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Aerial Surveys of Molting Long-tailed Ducks and Other Waterfowl in the Barrier Island-Lagoon Systems Between Spy Island and Brownlow Point, Alaska, 2001

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Aerial Surveys of Molting Long-tailed Ducks and Other Waterfowl in the Barrier Island-Lagoon Systems Between Spy Island and Brownlow Point, Alaska, 2001

by

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ABSTRACT

There is concern about declines in sea duck populations in western North America and Alaska. We collected aerial survey data for molting sea ducks and other waterfowl in central Alaskan Beaufort Sea barrier island-lagoon systems collected during July-August 2001. These data add to the 15 years of long-term monitoring data collected on the same survey transects over the 25-year period since 1977. Our study objectives were to determine current distribution and abundance of molting sea ducks and other waterfowl, and to compare current and historical numbers and distributions of long-tailed ducks (*Clangula hyemalis*) in the barrier island-lagoon system between Spy Island and Brownlow Point, Alaska. Three low-level aerial strip-transect surveys were conducted between 23 July-11 August 2001, covering 1986 linear km and 790 km^2. Long-tailed ducks comprised 78% of the avian fauna in July-August 2001. This is slightly lower than results since 1977 (80-98%) across this same survey area. Eiders, primarily common eiders (*Somateria mollissima v-nigrum*), were more abundant in the eastern lagoon system (west of the Arctic National wildlife Refuge; mean density ± standard error; 5.0 ± 2.13 eiders/km^2); while scoters, primarily surf scoters (*Melanitta perspicillata*), were more abundant in the western lagoon system (west of Prudhoe Bay; 1.8 ± 0.43 scoters/km^2). Geese and swans were most abundant along the mainland shoreline in the western lagoon (6.0 ± 2.04 geese/km^2) and on tundra transects south of the eastern lagoon (4.1 ± 2.28 geese/km^2). Gulls, primarily glaucous gulls (*Larus hyperboreus*), were more abundant in the western lagoon system (1.5 ± 0.78 gulls/km^2), compared to the eastern lagoon system (0.8 ± 0.61 gulls/km^2). During July-August 2001, density of long-tailed ducks was highest in the eastern lagoon system (18.5 ± 15.26 ducks/km^2), followed by Stefansson Sound (9.5 ± 6.93 ducks/km^2), the western lagoon system (8.1 ± 7.75 ducks/km^2), and tundra (0.1 ± 0.10 ducks/km^2). Throughout the survey area the total number of long-tailed ducks increased from 23 July (n = 8973) to 8 August (n = 14,736) and then decreased on 11 August 2001 (n = 3169). Mean density of long-tailed ducks within the entire survey area (combined western and eastern lagoons) during July and August declined from 1978-2001 (P = 0.018). Mean areal density declined for 9 of 16 western lagoon transects, 1 offshore, 4 barrier island, 2 lagoon, and 2 mainland, through the 3 summary time periods (1978-1984, 1989-1991, 1998-2001) between 1978 and 2001. In the eastern lagoon, mean long-tailed duck density decreased on 3 barrier island transects and 1 lagoon transect from 1989-1991 to 1998-2000, while density on 2 mainland shoreline transects increased.

Key Words: central Alaska Beaufort Sea, *Clangula hyemalis,* eider, glaucous gull, *Larus hyperboreus,* long-tailed duck, marine waterbirds, *Melanitta*, scoter, *Somateria*

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INTRODUCTION

Tens of thousands of molting/flightless waterfowl aggregate along the mainland and barrier island coastlines in the central Beaufort Sea, Alaska (Figures 1 and 2). Based on several decades of study, we know that these aggregations of molting/flightless waterfowl, primarily sea ducks and geese, are highly susceptible to disturbance, and to oil or fuel spills (Johnson and Richardson 1981; Johnson 1985, 1990; Johnson and Gazey 1992). Recently, concern has been expressed over the apparent decline in 10 of the 15 species of North American sea ducks (Elliot 1997, USFWS 1999). These include species that occur within the Spy Island to Brownlow Point barrier island-lagoon systems (Figures 1 and 2): long-tailed duck (*Clangula hyemalis*), common eider (*Somateria mollissima v-nigrum*), king eider (*Somateria spectabilis*), black scoter (*Melanitta nigra americana*), surf scoter (*Melanitta perspicillata*), and white-winged scoter (*Melanitta fusca deglandi*).

Long-tailed ducks (formerly called oldsquaw ducks) are the predominant species in central Alaskan Beaufort Sea lagoon systems, and therefore they were the focus for the development of a monitoring program that was designed to evaluate changes in abundance and distribution of marine waterfowl in relation to industrial development (Figure 1, Johnson and Gazey 1992). Currently, there is concern over reported declines in long-tailed duck populations in western North America, Alaska, and northwestern Canada (Hodges et al. 1996, Conant et al. 1997, Dickson and Gilchrist 2002, Mallek et al. 2002). Trend data for the long-tailed duck population nesting on the Arctic Coastal Plain, however, are conflicting. Larned et al. (1999:15) reported a slightly increasing trend in long-tailed ducks on the Arctic Coastal Plain of Alaska from 1992-1999. Other authors have reported stable long-tailed duck populations during the same period (Conant et al. 1997, Elliot 1997, Larned and Balogh 1997, USFWS 1999), whereas Mallek and King (2000) and Mallek et al. (2002) reported recent declines in the population.

In 1998-2001, BP Exploration (Alaska) Inc. (BPXA) and the Point Thomson Unit Owners (PTUO) funded LGL Alaska Research Associates, Inc. (LGL) to collect molting waterfowl distribution and abundance data (Noel et al. 1999, 2000, 2001) using methods developed and tested for this monitoring protocol (Johnson and Gazey 1992). BPXA and the PTUO have continued to fund LGL to monitor molting long-tailed ducks and other waterfowl using the Johnson and Gazey (1992) protocol to document activities that could disturb molting waterfowl and provide current distribution and abundance information for use in environmental assessments and environmental impact statements.

Business Rationale

Nesting populations of long-tailed ducks may be declining across the Arctic Coastal Plain of Alaska (Mallek et al. 2002), and in northwestern Canada (Dickson and Gilchrist 2002). This species is the most abundant molting waterfowl within the barrier island lagoons adjacent to oilfields in the Prudhoe Bay region and in areas of proposed coastal developments at Point Thomson. Waterfowl such as long-tailed ducks are susceptible to disturbance and petroleum spills during the molt when they are flightless. Development of new near shore (Northstar) and coastal oilfields (Badami and Point Thomson) increases the potential for disturbance from resource exploration and development activities and disturbance associated with wildlife research activities (Johnson et al. in prep.). Documenting and understanding how these activities affect distribution and abundance of long-tailed ducks is important for developing meaningful environmental assessments and impact statements.

Study Objectives

This report presents the results of molting long-tailed duck and other waterfowl monitoring surveys during July and August 2001 between Spy Island and Brownlow Point, Alaska. Aerial survey data for molting long-tailed ducks and other waterfowl in central Alaskan Beaufort Sea barrier island-lagoon systems collected during July-August 2001 add to the 15 years of long-term monitoring data collected over the 25-year period since 1977.

Objectives for the 2001 study were:

1. Document the distribution and abundance of molting long-tailed ducks and other waterfowl in the barrier island-lagoon systems between Spy Island and Brownlow Point, and on large lakes along an inland transect between Brownlow Point and the Shaviovik River, Alaska.

2. Compare current and historical numbers and distributions of long-tailed ducks in the barrier island-lagoon systems between Spy Island and Brownlow Point, Alaska.
3. Document the level of human activity during surveys in the barrier island-lagoon systems between Spy Island and Brownlow Point, Alaska.

METHODS

Survey methods and conditions adopted in this study were based on analyses that identified variables that influenced the numbers of long-tailed ducks recorded during low-level aerial surveys (Johnson 1990, Johnson and Gazey 1992). Three of five scheduled low-level aerial (fixed-wing aircraft) surveys were flown during the period 23 July – 11 August 2001 in the barrier island-lagoon systems from Spy Island in the west to Brownlow Point in the east (Figure 1, Table 1). Brownlow Point lies on the mainland just east of Flaxman Island (Figure 1). Sampling was balanced by surveying both the western and eastern lagoons on the same day. Four contiguous transects were surveyed within 4 habitat strata (offshore, barrier island, lagoon, mainland shoreline) in both the western and eastern lagoons (Figure 1). All habitats within a lagoon system were surveyed before continuing to the next lagoon system to reduce the time between sampling these transects, thereby minimizing the possibility of birds moving between transects. In addition to transects established by the monitoring protocol in the western and eastern lagoons (Johnson and Gazey 1992), barrier island and mainland shoreline habitats across Stefansson Sound, and large lakes on the tundra between the Staines River and the Shaviovik River were also surveyed (Figure 1).

The survey crew consisted of a pilot and two observers in a float equipped Cessna 206 fixed-wing aircraft (Figure 3); one observer sat in the right front seat and the other sat in the left rear seat. Survey altitude was approximately 45 m above ground level and ground speed approximately 180 km/h. Transect width was 400 m total: 200 m on each side of the aircraft. On-transect sightings were within 200 m from the aircraft, and off-transect sightings were more than 200 m from the aircraft. Observers were trained to estimate large numbers of birds in dense concentrations using the simulation program Counting Wildlife© v. 2.0 (1986, Wildlife Counts, Juneau, AK) and using poppy seed scatter trials (Johnson 1990, Johnson and Gazey 1992).

The survey period was focused on the peak of the male long-tailed duck flightless period from 15 July to 21 August, based on progression of the wing molt (Johnson and Richardson 1981, Johnson and Gazey 1992). Six to 8 replicate surveys at even intervals during this period were recommended (Johnson and Gazey 1992). Surveys were scheduled as late in the day as practical; as late as 1700 h Alaska Daylight Savings Time, because long-tailed ducks have been found to concentrate along the barrier islands in the late afternoon (Johnson and Richardson 1981; Johnson 1982, 1985). Surveys on days with high winds (>37 km/h, 20 kts) were delayed until winds, wave height, and chop diminished, thereby improving sightability of birds on the water (Johnson 1990, Johnson and Gazey 1992). Marginal survey conditions were when winds approached 37 km/h.

Tape recorders were used to record information about observed birds, mammals, habitats, and environmental conditions. Continuous audio-tape recordings were made which included information on transects, sightings, and 30-s intervals (time period) marked by an audio-intervalometer (timer). Variables recorded include: ***Transect*** - start time (h-min-s), general location, transect number, temperature, wind speed, wind direction, Beaufort Sea state, wave height, cloud cover, habitat type, stop time; ***Sighting*** - species, number, behavior, habitat type, human activity, on- or off-transect; ***Time period*** – time at "beep" sound, ice cover, wave height, glare on the water surface, wind speed, wind direction, any changes in any particular variable. A notebook computer equipped with a Global Positioning System (GPS) receiver coupled with mapping software was used to record the flight line on a map of the area at 1-s intervals during surveys. Observers synchronized their watches with the GPS satellite time, and these times (recorded for transects and time periods) were used to geo-reference the survey data.

Survey Conditions

General weather conditions in the study area were recorded during each survey and as broadcast by radio operators at the Deadhorse airport or at the Badami weather office. Wind speed and direction were assessed by a combination of water surface conditions and pilot observations. Temperatures were either recorded at altitude from the aircraft or from Deadhorse or Badami air-radio broadcast. Wind speed and direction greatly influence sightability and behavior of molting waterfowl (Johnson and Richardson 1981, Johnson 1990, Johnson and Gazey 1992). We attempted to limit survey days to those with winds <37 km/h (Table 1). Weather data recorded over this survey period by the National Oceanic and Atmospheric Administration (NOAA) station at West Dock is presented in Appendix A.

Data Summary and Analysis

Our unit of replication for summaries and analyses is the survey. For visual comparisons among regions, transects within regions were summed for each survey and mean values for the 3 replicate surveys during 2001 were computed with standard errors and standard deviations. To compare changes in the molting long-tailed duck population over time, we summed the number of long tailed ducks for transects in both the western and eastern lagoons for each survey and computed the mean values based on survey replicates for each year. We then completed simple linear regression to evaluate data for any trend over time (Zar 1974). To compare changes in long-tailed duck density over time for individual transects, we computed the mean and standard errors for long-tailed duck density during 3 time periods 1978-1984 (n = 6 to 15 surveys), 1989-1991 (n = 11 to 20 surveys), and 1998-2001 (n = 9 to 12 surveys) for transects in the western and eastern lagoons.

Habitat and behavior summaries were based on the number of sightings of each species. Sightings are based on flocks rather than individuals. Individuals within a flock behave similarly and respond to others within the flock, and therefore are not independent. Flocks consisting of 1 or many individuals were considered independent from one another.

RESULTS

Total survey effort was 1986 linear km (790.4 km^2, Table 2). Results are presented below as a general overview, followed by sections for taxonomic groupings. We rely on graphs, maps, and tables to illustrate relative abundances, distributions, and habitat associations. Graphics and tables are presented in the order cited, following the body of the report. Areal density maps for taxonomic groups are presented as the number of individuals per km^2 for on-transect data, plotted at the mid-point of each 30-s time period, for each transect. Data for all 3 surveys are presented on a series of 3 maps covering the survey area. Maps for each survey date in 2001 for long-tailed ducks are presented in Appendix B. Maps for other selected species are presented in Appendix C.

Overview

Long-tailed ducks dominated the avian fauna in 2001, both in terms of numbers of individuals and numbers of sightings (Table 3), which is consistent with results since 1977 (Figure 4, Table B1, Johnson and Gazey 1992). Long-tailed ducks dominated in the western lagoon, Stefansson Sound, and the eastern lagoon during 2001, ranging from 75-81% of the total number of individuals recorded (Figure 1, Tables 4-6).

Relative abundance among other avian groups differed among the 4 survey regions (western lagoon, Stefansson Sound, eastern lagoon, and tundra, Figure 1). Loons dominated in terms of number of sightings, while geese and swans dominated the number of individuals on tundra transects (Table 7). Relative abundance of gulls was highest in the western lagoon, but was highly variable (Figure 5). Eiders were more abundant in the eastern lagoon; while scoters were more abundant in the western lagoon (Figure 5). Geese and swans were most abundant in the western lagoon and tundra (Figure 5).

Long-tailed Duck

2001 Distribution and Abundance

Mean areal long-tailed duck density was highest in the eastern lagoon (18.5 ± 15.26 ducks/km^2), followed by Stefansson Sound (9.5 ± 6.93 ducks/km^2), the western lagoon (8.1 ± 7.75 ducks/km^2), and tundra (0.1 ± 0.10 ducks/km^2) for surveys in July and August 2001; although variability (ducks/km^2 ± standard error) was high (Figure 6). Throughout the survey area the total number of long-tailed ducks increased from 23 July-8 August (8973, 27.5 ± 3.02 individuals/flock to 14,736, 38.7 ± 3.56 individuals/flock) and decreased between 8 August-11 August 2001 (14,736, 38.7 ± 3.56 individuals/flock to 3,169, 21.2 ± 3.41 individuals/flock, Figure 7). In the western lagoon, long-tailed ducks were concentrated along the barrier islands and in the lagoon, with few long-tailed ducks along the mainland shoreline (Figure 8, Table 8).

Current and Historical Distribution and Abundance

The relatively low use of the mainland shoreline in the western lagoon in 2001 (Figure 8) is consistent with the distribution of long-tailed ducks observed in 2000 (Figure 9) and 1999 (Figure 10). In the eastern lagoon, long-tailed ducks were concentrated near Pole Island (Transect #133), Tigvariak Island (Transect #193), and along the mainland shoreline (Transect #190, Figure 11, Table 9). Long-tailed duck use of the mainland shoreline in the eastern lagoon in 2001 is consistent with distributions observed in 2000, 1999 and 1998 (Figures 12, 13, and 14). In Stefansson Sound, long-tailed ducks were concentrated in the lee of Cross Island and the McClure Islands in 2001 (Figure 15), similar to distributions in 2000 (Figure 16) and 1999 (Figure 17, Table 10). Distribution maps for each region by survey, showing long-tailed duck density by 30-s period and vessel traffic, are presented in Appendix B.

Long-tailed duck was the dominant species in the barrier island-lagoon systems between Spy Island and Brownlow Point during 2001 (Table 3), consistent with survey data since 1977 (Figure 4, Table B1). Mean areal density of long-tailed ducks within this survey area during July and August appears to have declined from 1978-2001, although time appears to explain only 38% of the variation in long-tailed duck density (Figure 18). This summary does not correct for factors which influence mean density such as the total number of km^2 surveyed, regions covered, or variability in survey conditions (Johnson and Gazey 1992, Johnson et al. in prep.).

The molting long-tailed duck population in Beaufort Sea lagoons from 15 July to 21 August is primarily composed of flightless males, as determined by wing measurements (Johnson and Richardson 1981, Johnson 1985). Mean long-tailed duck density among some transects in the western lagoon during this molt period shows a general decline from 1978-1984 to 1998-2001 (Figure 19). This trend is most pronounced for the barrier island transects at the western end of Simpson Lagoon (Figure 19). Mean areal density declined for 9 of 12 western lagoon transects (1 offshore, 4 barrier island, 2 lagoon, and 2 mainland) through the 3 summary time periods between 1978 and 2001 (Figure 19). In the eastern lagoon, mean long-tailed duck density decreased on 3 of 4 barrier island transects and 1 of 4 lagoon transects from 1989-1991 to 1998-2001, while mean long-tailed duck density on 2 of 4 mainland shoreline transects increased (Figure 20).

Loons

Although there was variability between individual surveys, loons were most abundant on tundra transects, followed by the western lagoon, Stefansson Sound, and eastern lagoon (Figure 5). The number of loons per survey by region ranged from >180 on 8 August (western lagoon) to <1 on 23 July (tundra) and 11 August (Stefansson Sound, Figure 21). Areal loon density was highest in the western lagoon on 8 August and was lowest in Stefansson Sound on 11 August (Figure 22). Pacific loons (*Gavia pacifica*) and red-throated loons (*Gavia stellata*) were the most common loon species, with the total density of Pacific loons more than twice that of red-throated loons in the survey area (Table 11). Loons were scattered throughout the survey area in low numbers (Figures 23-25). Pacific loons were the most widely distributed across habitat types with a higher proportion of sightings in lagoon, mainland shoreline, and barrier island shoreline habitats (Table 12). Red-throated loons occurred in the same habitats as Pacific loons, except the red-throated loons were not recorded in the tundra habitats surveyed (Table 12). Yellow-billed loons (*Gavia adamsii)* were the least common loon species, and occurred primarily along mainland shorelines and in lagoons (Table 12).

Seabirds

Gulls, primarily glaucous gulls (*Larus hyperboreus*), were the most common seabird within the survey area (Figure 26, Table 3-7).

Gulls

Gull abundance (both total numbers and density) decreased in the western and eastern lagoons from 23 July-8 August (Figures 26 and 27). The mean density of gulls in the western lagoon was nearly twice that of gulls in the eastern lagoon (Figure 5). Most glaucous gull sightings were along the barrier islands (55%), followed by the mainland shoreline (33%, Table 13). The greatest concentrations of gulls in the western lagoon occurred near Stump Island and Bertoncini Island (Figure 28). In the Stefansson Sound region, gulls were scattered throughout the barrier islands (Figure 29). In the eastern lagoon, gulls were concentrated on the shoreline of Mikkelson Bay (Figure 30). Three flocks with 49 Sabine's gulls (*Xema sabini*) were also recorded, with the largest flock (84% of individuals) offshore in the western lagoon.

Arctic Terns

Arctic terns (*Sterna paradisaea)* were not abundant in the survey area, but occurred most frequently in the Stefansson Sound and eastern lagoon (Figures 5 and 26, Tables 3-7). Arctic tern density was highest on 11 August in the Stefansson Sound region (Figure 31). Most sightings were adjacent to the barrier islands (Figures 32-34, Table 13).

Miscellaneous Seabirds

Two Pomarine Jaegers (*Stercoratius pomarinus*) were sighted on 8 August near the Shaviovik River (Figures C10 and C11). A common murre (*Uria aalge*) and a black guillemot (*Cepphus grylle*) were sighted on 11 August in the eastern lagoon and Stefansson Sound regions respectively (Figure C12, Tables 3-7).

Ducks

Eiders

Eiders were most abundant in the eastern lagoon and Stefansson Sound with highest numbers on 23 July in both areas (Figures 5, 35, and 36). Eider densities were higher in the eastern lagoon and Stefansson Sound than in the western lagoon or tundra regions (Figure 5). Density was highest in the eastern lagoon on 23 July and was lowest in the

tundra region on 11 August (Figure 36). Common eiders were the most abundant species in this group, comprising over 99% of eiders that were classified to species (Table 3). In the western lagoon, most eiders were scattered in small numbers along the barrier islands and in the lagoon with a few large groups offshore from Pingok and Bodfish islands and along the mainland on either side of Milne Point (Figure 37). In Stefansson Sound, eiders occurred south of Reindeer, Cross, Narwhal, and Jeanette islands (Figure 38). In the eastern lagoon large flocks of eiders occurred along the barrier islands and in the lagoons between the Stockton Islands and the Maguire Islands (Figure 39). Over half of common eider sightings (57%) were associated with the barrier islands (Table 14).

Scoters

Scoters, primarily surf scoters, were most abundant in the western lagoon, with the highest density on 8 August (Figures 5, 40, and 41; Tables 3-7). Over 75% of scoter sightings were on lagoon transects (Table 15). The largest flocks of scoters were in Simpson Lagoon (Figures 42 and 43).

Miscellaneous Ducks

Aside from scoters, eiders, and long-tailed ducks, only a few other duck species were recorded. Scaup (*Aythya spp.*) were recorded in the western lagoon, eastern lagoon, and tundra; northern pintails (*Anas acuta*) were recorded in the eastern lagoon; and a red-breasted merganser (*Mergus serrator*) was recorded in the eastern lagoon.

Geese and Swans

Within the survey area during 2001, geese and swans were most abundant along the mainland shoreline of the western lagoon and on tundra (Figure 5, 44, and 45; Table 16), with highest numbers on 8 August in the western lagoon (Figure 44). Goose and swan density was consistently higher in the western lagoon than in the eastern lagoon (Figures 5, 45-48, Table 4 and 6). Greater white-fronted goose (*Anser albifrons*) and black brant (*Branta bernicla*) were the most common species, occurring primarily along the coastline in the western lagoon (Figure 46, Tables 4 and 16). Lesser snow geese (*Chen caerulescens caerulescens*) and Canada geese (*Branta canadensis*) were the most common species in the eastern lagoon primarily on Tigvariak Island and in the Shaviovik River delta (Figure 48, Tables 6 and 16). A few tundra swans (*Cygnus columbianus*) were recorded on coastal tundra in the eastern and western lagoons, and on tundra transects (Figure 44, Table 16).

2001 Human Activity

Vessel traffic was highest on 8 August 2001 in the western lagoon region (Table B3). Vessel traffic was generally higher within the western lagoon than within the eastern lagoon, although vessel traffic was recorded throughout the survey area during 2001 (Figure 49, Table B3). Vessel sightings included small and medium sized boats, seismic boats, large ships, and small aircraft (Table B3). Human activity other than the established oilfield facilities included field camps at Cottle Island, Flaxman Island, and the Point Thomson #3 pad (Table B3). Other human activity sightings included fyke nets, bird capture nets, telemetry monitoring stations, people, and telemetry antennas (Table B3). On transect vessel traffic has remained generally higher in the western lagoon than in the eastern lagoon from 1999-2001, although there does not appear to be a similar pattern for human activity (Figure 49).

DISCUSSION

Long-tailed Duck Distribution and Abundance

Survey data for the central Beaufort Sea barrier island-lagoon systems collected during August 2001 supplement the 14 years of long-term monitoring data collected over the 25 year period since 1977. Based on the 2001 data, long-tailed ducks continue to be the most numerous birds in Beaufort Sea barrier island-lagoon systems, where they feed primarily on epibenthic organisms including mysids (*Mysis relicta* and *M. litoralis*) and amphipods (*Onisimus glacialis*) (Johnson 1982). During the flightless molt period from mid July to late August, male long-tailed ducks and some non-breeding females congregate in very large numbers in barrier island-lagoon systems such as Simpson Lagoon, Gwydyr Bay, and south of Flaxman Island. The highest densities of molting flocks generally concentrate immediately south of barrier island shorelines. Barrier islands provide protection from prevailing winds and rough water, provide easy access to roosting areas along leeward beaches, and are close to abundant prey resources in the lagoons (Johnson 1982).

Mean density of long-tailed ducks within the combined western and eastern lagoons during July and August appears to have declined from 1978-2001 (Figure 18, $y = -4.96x + 178$, $R^2 = 0.382$, $P = 0.018$), without correction for number of km^2 surveyed, regions covered, or variability in survey conditions. During periods of disturbance (aircraft, boat and humans) and rough water, Johnson (1982) found that long-tailed ducks responded by moving to a nearby

location that provided protection from wind and waves. Changes in distribution appeared to be primarily related to weather conditions rather than disturbance, but a decline in overall long-tailed duck numbers within the study area in 1981 (4000 to 2000) indicated that there was a general pattern of movement away from the sources of disturbance (Johnson 1982). This suggests that continuous vessel traffic and aircraft disturbance during molting may lead to displacement of long-tailed ducks. Development and expansion of the oilfields in the Prudhoe Bay region since 1977, with an assumed increase in nearshore traffic, may have contributed to the decreased density of long-tailed ducks within the western lagoon systems from 1977-1984 to 1998-2001 (Figure 19).

Since 1998, an assumed increase in vessel and aircraft traffic associated with development of the Badami oilfield, exploration in the Flaxman Island area, and intensive environmental studies may also have contributed to a decrease in density of long-tailed ducks on 3 of 4 barrier islands and an increase in density on 2 of 4 mainland shoreline transects from 1989-1991 to 1998-2001 (Figure 20). This may in part be a reflection of sampling intensity, survey timing, survey weather conditions, and the general decline in the Arctic Coastal Plain nesting population; but may also be related to increased disturbance within this lagoon system. A detailed analysis of these data, incorporating disturbance and other environmental variables known to influence the number of long-tailed ducks recorded during monitoring surveys, is beyond the scope of this presentation of our 2001 survey results. This analysis has recently been completed and the manuscript based on this analysis is in preparation (Johnson et al. in prep.).

Weather conditions influence the total number and distribution of long-tailed ducks recorded during our monitoring surveys (Johnson 1982, Johnson and Gazey 1992). Moderate to strong winds (20-37 km/h) directly influence sightability of birds on the water by increasing wave height and surface disturbance (Johnson and Gazey 1992). During periods of strong southwesterly winds, long-tailed ducks move toward the mainland coast and/or out of the lagoon through the inter-island passes to take shelter in the lee of the mainland coast or north of the barrier islands (Johnson and Richardson 1981).

Undisturbed molting long-tailed ducks typically cycle through a 24-h period of activity, with peak numbers resting and preening in the leeward nearshore and beach habitats during evening and early morning (Johnson 1982, 1985; Flint et al. 2001). During mid-day, long-tailed ducks typically move farther from shore into mid-lagoon habitats to feed (Johnson 1982, Flint et al. 2001). Although molting sea ducks have been found to spend more time in open water when disturbed intermittently by aircraft; time spent swimming and feeding, and population levels appeared to be unaffected (Gollop et al. 1974). Flint et al. (2001) conducted experimental boat disturbances but could not identify changes in location, changes in movement patterns, or changes in feeding frequency associated with these experimental disturbances. Poor resolution for radio triangulated locations, and behavioral differences between experimental and control areas were cited as reasons for an inability to measure a response to experimental disturbances (Flint et al. 2001). Johnson (1982) documented a breakdown in the 24-h activity cycle with disturbance and increased wind, although cyclic movements continued in an adjacent undisturbed sheltered area (Johnson 1982).

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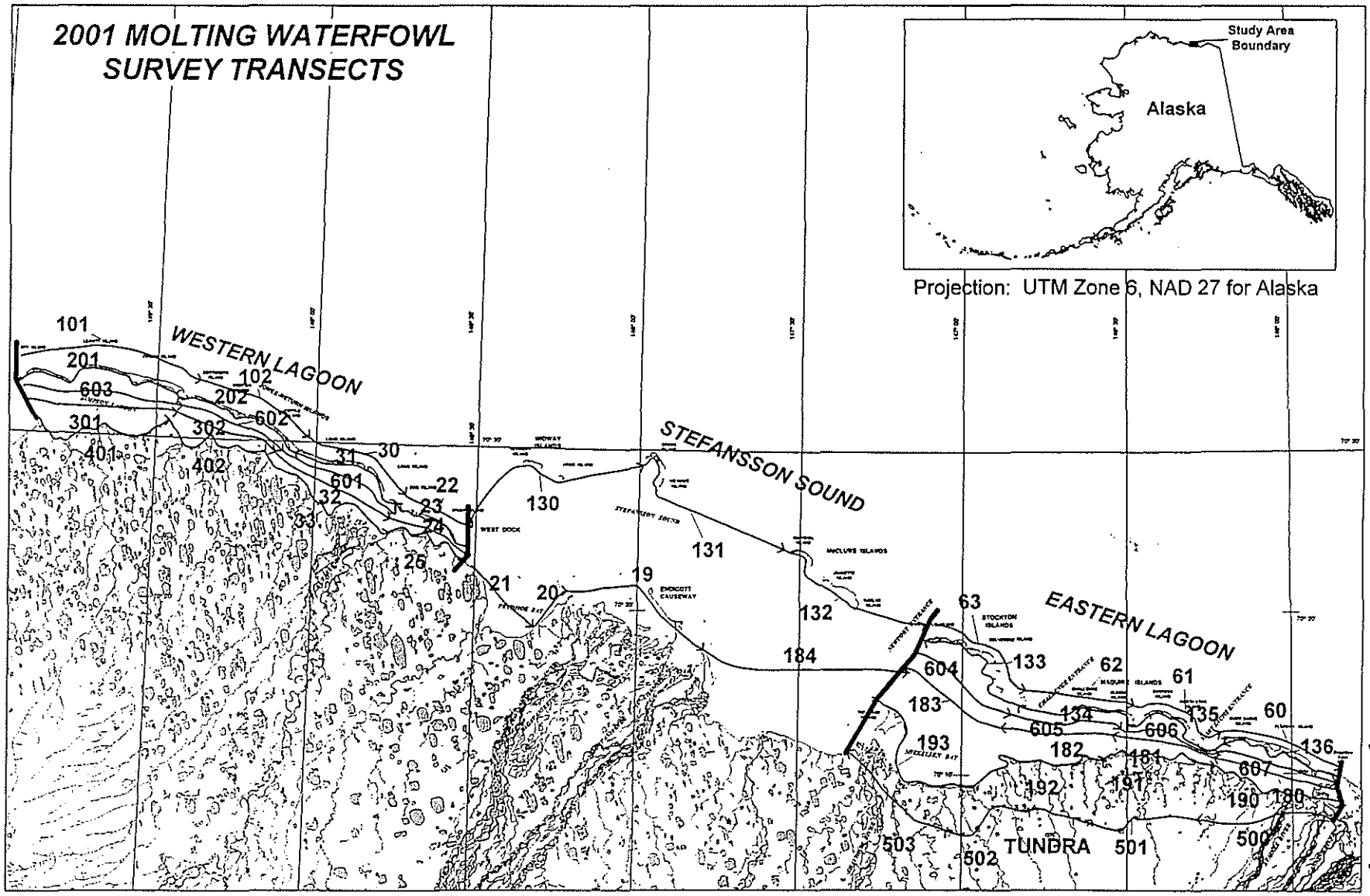


Figure 1. Locations and numbers for aerial survey transects and survey regions in the barrier island-lagoon systems between Spy Island and Brownlow Point, Alaska. Transect numbering is consistent with Johnson and Gazey (1992).

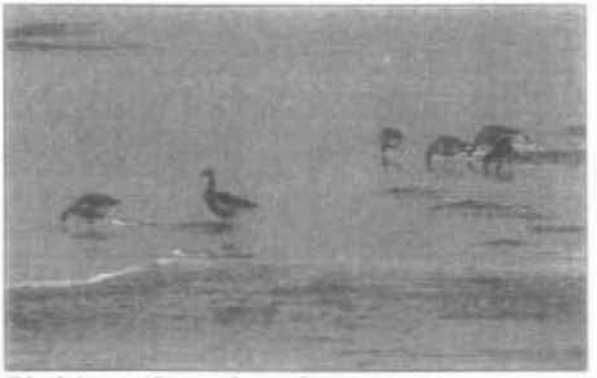
Male long-tailed duck (*Clangula hyemalis*).
Photo by John Warden

Pair of long-tailed ducks.
Photo BPXA file

Nesting female common eider (*Somateria mollissima v-nigrum*). *Photo by John Warden*

Pair of common eiders.
Photo by John Warden

Glaucous gull (*Larus hyperboreas*).
Photo by John Warden



Black brant (*Branta bernicla nigricans*).
Photo by Lynn Noel

Figure 2. Avian species occurring within the barrier island-lagoon systems between Spy Island and Brownlow Point, Alaska.

Photo by Lynn Noel

Survey aircraft; float-equipped Cessna 206.

Photo by Steve Johnson

Long-tailed duck molting habitat.

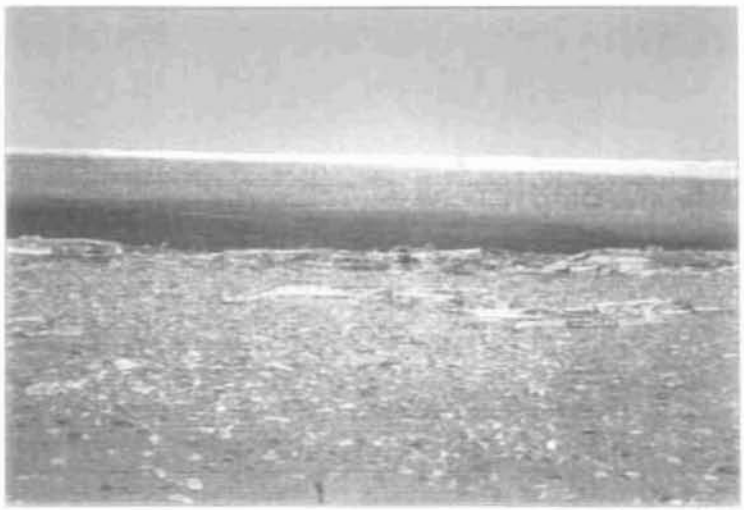


Photo by Lynn Noel

Common eider nesting habitat-Pole Island.

Figure 3. Survey aircraft and examples of habitats covered in the barrier island-lagoon systems between Spy Island and Brownlow Point, Alaska.

