-97 | 49 | 14 | | | 20 | 14 | 20 |
| 17-Oct-97 | 50 | 22 | | | | 22 | 0 |
| 17-Oct-97 | 50 | 11 | | | | 11 | 0 |
| 17-Oct-97 | 51 | 24 | | 8 | 10 | 32 | 10 |
| 17-Oct-97 | 52 | 54 | 18 | 1 | 1 | 55 | 19 |
| 17-Oct-97 | 53 | 60 | | 95 | 20 | 155 | 20 |
| 17-Oct-97 | 53 | 37 | | | | 37 | 0 |
| 17-Oct-97 | 54 | 170 | | 55 | | 225 | 0 |
| 17-Oct-97 | 54 | | | 40 | | 40 | 0 |
| 17-Oct-97 | 54 | | | 80 | | 80 | 0 |
| 17-Oct-97 | 54 | | | 11 | | 11 | 0 |
| 17-Oct-97 | 55 | 200 | | | | 200 | 0 |
| 17-Oct-97 | 56 | 120 | | 9 | 2 | 129 | 2 |
| 17-Oct-97 | 56 | 260 | | 9 | | 269 | 0 |
| 17-Oct-97 | 56 | | | 10 | | 10 | 0 |
| 17-Oct-97 | 56 | | | 600 | | 600 | 0 |
| 17-Oct-97 | 57 | 120 | | 100 | | 220 | 0 |
| 17-Oct-97 | 57 | 200 | | | | 200 | 0 |
| 17-Oct-97 | 58 | 500 | | 55 | | 555 | 0 |
| 17-Oct-97 | 58 | 100 | | 10 | | 110 | 0 |
| 17-Oct-97 | 59 | 16 | | 30 | | 46 | 0 |
| 17-Oct-97 | 59 | 40 | | 25 | | 65 | 0 |
| 17-Oct-97 | 59 | 150 | | 50 | | 200 | 0 |
| 17-Oct-97 | 60 | 200 | | 200 | | 400 | 0 |
| 17-Oct-97 | 60 | 20 | | | | 20 | 0 |
| 17-Oct-97 | 61 | 57 | | 90 | | 147 | 0 |
| 17-Oct-97 | 61 | 30 | | | | 30 | 0 |
| 17-Oct-97 | 62 | 10 | | 10 | | 20 | 0 |
| 17-Oct-97 | 62 | | | 5 | | 5 | 0 |
| 17-Oct-97 | 62 | | | 40 | | 40 | 0 |
| 17-Oct-97 | 62 | | | 40 | | 40 | 0 |
| 17-Oct-97 | 63 | 19 | | 10 | | 29 | 0 |
| 17-Oct-97 | 63 | 22 | | 2 | | 24 | 0 |
| 17-Oct-97 | 63 | 37 | | | | 37 | 0 |
| 17-Oct-97 | 63 | 10 | | | | 10 | 0 |
| 17-Oct-97 | 63 | 9 | | | | 9 | 0 |
| 17-Oct-97 | 64 | 5 | | 8 | | 13 | 0 |
| 17-Oct-97 | 64 | 2 | | 10 | | 12 | 0 |
| 17-Oct-97 | 64 | | | 10 | 5 | 10 | 5 |

**Appendix C**. *continued*

| Date | Obs # | Left observer | | Right observer | | Total | |
|---|---|---|---|---|---|---|---|
| | | On transect | Off transect | On transect | Off transect | On transect | Off transect |
| 18-Oct-97 | 70 | | | 12 | | 12 | 0 |
| 18-Oct-97 | 70 | | | 30 | | 30 | 0 |
| 18-Oct-97 | 71 | 10 | 20 | | 110 | 10 | 130 |
| 18-Oct-97 | 71 | 8 | | | | 8 | 0 |
| 18-Oct-97 | 71 | 16 | | | | 16 | 0 |
| 18-Oct-97 | 72 | 12 | | 6 | | 18 | 0 |
| 18-Oct-97 | 72 | | | 8 | | 8 | 0 |
| 18-Oct-97 | 72 | | | 1 | | 1 | 0 |
| 18-Oct-97 | 72 | | | 19 | | 19 | 0 |
| 18-Oct-97 | 72 | | | 8 | | 8 | 0 |
| 18-Oct-97 | 72 | | | 4 | | 4 | 0 |
| 18-Oct-97 | 73 | | | | | 0 | 0 |
| 18-Oct-97 | 73 | 16 | | | 25 | 16 | 25 |
| 18-Oct-97 | 74 | 100 | | 24 | | 124 | 0 |
| 18-Oct-97 | 74 | 4 | | 6 | | 10 | 0 |
| 18-Oct-97 | 74 | 35 | | 2 | | 37 | 0 |
| 18-Oct-97 | 74 | | | 1 | 15 | 1 | 15 |
| 18-Oct-97 | 74 | | | 26 | | 26 | 0 |
| 18-Oct-97 | 75 | 35 | | | 30 | 35 | 30 |
| 18-Oct-97 | 75 | 30 | | | 5 | 30 | 5 |
| 18-Oct-97 | 75 | 16 | | | | 16 | 0 |
| 18-Oct-97 | 75 | 5 | | | 25 | 5 | 25 |
| 18-Oct-97 | 75 | 16 | | | | 16 | 0 |
| 18-Oct-97 | 75 | 2 | | | | 2 | 0 |
| 18-Oct-97 | 76 | 11 | | 12 | | 23 | 0 |
| 18-Oct-97 | 76 | 15 | | 8 | | 23 | 0 |
| 18-Oct-97 | 76 | 15 | 20 | 32 | 25 | 47 | 45 |
| 18-Oct-97 | 76 | 1 | 17 | 7 | 15 | 8 | 32 |
| 18-Oct-97 | 76 | 1 | | | | 1 | 0 |
| 18-Oct-97 | 77 | 2 | | 1 | 20 | 3 | 20 |
| 18-Oct-97 | 77 | 6 | | | | 6 | 0 |
| 18-Oct-97 | 77 | 2 | | | | 2 | 0 |
| 18-Oct-97 | 77 | 10 | | | | 10 | 0 |
| 18-Oct-97 | 77 | 4 | | | | 4 | 0 |
| 18-Oct-97 | 77 | 21 | | | | 21 | 0 |
| 18-Oct-97 | 77 | 8 | | | | 8 | 0 |
| 18-Oct-97 | 77 | 16 | | | | 16 | 0 |
| 18-Oct-97 | 77 | 4 | | | | 4 | 0 |
| 18-Oct-97 | 78 | | | 2 | 10 | 2 | 10 |
| 18-Oct-97 | 78 | | | 7 | 19 | 7 | 19 |
| 18-Oct-97 | 78 | | | | 13 | 0 | 13 |
| 18-Oct-97 | 78 | | | | 4 | 0 | 4 |
| 18-Oct-97 | 79 | 1 | | 4 | 7 | 5 | 7 |
| 18-Oct-97 | 79 | 2 | | 3 | | 5 | 0 |
| 18-Oct-97 | 79 | 1 | | 15 | | 16 | 0 |
| 18-Oct-97 | 81 | | | | 9 | 0 | 9 |