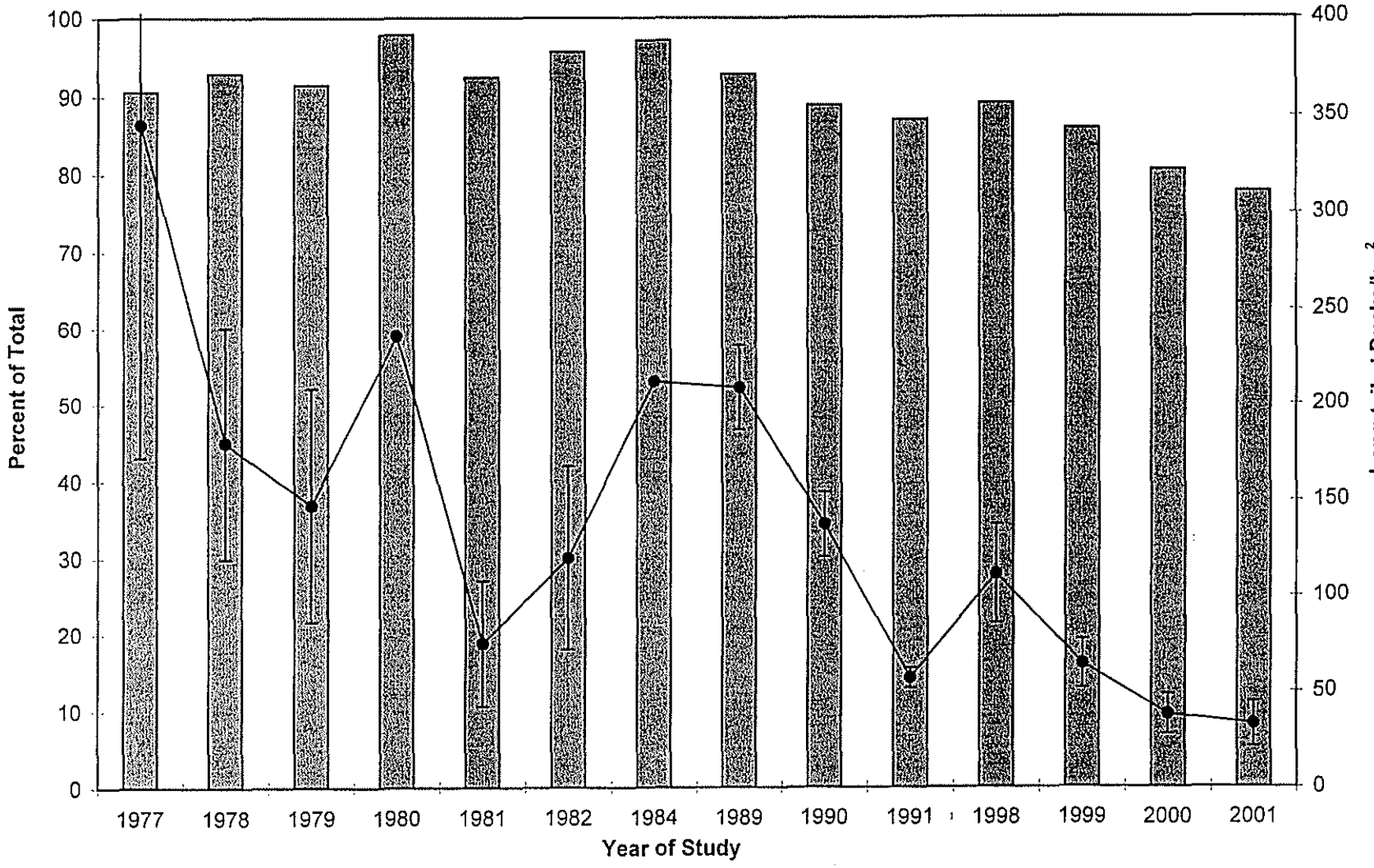


Figure 4. Long-tailed duck sightings as percentage of all bird sightings for aerial surveys with annual mean densities showing standard error in nearshore waters of the central Alaska Beaufort Sea, 1977-2001 (Table B1. Johnson and Gazey 1992; Noel et al. 1999, 2000, 2001).

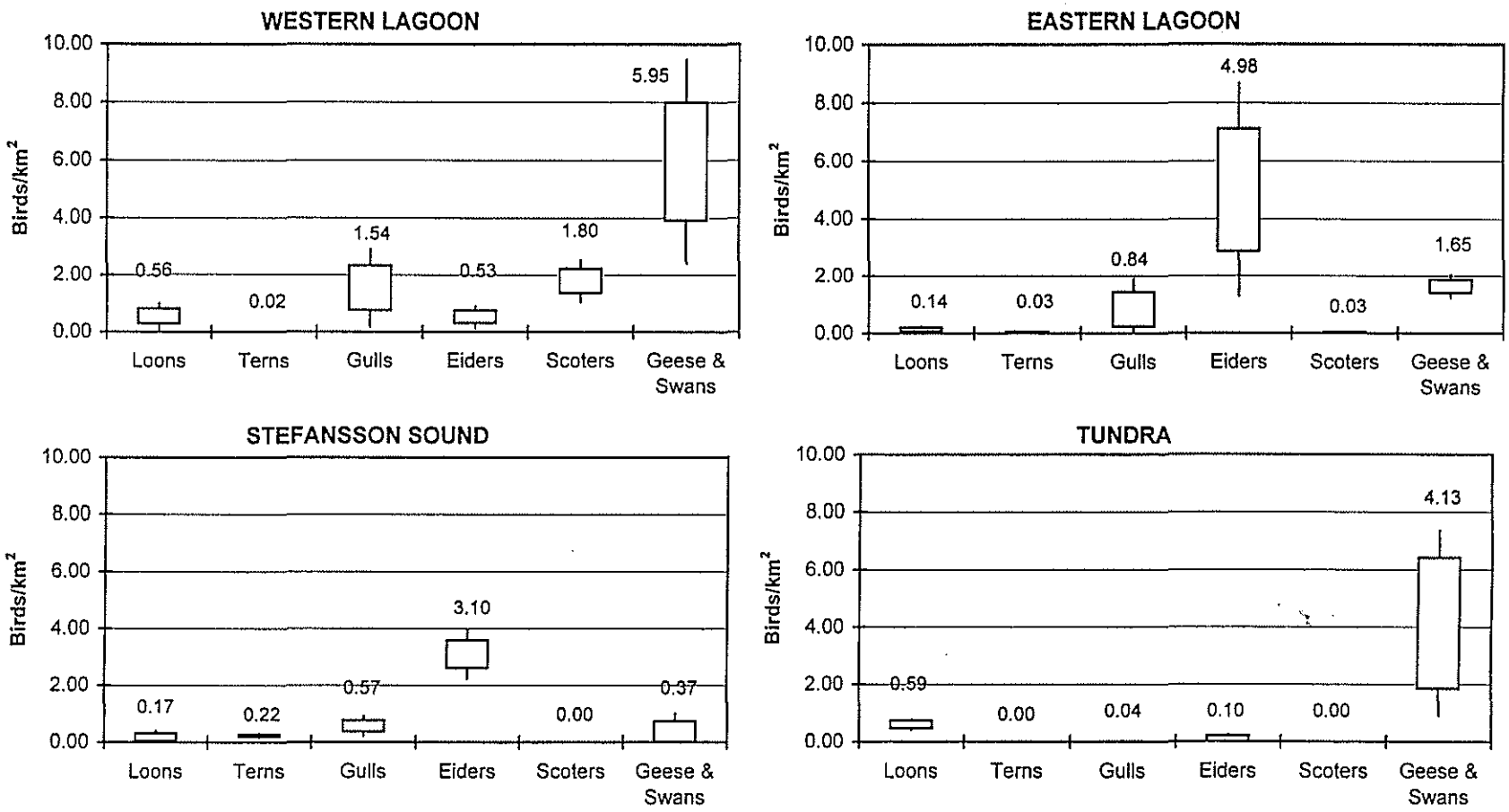


Figure 5. Mean with standard error bar and standard deviation line for areal density of avian groups among survey regions for 2 or 3 aerial survey replicates between Spy Island and Brownlow Point, Alaska, 23 July-11 August 2001. Western lagoon and Stefansson Sound regions were surveyed on 3 dates. Two mainland shoreline transects in the eastern lagoon and the tundra region were surveyed on 2 dates.

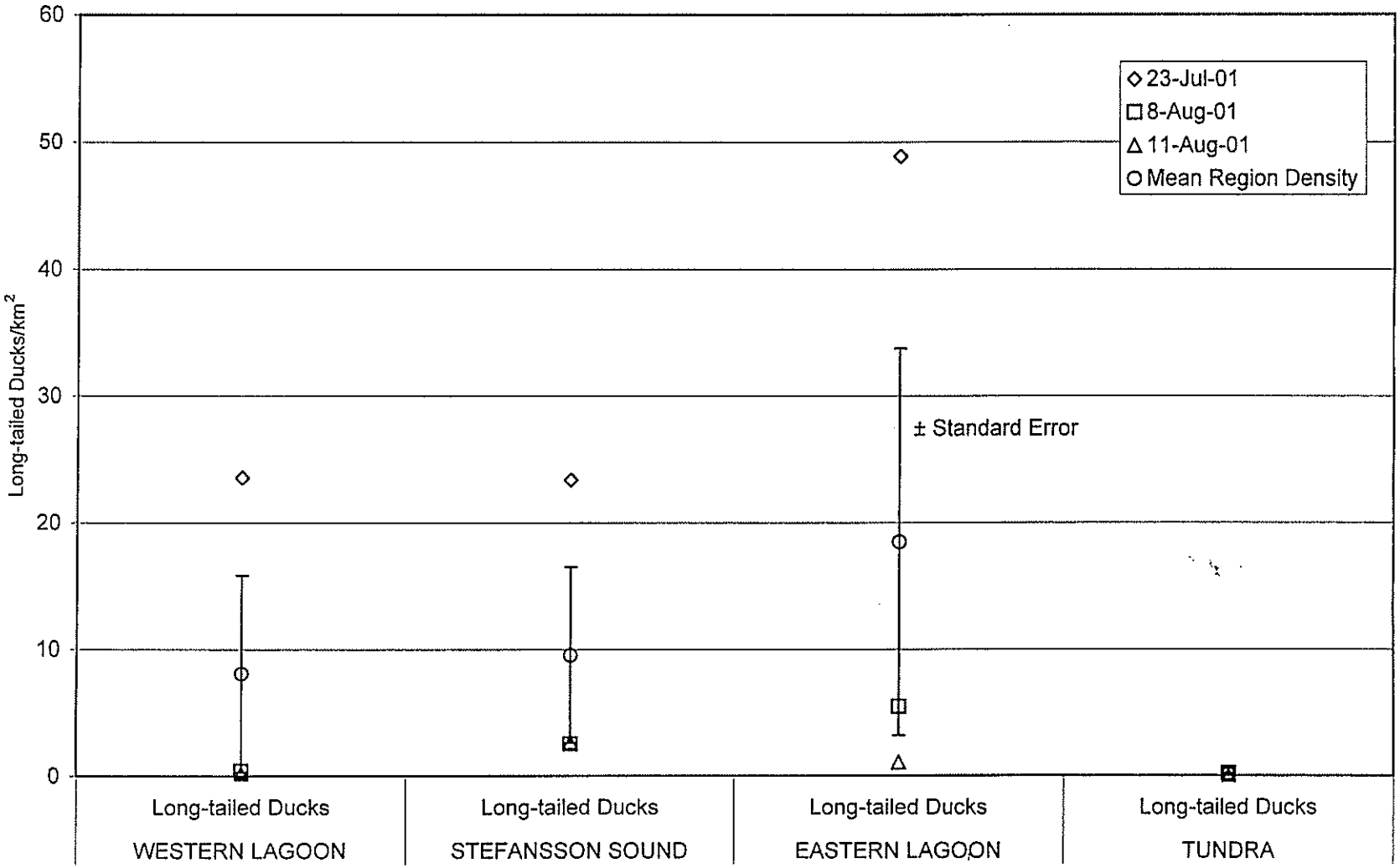


Figure 6. Areal density of long-tailed ducks for 3 aerial surveys during 23 July-11 August 2001, and mean areal density with standard error for all surveys by region between Spy Island and Brownlow Point, Alaska. On 23 July 2001, two mainland transects in the eastern lagoon and all tundra transects were not flown because of fog.

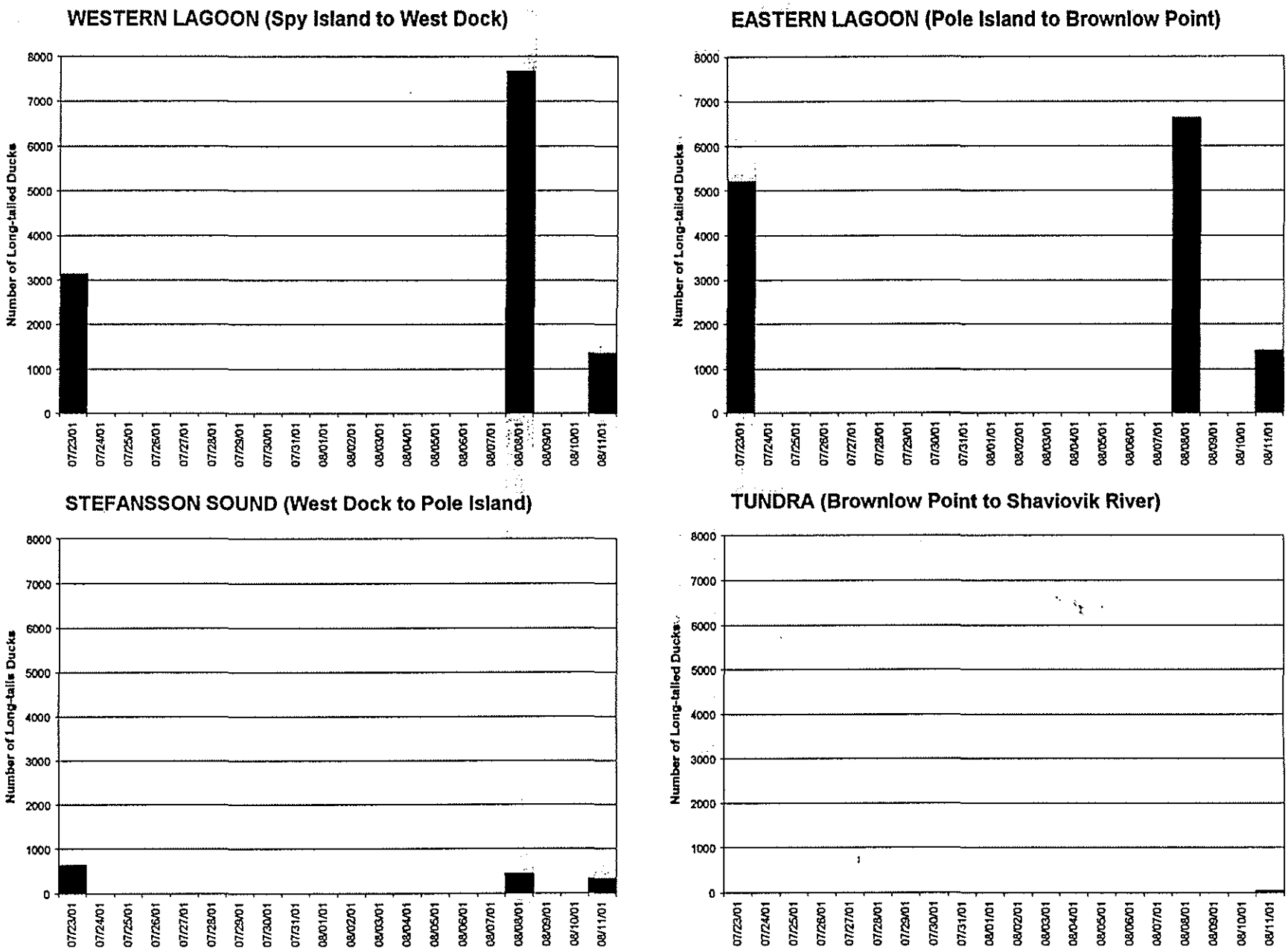


Figure 7. Total number of long-tailed ducks on- and off-transect during aerial surveys in the barrier island-lagoon systems between Spy Island and Brownlow Point, Alaska, 23 July – 11 August 2001. Surveys were flown on 23 July, 8 August and 11 August 2001.

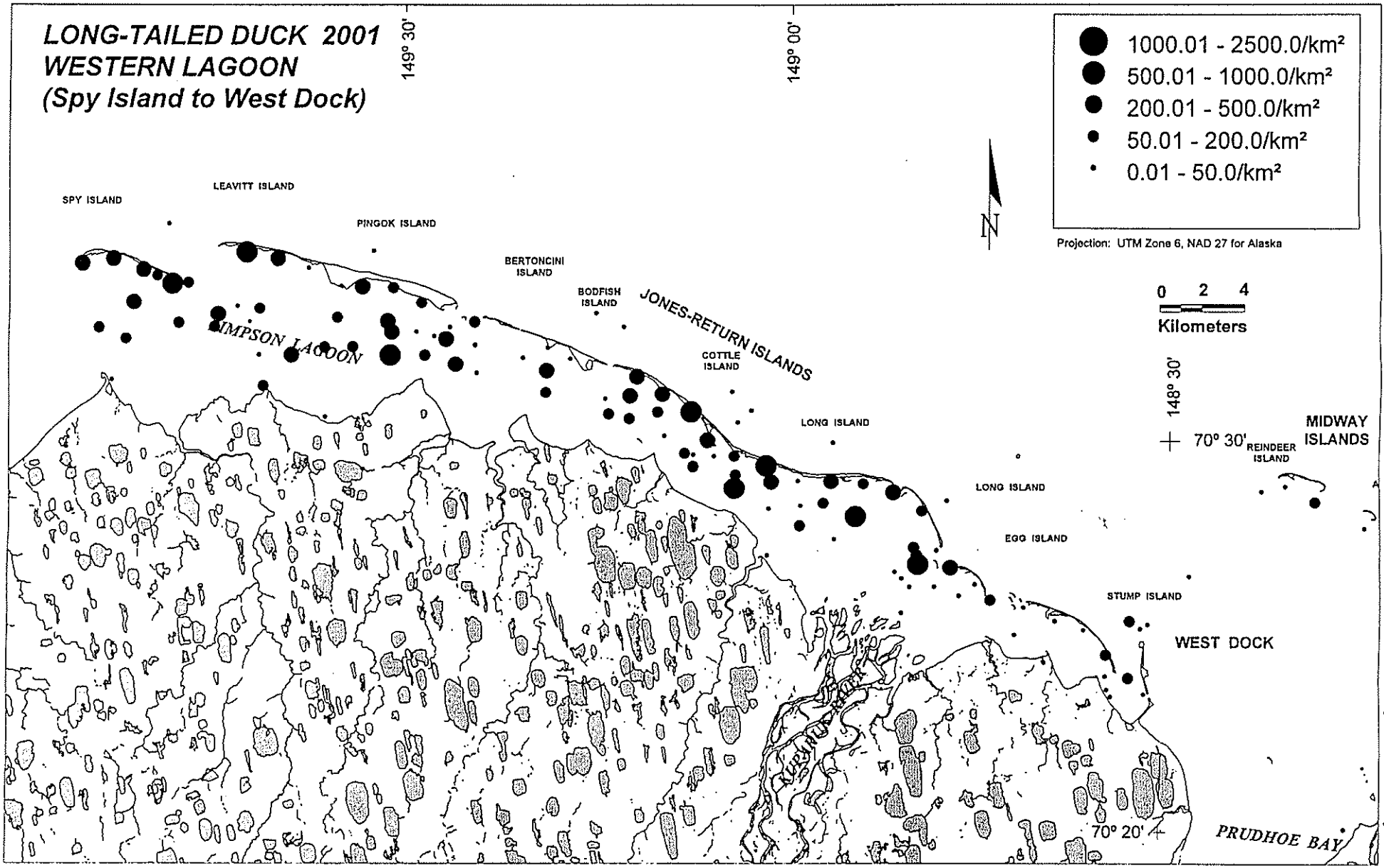


Figure 8. Summary of density for long-tailed ducks by 30-s time period segments in the barrier island-lagoon system between Spy Island and West Dock, Alaska, 23 July-11 August 2001.

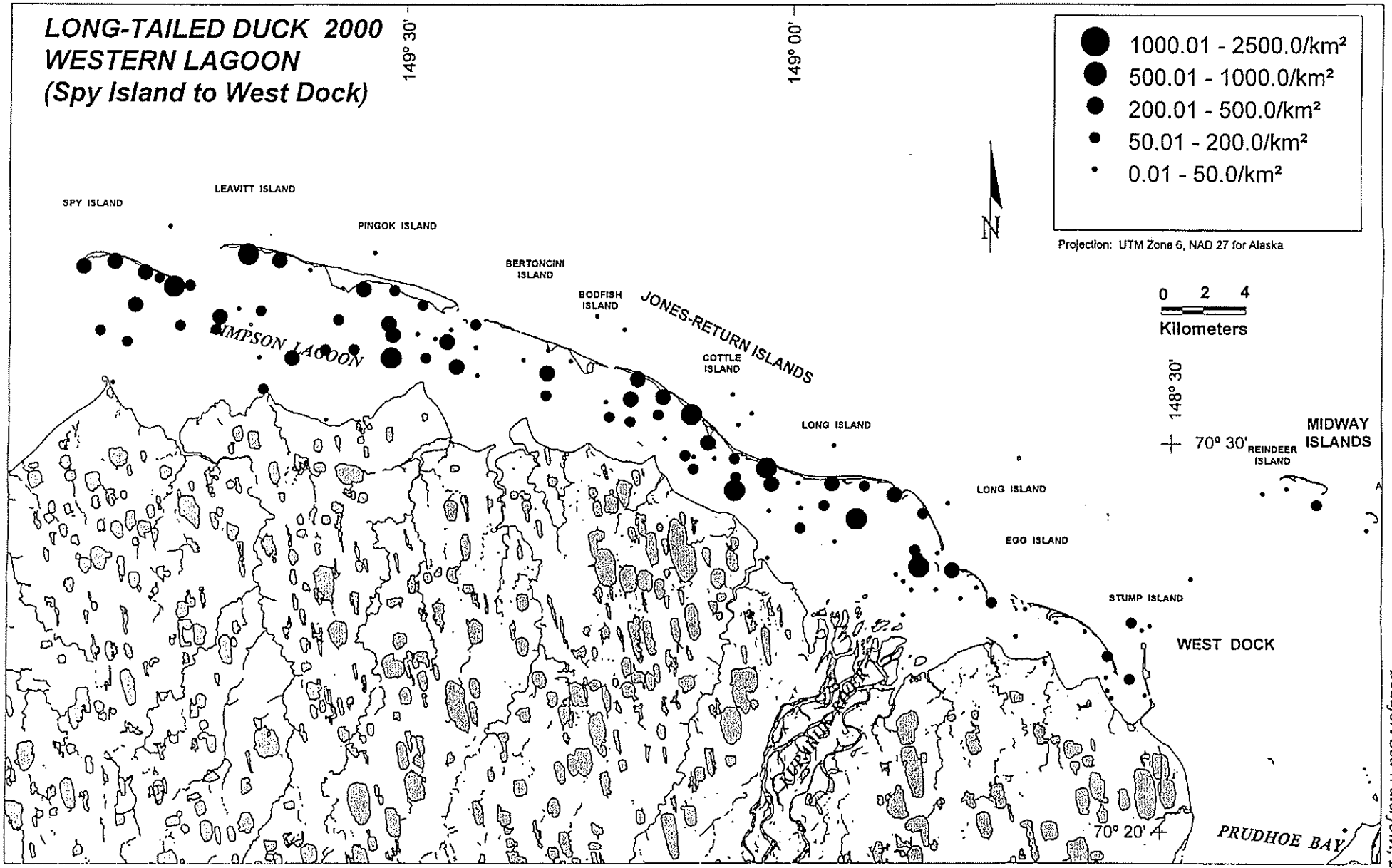


Figure 9. Summary of density for long-tailed ducks by 30-s time period segments in the barrier island-lagoon system between Spy Island and West Dock, Alaska, 1-24 August 2000.

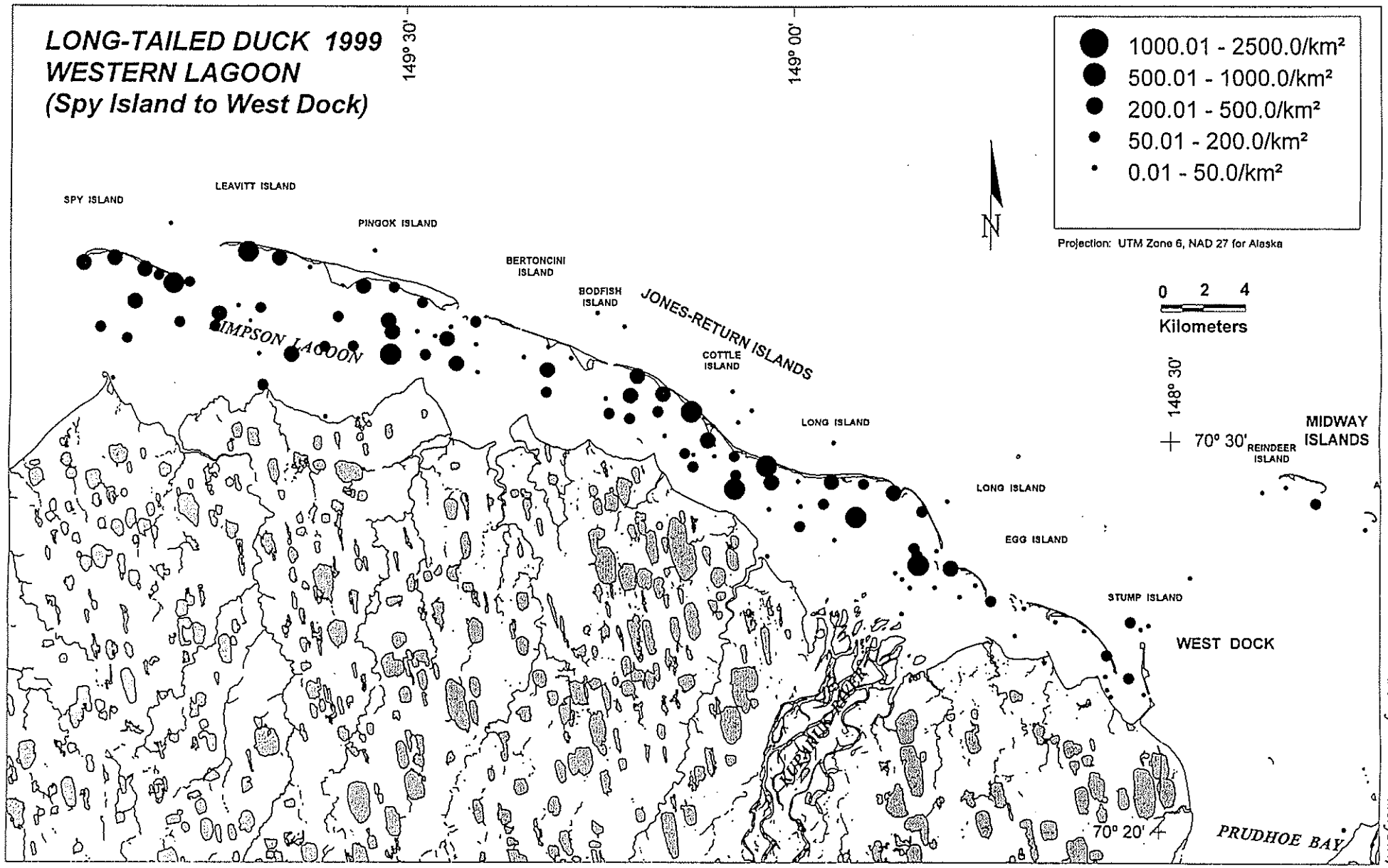


Figure 10. Summary of density for long-tailed ducks by 30-s time period segments in the barrier island-lagoon system between Spy Island and West Dock, Alaska, 30 July-26 August 1999.

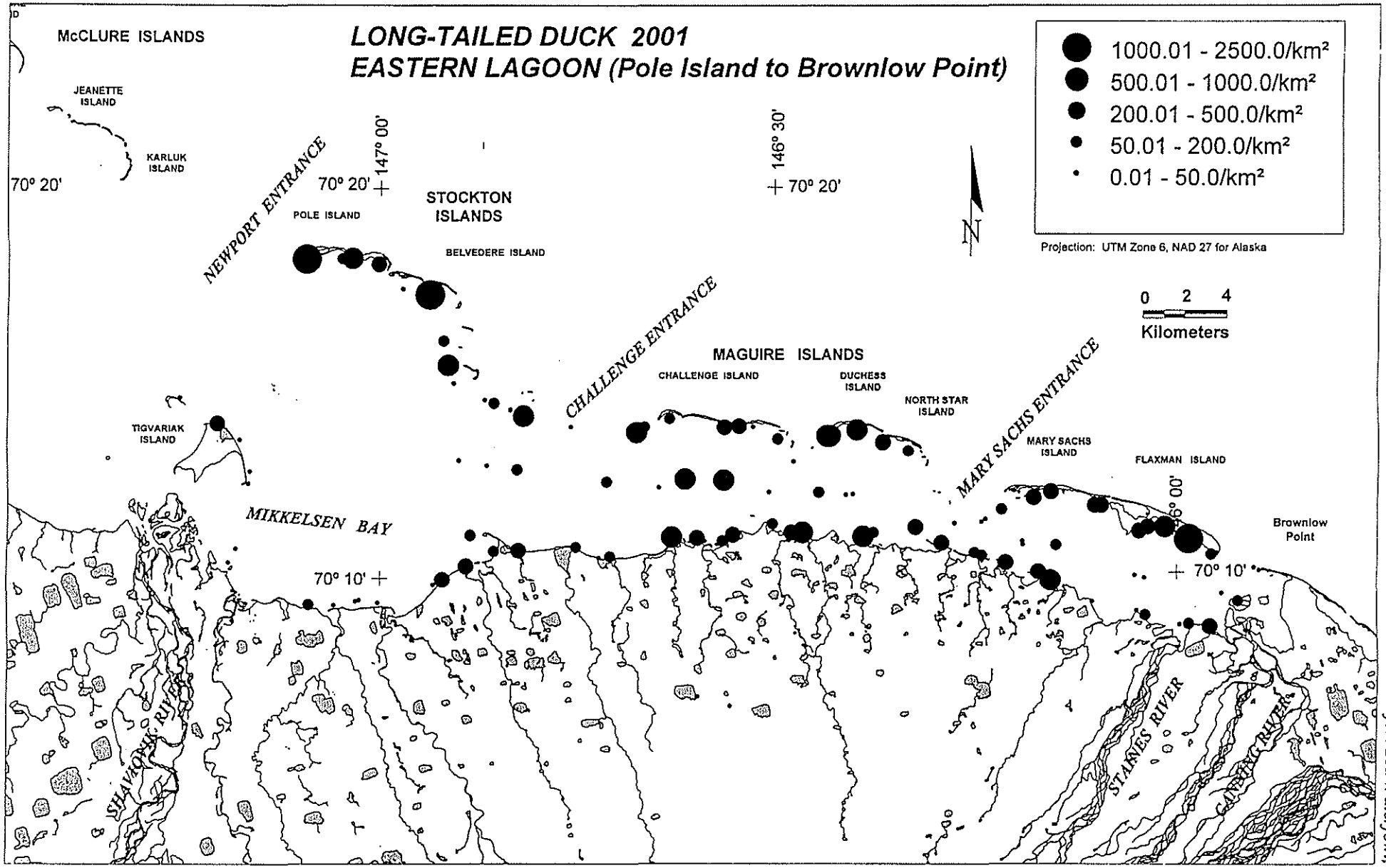


Figure 11. Summary of density for long-tailed ducks by 30-s time period segments in the barrier island-lagoon system between Pole Island and Brownlow Point, Alaska, 23 July-11 August 2001.

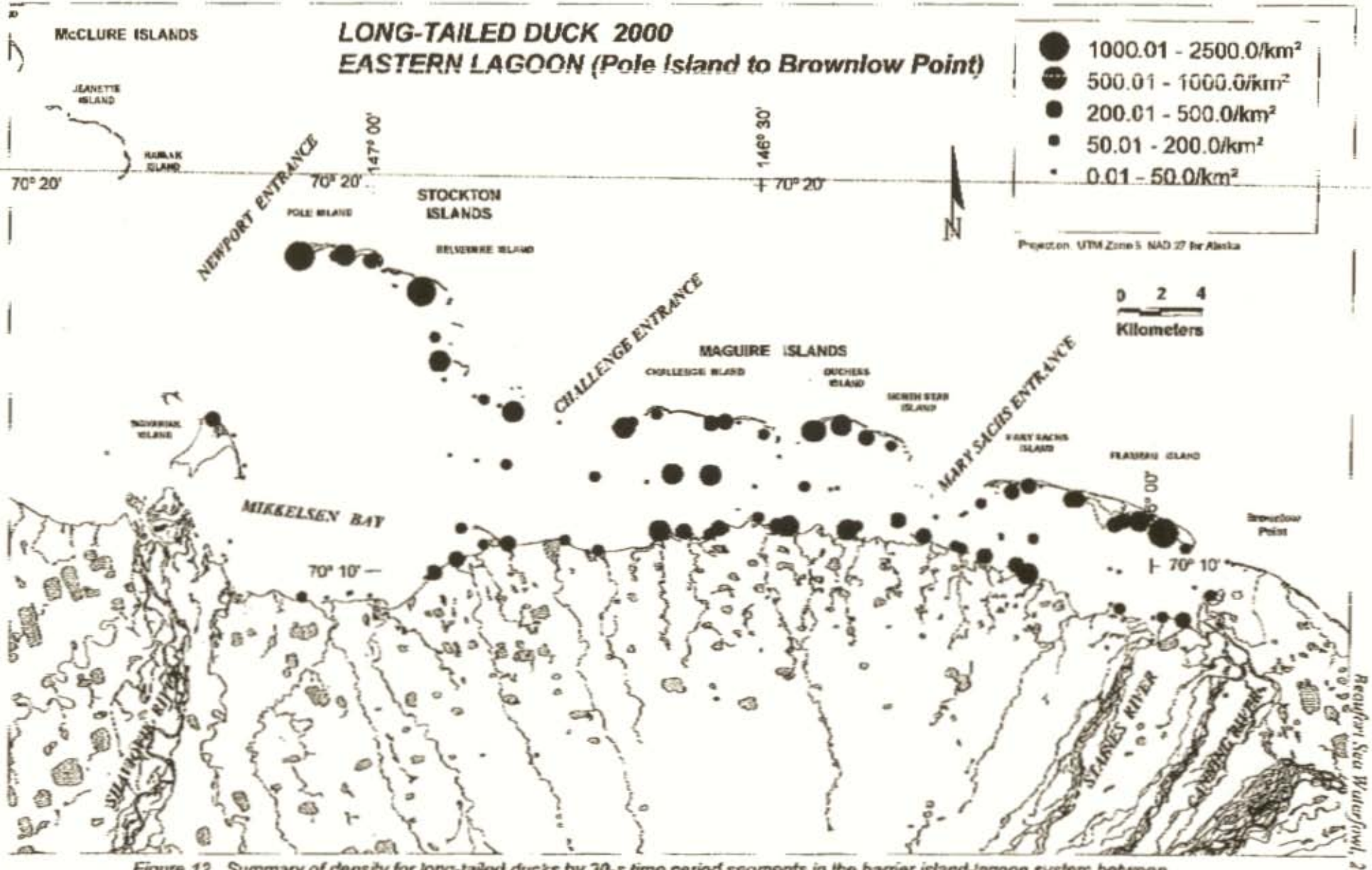


Figure 12. Summary of density for long-tailed ducks by 30-s time period segments in the barrier island-lagoon system between Pole Island and Brownlow Point, Alaska, 1-24 August 2000.

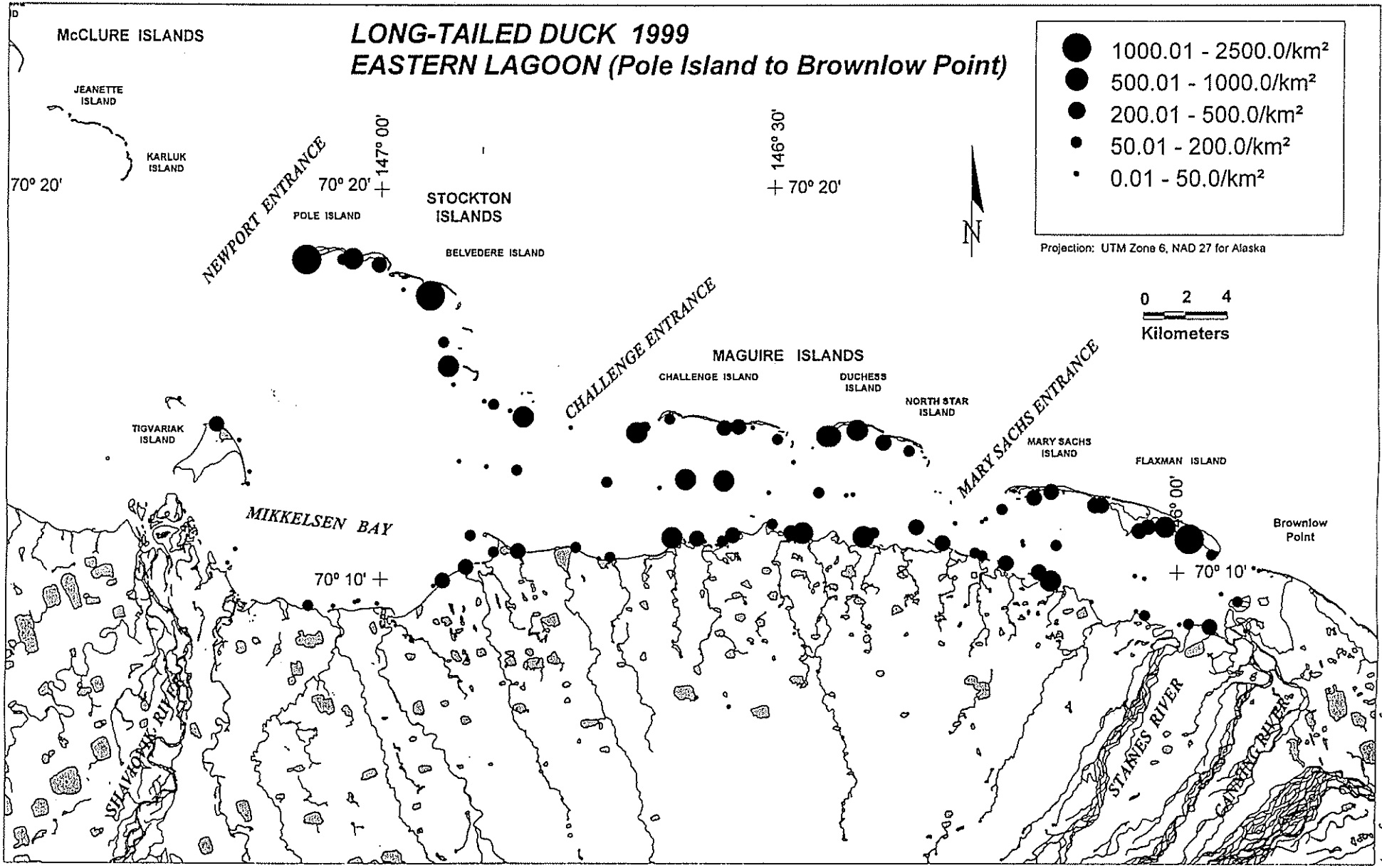


Figure 13. Summary of density for long-tailed ducks by 30-s time period segments in the barrier island-lagoon system between Pole Island and Brownlow Point, Alaska, 30 July-26 August 1999.

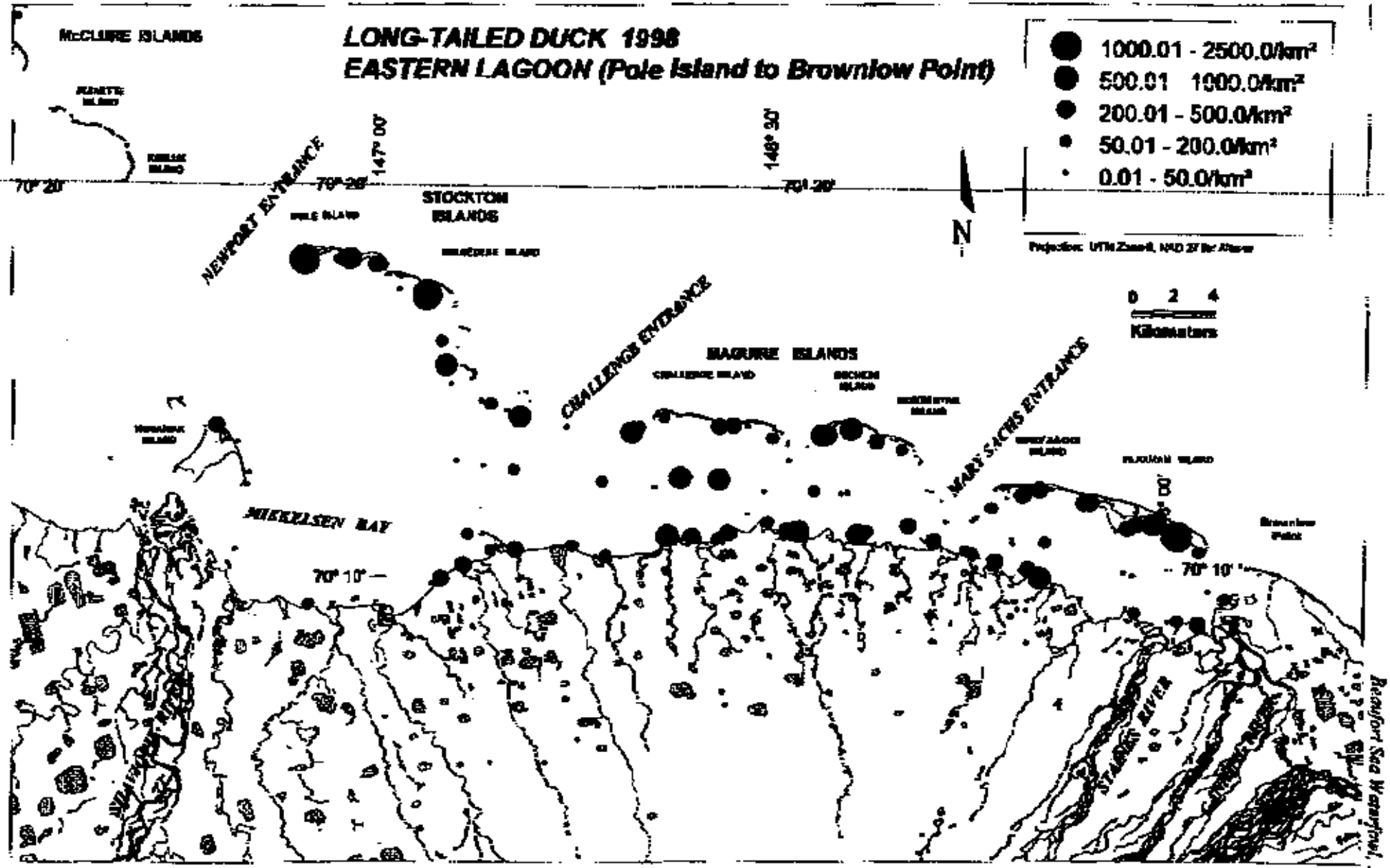


Figure 14. Summary of density for long-tailed ducks by 30-s time period segments in the barrier island-lagoon system between Pole Island and Brownlow Point, Alaska, 5 August-3 September 1998.

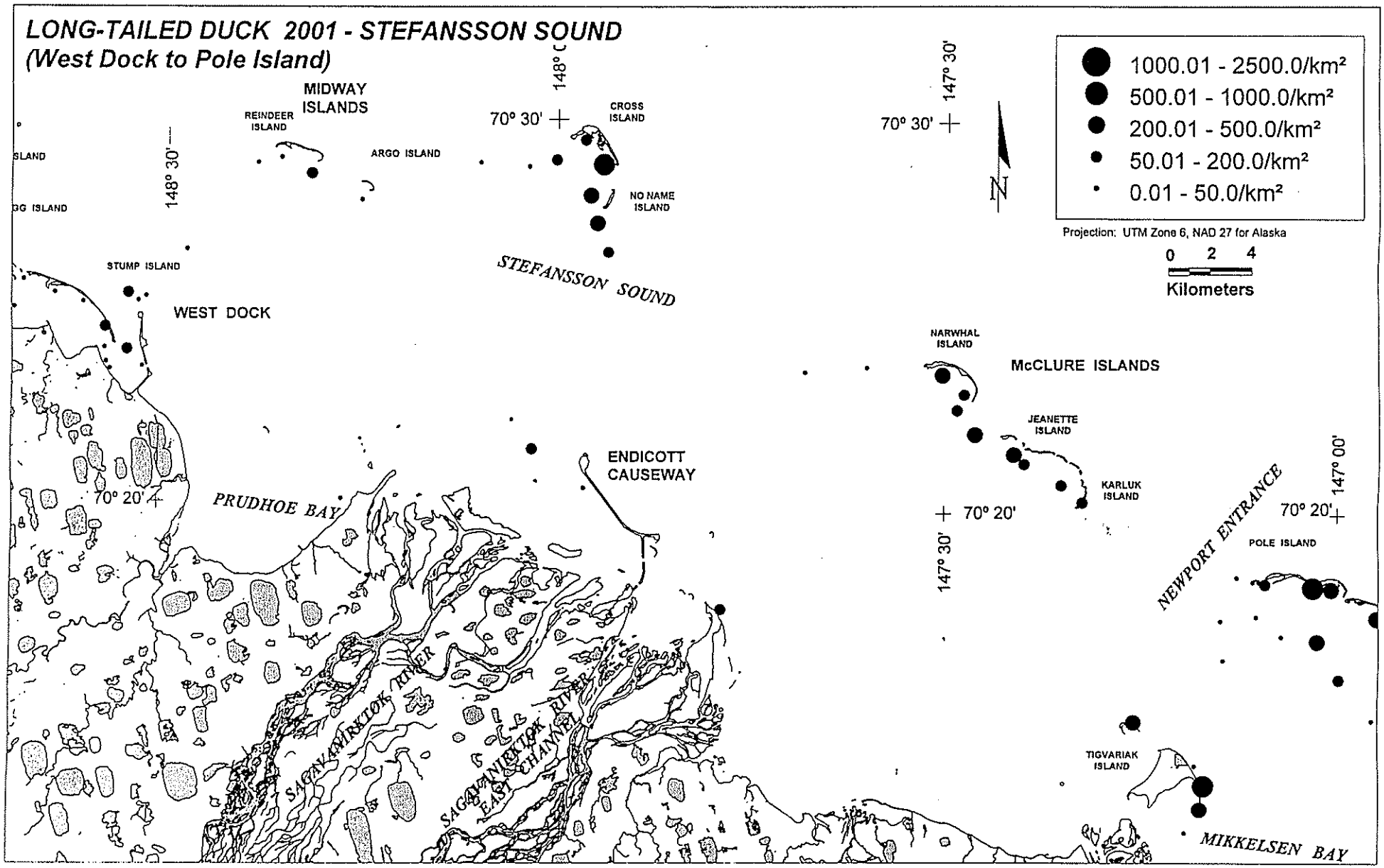


Figure 15. Summary of density for long-tailed ducks by 30-s time period segments in the barrier island-lagoon system between West Dock and Pole Island, Alaska, 23 July-11 August 2001.

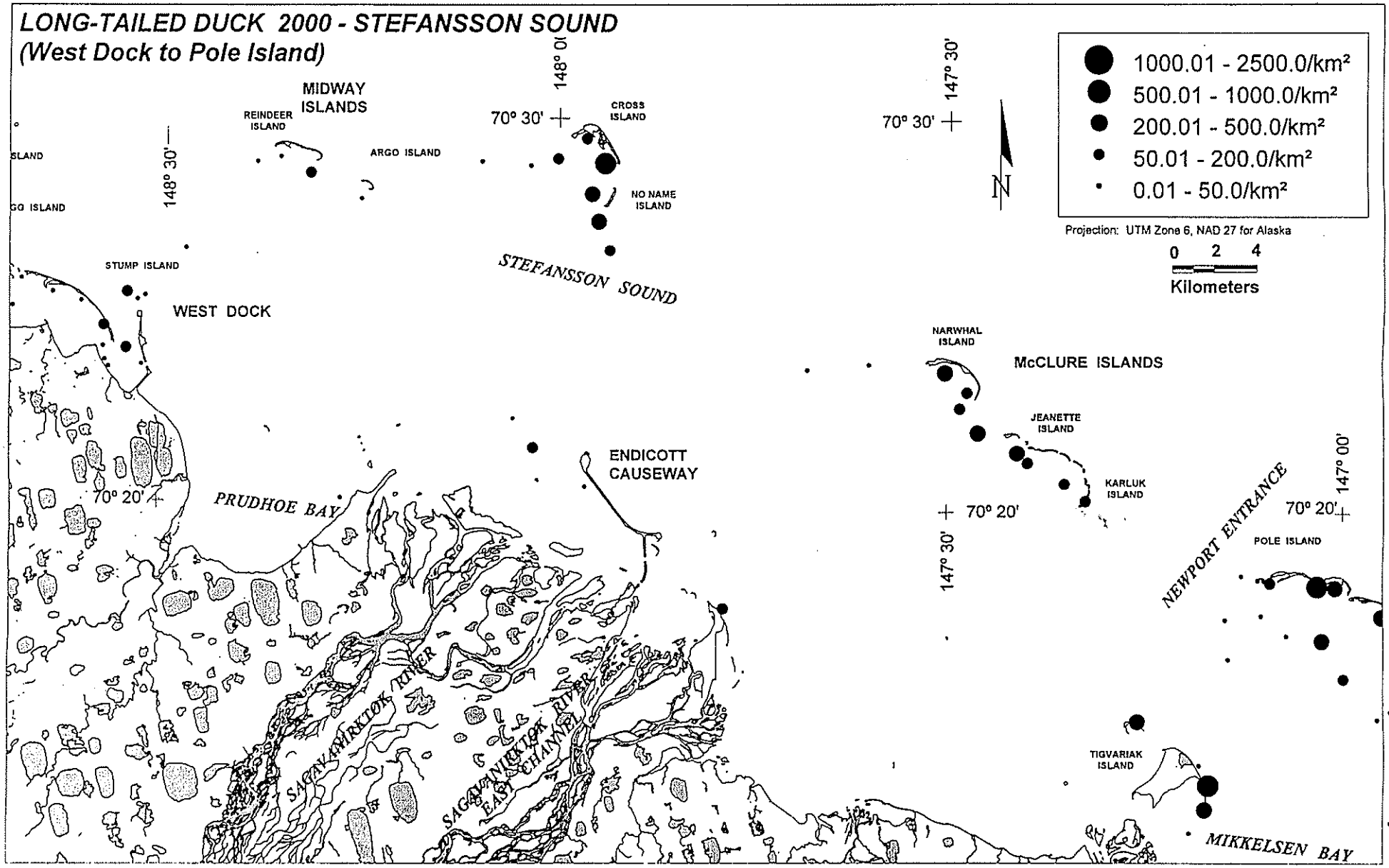


Figure 16. Summary of density for long-tailed ducks by 30-s time period segments in the barrier island-lagoon system between West Dock and Pole Island, Alaska, 1-24 August 2000.

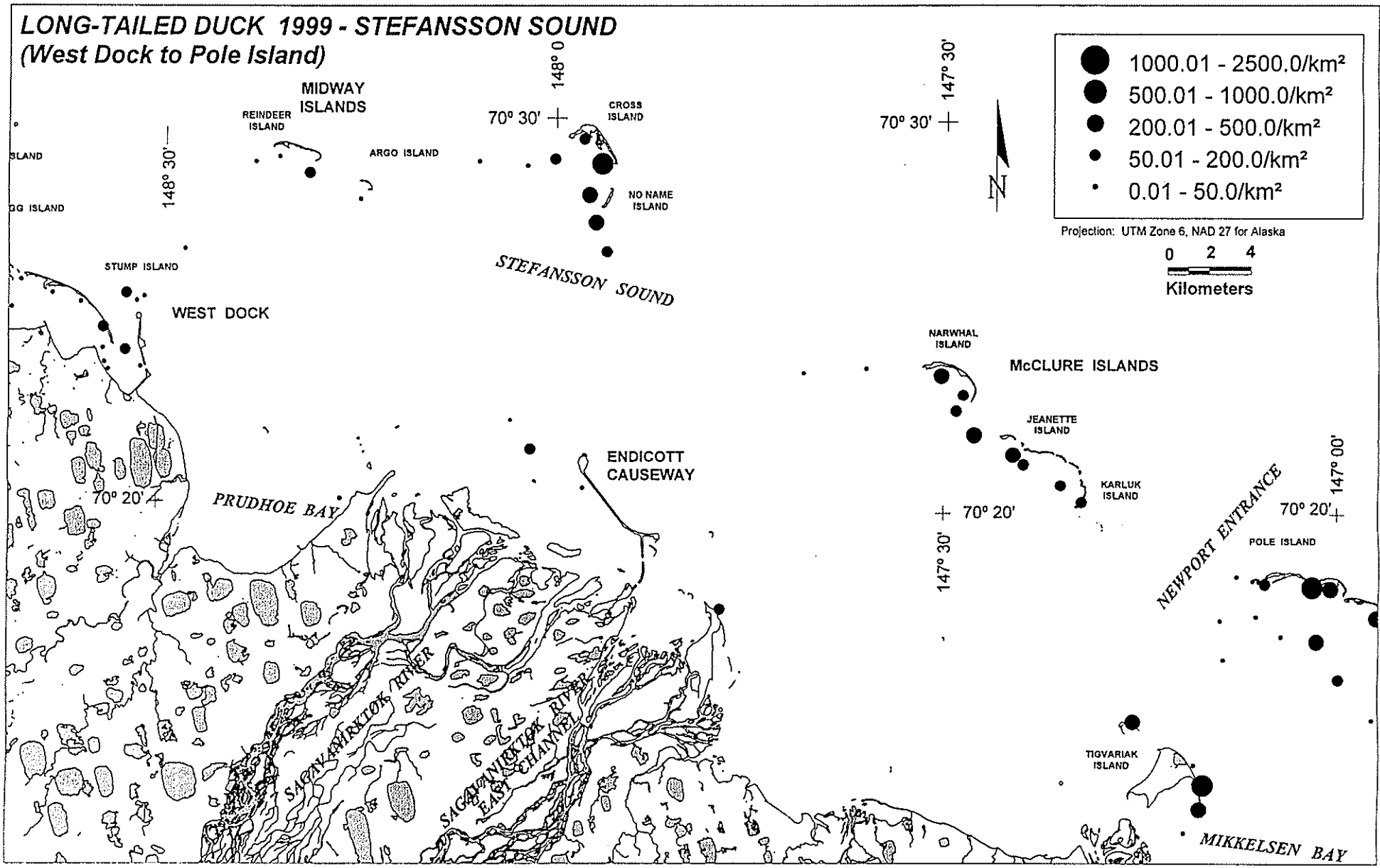


Figure 17. Summary of density for long-tailed ducks by 30-s time period segments in the barrier island-lagoon system between West Dock and Pole Island, Alaska, 30 July to 26 August 1999.

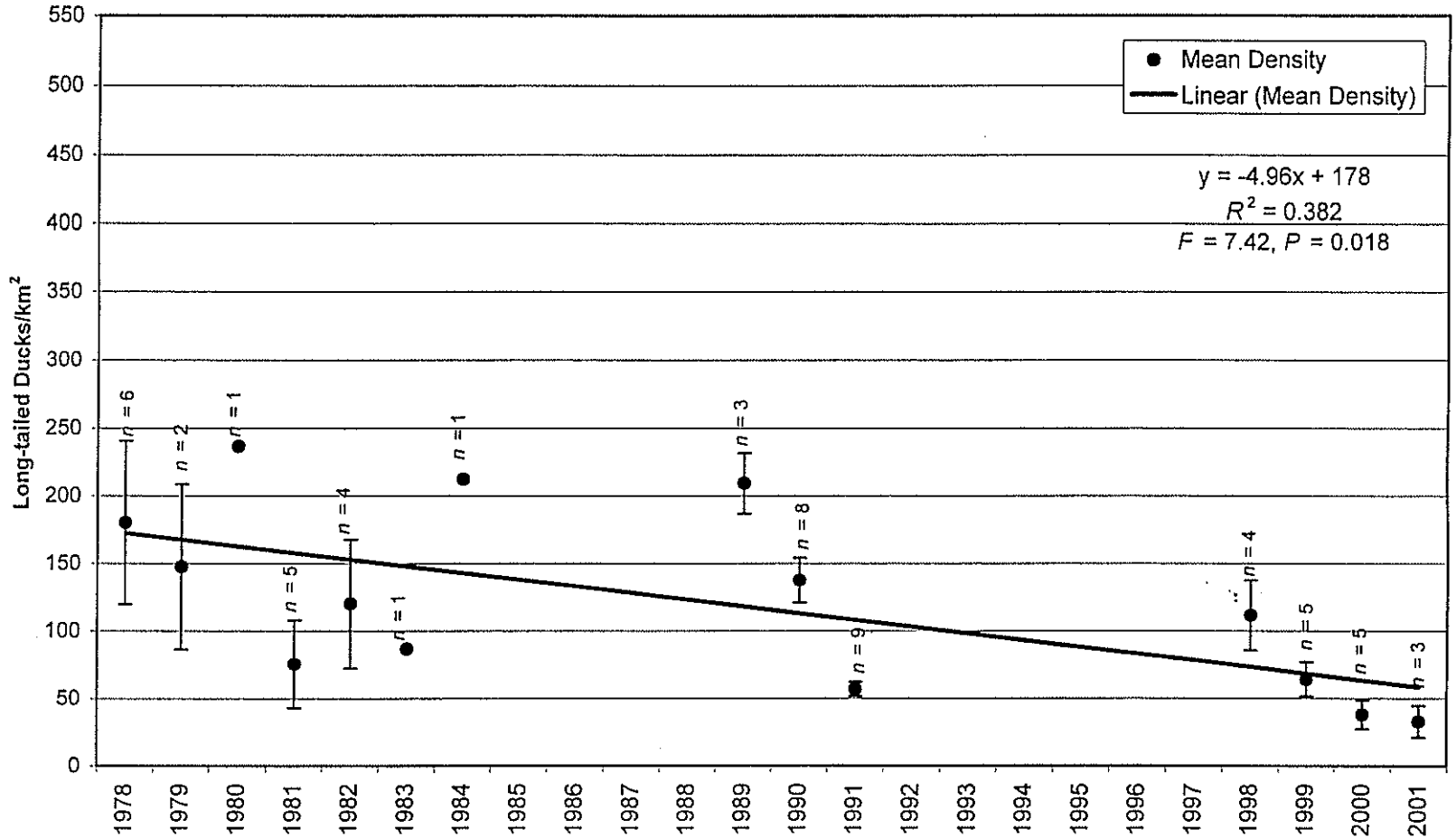


Figure 18. Mean areal long-tailed duck density with standard error by year for aerial surveys in the lagoon systems between Spy Island and Brownlow Point, Alaska, during July and August 1978-2001 (Table A2). Number of surveys is noted above bars. Data includes the western lagoon from Spy Island to West Dock, and the eastern lagoon from Pole Island to Brownlow Point, Alaska. Some surveys did not include all transects.

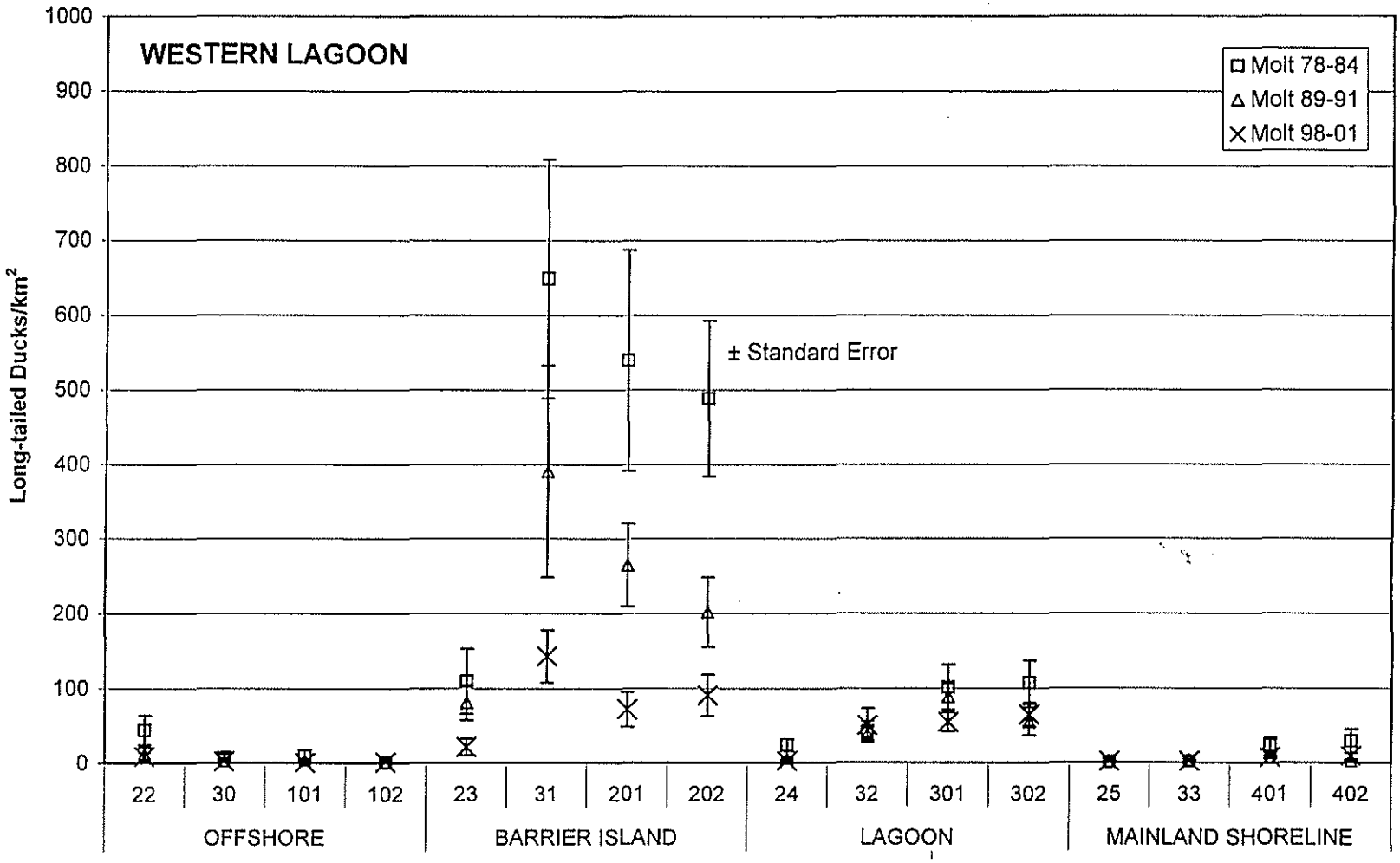


Figure 19. Mean areal long-tailed duck density with standard error by transect for aerial surveys between Spy Island and West Dock, Alaska, during male long-tailed duck molt period from 15 July to 21 August 1978-1984, 1989-1991, and 1998-2001 (Table A2).

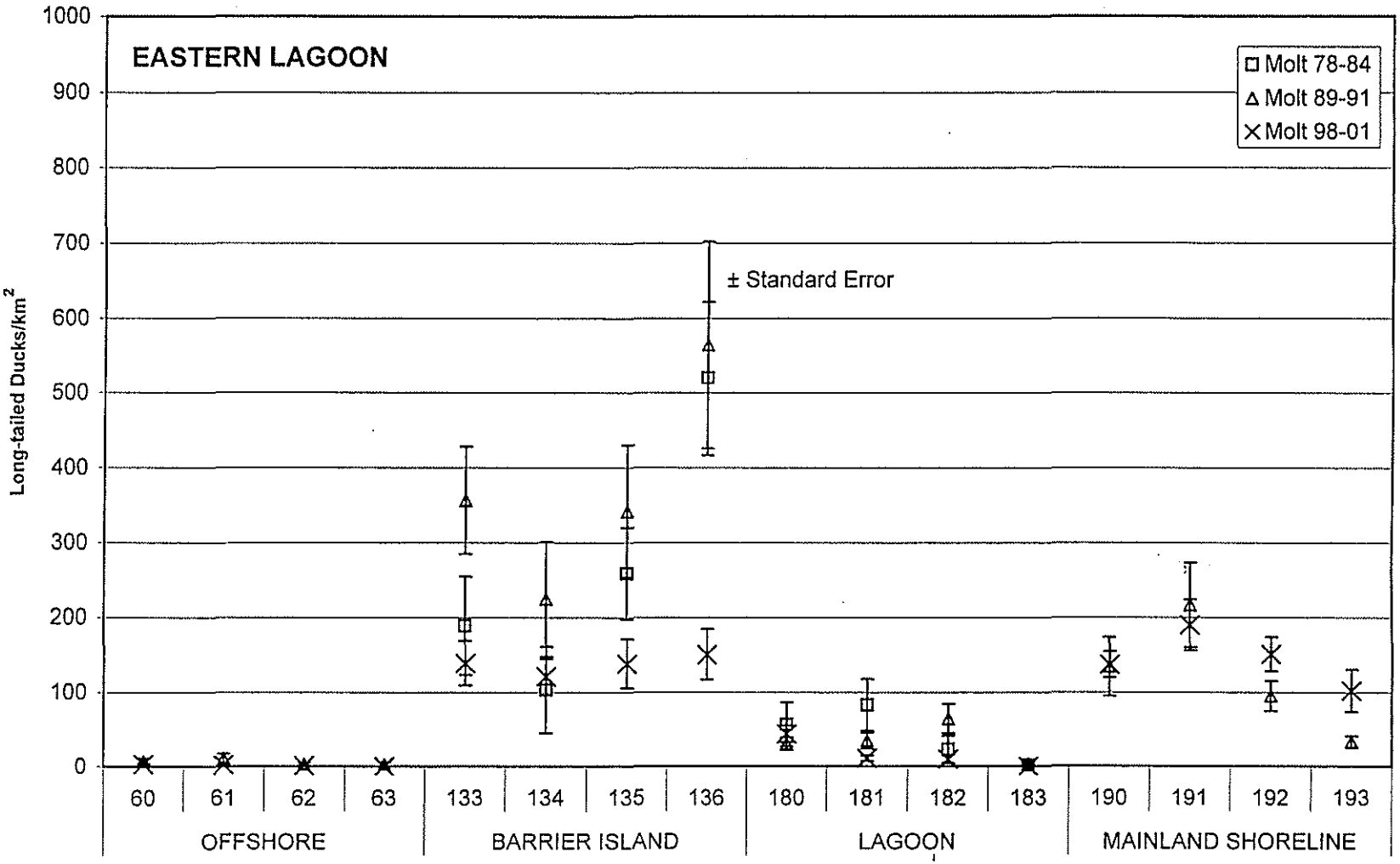


Figure 20. Mean areal long-tailed duck density with standard error by transect for aerial surveys between Pole Island and Brownlow Point, Alaska, during male long-tailed duck molt period from 15 July to 21 August 1978-1984, 1989-1991, and 1998-2001 (Table A2). No offshore or mainland shoreline transects were flown during 1978-1984.

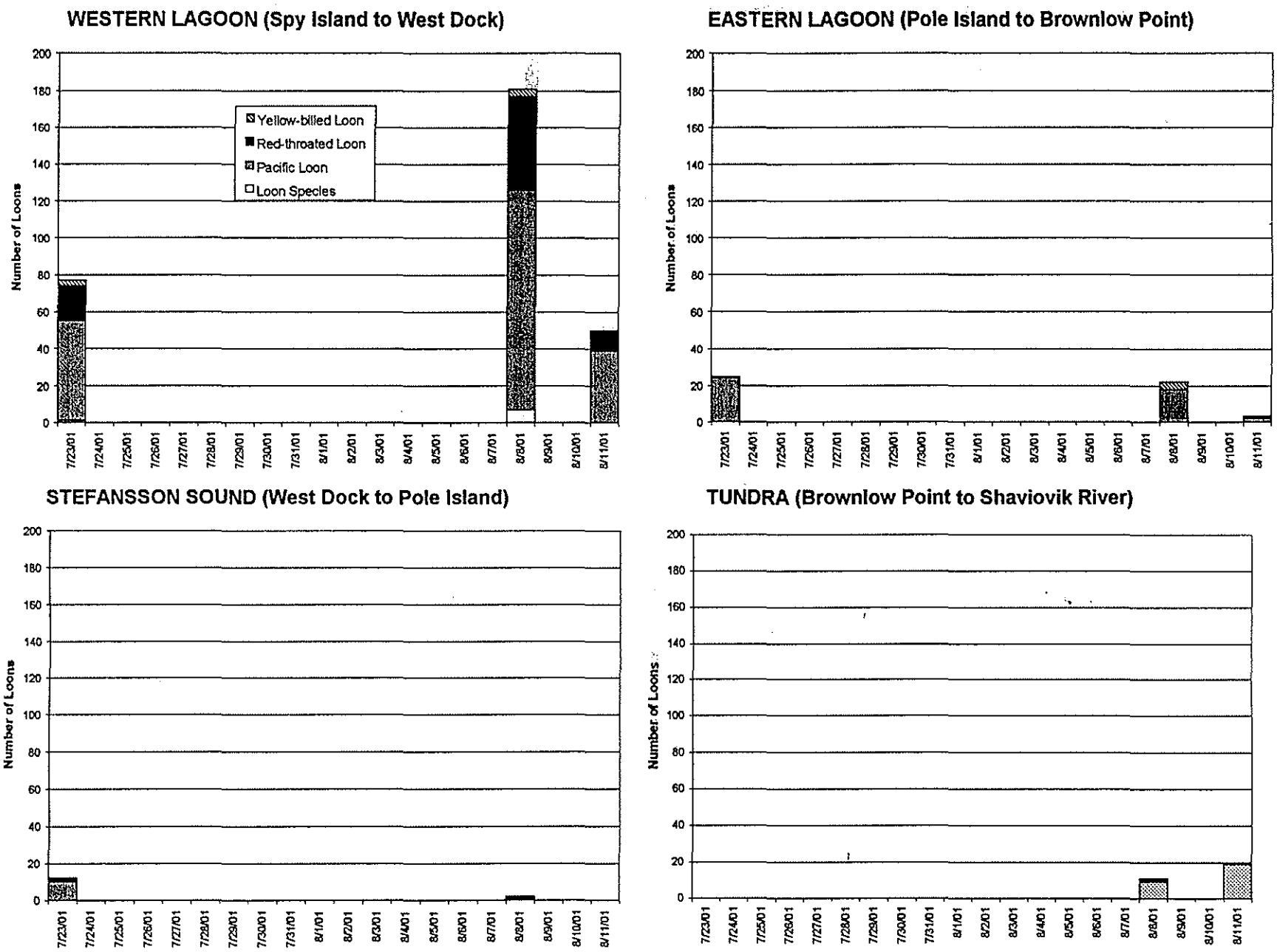


Figure 21. Total number of loons on- and off-transect during aerial surveys in the barrier island-lagoon systems between Spy Island and Brownlow Point, Alaska, 23 July – 11 August 2001. Surveys were flown on 23 July, 8 August, and 11 August 2001.