**Appendix C**. *continued*

| | | Left observer | | Right observer | | Total | |
|---|---|---|---|---|---|---|---|
| Date | Obs # | On transect | Off transect | On transect | Off transect | On transect | Off transect |
| 18-Oct-97 | 82 | 9 | | 3 | 3 | 12 | 3 |
| 18-Oct-97 | 82 | 2 | | | | 2 | 0 |
| 18-Oct-97 | 84 | | | | 5 | 0 | 5 |
| 18-Oct-97 | 85 | | | 6 | | 6 | 0 |
| 18-Oct-97 | 85 | 5 | | 13 | | 18 | 0 |
| 18-Oct-97 | 86 | 6 | | | 16 | 6 | 16 |
| 18-Oct-97 | 86 | 1 | | | | 1 | 0 |
| 18-Oct-97 | 87 | | 14 | | | 0 | 14 |
| 18-Oct-97 | 88 | 8 | | | | 8 | 0 |
| 18-Oct-97 | 88 | 11 | | | | 11 | 0 |
| 18-Oct-97 | 89 | | 17 | | | 0 | 17 |
| 18-Oct-97 | 90 | 9 | 21 | | | 9 | 21 |
| 18-Oct-97 | 90 | 5 | | | | 5 | 0 |
| 18-Oct-97 | 91 | 10 | | 32 | | 42 | 0 |
| 18-Oct-97 | 91 | 8 | | 15 | | 23 | 0 |
| 18-Oct-97 | 92 | 22 | | | | 22 | 0 |
| 18-Oct-97 | 92 | 2 | | | | 2 | 0 |
| 18-Oct-97 | 93 | 18 | | | | 18 | 0 |
| 18-Oct-97 | 93 | 30 | | 1 | | 31 | 0 |
| 18-Oct-97 | 94 | 1 | 23 | | | 1 | 23 |
| 18-Oct-97 | 95 | 6 | | | | 6 | 0 |
| 18-Oct-97 | 95 | 5 | | | | 5 | 0 |
| 18-Oct-97 | 95 | 40 | | | | 40 | 0 |
| 18-Oct-97 | 96 | 5 | | | | 5 | 0 |
| 18-Oct-97 | 97 | 22 | | | | 22 | 0 |
| 18-Oct-97 | 98 | 32 | | | | 32 | 0 |
| 18-Oct-97 | 98 | 15 | | | | 15 | 0 |
| 18-Oct-97 | 98 | 2 | | | | 2 | 0 |
| 18-Oct-97 | 99 | 45 | | | 3 | 45 | 3 |
| 18-Oct-97 | 99 | 40 | | | | 40 | 0 |
| 18-Oct-97 | 99 | 40 | | | | 40 | 0 |
| 18-Oct-97 | 100 | | 25 | | | 0 | 25 |
| 18-Oct-97 | 101 | 90 | | | | 90 | 0 |
| 18-Oct-97 | 102 | 35 | | 50 | 10 | 85 | 10 |
| 18-Oct-97 | 102 | | | 5 | | 5 | 0 |
| 18-Oct-97 | 103 | 9 | | 19 | 11 | 28 | 11 |
| 18-Oct-97 | 103 | 12 | | 1 | | 13 | 0 |
| 18-Oct-97 | 103 | 6 | | | | 6 | 0 |
| 18-Oct-97 | 104 | 11 | | 35 | | 46 | 0 |
| 18-Oct-97 | 104 | 90 | | | | 90 | 0 |
| 18-Oct-97 | 104 | 70 | | | | 70 | 0 |
| 18-Oct-97 | 104 | 25 | | | | 25 | 0 |
| 18-Oct-97 | 105 | 10 | | | 35 | 10 | 35 |
| 18-Oct-97 | 105 | 44 | | | | 44 | 0 |
| 18-Oct-97 | 106 | 10 | | 6 | | 16 | 0 |
| 18-Oct-97 | 106 | 30 | | | | 30 | 0 |