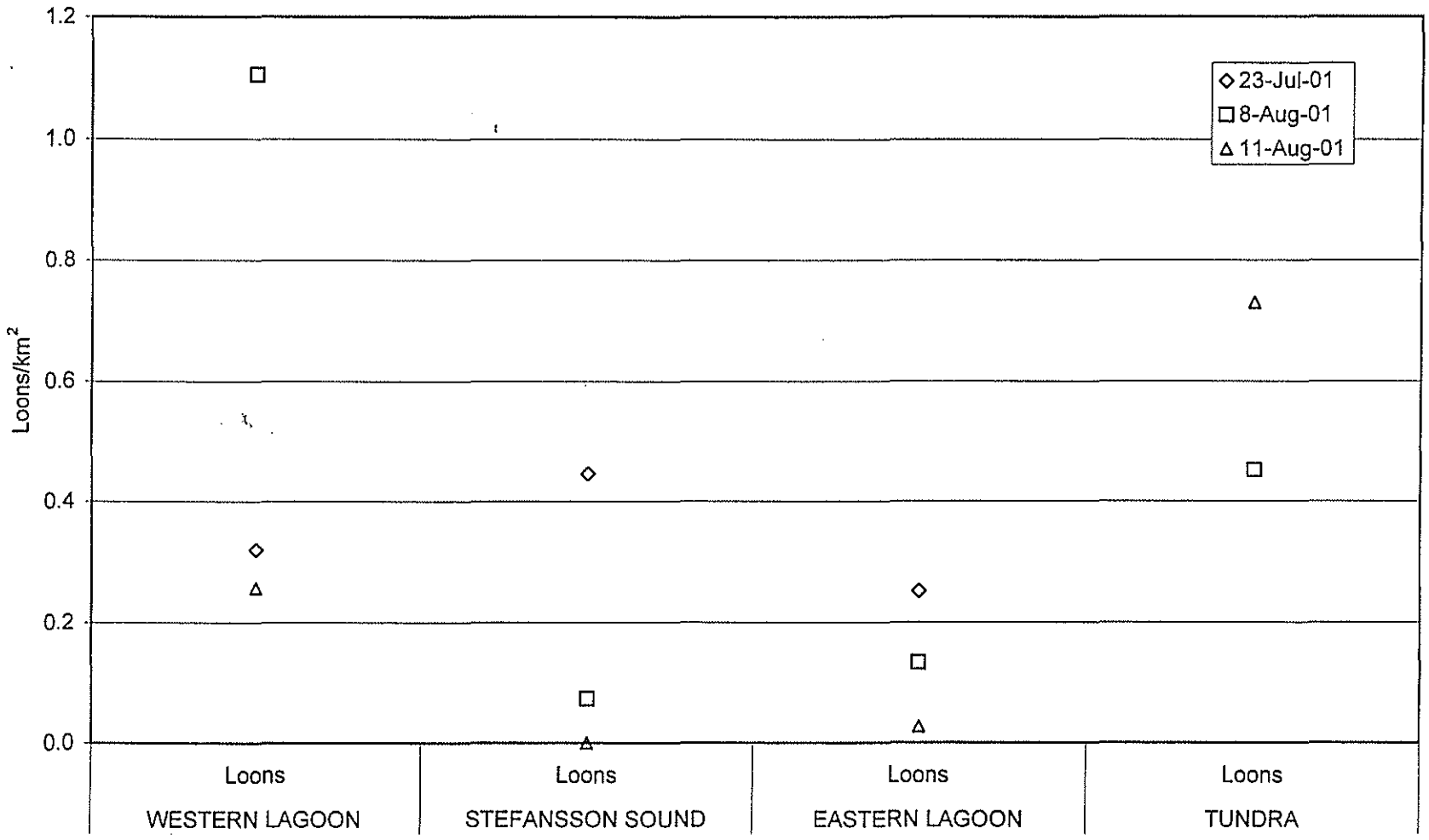


Figure 22. Areal density of loons for 3 aerial surveys by region between Spy Island and Brownlow Point, Alaska,23 July-11 August 2001. On 23 July 2001, two mainland transects in the eastern lagoon and all tundra transects were not flown because of fog.

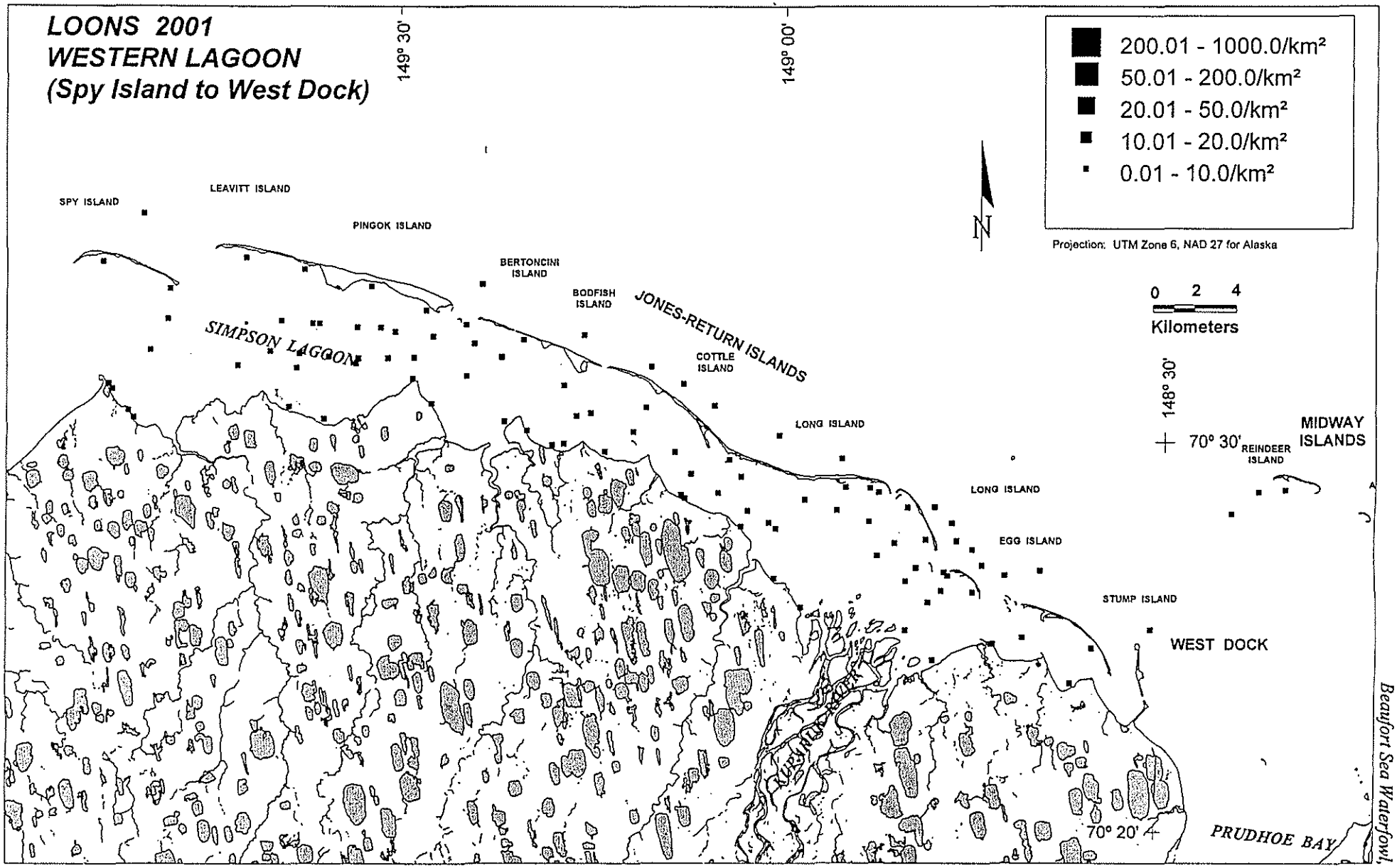


Figure 23. Summary of density for loons by 30-s time period segments in the barrier island-lagoon system between Spy Island and West Dock, Alaska, 23 July-11 August 2001.

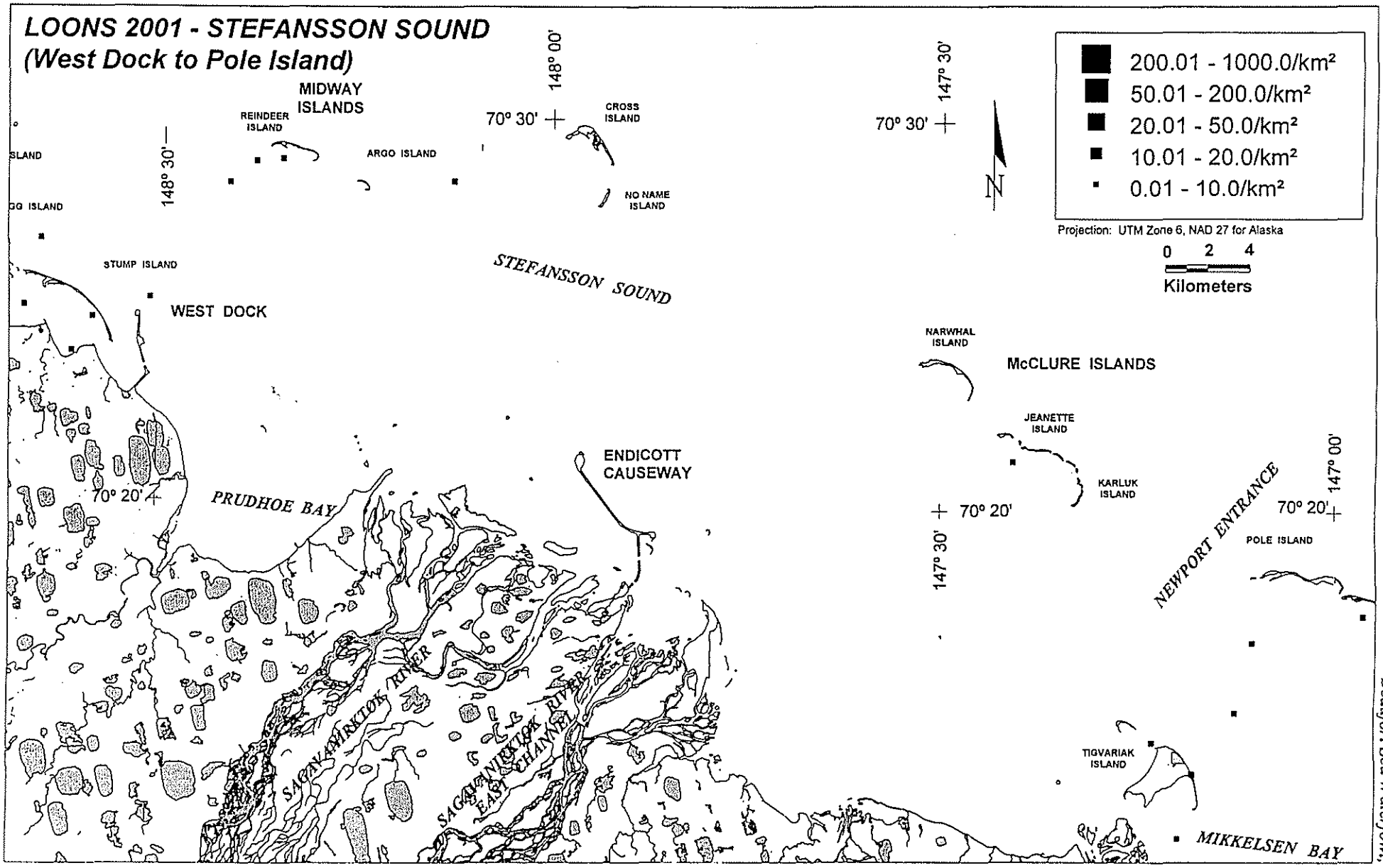


Figure 24. Summary of density for loons by 30-s time period segments in the barrier island-lagoon system between West Dock and Pole Island, Alaska, 23 July-11 August 2001.

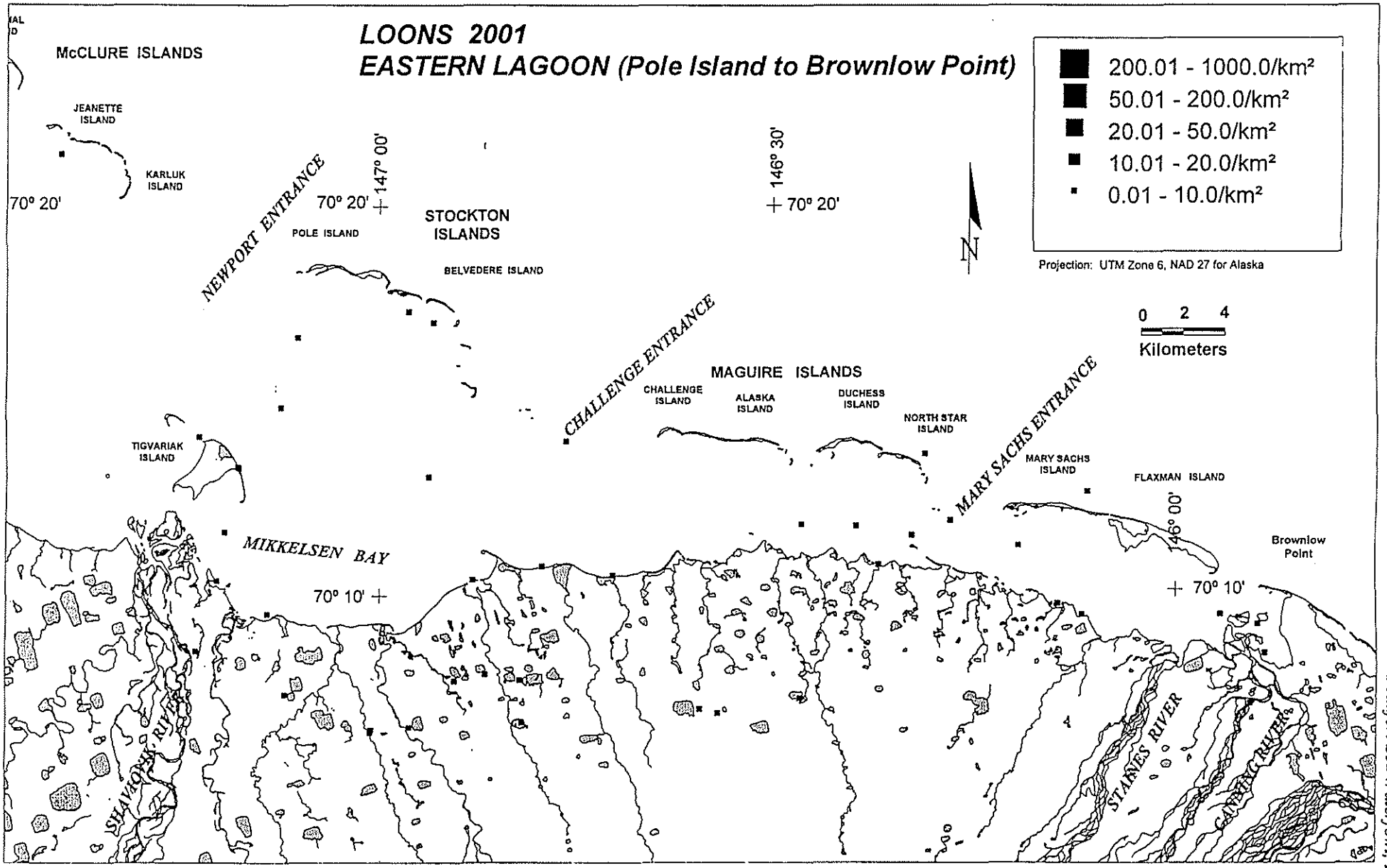


Figure 25. Summary of density for loons by 30-s time period segments in the barrier island-lagoon system between Pole Island and Brownlow Point, Alaska, 23 July-11 August 2001.

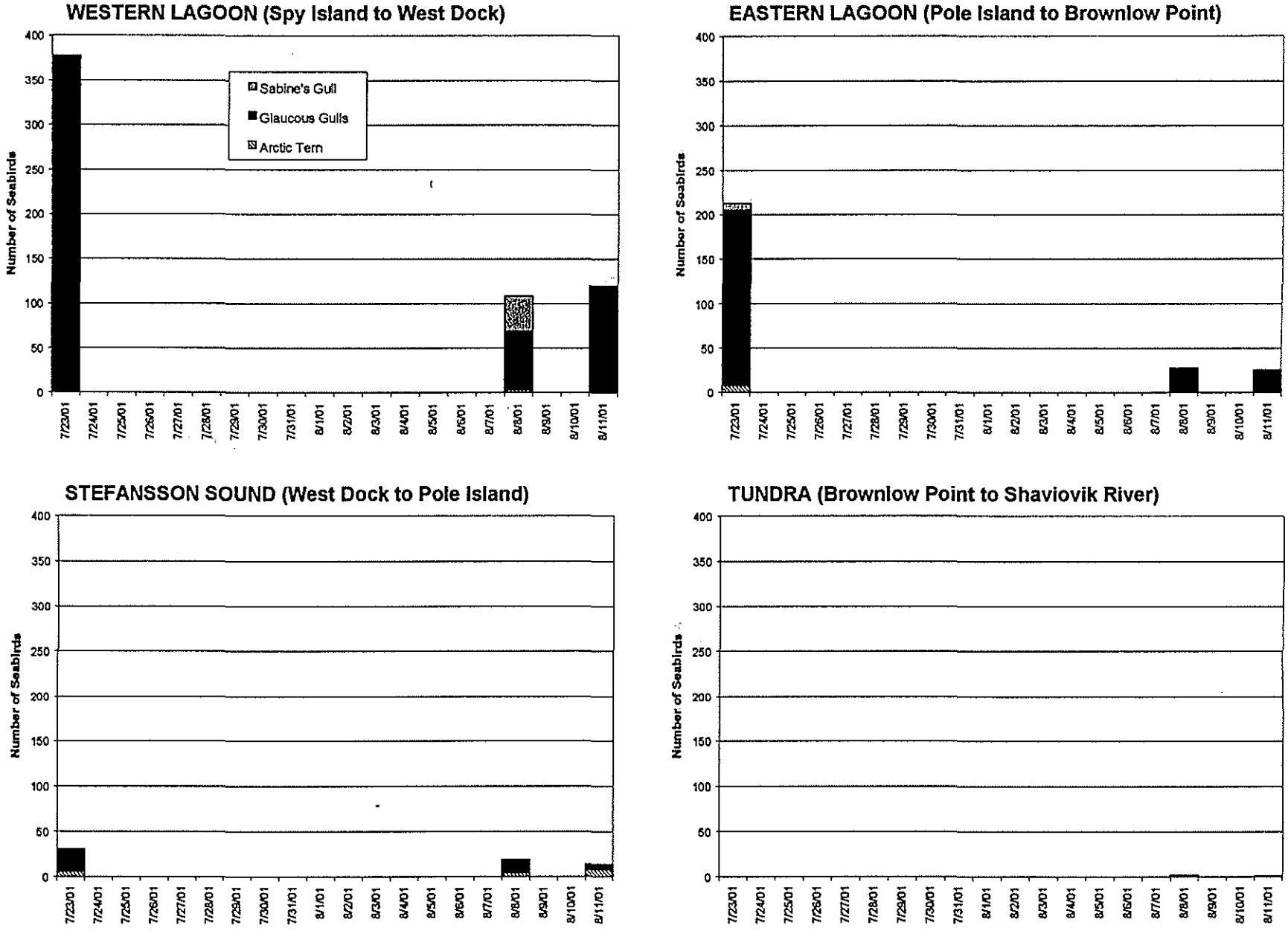


Figure 26. Total number of seabirds on- and off-transect during aerial surveys in the barrier island-lagoon systems between Spy Island and Brownlow Point, Alaska, 23 July–11 August 2001. Surveys were flown on 23 July, 8 August and 11 August 2001.

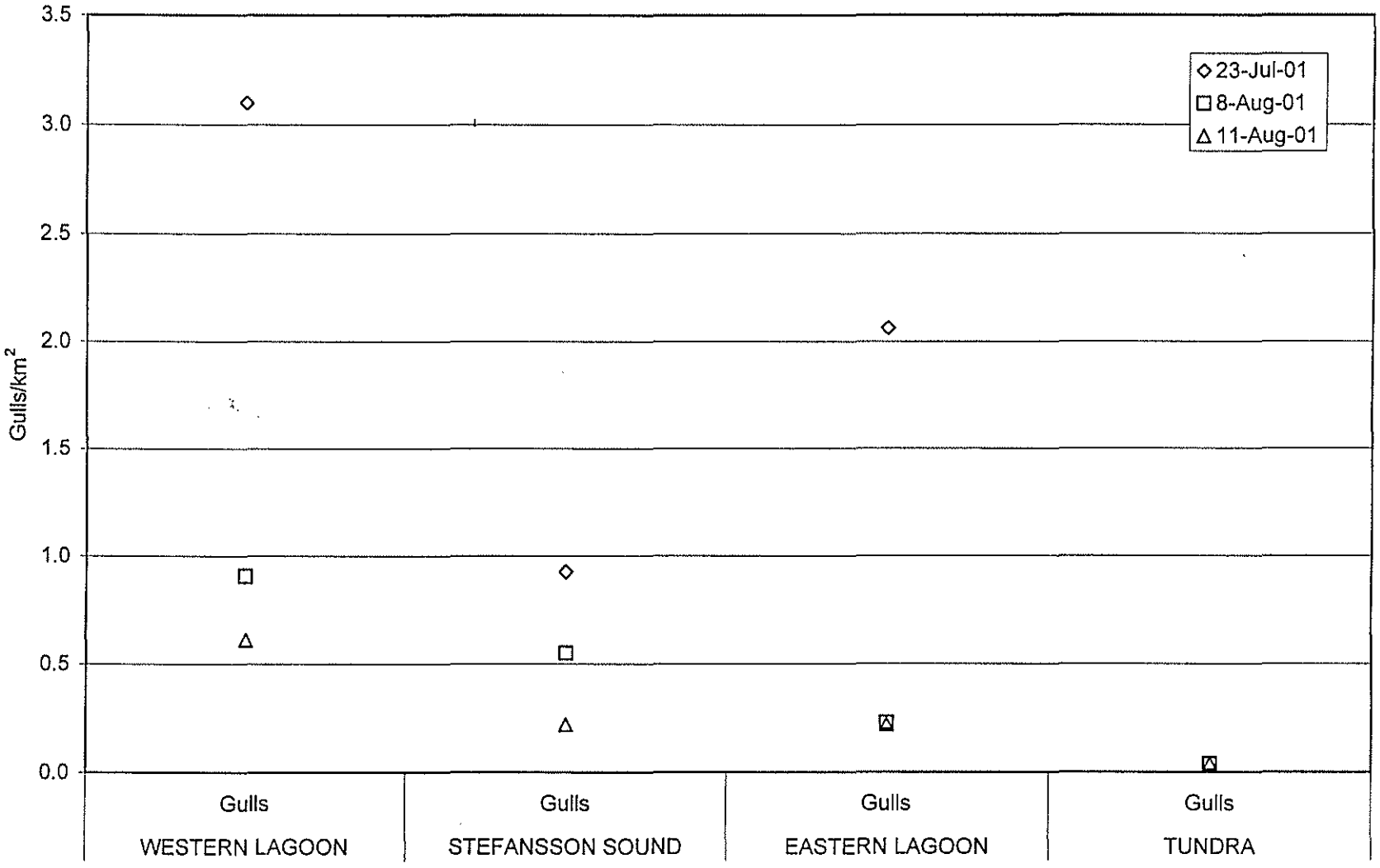


Figure 27. Areal density of gulls for 3 aerial surveys by region between Spy Island and Brownlow Point, Alaska,23 July-11 August 2001. On 23 July 2001, two mainland transects in the eastern lagoon and all tundra transects were not flown because of fog.

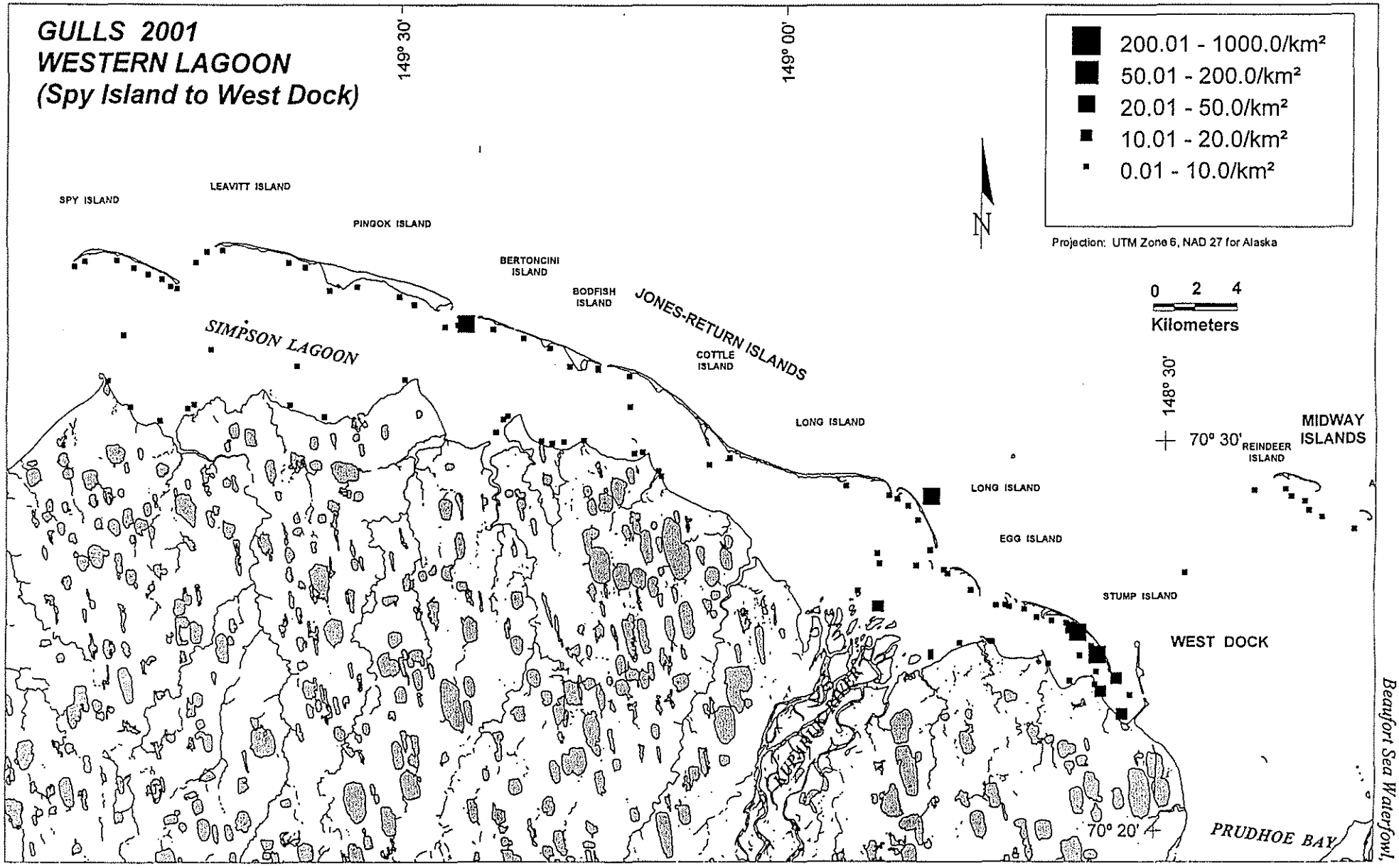


Figure 28. Summary of density for gulls by 30-s time period segments in the barrier island-lagoon system between Spy Island and West Dock, Alaska, 23 July-11 August 2001.

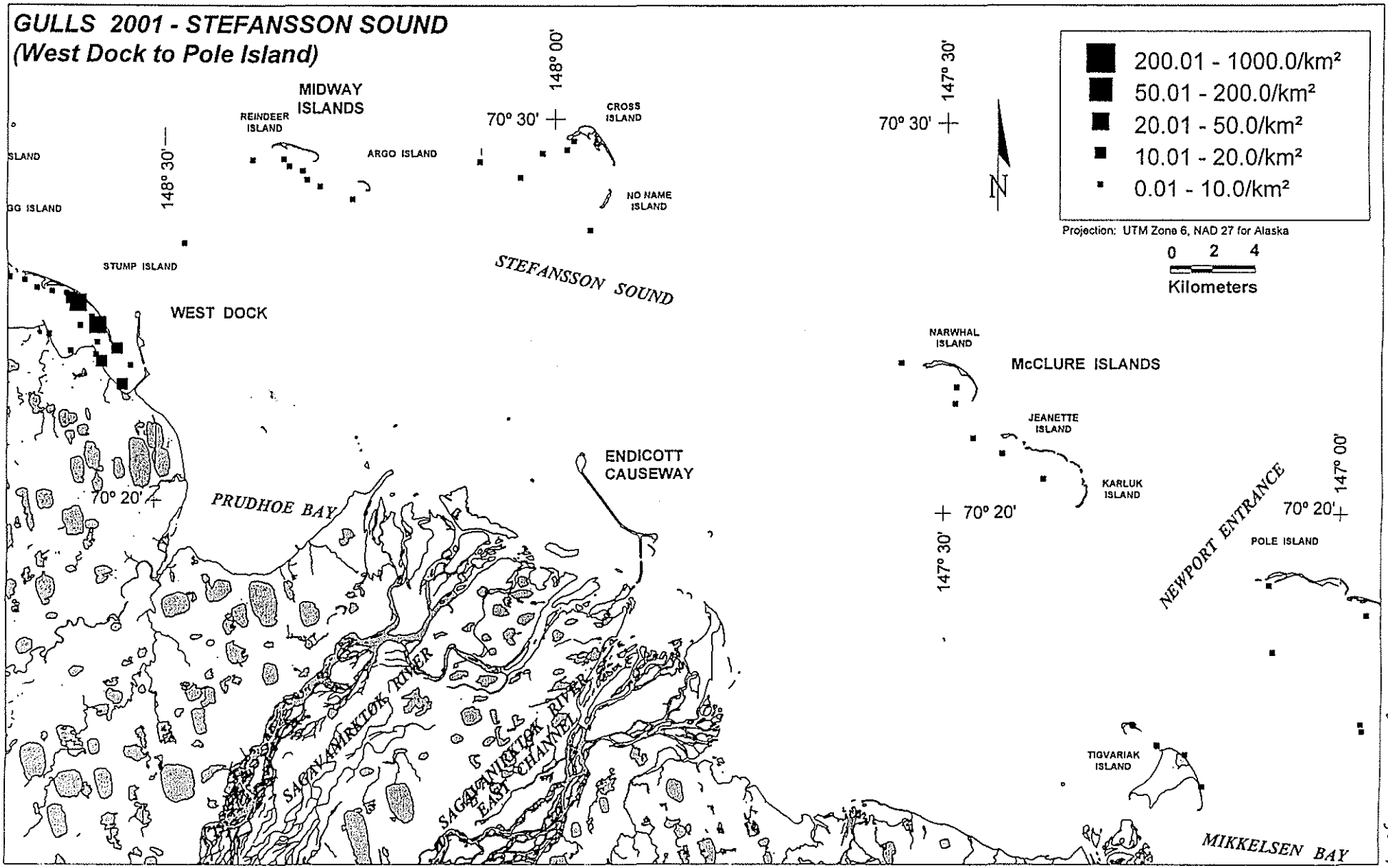


Figure 29. Summary of density for gulls by 30-s time period segments in the barrier island-lagoon system between West Dock and Pole Island, Alaska, 23 July-11 August 2001.

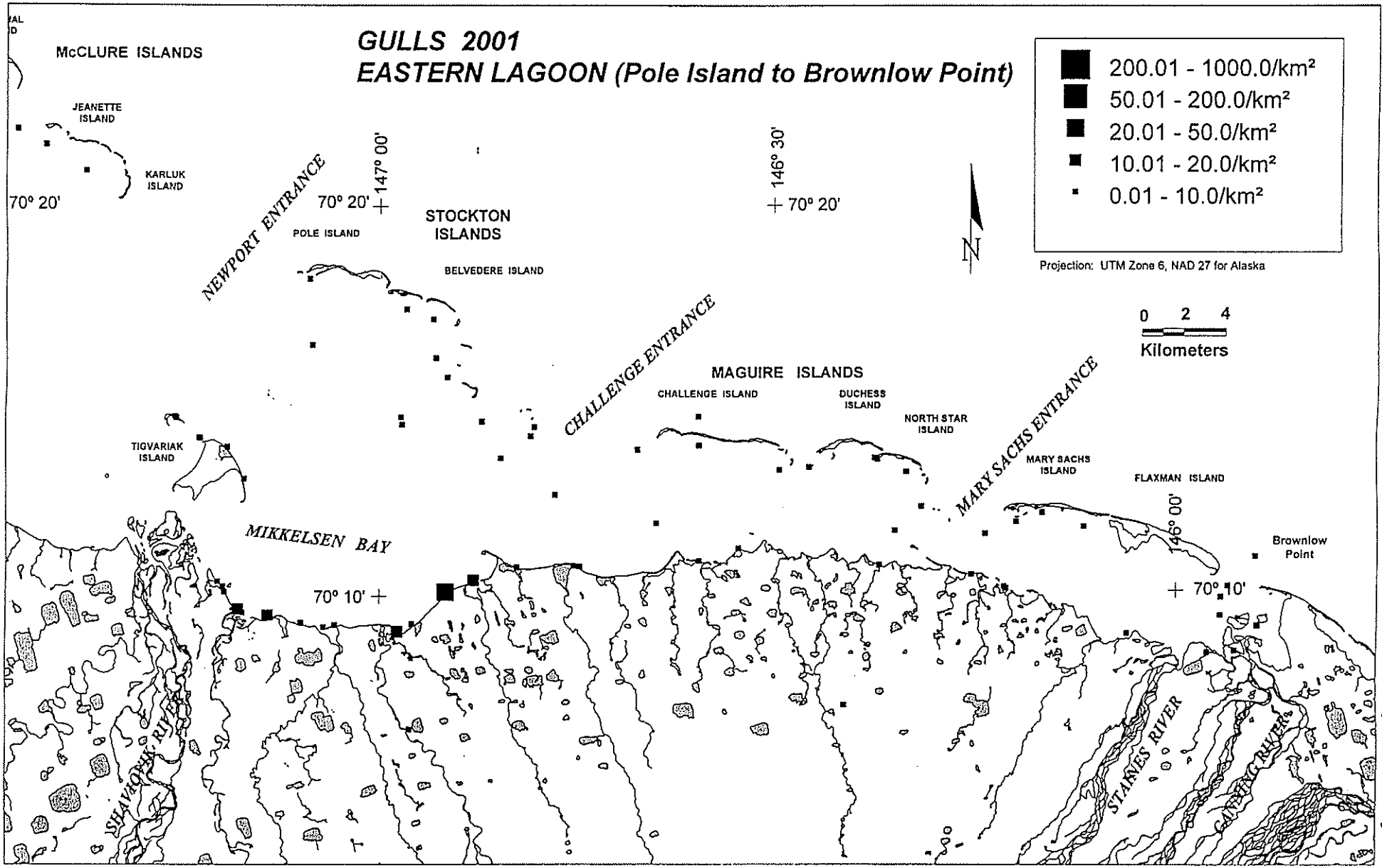


Figure 30. Summary of density for gulls by 30-s time period segments in the barrier island-lagoon system between Pole Island and Brownlow Point, Alaska, 23 July-11 August 2001.