**Appendix C**. *continued*

| | | Left observer | | Right observer | | Total | |
|---|---|---|---|---|---|---|---|
| Date | Obs # | On transect | Off transect | On transect | Off transect | On transect | Off transect |
| 18-Oct-97 | 107 | | | 6 | | 6 | 0 |
| 18-Oct-97 | 107 | | | | 2 | 0 | 2 |
| 18-Oct-97 | 107 | | | | 11 | 0 | 11 |
| 18-Oct-97 | 108 | 27 | | 5 | | 32 | 0 |
| 18-Oct-97 | 108 | 4 | | | | 4 | 0 |
| 18-Oct-97 | 109 | 10 | | 6 | 25 | 16 | 25 |
| 18-Oct-97 | 109 | 60 | | 8 | 13 | 68 | 13 |
| 18-Oct-97 | 109 | 45 | | 18 | | 63 | 0 |
| 18-Oct-97 | 109 | 35 | | | | 35 | 0 |
| 18-Oct-97 | 109 | 25 | | | | 25 | 0 |
| 18-Oct-97 | 109 | 25 | | | | 25 | 0 |
| 18-Oct-97 | 110 | 22 | | | | 22 | 0 |
| 18-Oct-97 | 110 | 30 | | | | 30 | 0 |
| 18-Oct-97 | 111 | 110 | | | 30 | 110 | 30 |
| 18-Oct-97 | 111 | 25 | | | | 25 | 0 |
| 18-Oct-97 | 111 | 6 | | | | 6 | 0 |
| 18-Oct-97 | 111 | 15 | | | | 15 | 0 |
| 18-Oct-97 | 112 | 18 | | 34 | 35 | 52 | 35 |
| 18-Oct-97 | 112 | 35 | | | 13 | 35 | 13 |
| 18-Oct-97 | 113 | 110 | | | 50 | 110 | 50 |
| 18-Oct-97 | 113 | 8 | | | | 8 | 0 |
| 18-Oct-97 | 113 | 20 | | | | 20 | 0 |
| 18-Oct-97 | 113 | 5 | | | | 5 | 0 |
| 18-Oct-97 | 114 | | | | 28 | 0 | 28 |
| 18-Oct-97 | 115 | | | 32 | | 32 | 0 |
| 18-Oct-97 | 116 | 10 | | 6 | 7 | 16 | 7 |
| 18-Oct-97 | 116 | | | 76 | | 76 | 0 |
| 18-Oct-97 | 117 | 15 | 9 | 17 | 15 | 32 | 24 |
| 18-Oct-97 | 117 | 2 | | 4 | | 6 | 0 |
| 18-Oct-97 | 117 | 5 | | 7 | | 12 | 0 |
| 18-Oct-97 | 117 | 23 | | | | 23 | 0 |
| 18-Oct-97 | 118 | 13 | | | | 13 | 0 |
| 18-Oct-97 | 119 | 250 | | 7 | 9 | 257 | 9 |
| 18-Oct-97 | 119 | 80 | | | | 80 | 0 |
| 18-Oct-97 | 119 | 35 | | | | 35 | 0 |
| 18-Oct-97 | 120 | 60 | | 10 | | 70 | 0 |
| 18-Oct-97 | 120 | 7 | | | 9 | 7 | 9 |
| 18-Oct-97 | 121 | 70 | | | 5 | 70 | 5 |
| 18-Oct-97 | 121 | 10 | | | | 10 | 0 |
| 18-Oct-97 | 121 | 12 | | | | 12 | 0 |
| 18-Oct-97 | 122 | 2 | | | | 2 | 0 |
| 18-Oct-97 | 122 | 3 | | | | 3 | 0 |
| 18-Oct-97 | 122 | 25 | | | | 25 | 0 |
| 18-Oct-97 | 123 | 4 | | | | 4 | 0 |
| 18-Oct-97 | 123 | 12 | | | | 12 | 0 |
| 18-Oct-97 | 123 | 7 | | | | 7 | 0 |
| 18-Oct-97 | 123 | 4 | | | | 4 | 0 |
| 18-Oct-97 | 123 | 20 | | | | 20 | 0 |