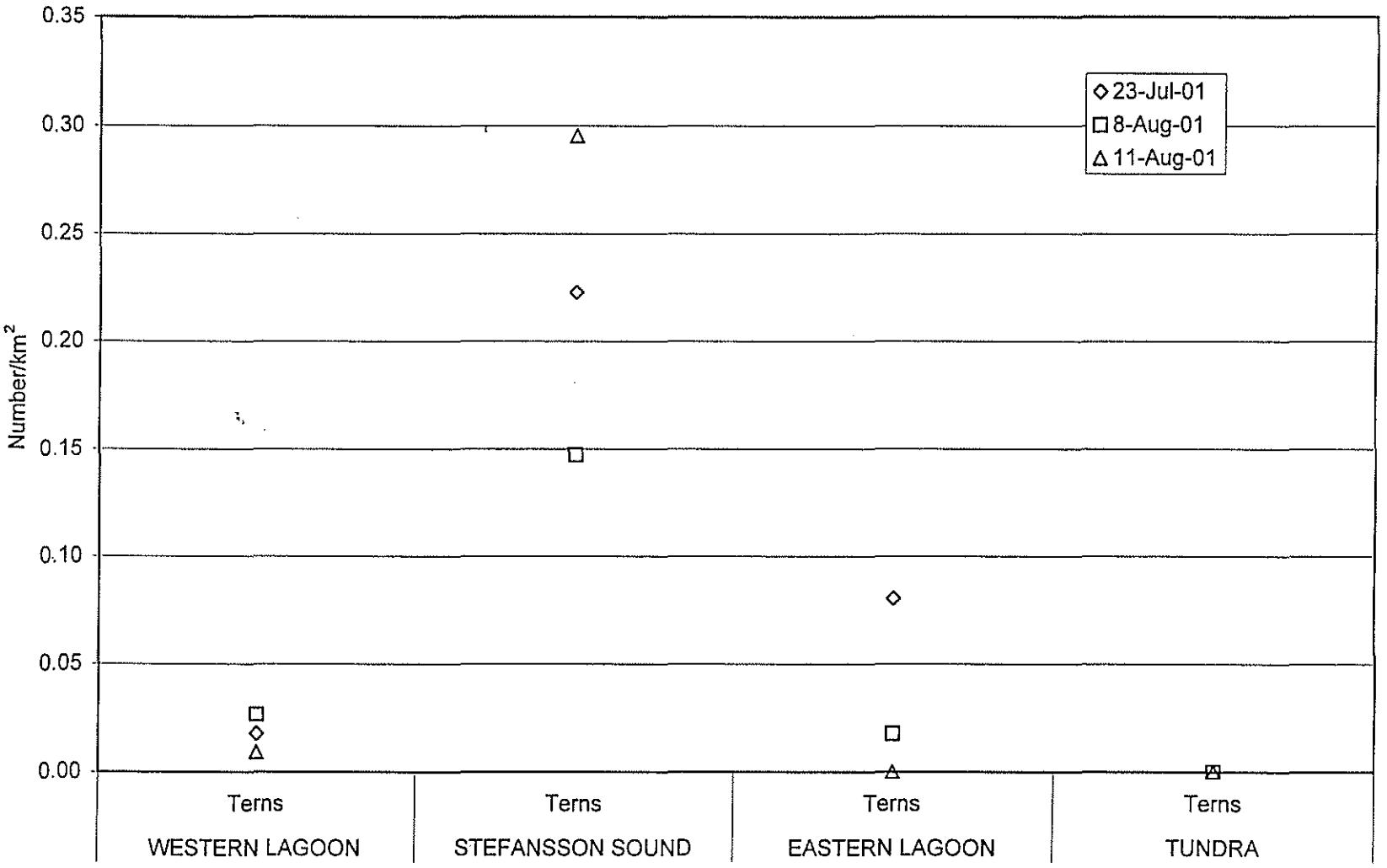


Figure 31. Areal density of terns for 3 aerial surveys by region between Spy Island and Brownlow Point, Alaska, 23 July-11 August 2001. On 23 July 2001, two mainland transects in the eastern lagoon and all tundra transects were not flown because of fog.

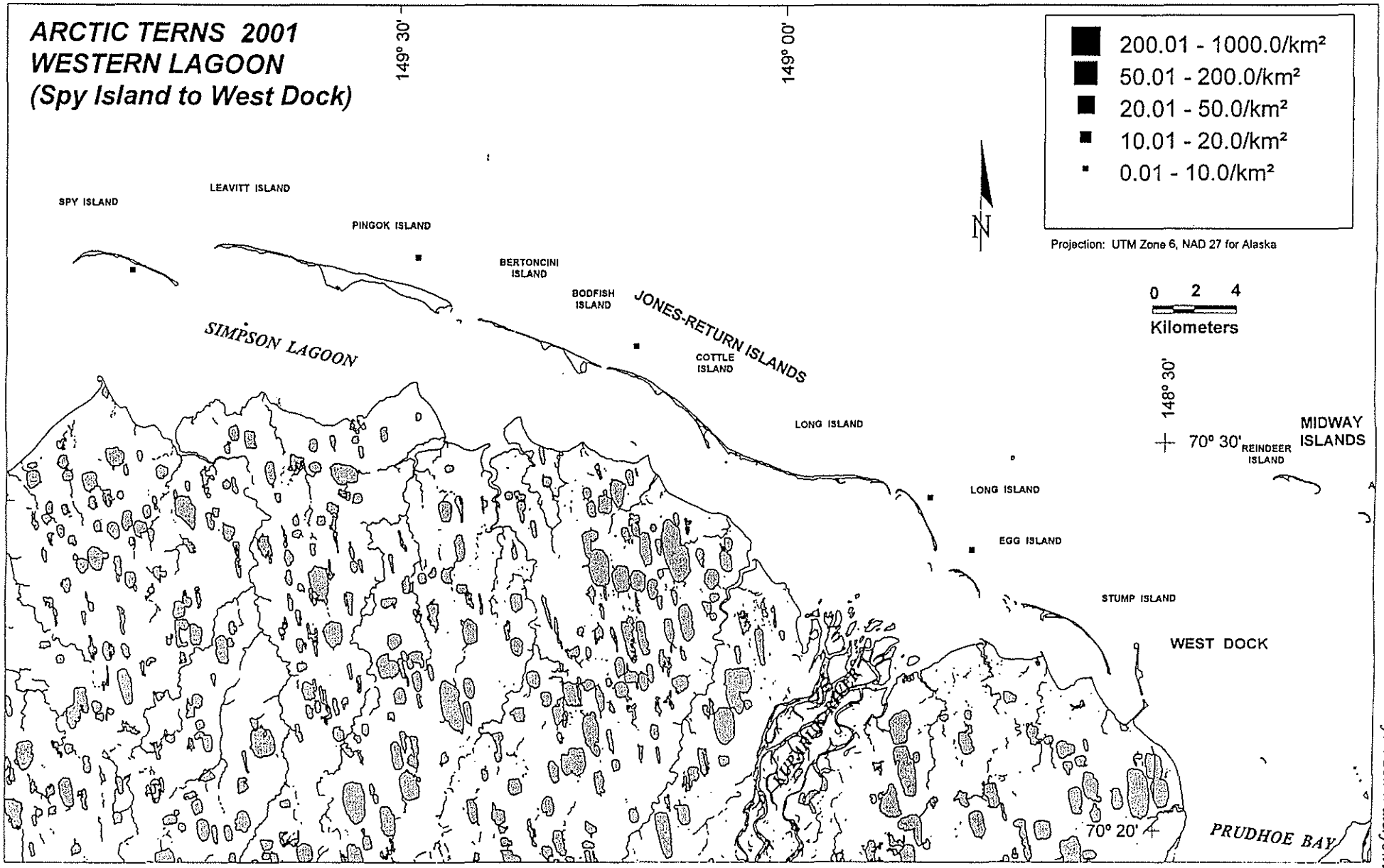


Figure 32. Summary of density for Arctic terns by 30-s time period segments in the barrier island-lagoon system between Spy Island and West Dock, Alaska, 23 July-11 August 2001.

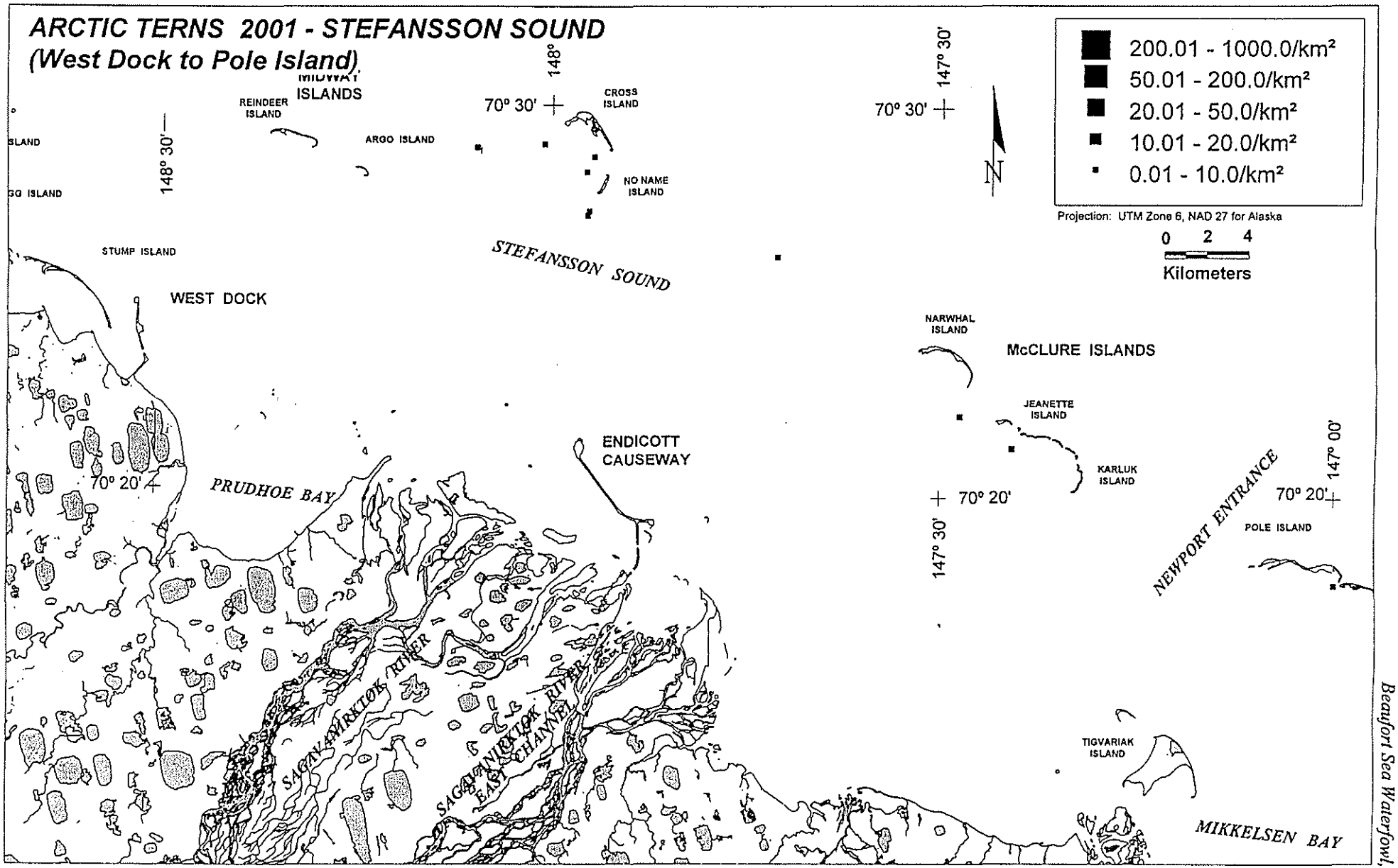


Figure 33. Summary of density for Arctic terns by 30-s time period segments in the barrier island-lagoon system between West Dock and Pole Island, Alaska, 23 July-11 August 2001.

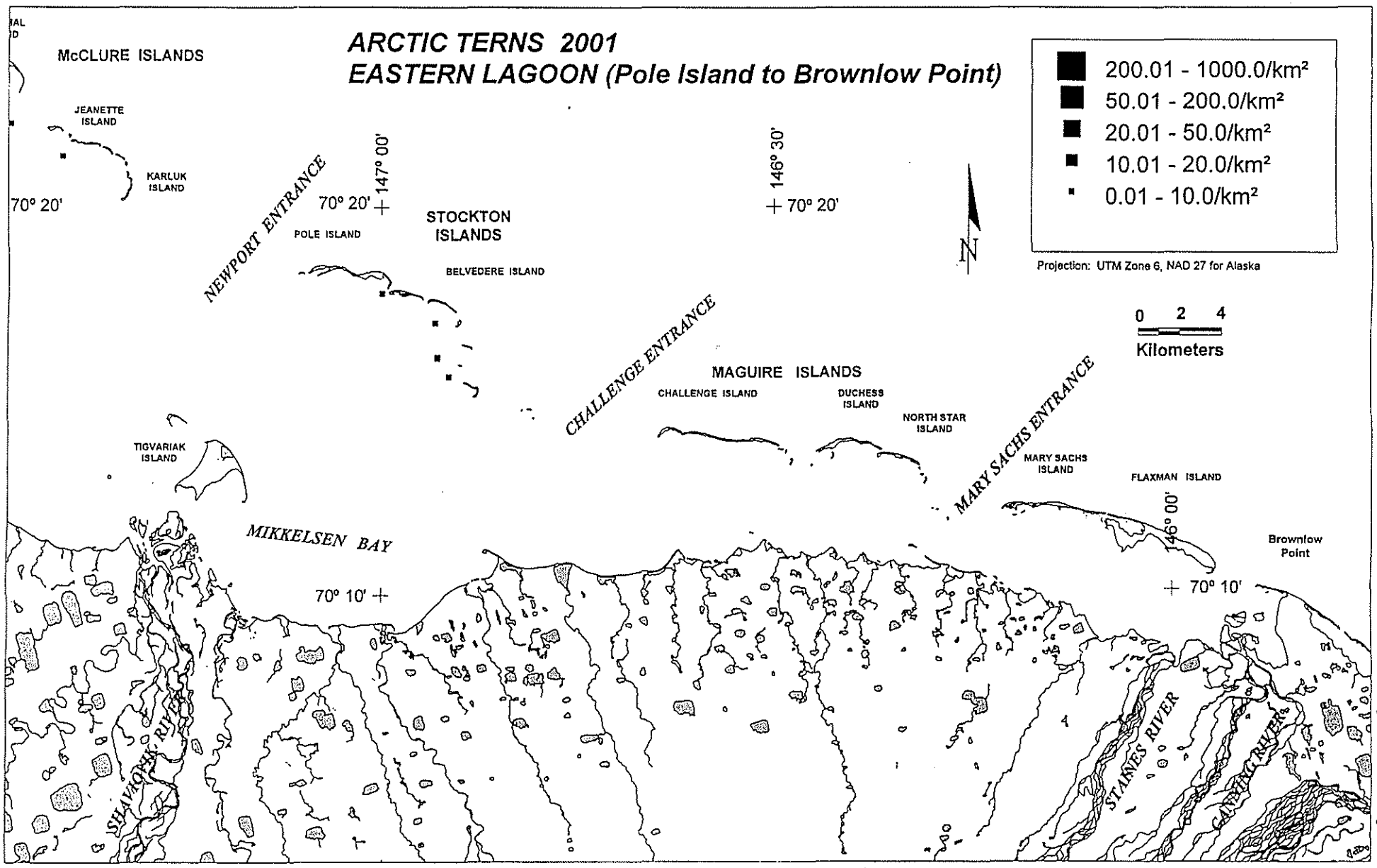


Figure 34. Summary of density for Arctic terns by 30-s time period segments in the barrier island-lagoon system between Pole Island and Brownlow Point, Alaska, 23 July-11 August 2001.

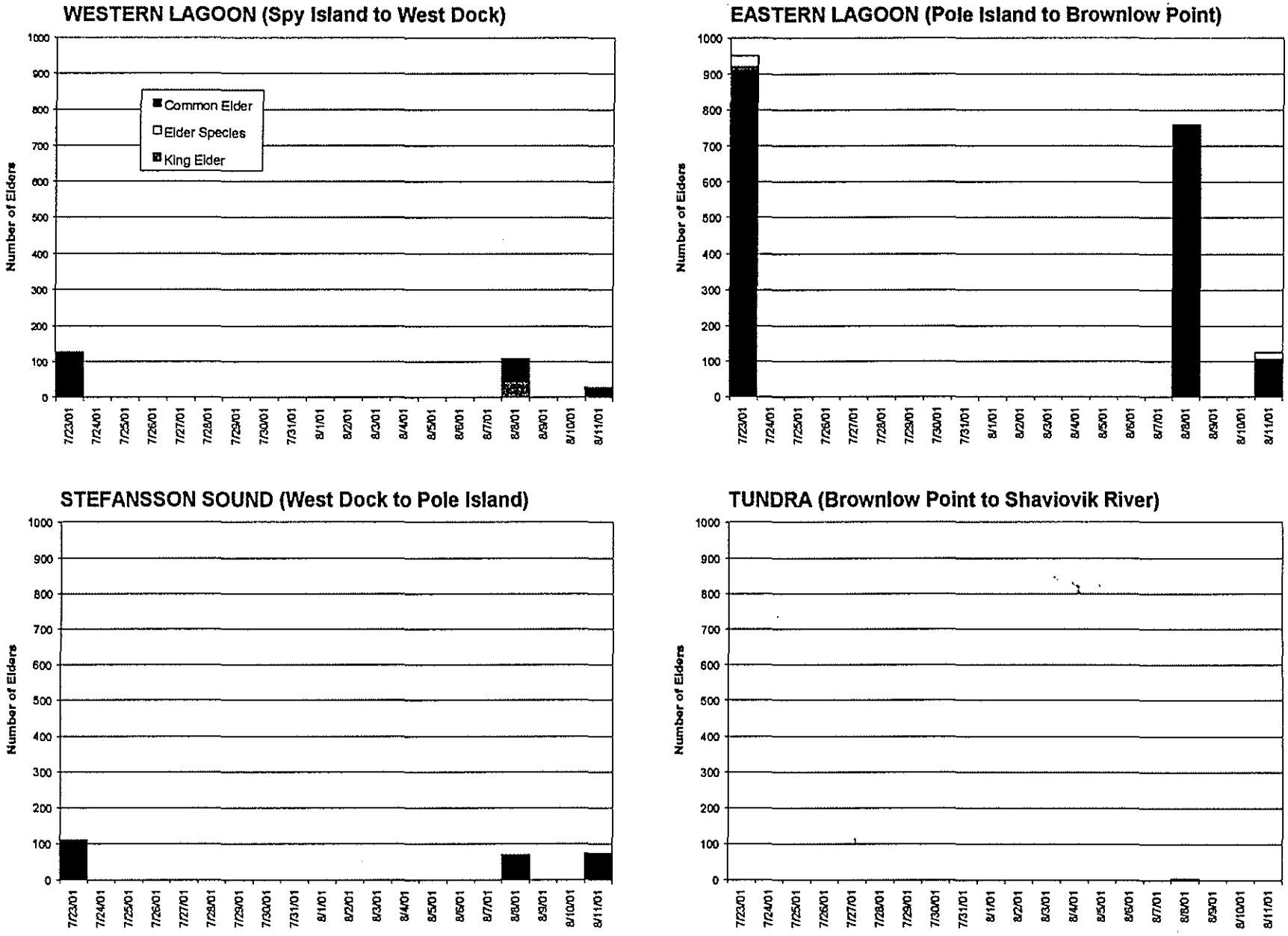


Figure 35. Total number of eiders on- and off-transect during aerial surveys in the barrier island-lagoon systems between Spy Island and Brownlow Point, Alaska, 23 July–11 August 2001. Surveys were flown on 23 July, 8 August and 11 August 2001.

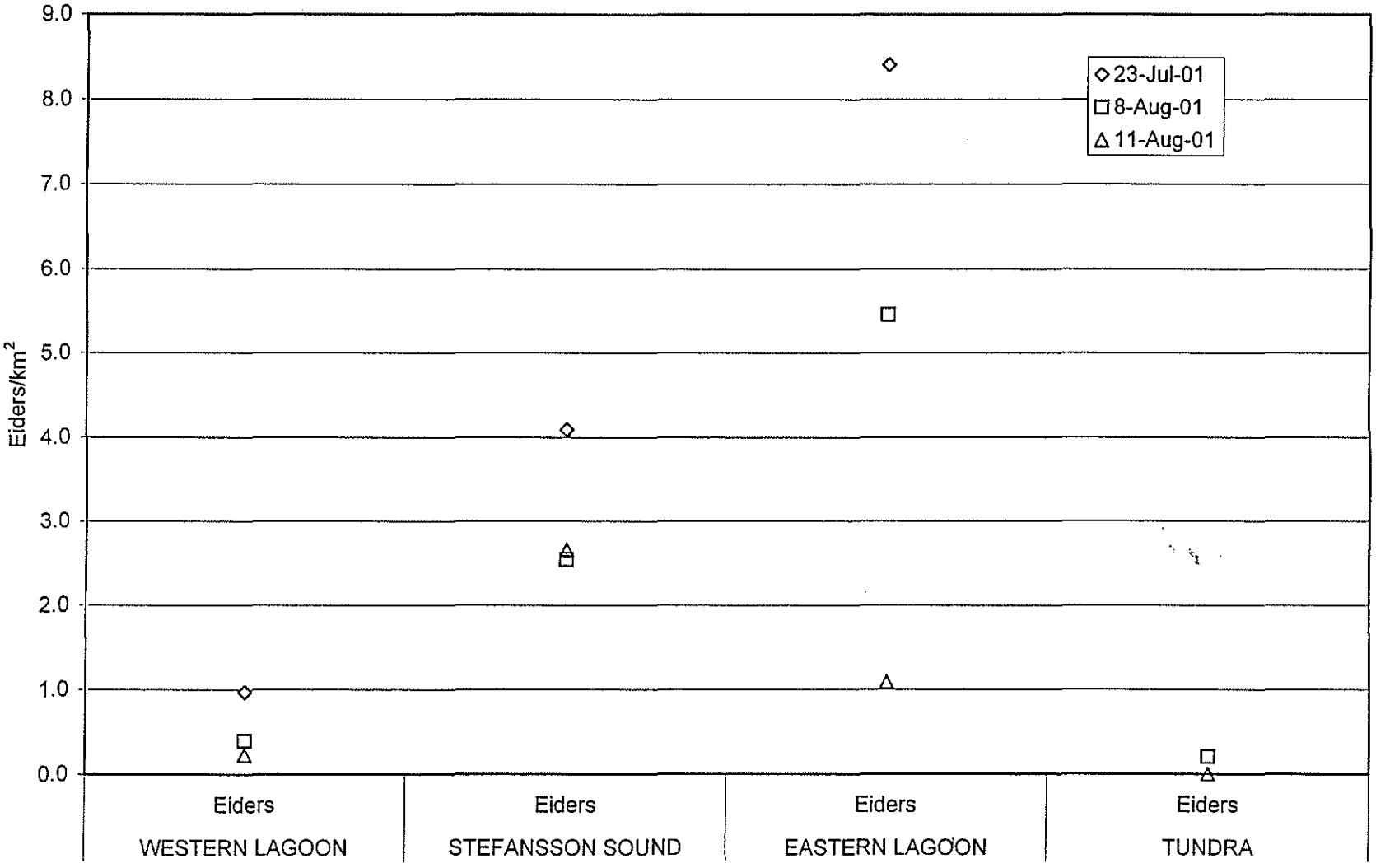


Figure 36. Areal density of eiders for 3 aerial surveys by region between Spy Island and Brownlow Point, Alaska, 23 July-11 August 2001. On 23 July 2001, two mainland transects in the eastern lagoon and all tundra transects were not flown because of fog.

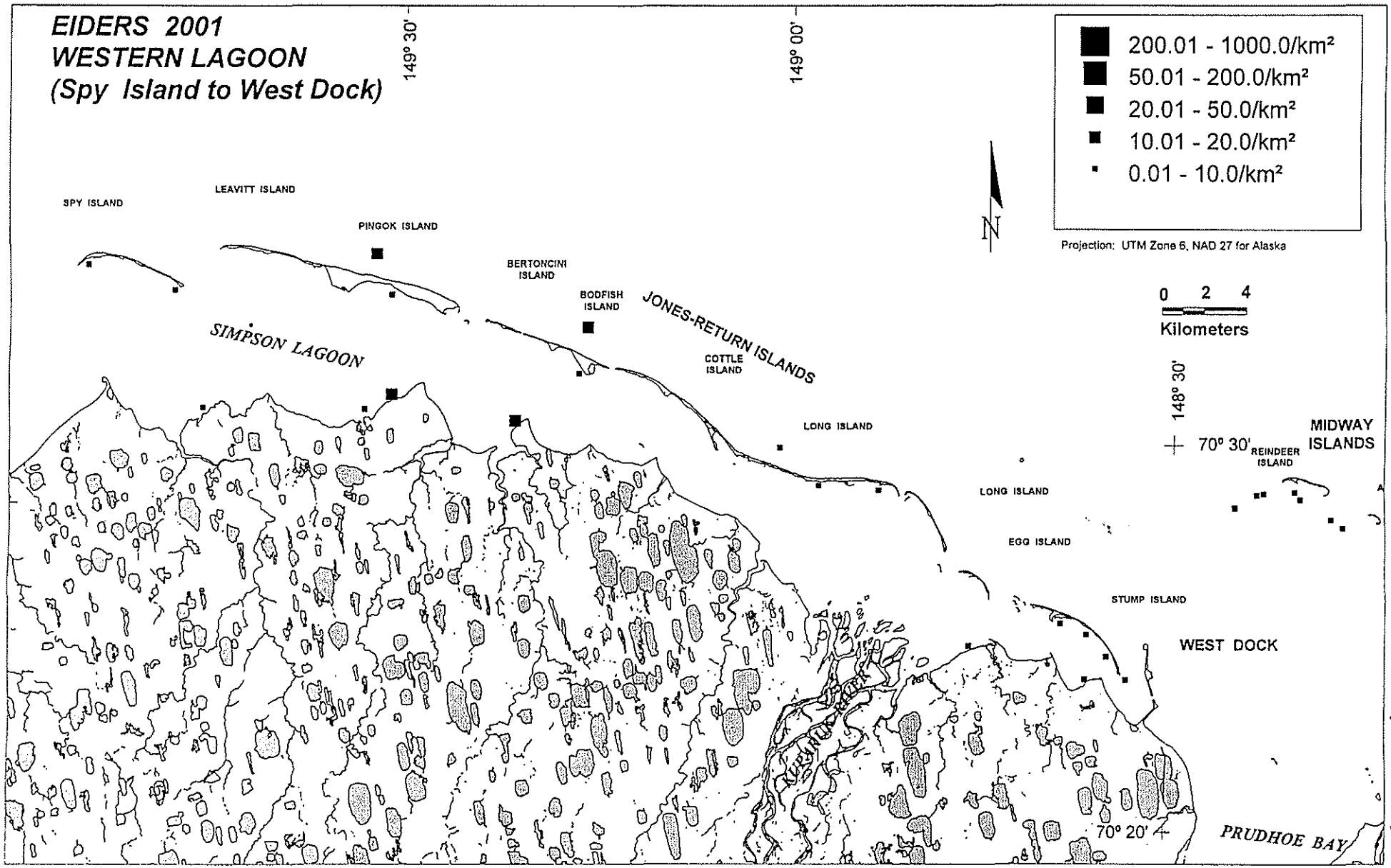


Figure 37. Summary of density for eiders by 30-s time period segments in the barrier island-lagoon system between Spy Island and West Dock, Alaska, 23 July-11 August 2001.

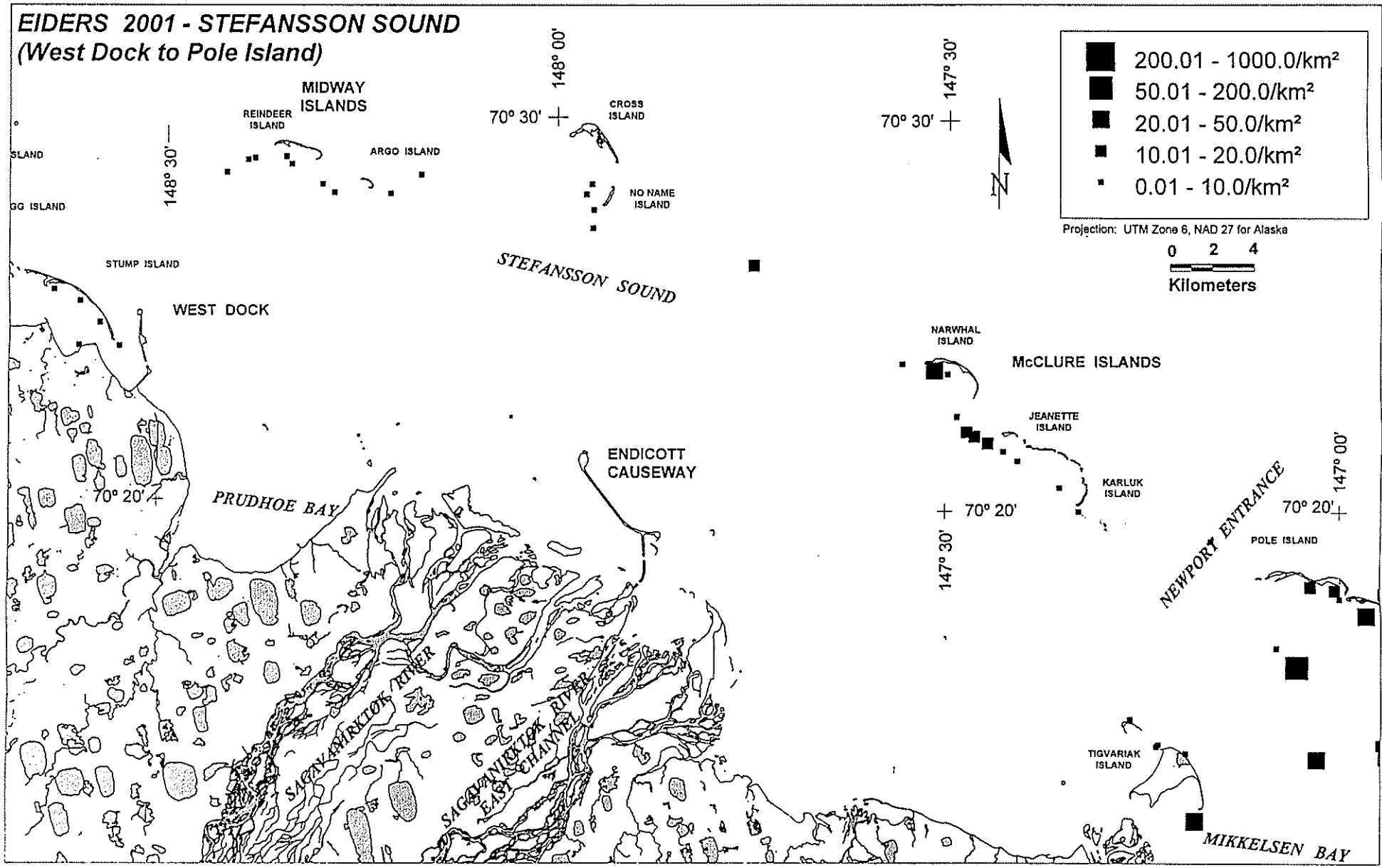


Figure 38. Summary of density for eiders by 30-s time period segments in the barrier island-lagoon system between West Dock and Pole Island, Alaska, 23 July-11 August 2001.

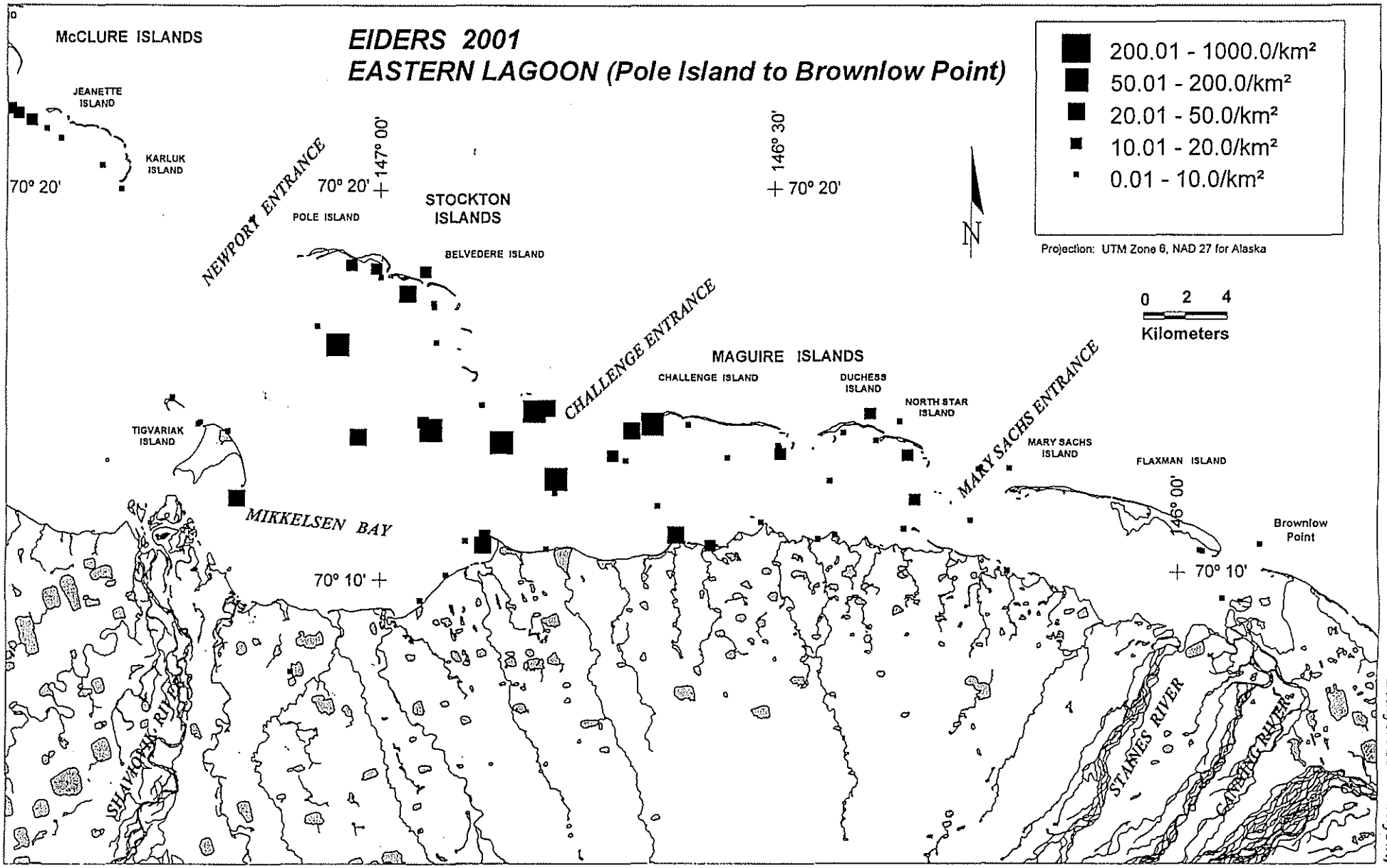


Figure 39. Summary of density for eiders by 30-s time period segments in the barrier island-lagoon system between Pole Island and Brownlow Point, Alaska, 23 July-11 August 2001.

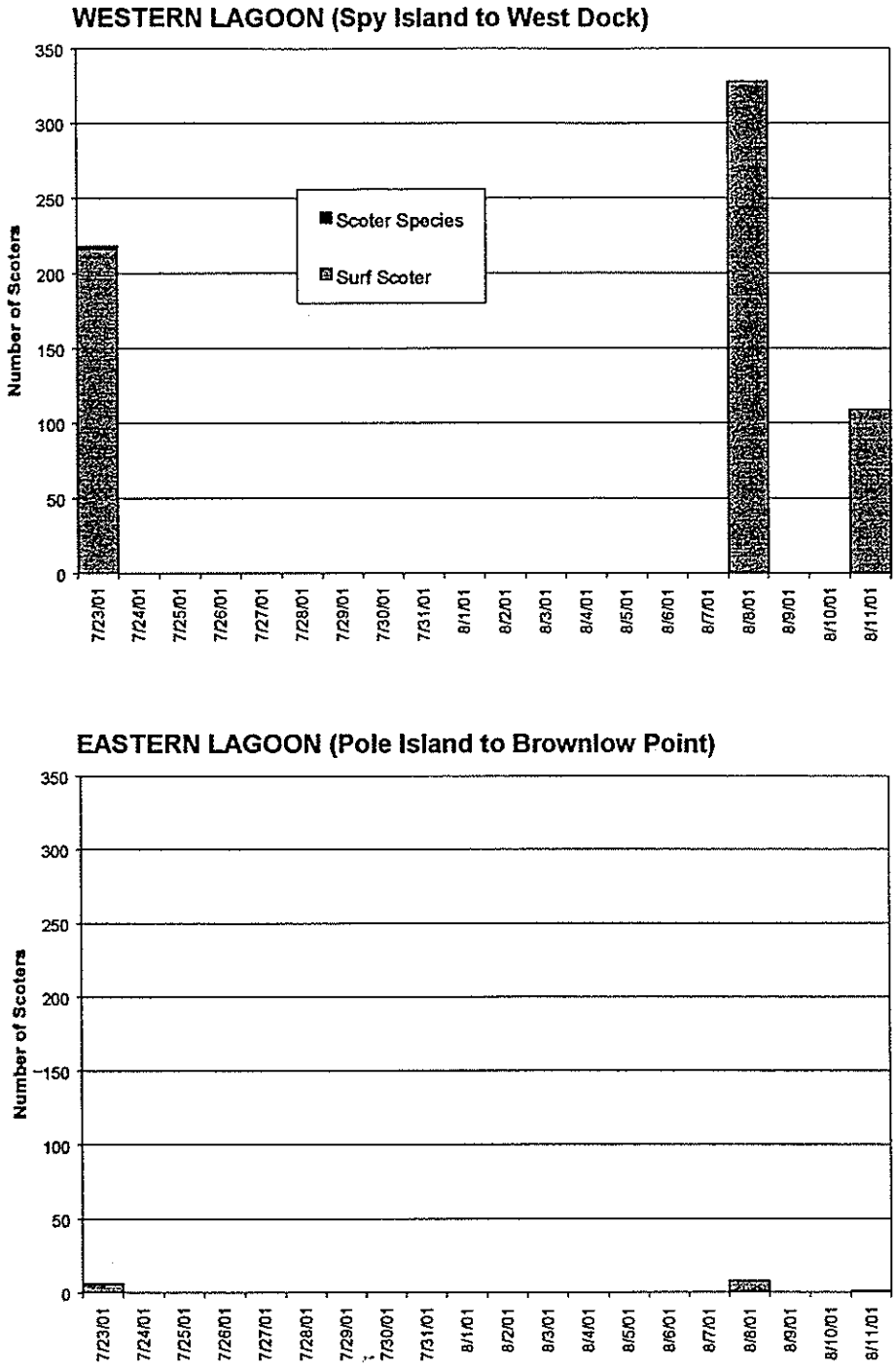


Figure 40. Total number of scoters on- and off-transect during aerial surveys in the barrier island-lagoon systems between Spy Island and Brownlow Point, Alaska, 23 July–11 August 2001. Surveys were flown on 23 July, 8 August and 11 August 2001.

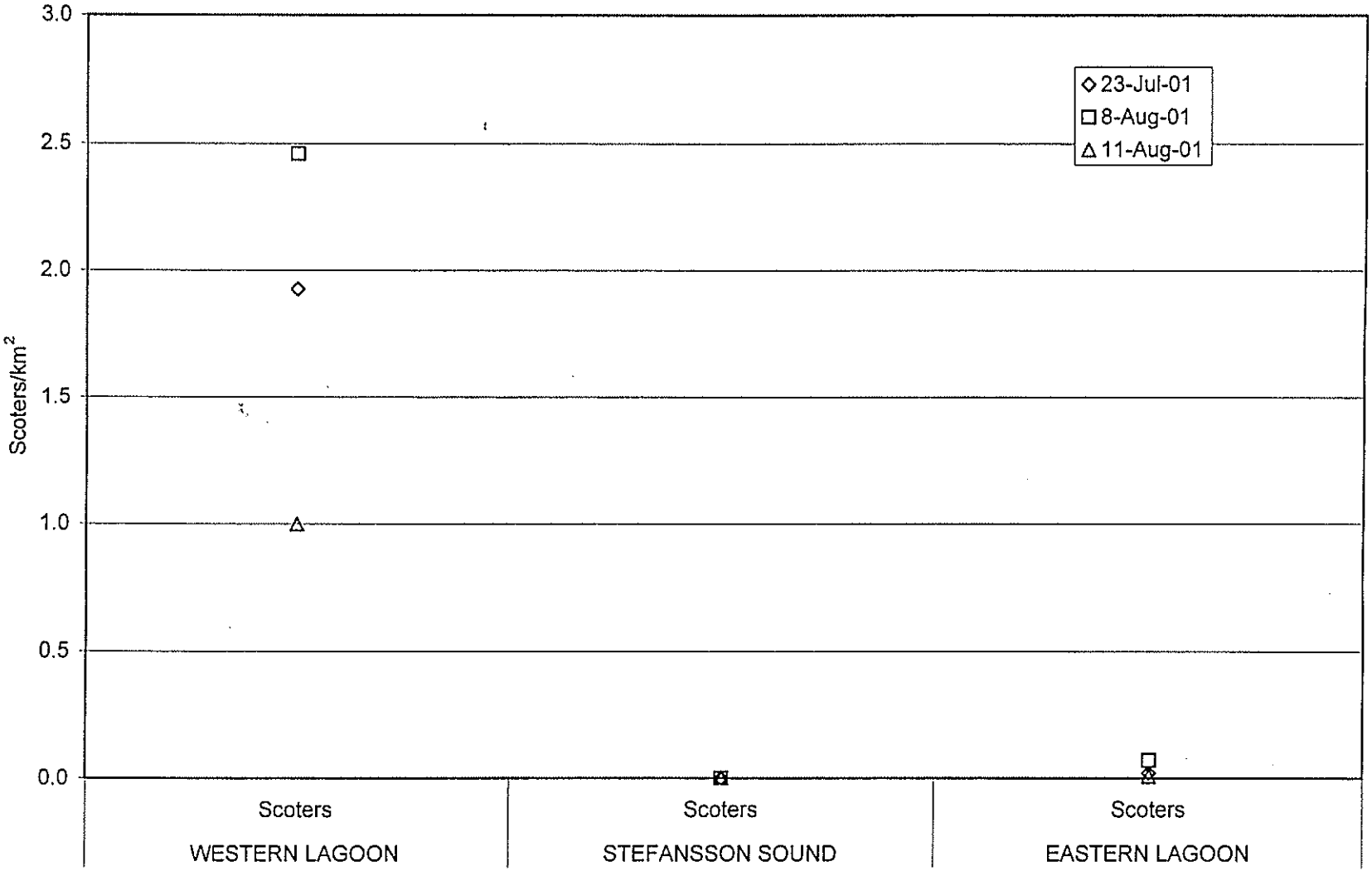


Figure 41. Areal density of scoters for 3 aerial surveys by region between Spy Island and Brownlow Point, Alaska, 23 July-11 August 2001. On 23 July 2001, two mainland transects in the eastern lagoon and all tundra transects were not flown because of fog.

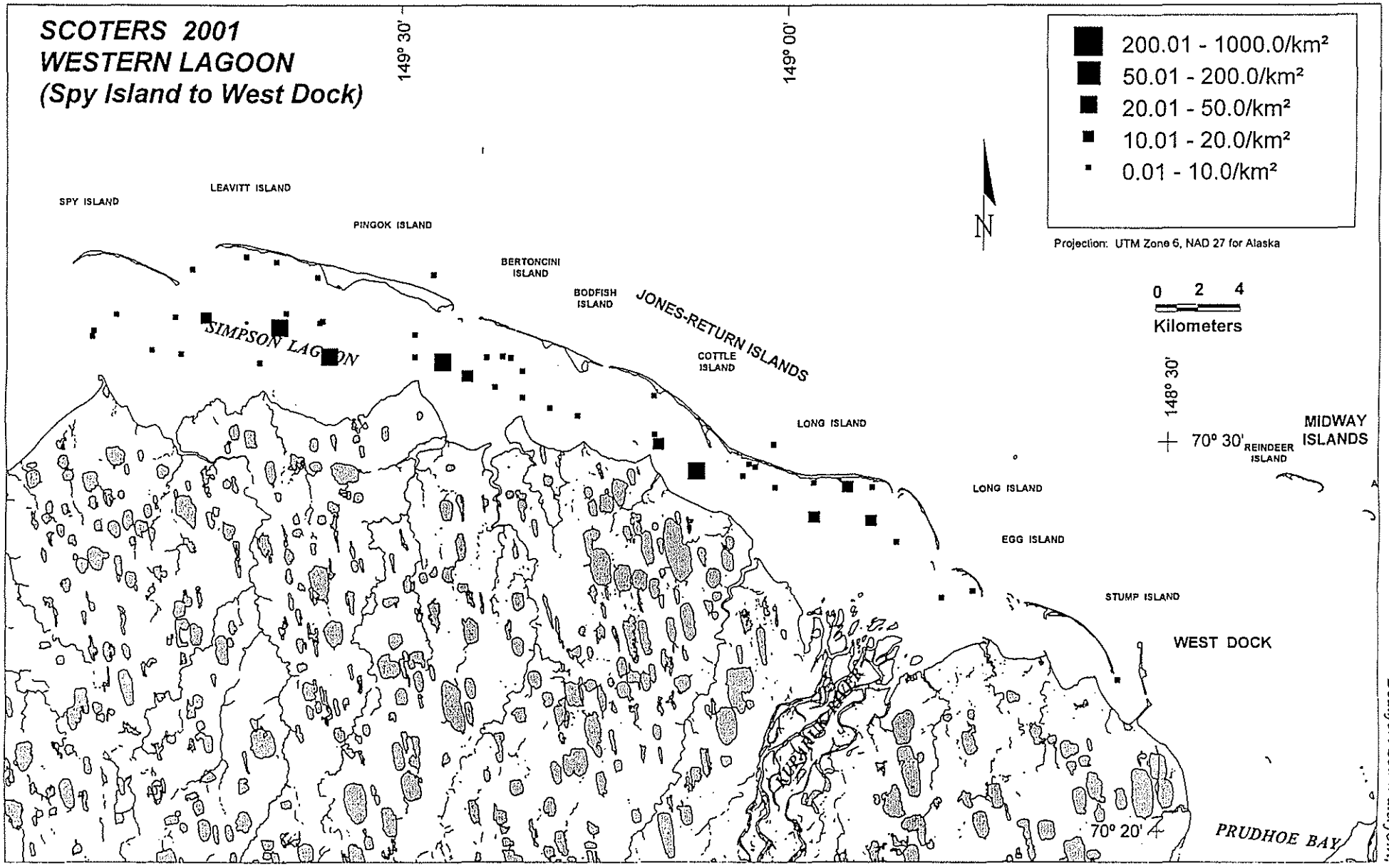


Figure 42. Summary of density for scoters by 30-s time period segments in the barrier island-lagoon system between Spy Island and West Dock, Alaska, 23 July-11 August 2001.

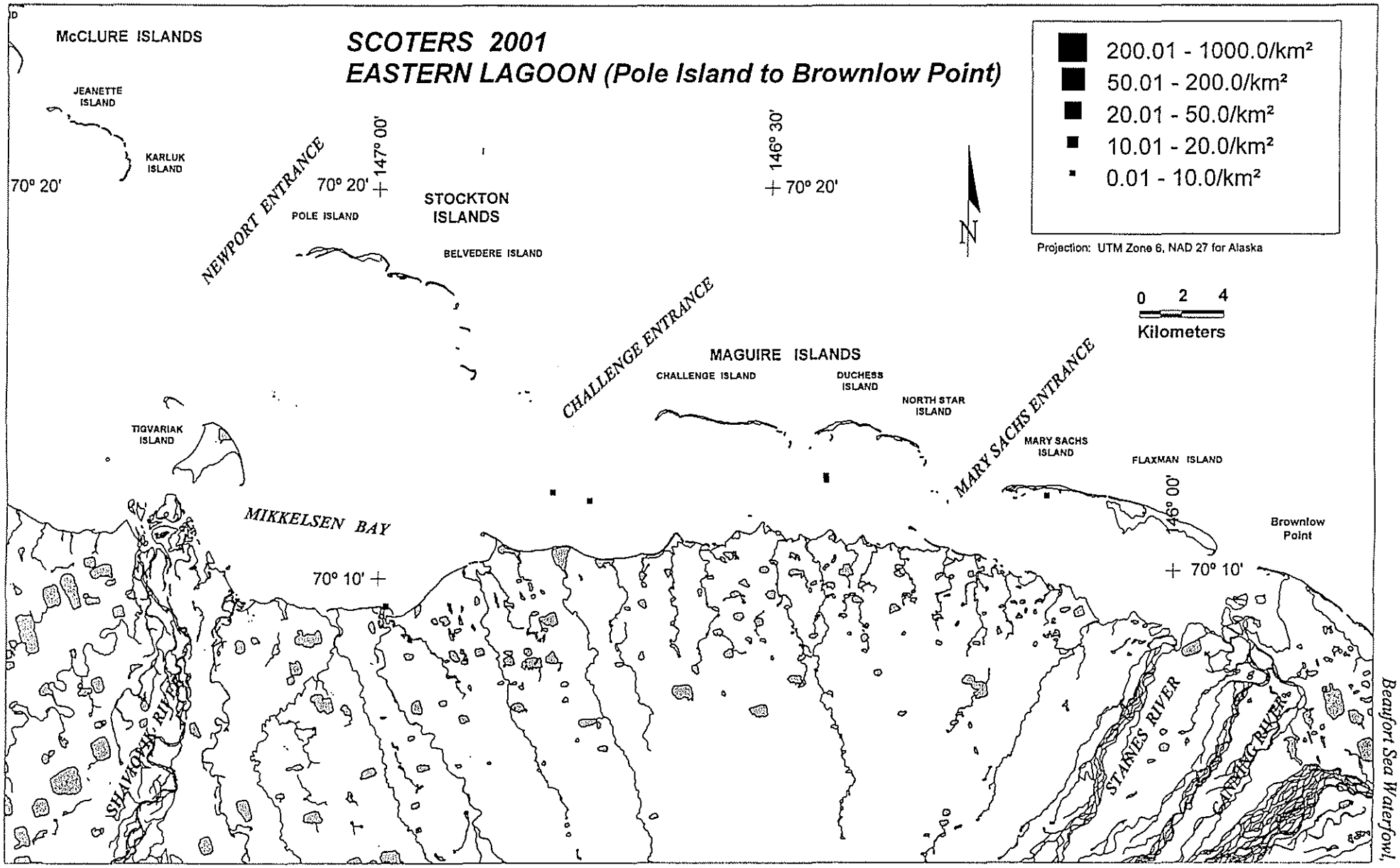


Figure 43. Summary of density for scoters by 30-s time period segments in the barrier island-lagoon system between Pole Island and Brownlow Point, Alaska, 23 July-11 August 2001.

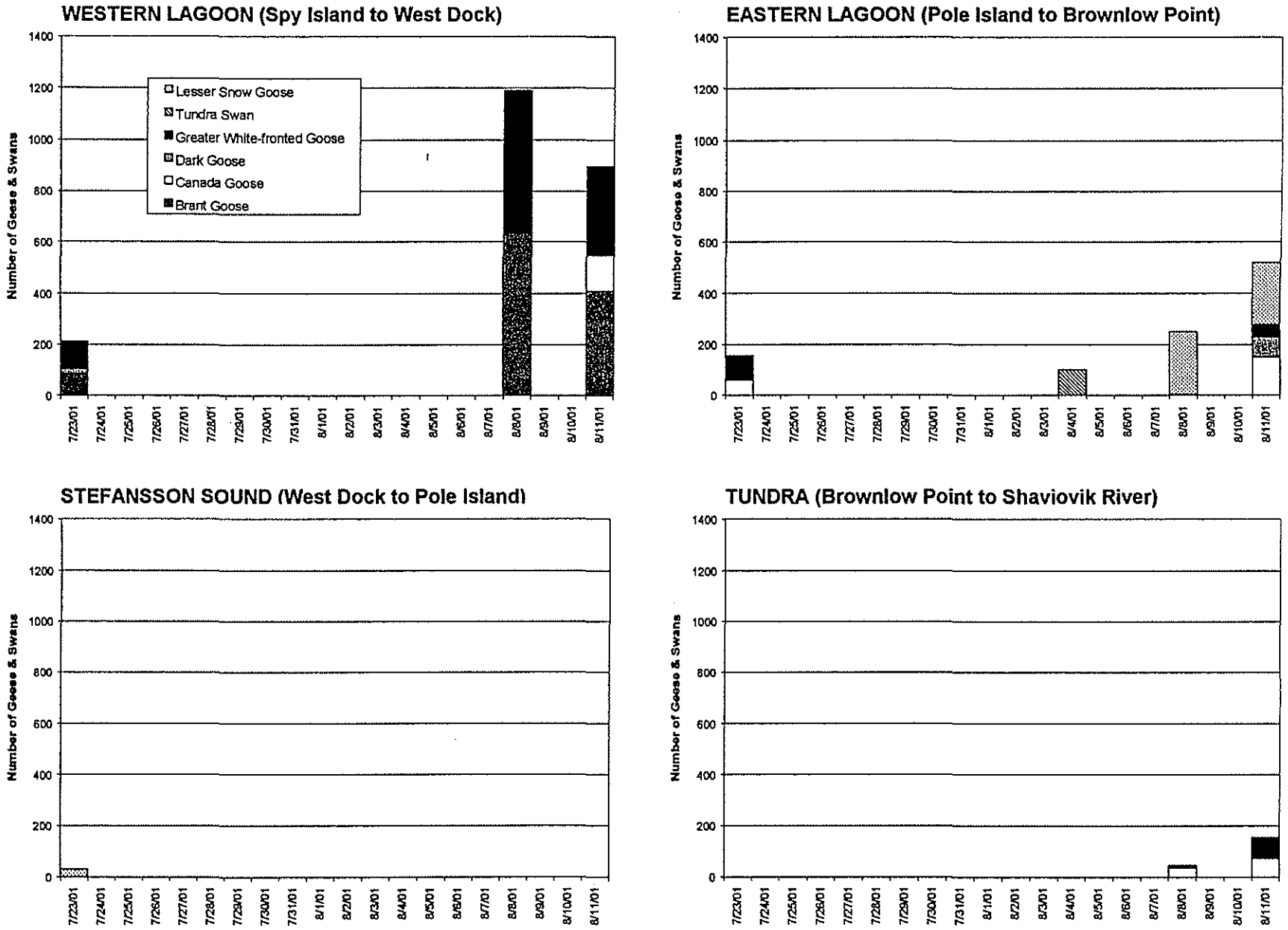


Figure 44. Total number of geese and swans observed both on- and off-transect during aerial surveys in the barrier island-lagoon systems between Spy Island and Brownlow Point, Alaska, 23 July–11 August 2001. Surveys were flown on 23 July, 8 August and 11 August 2001.

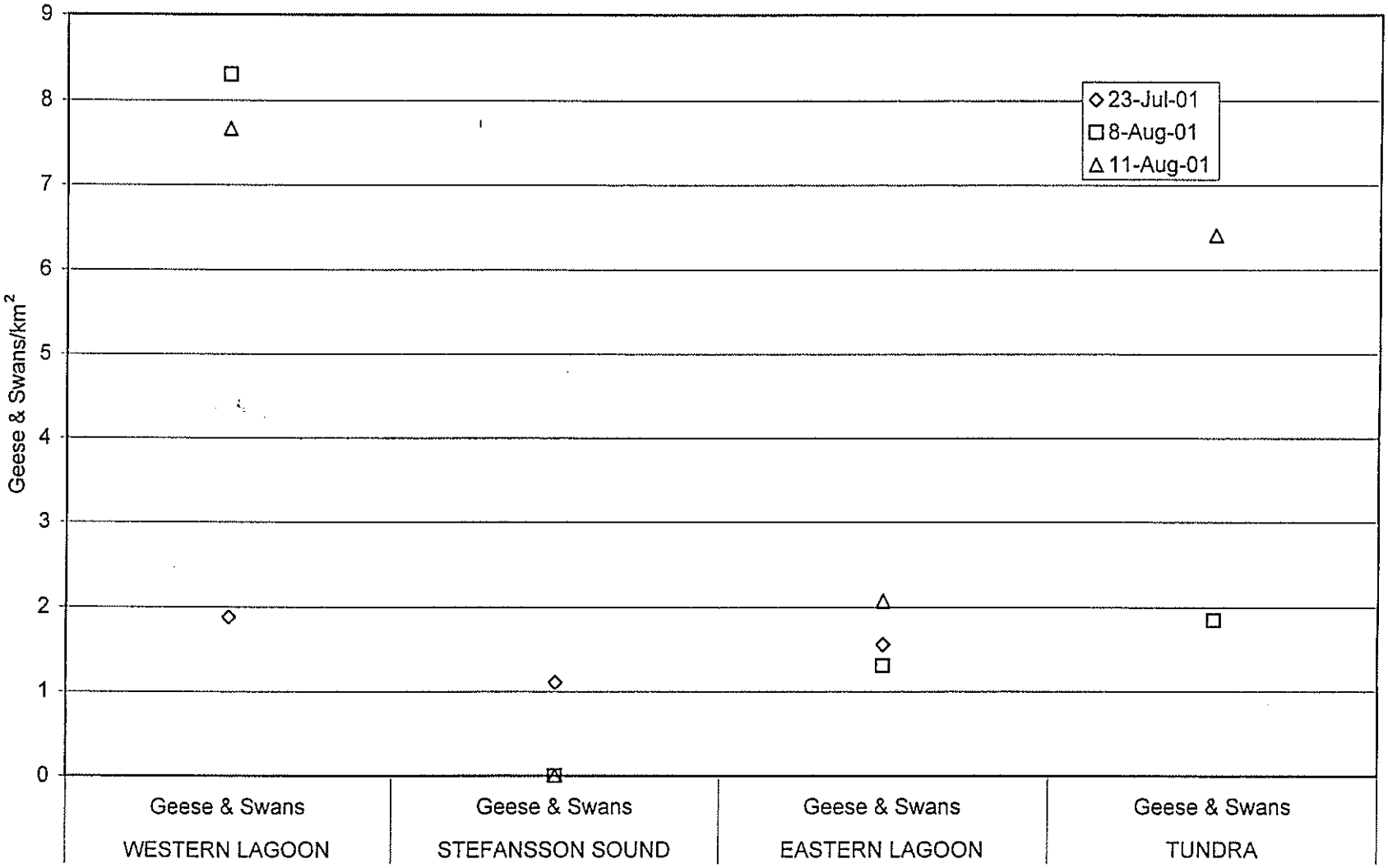


Figure 45. Areal density of geese and swans for 3 aerial surveys by region between Spy Island and Brownlow Point, Alaska, 23 July-11 August 2001. On 23 July 2001, two mainland transects in the eastern lagoon and all tundra transects were not flown because of fog.

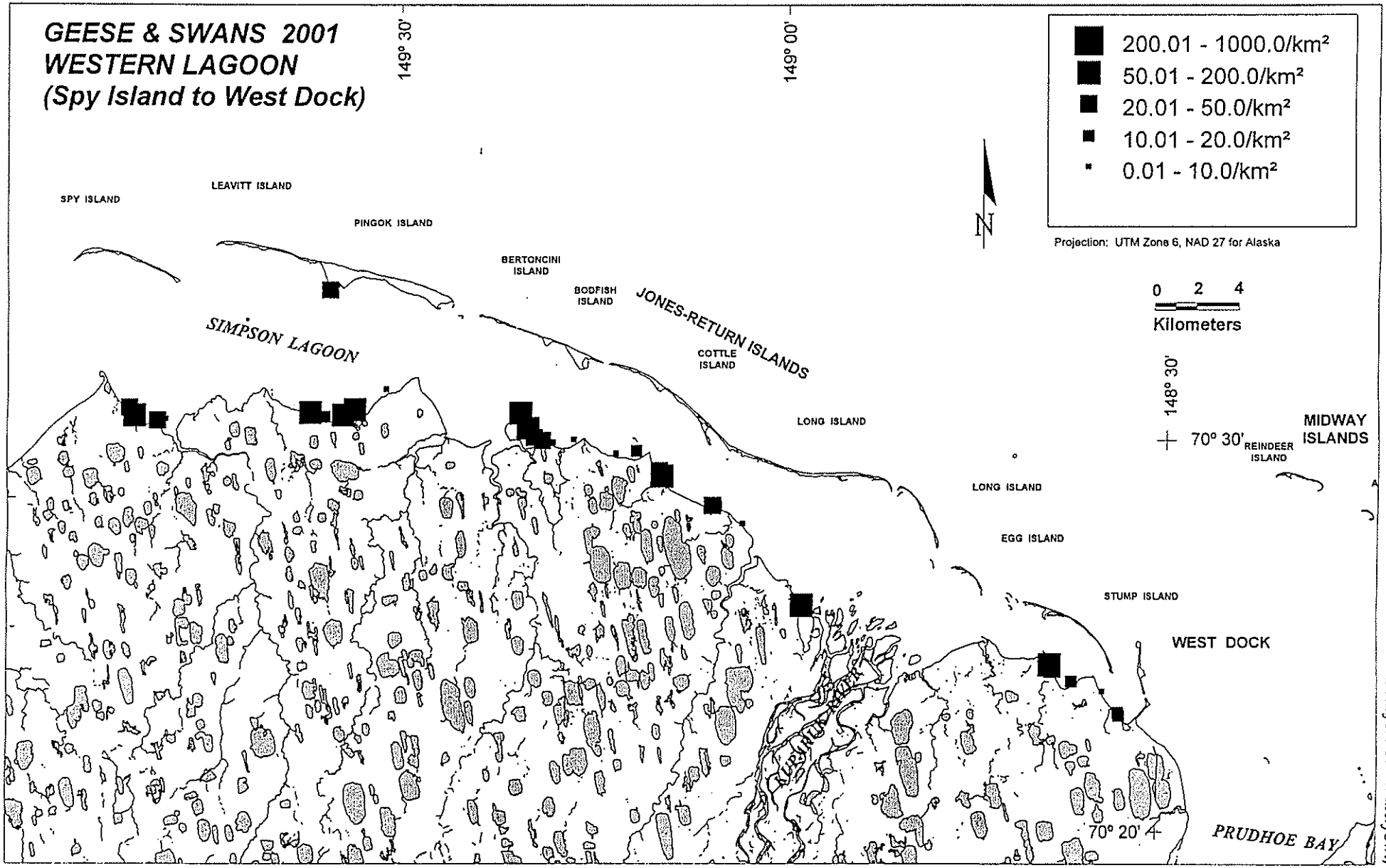


Figure 46. Summary of density for geese and swans by 30-s time period segments in the barrier island-lagoon system between Spy Island and West Dock, Alaska, 23 July-11 August 2001.

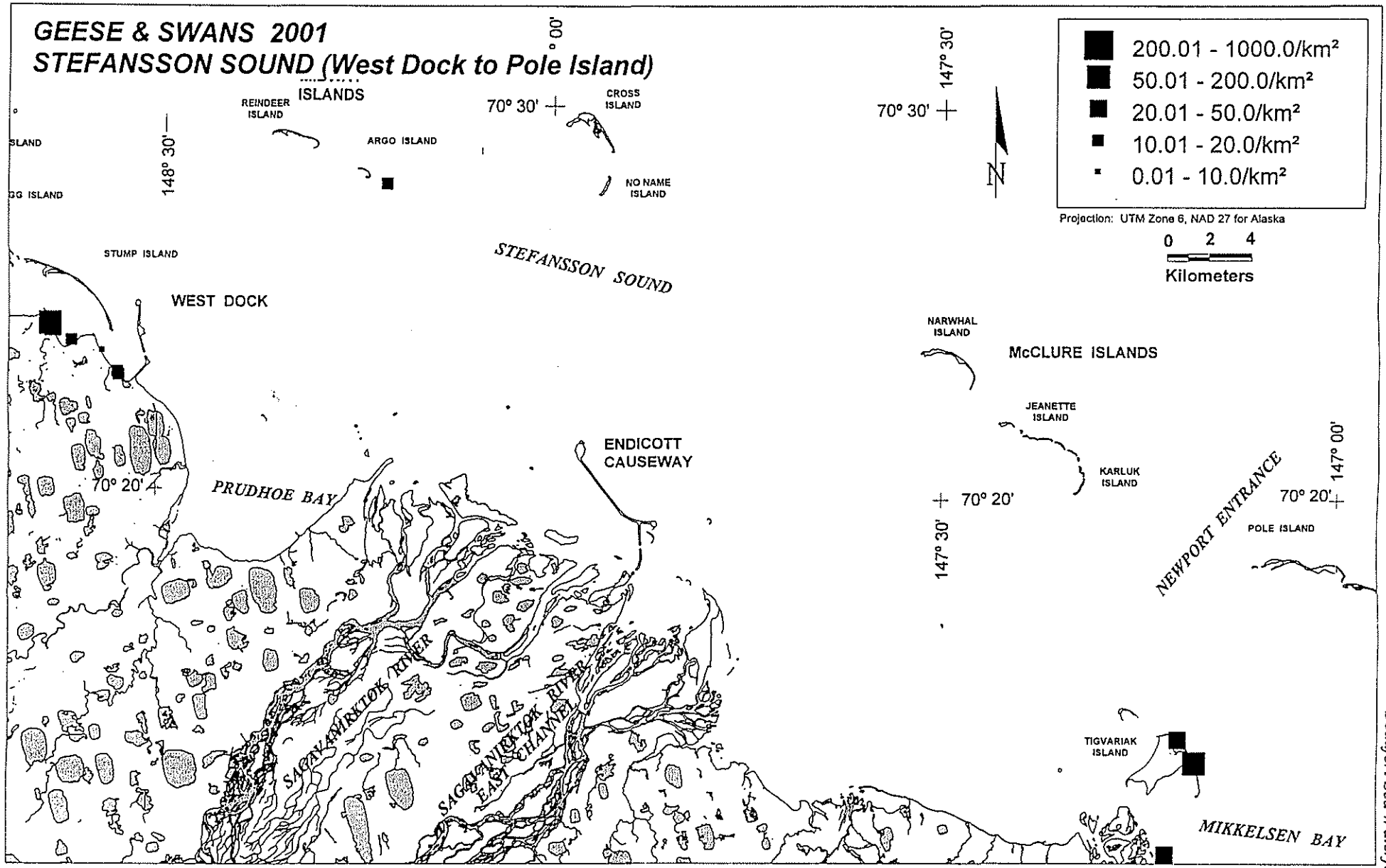


Figure 47. Summary of density for geese and swans by 30-s time period segments in the barrier island-lagoon system between West Dock and Pole Island, Alaska, 23 July-11 August 2001.

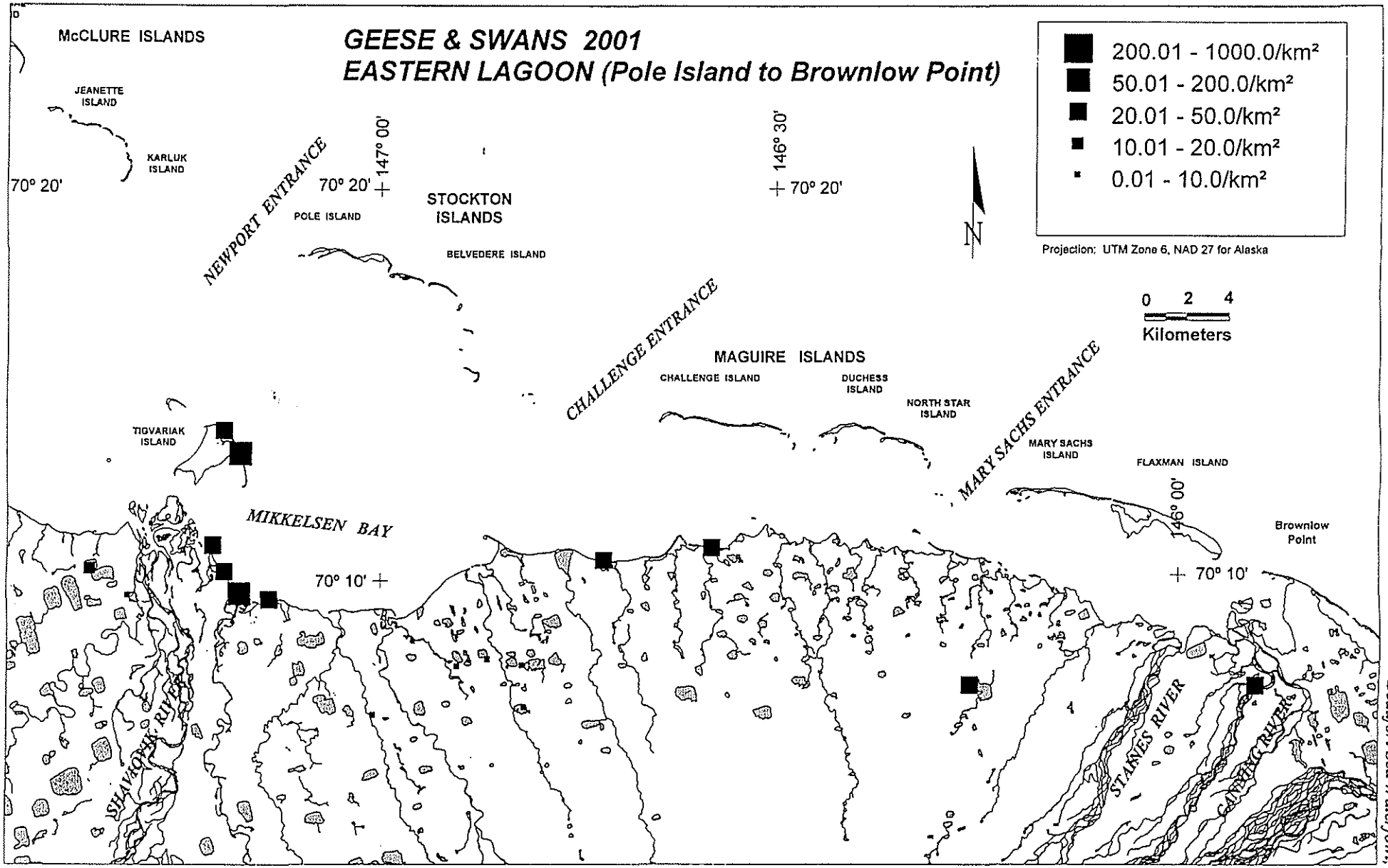


Figure 48. Summary of density for geese and swans by 30-s time period segments in the barrier island-lagoon system between Pole Island and Brownlow Point, Alaska, 23 July-11 August 2001.