**Appendix C**. *continued*

| | | Left observer | | Right observer | | Total | |
|---|---|---|---|---|---|---|---|
| Date | Obs # | On transect | Off transect | On transect | Off transect | On transect | Off transect |
| 18-Oct-97 | 124 | 8 | | | 15 | 8 | 15 |
| 18-Oct-97 | 124 | | | | 15 | 0 | 15 |
| 18-Oct-97 | 125 | 3 | | | | 3 | 0 |
| 18-Oct-97 | 125 | 14 | | 1 | | 15 | 0 |
| 18-Oct-97 | 126 | 27 | | 4 | | 31 | 0 |
| 18-Oct-97 | 127 | 22 | | 6 | | 28 | 0 |
| 18-Oct-97 | 127 | 4 | | | | 4 | 0 |
| 18-Oct-97 | 127 | 14 | | | | 14 | 0 |
| 18-Oct-97 | 127 | 6 | | | | 6 | 0 |
| 18-Oct-97 | 128 | 35 | | | | 35 | 0 |
| 18-Oct-97 | 128 | 22 | | | | 22 | 0 |
| 18-Oct-97 | 128 | 9 | | | | 9 | 0 |
| 18-Oct-97 | 128 | 2 | | | | 2 | 0 |
| 18-Oct-97 | 129 | 18 | | | 21 | 18 | 21 |
| 18-Oct-97 | 129 | 9 | | | | 9 | 0 |
| 18-Oct-97 | 129 | 10 | | | | 10 | 0 |
| 18-Oct-97 | 129 | 12 | | | | 12 | 0 |
| 18-Oct-97 | 130 | 25 | | | | 25 | 0 |
| 18-Oct-97 | 130 | 46 | | | | 46 | 0 |
| 18-Oct-97 | 131 | 36 | | | | 36 | 0 |
| 18-Oct-97 | 131 | 19 | | | | 19 | 0 |
| 18-Oct-97 | 132 | 95 | | 12 | | 107 | 0 |
| 18-Oct-97 | 132 | 40 | | | | 40 | 0 |
| 18-Oct-97 | 132 | 29 | | | | 29 | 0 |
| 18-Oct-97 | 133 | 35 | | 2 | | 37 | 0 |
| 18-Oct-97 | 133 | 8 | | | | 8 | 0 |
| 18-Oct-97 | 134 | 6 | | | | 6 | 0 |
| 18-Oct-97 | 134 | 20 | | | | 20 | 0 |
| 18-Oct-97 | 135 | 10 | | | | 10 | 0 |
| 18-Oct-97 | 136 | 15 | | 4 | | 19 | 0 |
| 18-Oct-97 | 136 | 4 | | 8 | | 12 | 0 |
| 18-Oct-97 | 136 | 7 | | 17 | | 24 | 0 |
| 18-Oct-97 | 137 | 10 | | 16 | | 26 | 0 |
| 18-Oct-97 | 138 | 22 | | | | 22 | 0 |
| 18-Oct-97 | 138 | 10 | | | | 10 | 0 |
| 18-Oct-97 | 139 | 40 | | 70 | | 110 | 0 |
| 18-Oct-97 | 140 | | | | 17 | 0 | 17 |
| 18-Oct-97 | 141 | | | 60 | | 60 | 0 |
| 18-Oct-97 | 143 | | 120 | 14 | | 14 | 120 |
| 18-Oct-97 | 144 | | | 20 | | 20 | 0 |
| 18-Oct-97 | 145 | 5 | | 10 | | 15 | 0 |
| 18-Oct-97 | 146 | 10 | | | | 10 | 0 |
| 18-Oct-97 | 147 | 13 | | 4 | | 17 | 0 |
| 18-Oct-97 | 147 | 4 | | | | 4 | 0 |
| 18-Oct-97 | 147 | 70 | | | | 70 | 0 |
| 18-Oct-97 | 147 | 10 | | | | 10 | 0 |
| 18-Oct-97 | 148 | | | 8 | | 8 | 0 |