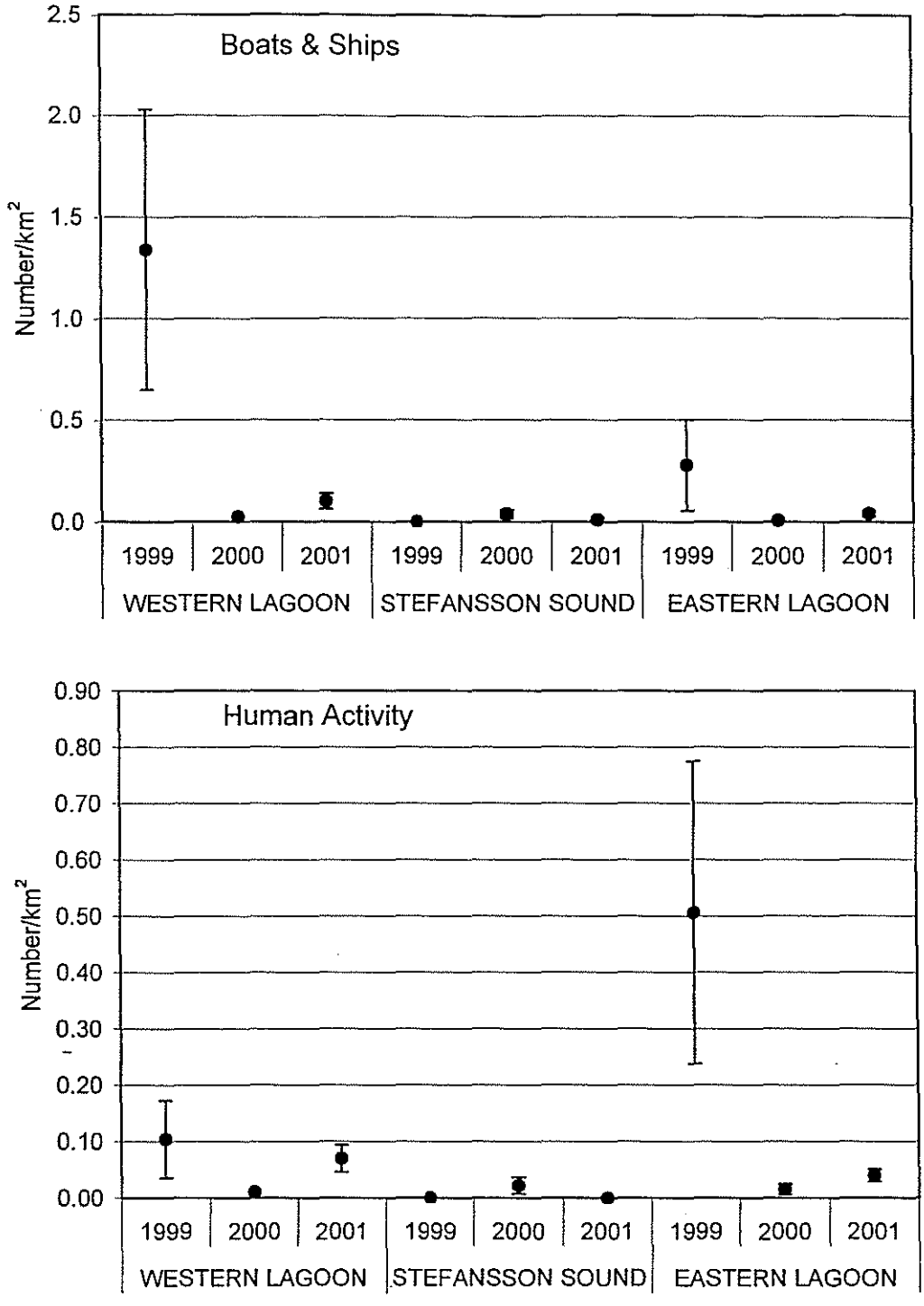


Figure 49. Mean areal density with standard error for vessel traffic and human activity (nets, camps, and/or people) during aerial surveys by region between Spy Island and Brownlow Point, Alaska, July-August 1999-2001.

Table 1. Summary of weather and lagoon conditions during 3 aerial surveys in the barrier island-lagoon systems between Spy Island and Brownlow Point and on tundra transects from Brownlow Point to the Shaviovik River, Alaska, 23 July–11 August 2001. (ADST = Alaska Daylight Savings Time)

Survey	Start Time (ADST)	Survey Duration (minutes)	Air Temperature (°C)	Wind Speed (kph)	Cloud Cover (tenths)	Right Front Observer	Left Rear Observer
WESTERN LAGOON (Spy Island to West Dock)							
23 Jul 01	13:35:04	96.6	19°	9	2	Lynn Noel	Bob Rodrigues
08 Aug 01	13:40:47	91.7	13°	8	9	Lynn Noel	Bob Rodrigues
11 Aug 01	13:43:24	96.3	9°	8	3	Lynn Noel	Paul Jensen
STEFANSSON SOUND (West Dock to Pole Island)							
23 Jul 01	16:09:04	20.6	19°	8	6	Lynn Noel	Bob Rodrigues
08 Aug 01	16:14:03	22.7	12°	8	6	Lynn Noel	Bob Rodrigues
11 Aug 01	16:10:45	23.0	6°	8	5	Lynn Noel	Paul Jensen
EASTERN LAGOON (Pole Island to Brownlow Point)							
23 Jul 01	16:29:53	85.8	19°	10	5	Lynn Noel	Bob Rodrigues
08 Aug 01	16:37:18	98.3	11°	8	6	Lynn Noel	Bob Rodrigues
11 Aug 01	16:34:24	95.6	5°	8	8	Lynn Noel	Paul Jensen
TUNDRA (Brownlow Point to Shaviovik River)							
23 Jul 01	Fog-no survey						
08 Aug 01	18:16:36	17.2	11°	8	9	Lynn Noel	Bob Rodrigues
11 Aug 01	18:11:04	18.4	6°	8	10	Lynn Noel	Paul Jensen

Table 2. Summary of survey effort in the barrier island-lagoon systems between Spy Island and Brownlow Point and tundra between Brownlow Point and the Shaviovik River, Alaska, 23 July–11 August 2001. Western Lagoon (Spy Island to West Dock), Stefansson Sound (West Dock to Pole Island), Eastern Lagoon (Pole Island to Flaxman Island), and Tundra (Brownlow Point to Shaviovik River).

Region	Transect Number	Number of Replicates	Total Length (km)	Total Areal Coverage (km^2)
Western Lagoon	22	3	23.8	9.52
	23	3	30.3	12.12
	24	3	32.4	12.96
	25	3	34.1	13.64
	30	3	39.9	15.96
	31	3	41.7	16.68
	32	3	45.5	18.20
	33	3	55.0	22.00
	101	3	66.4	26.56
	102	3	42.8	17.12
	201	3	64.5	25.80
	202	3	47.2	18.88
	301	3	53.1	21.24
	302	3	36.7	14.68
	401	3	54.6	21.84
	402	3	42.5	17.00
	601	3	43.3	14.44
	602	3	38.2	13.98
	603	3	55.2	22.08
Total Effort			**847.2**	**334.70**
Stefansson Sound	130	3	75.2	30.08
	131	3	74.6	29.84
	132	3	53.1	21.24
Total Effort			**202.9**	**81.16**
Eastern Lagoon	60	3	38.7	15.48
	61	3	37.4	14.96
	62	3	36.7	14.68
	63	3	40.2	16.08
	133	3	43.1	17.24
	134	3	41.0	16.40
	135	3	41.3	16.52
	136	3	46.0	18.40
	180	3	44.1	17.64
	181	3	36.7	14.68
	182	3	39.0	15.60
	183	3	35.2	14.08
	190	2	32.0	12.80
	191	2	29.2	11.68
	192	3	52.7	21.08
	193	3	64.1	25.64
	604	3	39.4	15.76
	605	3	39.7	15.88
	606	3	36.1	14.44
	607	3	41.2	16.48
Total Effort			**813.8**	**325.52**
Tundra	500	2	32.8	13.12
	501	2	30.1	12.04
	502	2	31.7	12.68
	503	2	27.9	11.16
Total Effort			**122.5**	**49.00**
Total Effort All Transects			**1986.4**	**790.38**

Table 3. Total number of bird sightings and individuals seen on- and off-transect for all aerial survey transects (total length = 1986.4 km) in the barrier island-lagoon system, offshore, and on tundra between Spy Island and Brownlow Point, Alaska, 23 July - 11 August 2001.

Species Code	Species Name	Number of Sightings	Percent of Sightings	Number of Individuals	Percent of Individuals	Percent of Classified for Group
PALO	Pacific Loon (*Gavia pacifica*)	146	7.9	212	0.6	70.7
RTLO	Red-throated Loon (*Gavia stellata*)	59	3.2	80	0.2	26.7
YBLO	Yellow-billed Loon (*Gavia adamsii*)	8	0.4	8	0.0	2.7
LOSP	Loon Species (*Gavia* spp.)	7	0.4	8	0.0	
Loons		**220**	**11.9**	**308**	**0.9**	
POJA	Pomarine Jaeger (*Stercorarius pomarinus*)	1	0.1	2	0.0	100.0
Jaegers		**1**	**0.1**	**2**	**0.0**	
GLGU	Glaucous Gull (*Larus hyperboreus*)	347	18.7	856	2.5	94.6
SAGU	Sabine's Gull (*Xema sabini*)	3	0.2	49	0.1	5.4
Gulls		**350**	**18.9**	**905**	**2.6**	
ARTE	Arctic Tern (*Sterna paradisaea*)	21	1.1	34	0.1	
COMU	Common Murre (*Uria aalge*)	1	0.1	1	0.0	
BLGU	Black Guillemot (*Cepphus grylle*)	1	0.1	1	0.0	
SEABIRDS (Jaegers, Gulls, and Terns)		**374**	**20.1**	**942**	**2.7**	
COEI	Common (Pacific) Eider (*Somateria mollissima v-nigrum*)	190	10.3	2240	6.4	99.5
KIEI	King Eider (*Somateria spectabilis*)	1	0.1	11	0.0	0.5
EISP	Eider Species (*Somateria* spp.)	6	0.3	104	0.3	
Eiders		**197**	**10.6**	**2355**	**6.7**	
SUSC	Surf Scoter (*Melanitta perspicillata*)	71	3.8	698	2.0	99.6
BLSC	Black Scoter (*Melanitta nigra*)	1	0.1	1	0.0	0.1
SCOT	Scoter Species (*Melanitta* spp.)	2	0.1	2	0.0	0.3
Scoters		**74**	**4.0**	**701**	**2.0**	
NOPI	Northern Pintail (*Anas acuta*)	2	0.1	24	0.1	
OLDS	Long-tailed Duck (*Clangula hyemalis*)	857	46.3	26878	77.0	
RBME	Red-breasted Merganser (*Mergus serrator*)	1	0.1	1	0.0	
GRSC	Greater Scaup (*Aythya marila*)	1	0.1	20	0.1	
SCAUP	Scaup Species (*Aythya* spp.)	3	0.2	10	0.0	
DKSP	Duck Species	22	1.2	201	0.6	
Ducks		**1157**	**62.5**	**30190**	**86.5**	
BRAN	Black Brant (*Branta bernicla*)	21	1.1	1129	3.2	33.6
CAGO	Canada Goose (*Branta canadensis*)	17	0.9	461	1.3	13.7
GWGO	Greater White-fronted Goose (*Anser albifrons*)	31	1.7	1230	3.5	36.6
LSGO	Lesser Snow Goose (*Chen caerulescens caerulescens*)	8	0.4	520	1.5	15.5
TUSW	Tundra Swan (*Cygnus columbianus*)	7	0.4	19	0.1	0.6
DAGO	Dark Goose	2	0.1	100	0.3	
Geese & Swans		**84**	**4.5**	**3359**	**9.6**	
WATERFOWL (Ducks, Geese & Swans)		**1241**	**67.0**	**33549**	**96.1**	
PHSP	Phalarope Species (*Phalaropus* spp.)	3	0.2	81	0.2	
SMSH	Small Shorebird	5	0.3	11	0.0	
MESH	Medium Shorebird	2	0.1	5	0.0	
SHOREBIRDS		**10**	**0.5**	97	**0.3**	
SNOW	Snowy Owl (*Nyctea scandiaca*)	1	0.1	1	0.0	
SNBU	Snow Bunting (*Plectrophenax nivalis*)	1	0.1	1	0.0	
RLHA	Rough-legged Hawk (*Buteo lagopus*)	1	0.1	1	0.0	
BISP	Bird Species	4	0.2	8	0.0	
ALL BIRDS		**1852**	**100**	**34907**	**100**	

Table 4. Total number of bird sightings and individuals seen on- and off-transect for aerial survey transects (total length = 847.2 km) in the barrier island-lagoon system and offshore between Spy Island and West Dock, Alaska, 23 July-11 August 2001.

Species Code	*WESTERN LAGOON* Species Name	Number of Sightings	Percent of Sightings	Number of Individuals	Percent of Individuals	Percent of Classified for Group
PALO	Pacific Loon (*Gavia pacifica*)	93	9.1	129	0.8	62.6
RTLO	Red-throated Loon (*Gavia stellata*)	51	5.0	71	0.4	34.5
YBLO	Yellow-billed Loon (*Gavia adamsii*)	6	0.6	6	0.0	2.9
LOSP	Loon Species (*Gavia* spp.)	7	0.7	8	0.0	
Loons		**157**	**15.3**	**214**	**1.3**	
GLGU	Glaucous Gull (*Larus hyperboreus*)	208	20.3	559	3.4	93.2
SAGU	Sabine's Gull (*Xema sabini*)	2	0.2	41	0.2	6.8
Gulls		**210**	**20.4**	**600**	**3.6**	
ARTE	Arctic Tern (*Sterna paradisaea*)	5	0.5	6	0.0	
SEABIRDS (Jaegers, Gulls, and Terns)		**215**	**20.93**	**606**	**3.7**	
COEI	Common (Pacific) Eider (*Somateria mollissima v-nigrum*)	30	2.9	219	1.3	100.0
EISP	Eider Species (*Somateria* spp.)	2	0.2	45	0.3	
Eiders		**32**	**3.1**	**264**	**1.6**	
SUSC	Surf Scoter (*Melanitta perspicillata*)	65	6.3	683	4.2	100.0
SCOT	Scoter Species (*Melanitta* spp.)	2	0.2	2	0.0	
Scoters		**67**	**6.5**	**685**	**4.2**	
NOPI	Northern Pintail (*Anas acuta*)	1	0.1	4	0.0	
OLDS	Long-tailed Duck (*Clangula hyemalis*)	479	46.6	12207	74.2	
GRSC	Greater Scaup (*Aythya marila*)	1	0.1	20	0.1	
SCAUP	Scaup Species (*Aythya* spp.)	1	0.1	2	0.0	
DKSP	Duck Species	14	1.4	147	0.9	
Ducks		**595**	**57.8**	**13329**	**81.0**	
BRAN	Black Brant (*Branta bernicla*)	21	2.0	1129	6.9	49.5
GWGO	Greater White-fronted Goose (*Anser albifrons*)	25	2.4	1009	6.1	44.3
CAGO	Canada Goose (*Branta canadensis*)	6	0.6	140	0.9	6.1
TUSW	Tundra Swan (*Cygnus columbianus*)	1	0.1	2	0.0	0.1
DAGO	Dark Goose	1	0.1	20	0.1	
Geese & Swans		**53**	**5.2**	**2280**	**13.9**	
WATERFOWL (Ducks, Geese & Swans)		**648**	**63.0**	**15609**	**94.9**	
MESH	Medium Shorebird	1	0.1	2		
SMSH	Small Shorebird	1	0.1	1	0.0	
SHOREBIRDS		**2**	**0.1**	**3**	**0.0**	
RLHA	Rough-legged Hawk (*Buteo lagopus*)	1	0.1	1	0.0	
RAPTORS		**1**	**0.1**	**1**	**0.0**	
BISP	Bird Species	4	0.4	8	0.0	
ALL BIRDS		**1027**	**100**	**16441**	**100**	

Table 5 Total number of bird sightings and individuals seen on- and off-transect for aerial survey transects (total length = 202.9 km) in the barrier island-lagoon system between West Dock and Pole Island, Alaska, 23 July-11 August 2001.

Species Code	*STEFANSSON SOUND* Species Name	Number of Sightings	Percent of Sightings	Number of Individuals	Percent of Individuals	Percent of Classified for Group
PALO	Pacific Loon (*Gavia pacifica*)	6	3.9	11	0.6	78.6
RTLO	Red-throated Loon (*Gavia stellata*)	2	1.3	2	0.1	14.3
YBLO	Yellow-billed Loon (*Gavia adamsii*)	1	0.6	1	0.1	7.1
Loons		**9**	**5.8**	**14**	**0.8**	
GLGU	Glaucous Gull (*Larus hyperboreus*)	27	17.4	46	2.6	100.0
Gulls		**27**	**17.4**	**46**	**2.6**	
ARTE	Arctic Tern (*Sterna paradisaea*)	11	7.1	18	1.0	
BLGU	Black Guillemot (*Cepphus grylle*)	1	0.6	1	0.1	
SEABIRDS (Jaegers, Gulls, and Terns)		**39**	**25.2**	**65**	**3.7**	
COEI	Common (Pacific) Eider (*Somateria mollissima v-nigrum*)	52	33.5	251	14.1	100.0
Eiders		**52**	**33.5**	**251**	**14.1**	
OLDS	Long-tailed Duck (*Clangula hyemalis*)	52	33.5	1370	77.2	
DKSP	Duck Species	1	0.6	4	0.2	
Ducks		**105**	**67.7**	**1625**	**91.6**	
LSGO	Lesser Snow Goose (*Chen caerulescens caerulescens*)	1	0.6	30	1.7	100.0
Geese & Swans		**1**	**0.6**	**30**	**1.7**	
WATERFOWL (Ducks, Geese & Swans)		**106**	**68.4**	**1655**	**93.3**	
PHSP	Phalarope Species (*Phalaropus* spp.)	1	0.6	40	2.3	100.0
SHOREBIRDS		**1**	**0.6**	**40**	**2.3**	
ALL BIRDS		**155**	**100**	**1774**	**100**	

Table 6. Total number of bird sightings and individuals seen on- and off-transect for aerial survey transects (total length = 813.8 km) in the barrier island-lagoon system and offshore between Pole Island and Brownlow Point, Alaska, 23 July-11 August 2001.

Species Code	*EASTERN LAGOON* Species Name	Number of Sightings	Percent of Sightings	Number of Individuals	Percent of Individuals	Percent of Classified for Group
PALO	Pacific Loon (*Gavia pacifica*)	30	5.8	44	0.3	88.0
RTLO	Red-throated Loon (*Gavia stellata*)	5	1.0	5	0.0	10.0
YBLO	Yellow-billed Loon (*Gavia adamsii*)	1	0.2	1	0.0	2.0
Loons		**36**	**7.0**	**50**	**0**	
GLGU	Glaucous Gull (*Larus hyperboreus*)	109	21.2	248	1.7	96.9
SAGU	Sabine's Gull (*Xema sabini*)	1	0.2	8	0.1	3.1
Gulls		**110**	**21.4**	**256**	**1.8**	
ARTE	Arctic Tern (*Sterna paradisaea*)	5	1.0	10	0.1	
COMU	Common Murre (*Uria aalge*)	1	0.2	1	0.0	
SEABIRDS (Jaegers, Gulls, and Terns)		**116**	**22.5**	**267**	**1.8**	
COEI	Common (Pacific) Eider (*Somateria mollissima v-nigrum*	108	21.0	1770	12.1	99.4
KIEI	King Eider (*Somateria spectabilis)*	1	0.2	11	0.1	0.6
EISP	Eider Species (*Somateria* spp.)	3	0.6	54	0.4	
Eiders		**4**	**0.8**	**65**	**0.4**	
SUSC	Surf Scoter (*Melanitta perspicillata*)	6	1.2	15	0.1	93.8
BLSC	Black Scoter (*Melanitta nigra*)	1	0.2	1	0.0	6.3
Scoters		**7**	**1.4**	**16**	**0.1**	
OLDS	Long-tailed Duck (*Clangula hyemalis*)	321	62.3	13249	90.9	
SCAUP	Scaup Species (*Aythya* spp.)	1	0.2	6	0.0	
NOPI	Northern Pintail (*Anas acuta*)	1	0.2	20	0.1	
RBME	Red-breasted Merganser (*Mergus serrator*)	1	0.2	1	0.0	
DKSP	Duck Species	7	1.4	50	0.3	
Ducks		**342**	**66.4**	**13407**	**92.0**	
CAGO	Canada Goose (*Branta canadensis*)	5	1.0	210	1.4	24.8
GWGO	Greater White-fronted Goose (*Anser albifrons*)	4	0.8	141	1.0	16.7
LSGO	Lesser Snow Goose (*Chen caerulescens caerulescens*)	7	1.4	490	3.4	57.9
TUSW	Tundra Swan (*Cygnus columbianus*)	2	0.4	5	0.0	0.6
DAGO	Dark Goose	1	0.2	80	0.5	
Geese & Swans		**18**	**3.5**	**846**	**5.8**	
WATERFOWL (Ducks, Geese & Swans)		**360**	**70**	**14253**	**98**	
SMSH	Small Shorebird	1	0.2	1	0.0	
MESH	Medium Shorebird	1	0.2	3	0.0	
SHOREBIRDS		**2**	**0.4**	**4**	**0.0**	
SNOW	Snowy Owl (*Nyctea scandiaca*)	1		1		
ALL BIRDS		**515**	**100**	**14575**	**100**	

Table 7. Total number of bird sightings and individuals seen on- and off-transect for aerial survey transects (total length = 122.5 km) on tundra between Brownlow Point and the Shaviovik River, Alaska, 8 and 11 August 2001.

Species Code	*TUNDRA* Species Name	Number of Sightings	Percent of Sightings	Number of Individuals	Percent of Individuals	Percent of Classified for Group
PALO	Pacific Loon (*Gavia pacifica*)	17	36.2	28	8.0	93.3
RTLO	Red-throated Loon (*Gavia stellata*)	1	2.1	2	0.6	6.7
Loons		**18**	**38.3**	**30**	**8.6**	
POJA	Pomarine Jaeger (*Stercorarius pomarinus*)	1	2.1	2	0.6	100.0
Jaegers		**1**	**2.1**	**2**	**0.6**	
GLGU	Glaucous Gull (*Larus hyperboreus*)	3	6.4	3	0.9	100.0
Gulls		**3**	**6.4**	**3**	**0.9**	
SEABIRDS (Jaegers, Gulls, and Terns)		**4**	**8.5**	**5**	**1.4**	
EISP	Eider Species (*Somateria* spp.)	1	2.1	5	1.4	
Eiders		**1**	**2.1**	**5**	**1.4**	
OLDS	Long-tailed Duck (*Clangula hyemalis*)	5	10.6	52	14.9	
SCAUP	Scaup Species (*Aythya* spp.)	1	2.1	2	0.6	
Ducks		**7**	**14.9**	**59**	**17.0**	
CAGO	Canada Goose (*Branta canadensis*)	6	12.8	111	31.9	54.7
GWGO	Greater White-fronted Goose (*Anser albifrons*)	2	4.3	80	23.0	39.4
TUSW	Tundra Swan (*Cygnus columbianus*)	4	8.5	12	3.4	5.9
Geese & Swans		**12**	**25.5**	**203**	**58.3**	
WATERFOWL (Ducks, Geese & Swans)		**19**	**40.4**	**262**	**75.3**	
PHSP	Phalarope Species (*Phalaropus* spp.)	2	4.3	41	11.8	
SMSH	Small Shorebirds	3	6.4	9	2.6	
SHOREBIRDS		**5**	**10.6**	**50**	**14.4**	
SNBU	Snow Bunting (*Plectrophenax nivalis*)	1	2.1	1	0.3	
ALL BIRDS		**47**	**100**	**348**	**100**	

Table 8. Long-tailed duck density (number of individuals/km^2) by aerial survey transect in the barrier island-lagoon system between Spy Island and West Dock, Alaska, 23 July - 11 August 2001.

	Transect Numbers																		
	Barrier Islands				Mid-Lagoon							Mainland Shore				Off Shore			
Date	23	31	202	201	24	32	301	302	601	602	603	25	33	401	402	22	30	101	102
Molt (15 July - 21 August)																			
23 Jul 01	15.50	124.44	34.18	41.25	3.29	32.57	27.92	28.48	55.21	10.66	32.43	0.44	0.00	3.69	0.71	24.06	7.46	2.67	3.15
8 Aug 01	21.36	218.39	27.04	36.84	0.72	68.18	45.08	182.79	91.03	119.04	40.61	6.53	0.53	9.39	45.18	0.00	0.38	2.75	0.00
11 Aug 01	1.25	34.79	0.97	4.13	0.00	0.84	9.04	34.76	0.00	90.26	29.70	2.16	0.00	6.32	6.08	1.58	0.00	0.12	0.00
Average Density	12.70	125.87	20.73	27.41	1.34	33.86	27.35	82.01	48.75	73.32	34.25	3.04	0.18	6.47	17.32	8.55	2.61	1.85	1.05

Table 9. Long-tailed duck density (number of individuals/km^2) by aerial survey transect in the barrier island-lagoon system and on tundra between Pole Island and Brownlow Point, Alaska, 23 July-11 August 2001.

	Transect Numbers															
	Barrier Islands				Mid-lagoon								Mainland Shore			
Date	133	134	135	136	180	181	182	183	604	605	606	607	190	191	192	193
MOLT 23 July - 11 August																
23 Jul 01	133.22	49.80	42.19	95.92	35.46	9.96	0.00	0.00	0.00	0.38	2.89	34.38	-	-	118.75	206.34
8 Aug 01	211.25	56.65	5.87	28.08	20.95	5.20	7.96	0.00	0.00	7.63	73.16	40.26	133.59	235.64	123.63	44.35
11 Aug 01	68.35	0.00	0.00	10.78	3.08	8.61	0.00	0.20	0.00	0.00	11.65	4.46	25.31	34.20	42.11	9.09
Average Density	137.61	35.48	16.02	44.93	19.83	7.92	2.65	0.07	0.00	2.67	29.23	26.37	79.45	134.92	94.83	86.59

	Off Shore				Tundra			
Date	60	61	62	63	500	501	502	503
MOLT 23 July - 11 August								
23 Jul 01	4.88	9.00	0.00	0.00	-	-	-	-
8 Aug 01	0.00	0.20	0.00	0.00	0.00	0.00	0.00	0.18
11 Aug 01	11.54	0.00	0.61	0.00	0.00	0.00	0.92	8.15
Average Density	5.47	3.07	0.20	0.00	0.00	0.00	0.46	4.17

Table 10. Long-tailed duck density (number of individuals/km^2) by aerial survey transect in the barrier island-lagoon system between West Dock and Pole Island, Alaska, 23 July-11 August 2001.

	Transect Numbers		
	Barrier Islands		
Date	130	131	132
Molt (15 July - 21 August)			
23 Jul 01	9.32	43.01	11.31
8 Aug 01	2.05	12.66	15.53
11 Aug 01	4.27	3.11	32.61
Average Density	5.21	19.59	19.82

Table 11. Species densities for all aerial survey transects (total area = 790.38 km^2) in the barrier island-lagoon systems and on tundra between Spy Island and Brownlow Point, Alaska, 23 July-11 August 2001.

Species Code	Species Name	Total Number of Birds on Transect	Number of Sightings on Transect	Bird Density (Number/km^2)
LOONS				
PALO	Pacific Loon (*Gavia pacifica*)	160	114	0.202
RTLO	Red-throated Loon (*Gavia stellata*)	76	57	0.096
YBLO	Yellow-billed Loon (*Gavia adamsii*)	8	8	0.010
LOSP	Loon Species (*Gavia* spp.)	2	2	0.003
SEABIRDS (Jaegers, Gulls, and Terns)				
GLGU	Glaucous Gull (*Larus hyperboreus*)	772	314	0.977
SAGU	Sabine's Gull (*Xema sabini*)	49	3	0.062
ARTE	Arctic Tern (*Sterna paradisaea*)	34	21	0.043
BLGU	Black Guillemot (*Cepphus grylle*)	1	1	0.001
COMU	Common Murre (*Uria aalge*)	1	1	0.001
WATERFOWL (Ducks, Geese & Swans)				
COEI	Common (Pacific) Eider (*Somateria mollissima v-nigrum*	1894	172	2.396
KIEI	King Eider (*Somateria spectabilis*)	11	1	0.014
EISP	Eider Species (*Somateria* spp.)	99	5	0.125
SUSC	Surf Scoter (*Melanitta perspicillata*)	643	68	0.814
BLSC	Black Scoter (*Melanitta nigra*)	1	1	0.001
SCOT	Scoter Species (*Melanitta* spp.)	1	1	0.001
OLDS	Long-tailed Duck (*Clangula hyemalis*)	22660	784	28.670
GRSC	Greater Scaup (*Aythya marila*)	20	1	0.025
SCAUP	Scaup Species (*Aythya* spp.)	8	2	0.010
NOPI	Northern Pintail (*Anas acuta*)	4	1	0.005
RBME	Red-breasted Merganser (*Mergus serrator*)	1	1	0.001
DKSP	Duck Species	11	3	0.014
DAGO	Dark Goose	20	1	0.025
BRAN	Black Brant (*Branta bernicla*)	1069	20	1.353
CAGO	Canada Goose (*Branta canadensis*)	348	10	0.440
GWGO	Greater White-fronted Goose (*Anser albifrons*)	893	26	1.130
LSGO	Lesser Snow Goose (*Chen caerulescens caerulescens*)	220	6	0.278
TUSW	Tundra Swan (*Cygnus columbianus*)	5	2	0.006
Other Species				
PHSP	Phalarope Species (*Phalaropus* spp.)	40	1	0.051
RLHA	Rough-legged Hawk (*Buteo lagopus*)	1	1	0.001
SMSH	Small Shorebirds	2	2	0.003
MESH	Medium Shorebirds	5	2	0.006
BISP	Bird Species	2	2	0.003

Table 12. Habitat associations of loons during aerial surveys in the barrier island-lagoon systems and tundra transects between Spy Island and Brownlow Point, Alaska, 23 July-11 August 2001

		Pacific Loon		Red-throated Loon		Yellow-billed Loon	
General Habitat Type	Specific Habitat Type	Number of Sightings	Percent of Total	Number of Sightings	Percent of Total	Number of Sightings	Percent of Total
Lagoon (9)	Lagoon (9)	55	38	23	39	3	38
Barrier Island (11)	Shoreline (water side; 15)	27	18	11	19	4	50
Nearshore Sea <3 mi. (13)	Ocean (8)	13	9	9	15	-	-
	Lagoon (9)	3	2	-	-	-	-
Wet Tundra (25)	Pond or Lake (18)	1	1	-	-	-	-
	Completely vegetated (25)	1	1	-	-	-	-
	Pond without Emegrants (46)	1	1	-	-	-	-
	Pond (47)	6	4	-	-	-	-
	River Delta (54)	1	1	-	-	-	-
	Stream (55)	1	1	-	-	-	-
	Pond with Emergents (45)	6	4	-	-	-	-
Mainland Coast (27)	Shoreline (water side; 15)	28	19	14	24	1	13
	River Delta (16)	1	1	-	-	-	-
River Delta (92)	Tide Flat (13)	2	1	2	3	-	-
TOTAL		146	100	59	100	8	100

Table 13. Habitat associations of seabirds during aerial surveys in the barrier island-lagoon systems and tundra transects between Spy Island and Brownlow Point, Alaska, 23 July-11 August 2001.

		Arctic Tern		Glaucous Gull		Sabine's Gull	
General Habitat Type	Specific Habitat Type	Number of Sightings	Percent of Total	Number of Sightings	Percent of Total	Number of Sightings	Percent of Total
Lagoon (9)	Lagoon (9)	-	-	25	7.2	1	33.3
	Smooth fast ice(1)	-	-	1	0.3	-	-
Barrier Island (11)	Spit (10)	-	-	6	1.7	-	-
	Island (11)	-	-	16	4.6	-	-
	Shoal (12)	1	4.8	3	0.9	-	-
	Shoreline (land side; 14)	-	-	9	2.6	-	-
	Shoreline (water side; 15)	13	61.9	158	45.5	1	33.3
Nearshore Sea <3 mi. (13)	Ocean (8)	4	19.0	3	0.9	1	33.3
	Lagoon (9)	3	14.3	11	3.2	-	-
Wet Tundra (25)	Pond (47)	-	-	1	0.3	-	-
	Lake Shore (44)	-	-	1	0.3	-	-
Mainland Coast (27)	Spit (10)	-	-	3	0.9	-	-
	Island (11)	-	-	4	1.2	-	-
	Shoal (12)	-	-	1	0.3	-	-
	Shoreline (land side; 14)	-	-	6	1.7	-	-
	Shoreline (water side; 15)	-	-	85	24.5	-	-
	River Delta (16)	-	-	1	0.3	-	-
	Mudflat (41)	-	-	1	0.3	-	-
River Delta (92)	Tide Flat (13)	-	-	8	2.3	-	-
	Mudflat (41)	-	-	4	1.2	-	-
TOTAL		21	100	347	100	3	100

Table 14. Habitat associations of eiders during aerial surveys in the barrier island-lagoon systems and tundra transects between Spy Island and Brownlow Point, Alaska, 23 July-11 August 2001.