**Appendix C**. *continued*

| Date | Obs # | Left observer | | Right observer | | Total | |
|---|---|---|---|---|---|---|---|
| | | On transect | Off transect | On transect | Off transect | On transect | Off transect |
| 18-Oct-97 | 149 | 2 | | 11 | 10 | 13 | 10 |
| 18-Oct-97 | 149 | 6 | | 8 | | 14 | 0 |
| 18-Oct-97 | 150 | 50 | | 5 | | 55 | 0 |
| 18-Oct-97 | 150 | 12 | | 30 | 5 | 42 | 5 |
| 18-Oct-97 | 150 | 20 | | | | 20 | 0 |
| 18-Oct-97 | 150 | 10 | | | | 10 | 0 |
| 18-Oct-97 | 150 | 15 | | | | 15 | 0 |
| 18-Oct-97 | 151 | 10 | | 6 | | 16 | 0 |
| 18-Oct-97 | 152 | 15 | | 14 | | 29 | 0 |
| 18-Oct-97 | 153 | 25 | | 15 | | 40 | 0 |
| 18-Oct-97 | 154 | 3 | | 3 | | 6 | 0 |
| 18-Oct-97 | 155 | | | 3 | | 3 | 0 |
| 18-Oct-97 | 156 | 6 | | 6 | 48 | 12 | 48 |
| 18-Oct-97 | 156 | 20 | | 38 | | 58 | 0 |
| 18-Oct-97 | 156 | 30 | | | | 30 | 0 |
| 18-Oct-97 | 157 | 20 | | | | 20 | 0 |
| 18-Oct-97 | 158 | 20 | | | | 20 | 0 |
| 18-Oct-97 | 159 | 3 | | 9 | | 12 | 0 |
| 18-Oct-97 | 160 | 1 | | 1 | | 2 | 0 |
| 18-Oct-97 | 161 | 8 | | 8 | | 16 | 0 |
| 18-Oct-97 | 161 | 4 | | 3 | | 7 | 0 |
| 18-Oct-97 | 162 | 6 | | 8 | | 14 | 0 |
| 18-Oct-97 | 163 | 9 | | 8 | | 17 | 0 |
| 18-Oct-97 | 163 | 12 | | | | 12 | 0 |
| 18-Oct-97 | 163 | 3 | | | | 3 | 0 |
| 18-Oct-97 | 164 | 13 | | | | 13 | 0 |
| 18-Oct-97 | 165 | 20 | | | | 20 | 0 |
| 18-Oct-97 | 165 | 7 | | | | 7 | 0 |
| 18-Oct-97 | 166 | 8 | | | 3 | 8 | 3 |
| 18-Oct-97 | 166 | 24 | | | | 24 | 0 |
| 18-Oct-97 | 168 | 15 | | | | 15 | 0 |
| 18-Oct-97 | 169 | 10 | | 8 | | 18 | 0 |
| 18-Oct-97 | 170 | 30 | | | | 30 | 0 |
| 18-Oct-97 | 170 | 10 | | | | 10 | 0 |
| 18-Oct-97 | 171 | 15 | | | | 15 | 0 |
| 18-Oct-97 | 172 | | | 1 | | 1 | 0 |
| 18-Oct-97 | 173 | 13 | | | | 13 | 0 |
| 18-Oct-97 | 176 | 1 | | | | 1 | 0 |
| 18-Oct-97 | 176 | 32 | | | | 32 | 0 |
| 18-Oct-97 | 176 | 16 | | | | 16 | 0 |
| 18-Oct-97 | 176 | 8 | | | | 8 | 0 |
| 18-Oct-97 | 176 | 15 | | | | 15 | 0 |
| 18-Oct-97 | 177 | 14 | | 33 | | 47 | 0 |
| 18-Oct-97 | 177 | 33 | | | | 33 | 0 |
| 18-Oct-97 | 177 | 11 | | | | 11 | 0 |
| 18-Oct-97 | 179 | | | 3 | | 3 | 0 |
| 18-Oct-97 | 180 | 2 | | 2 | | 4 | 0 |
| 18-Oct-97 | 180 | 1 | | | | 1 | 0 |

**Appendix C**. *continued*

| Date | Obs # | Left observer | | Right observer | | Total | |
|---|---|---|---|---|---|---|---|
| | | On transect | Off transect | On transect | Off transect | On transect | Off transect |
| 18-Oct-97 | 183 | | 2 | | | 0 | 2 |
| 18-Oct-97 | 184 | 14 | | | | 14 | 0 |
| 18-Oct-97 | 187 | | 4 | | | 0 | 4 |
| 18-Oct-97 | 188 | | | 6 | | 6 | 0 |
| 18-Oct-97 | 192 | 30 | | 5 | | 35 | 0 |
| 18-Oct-97 | 192 | 20 | | | | 20 | 0 |
| 18-Oct-97 | 193 | | | 5 | | 5 | 0 |
| 18-Oct-97 | 193 | | | 17 | | 17 | 0 |
| 18-Oct-97 | 193 | | | 5 | | 5 | 0 |
| 18-Oct-97 | 194 | | | | 1 | 0 | 1 |
| 18-Oct-97 | 196 | | | 4 | | 4 | 0 |
| 18-Oct-97 | 198 | | | 10 | | 10 | 0 |
| 18-Oct-97 | 199 | 20 | | | 24 | 20 | 24 |
| 18-Oct-97 | 205 | 1 | | | | 1 | 0 |
| 18-Oct-97 | 207 | | 7 | | | 0 | 7 |
| 18-Oct-97 | 209 | 1 | | | | 1 | 0 |
| 18-Oct-97 | 211 | | 13 | | | 0 | 13 |
| 18-Oct-97 | 219 | | | 2 | | 2 | 0 |
| 18-Oct-97 | 220 | 1 | | | | 1 | 0 |
| 18-Oct-97 | 221 | 16 | | | | 16 | 0 |
| 18-Oct-97 | 252 | | | 1 | | 1 | 0 |
| 18-Oct-97 | 254 | | | 5 | | 5 | 0 |
| 18-Oct-97 | 255 | 4 | | | | 4 | 0 |
| **SUM** | | **7072** | **469** | **3307** | **1177** | **10379** | **1064** |

**APPENDIX D.** Caribou observed on transect during an aerial survey of southern Victoria Island, 19–22 October 1997.

**ANDERSON NORTH (19 October 1997)**

| Transect no. | Transect area ($km^2$) | No. of caribou observed on transect | | |
|---|---|---|---|---|
| | | Left observer | Right observer | Total |
| 1 | not flown | -- | -- | -- |
| 2 | not flown | -- | -- | -- |
| 3 | not flown | -- | -- | -- |
| 4 | not flown | -- | -- | -- |
| 5 | not flown | -- | -- | -- |
| 6 | not flown | -- | -- | -- |
| 7 | not flown | -- | -- | -- |
| 8 | not flown | -- | -- | -- |
| 9 | not flown | -- | -- | -- |
| 10 | 20 | 1 | 1 | 2 |
| 11 | 20.25 | 0 | 0 | 0 |
| 12 | not flown | -- | -- | -- |
| 13 | not flown | -- | -- | -- |
| 14 | 19.75 | 10 | 0 | 10 |
| 15 | 20.25 | 0 | 5 | 5 |
| 16 | 20.25 | 3 | 3 | 6 |
| **SUM** | **100.5** | **14** | **9** | **23** |

**Appendix D**. *continued*

**ANDERSON SOUTH (19 October 1997)**

| Transect no. | Transect area ($km^2$) | No. of caribou observed on transect | | |
|---|---|---|---|---|
| | | Left observer | Right observer | Total |
| 1 | 10.5 | 81 | 452 | 533 |
| 2 | 15 | 178 | 59 | 237 |
| 3 | 33 | 225 | 261 | 486 |
| 4 | 30.25 | 181 | 105 | 286 |
| 5 | 21 | 97 | 157 | 254 |
| 6 | 20 | 116 | 71 | 187 |
| 7 | 10.5 | 1 | 0 | 1 |
| 8 | 10 | 11 | 18 | 29 |
| 9 | 10 | 0 | 21 | 21 |
| 10 | 10 | 1 | 3 | 4 |
| 11 | 10 | 0 | 0 | 0 |
| 12 | 10 | 1 | 2 | 3 |
| 13 | 10 | 0 | 8 | 8 |
| 14 | 10 | 6 | 9 | 15 |
| 15 | 10 | 17 | 124 | 141 |
| 16 | 10 | 27 | 21 | 48 |
| **SUM** | **230.25** | **942** | **1311** | **2253** |

**KITIGA (19 October 1997)**

| Transect no. | Transect area ($km^2$) | No. of caribou observed on transect | | |
|---|---|---|---|---|
| | | Left observer | Right observer | Total |
| 1 | 9.75 | 15 | 2 | 17 |
| 2 | 12.5 | 33 | 65 | 98 |
| 3 | 10 | 32 | 2 | 34 |
| 4 | 10 | 45 | 26 | 71 |
| 5 | 10 | 52 | 23 | 75 |
| 6 | 10 | 0 | 18 | 18 |
| 7 | 10 | 60 | 159 | 219 |
| 8 | 10 | 0 | 49 | 49 |
| 9 | 10 | 88 | 0 | 88 |
| 10 | 10 | 25 | 0 | 25 |
| 11 | 10 | 0 | 2 | 2 |
| **SUM** | **112.25** | **350** | **346** | **696** |

**Appendix D**. *continued*

**WELLINGTON (19 October 1997)**

| Transect no. | Transect area ($km^2$) | No. of caribou observed on transect | | |
|---|---|---|---|---|
| | | Left observer | Right observer | Total |
| 1 | 10 | 0 | 0 | 0 |
| 2 | 10 | 0 | 0 | 0 |
| 3 | 10 | 0 | 0 | 0 |
| 4 | 10 | 0 | 0 | 0 |
| 5 | 10 | 0 | 0 | 0 |
| 6 | 10 | 0 | 0 | 0 |
| 7 | 10 | 6 | 0 | 6 |
| 8 | 10 | 0 | 0 | 0 |
| 9 | 20 | 0 | 0 | 0 |
| 10 | 20 | 14 | 0 | 14 |
| **SUM** | **120** | **20** | **0** | **20** |

**BYRON (19 and 20 October 1997)**

| Transect no. | Transect area ($km^2$) | No. of caribou observed on transect | | |
|---|---|---|---|---|
| | | Left observer | Right observer | Total |
| 1 | 10 | 15 | 4 | 19 |
| 2 | 10 | 17 | 7 | 24 |
| 3 | 10 | 3 | 15 | 18 |
| 4 | 10 | 9 | 45 | 54 |
| 5 | 10 | 1 | 9 | 10 |
| 6 | 10 | 19 | 6 | 25 |
| 7 | 10 | 38 | 7 | 45 |
| 8 | 10 | 5 | 0 | 5 |
| 9 | 10 | 32 | 38 | 70 |
| 10 | 10.5 | 5 | 24 | 29 |
| 11 | 10.25 | 5 | 10 | 15 |
| 12 | 10.5 | 19 | 14 | 33 |
| 13 | 10 | 13 | 40 | 53 |
| 14 | 10 | 0 | 0 | 0 |
| 15 | 10 | 26 | 17 | 43 |
| 16 | 10 | 95 | 45 | 140 |
| 17 | 10 | 110 | 140 | 250 |
| 18 | 10 | 0 | 0 | 0 |
| 19 | 10.25 | 0 | 0 | 0 |
| **SUM** | **191.5** | **412** | **421** | **833** |

**Appendix D**. *continued*

**RICHARDSON (20 October 1997)**

| Transect no. | Transect area ($km^2$) | No. of caribou observed on transect | | |
|---|---|---|---|---|
| | | Left observer | Right observer | Total |
| 1 | 11.25 | 11 | 1 | 12 |
| 2 | 18.5 | 39 | 85 | 124 |
| 3 | 19 | 89 | 114 | 203 |
| 4 | 16 | 178 | 161 | 339 |
| 5 | 17.25 | 3 | 61 | 64 |
| 6 | 10 | 12 | 0 | 12 |
| 7 | 10 | 32 | 5 | 37 |
| 8 | 10 | 14 | 6 | 20 |
| 9 | 10 | 55 | 9 | 64 |
| 10 | 10 | 71 | 54 | 125 |
| 11 | 10 | 22 | 2 | 24 |
| 12 | 10 | 1 | 0 | 1 |
| 13 | 10 | 6 | 0 | 6 |
| 14 | 10 | 12 | 22 | 34 |
| **SUM** | **172** | **545** | **520** | **1065** |

**LADY FRANKLIN (20–22 October 1997)**

| Transect no. | Transect area ($km^2$) | No. of caribou observed on transect | | |
|---|---|---|---|---|
| | | Left observer | Right observer | Total |
| 1 | 7.5 | 0 | 0 | 0 |
| 3 | 14.25 | 0 | 7 | 7 |
| 5 | 7.5 | 8 | 0 | 8 |
| 7 | 5.75 | 15 | 7 | 22 |
| 9 | 5.5 | 0 | 0 | 0 |
| 11 | 5.5 | 0 | 0 | 0 |
| 13 | 10 | 0 | 1 | 1 |
| 15 | 10 | 0 | 3 | 3 |
| 17 | 10 | 16 | 16 | 32 |
| 19 | 13.75 | 74 | 12 | 86 |
| **SUM** | **89.75** | **113** | **46** | **159** |

**Appendix D**. *continued*

**READ (22 October 1997)**

| Transect no. | Transect area ($km^2$) | No. of caribou observed on transect | | |
|---|---|---|---|---|
| | | Left observer | Right observer | Total |
| 6 | 5.5 | 0 | 3 | 3 |
| 7 | 5.75 | 0 | 0 | 0 |
| 8 | 5 | 0 | 6 | 6 |
| 9 | 5 | 0 | 2 | 2 |
| 10 | 9 | 27 | 0 | 27 |
| **SUM** | **89.75** | **27** | **11** | **38** |