		Common Eider		King Eider		Eider Species		All Eiders	
General Habitat Type	Specific Habitat Type	Number of Sightings	Percent of Total	Number of Sightings	Percent of Total	Number of Sightings	Percent of Total	Number of Sightings	Percent of Total
Lagoon (9)	Lagoon (9)	29	15.3	1	100	-	-	30	15.6
	Smooth fast ice (1)	2	1.1	-	-	-	-	-	-
Barrier Island (11)	Lagoon (9)	1	0.5	-	-	-	-	-	-
	Smooth fast ice (1)	1	0.5	-	-	-	-	-	-
	Shoreline (land side; 14)	2	1.1	-	-	-	-	2	1.0
	Shoreline (water side; 15)	102	53.7	-	-	1	16.7	103	53.6
	Shoal (12)	2	1.1	-	-	-	-	2	1.0
Nearshore Sea <3 mi. (13)	Ocean (8)	12	6.3	-	-	-	-	12	6.3
	Lagoon (9)	20	10.5	-	-	-	-	20	10.4
Wet Tundra (25)	Pond (47)	-	-	-	-	1	16.7	1	0.5
Mainland Coast (27)	Spit (10)	1	0.5	-	-	-	-	-	-
	Shoreline (water side; 15)	18	9.5	-	-	4	66.7	22	11.5
TOTAL		190	100	1	100	6	100	192	100

Table 15. Habitat associations of scoters during aerial surveys in the barrier island-lagoon systems between Spy Island and Brownlow Point, Alaska, 23 July-11 August 2001.

		Surf Scoter		Black Scoter		Scoter Species		All Scoters	
General Habitat Type	Specific Habitat Type	Number of Sightings	Percent of Total	Number of Sightings	Percent of Total	Number of Sightings	Percent of Total	Number of Sightings	Percent of Total
Lagoon (9)	Lagoon (9)	55	77.5	1	100	-	-	56	75.7
Barrier Island (11)	Shoreline (water side; 15)	13	18.3	-	-	1	50	14	18.9
Nearshore Sea <3 mi. (13)	Ocean (8)	2	2.8	-	-	-	-	2	2.7
Mainland Coast (27)	Shoreline (water side; 15)	1	1.4	-	-	1	50	2	2.7
TOTAL		71	100	1	100	2	100	74	100

Table 16. Habitat associations of geese and swans during aerial surveys in the barrier island-lagoon systems and tundra transects between Spy Island and Brownlow Point, Alaska, 23 July-11 August 2001.

		Black Brant		Canada Goose		Greater White-fronted Goose		Tundra Swan	
General Habitat Type	Specific Habitat Type	Number of Sightings	Percent of Total	Number of Sightings	Percent of Total	Number of Sightings	Percent of Total	Number of Sightings	Percent of Total
Barrier Island (11)	Shoreline (water side; 15)	1	4.8	2	11.8	1	3.2	-	-
Wet Tundra (25)	Pond or Lake (18)	-	-	1	5.9	-	-	-	-
	Lake with Emergents (42)	-	-	-	-	-	-	1	14.3
	Lake (50)	-	-	1	5.9	-	-	-	-
	Pond (47)	-	-	-	-	1	3.2	3	42.9
	River Delta (54)	-	-	1	5.9	-	-	-	-
	Lake Shore (44)	-	-	1	5.9	-	-	-	-
	Pond with Emergents (45)	-	-	1	5.9	-	-	-	-
	Large Lake (49)	-	-	-	-	1	3.2	-	-
Mainland Coast (27)	Shoreline (water side; 15)	20	95.2	9	52.9	28	90.3	3	42.9
River Delta (92)	Tide Flat (13)	-	-	1	5.9	-	-	-	-
TOTAL		21	100	17	100	31	100	7	100

APPENDIX A:

JULY AND AUGUST 2001
WEST DOCK NOAA STATION DATA

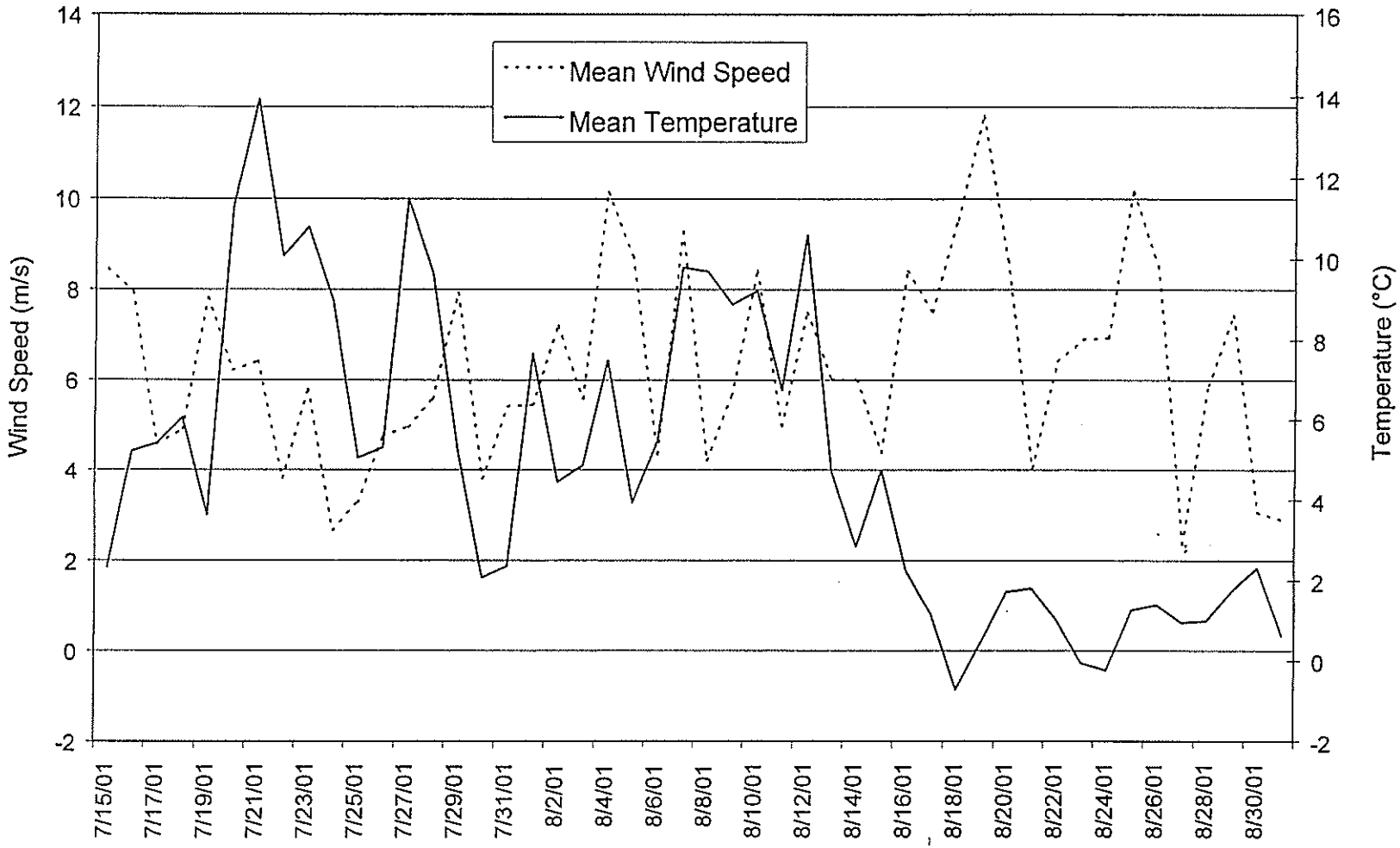


Figure A1. Daily mean temperature and wind speed recorded at the Prudhoe Bay NOAA Station at West Dock, Alaska, 15 July – 31 August 2001. Data available at http://co-ops.nos.noaa.gov/co-ops.html.

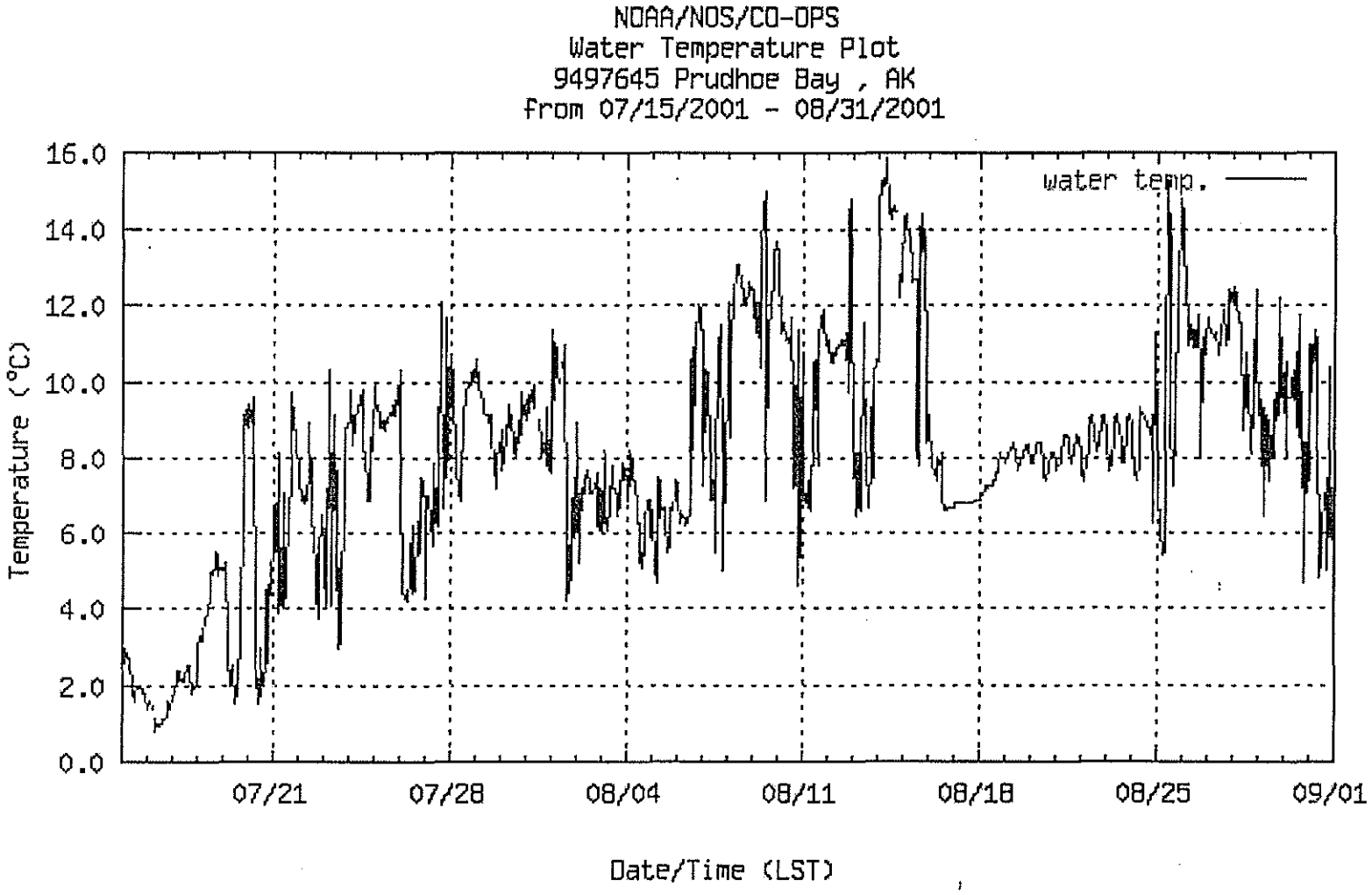


Figure A2. Hourly mean water temperature recorded at the Prudhoe Bay NOAA Station at West Dock, Alaska, 15 July – 1 September 2001. Data available at http://co-ops.nos.noaa.gov/co-ops.html.

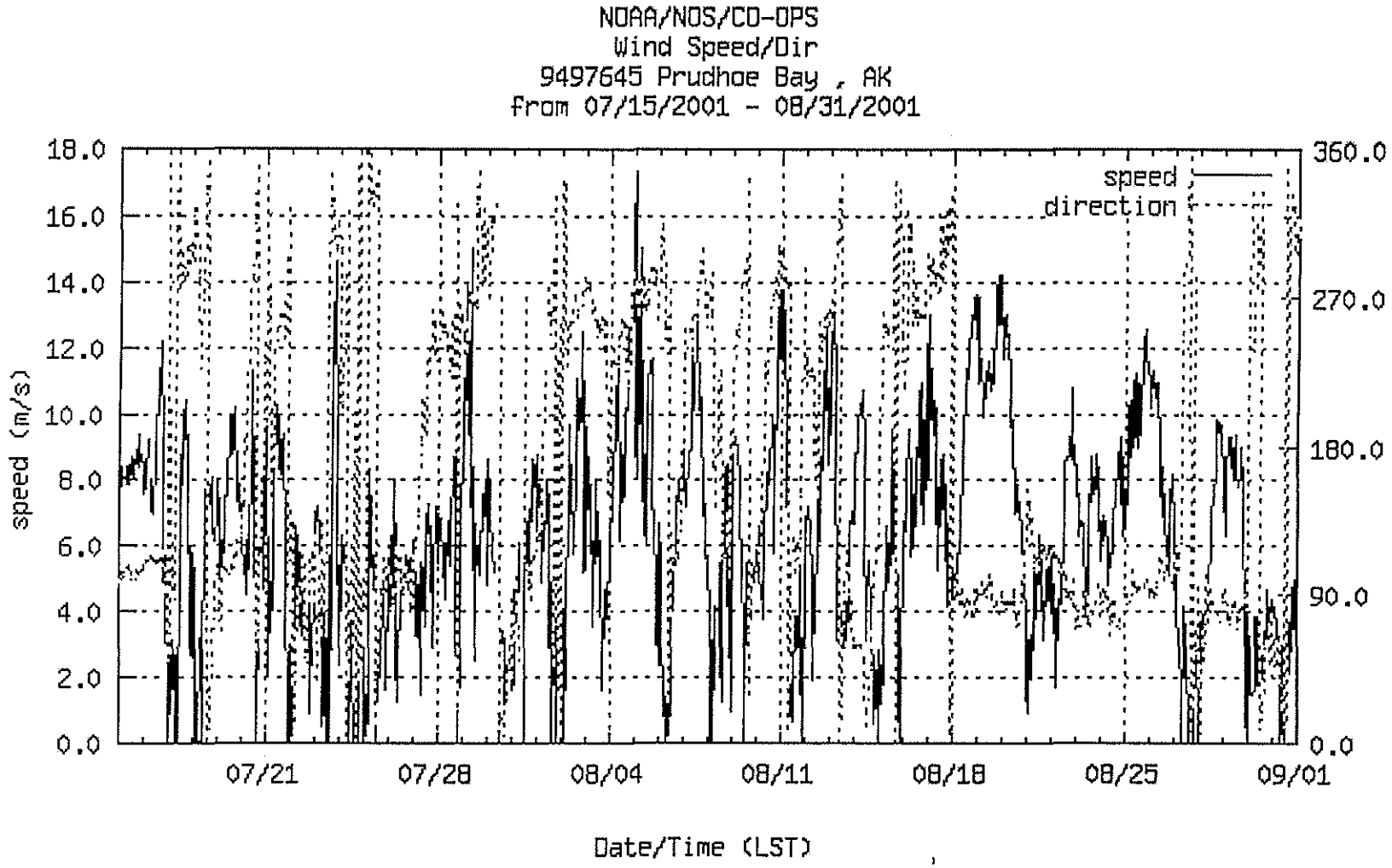


Figure A3. Hourly mean wind speed and direction recorded at the Prudhoe Bay NOAA Station at West Dock, Alaska, 15 July – 1 September 2001. Data available at http://co-ops.nos.noaa.gov/co-ops.html.

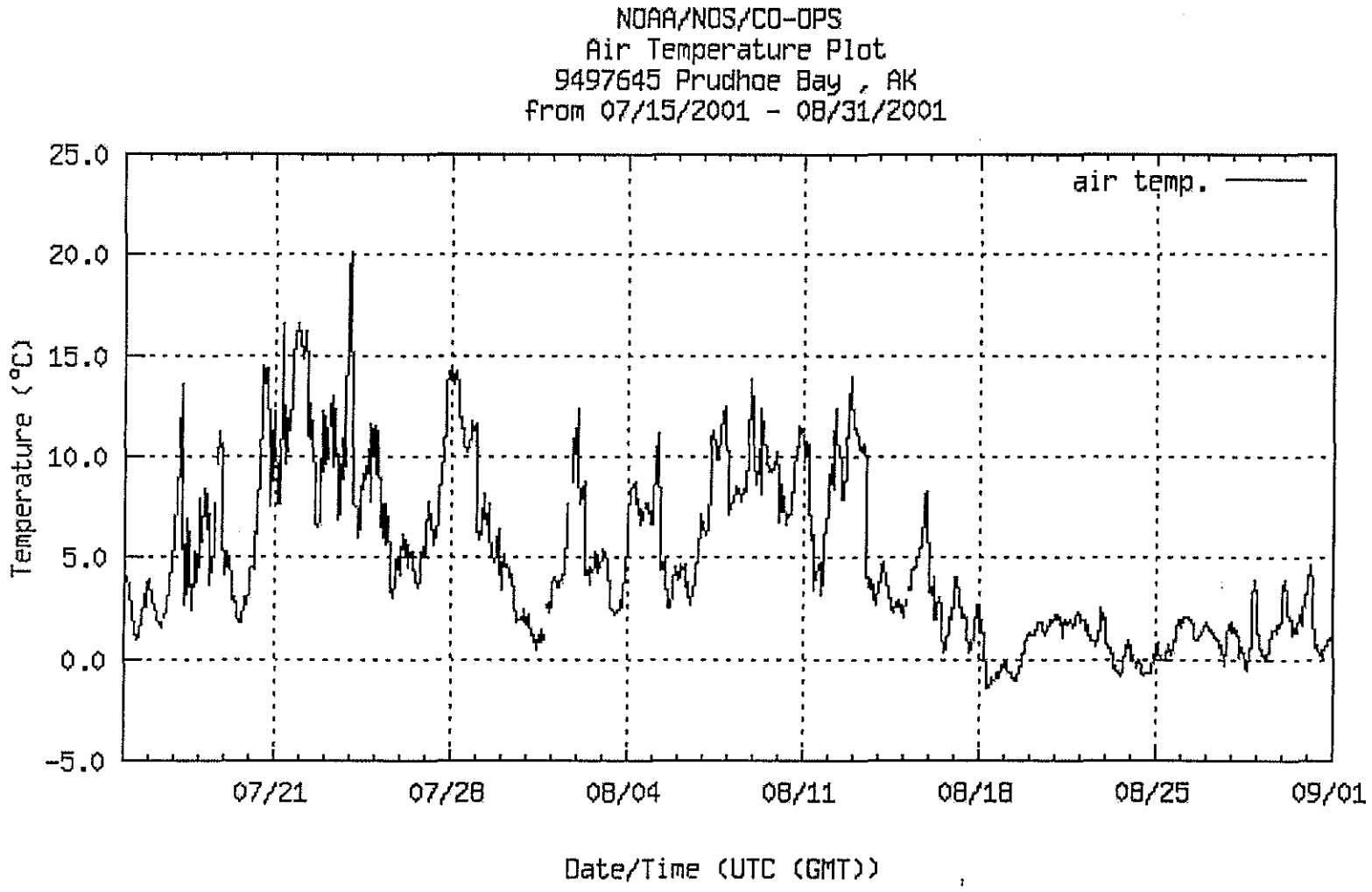


Figure A4. Hourly mean air temperature recorded at the Prudhoe Bay NOAA Station at West Dock, Alaska, 15 July-1 September 2001. Data available at http://co-ops.nos.noaa.gov/co-ops.html.

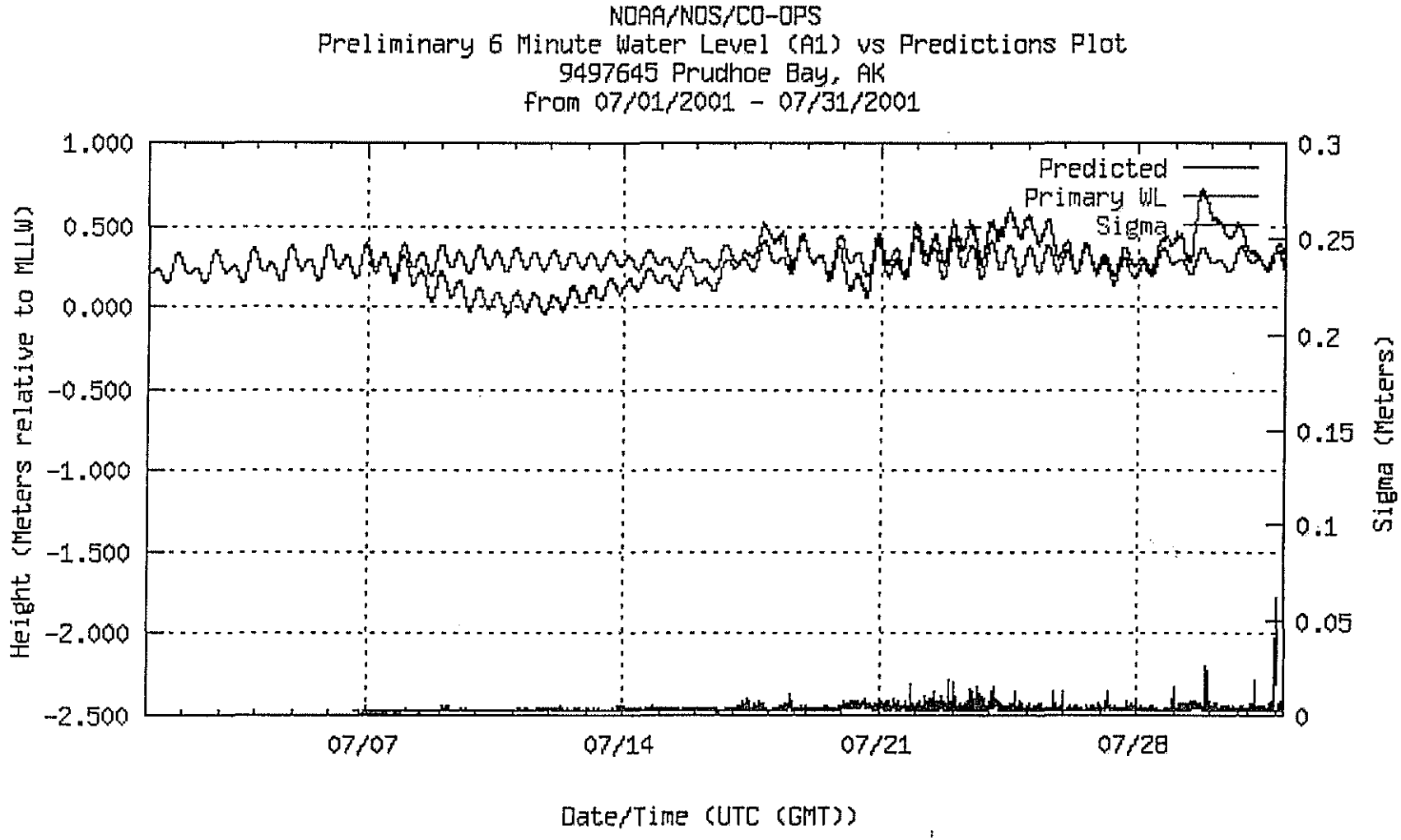


Figure A5. Water level relative to mean low, low water level recorded at 6-min intervals at the Prudhoe Bay NOAA Station at West Dock, Alaska, 1-31 July, 2001. Data downloaded at http://co-ops.nos.noaa.gov/co-ops.html.

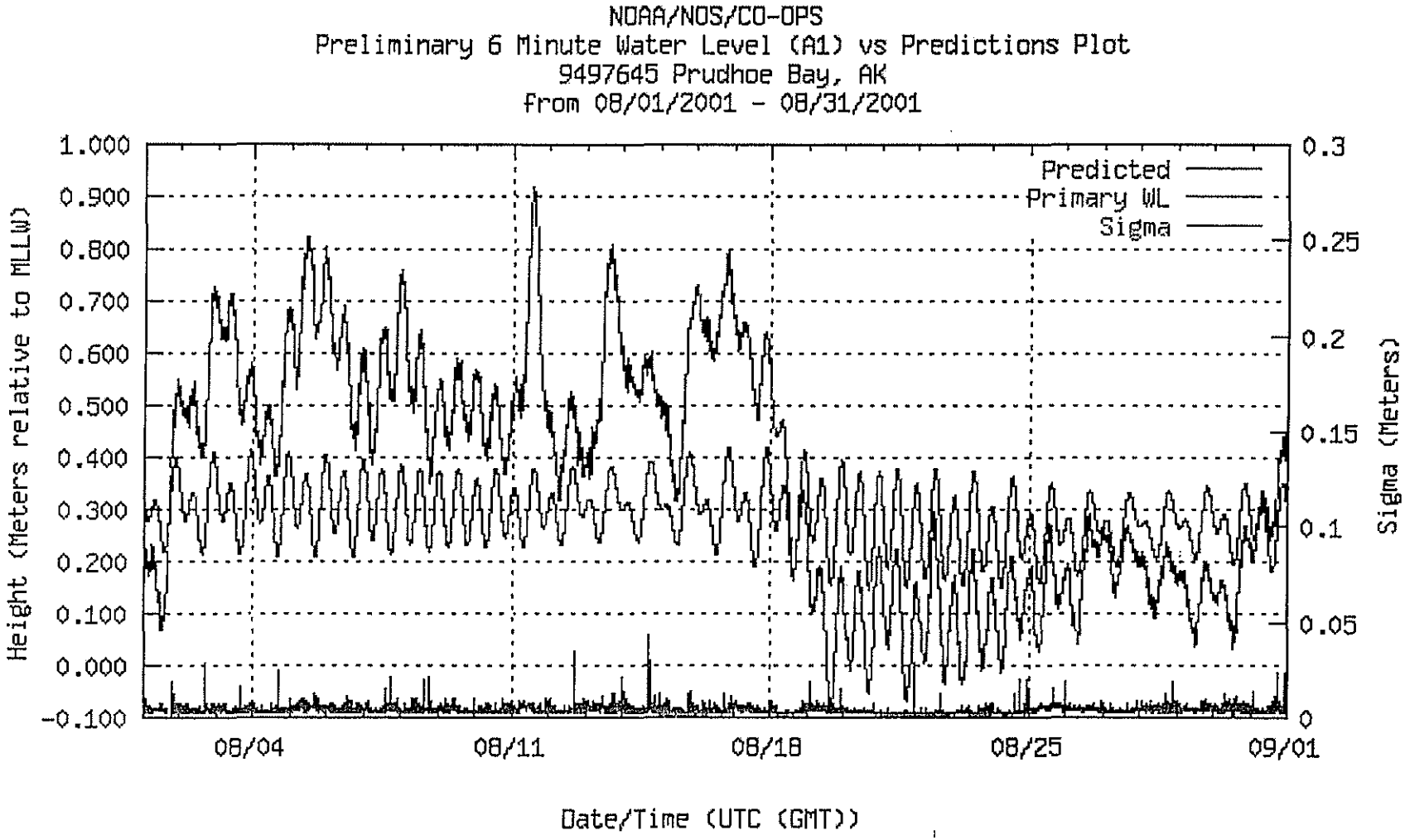


Figure A6. Water level relative to mean low, low water level recorded at 6-min intervals at the Prudhoe Bay NOAA Station at West Dock, Alaska, 1-31 August 2001. Data downloaded at http://co-ops.nos.noaa.gov/co-ops.html.

APPENDIX B:

2001 LONG-TAILED DUCK DENSITY BY SURVEY AND HISTORICAL DATA

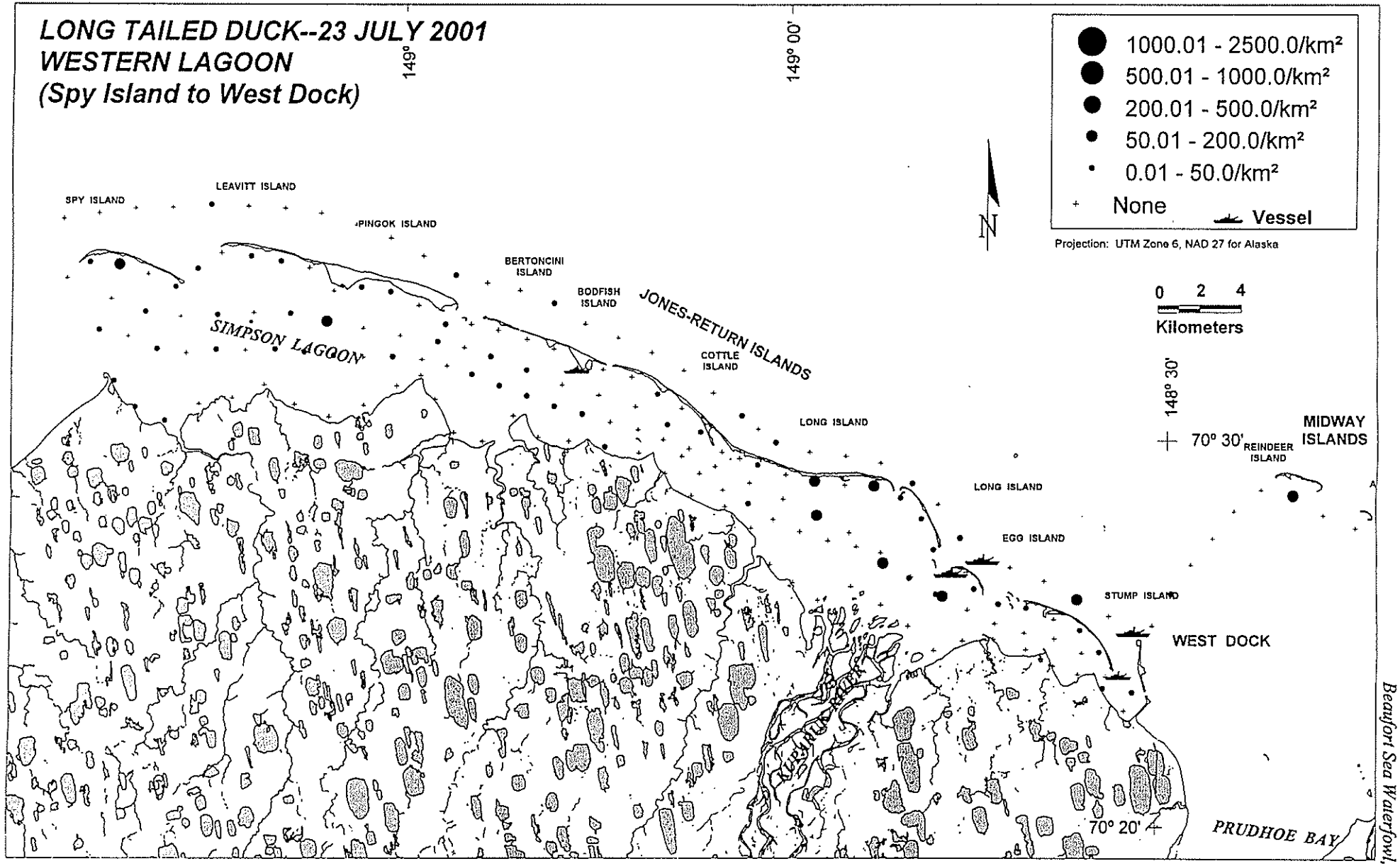


Figure B1. Summary of density for long-tailed ducks by 30-s time period segments in the barrier island-lagoon system between Spy Island and West Dock, Alaska, 23 July 2001.

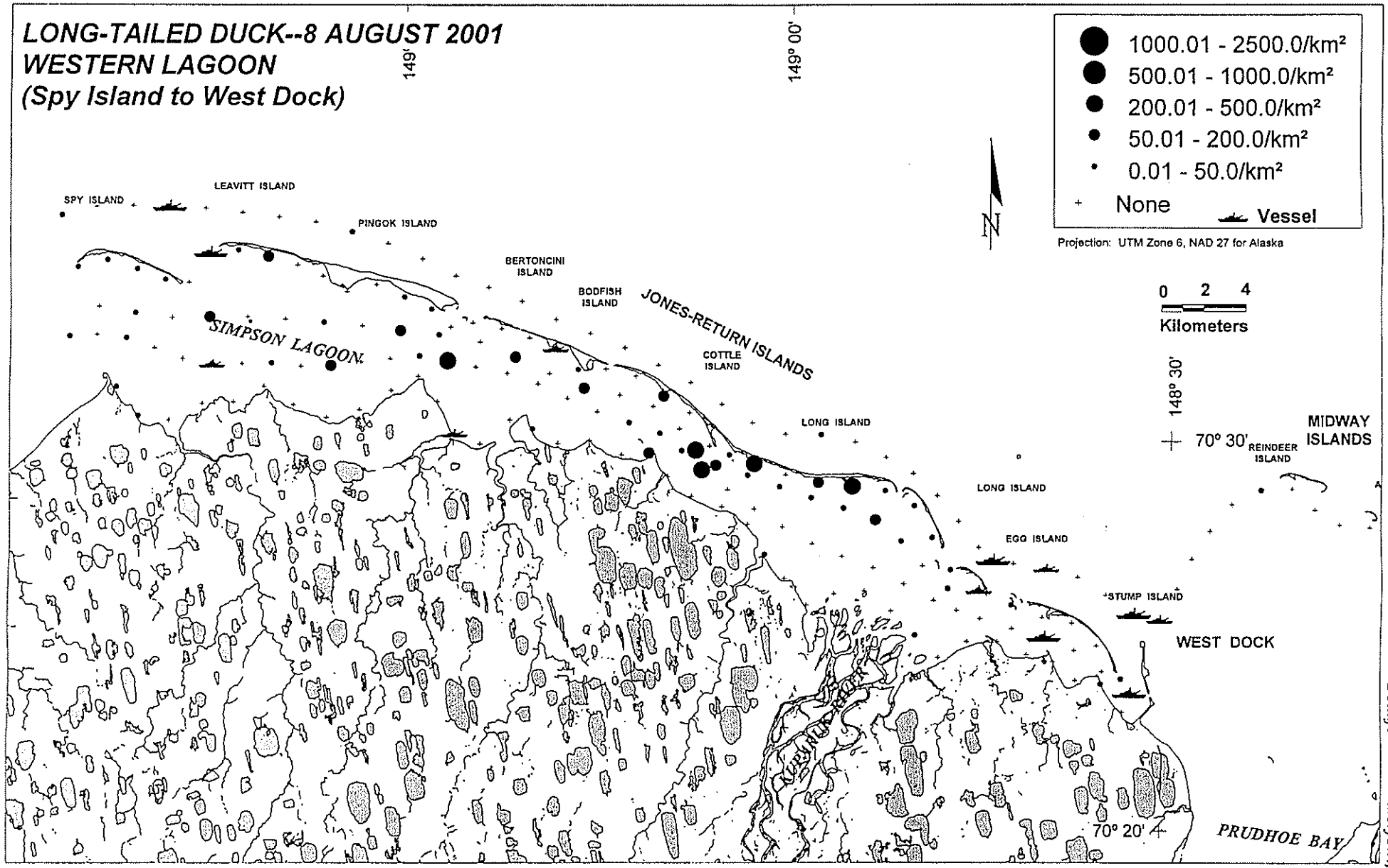


Figure B2. Summary of density for long-tailed ducks by 30-s time period segments in the barrier island-lagoon system between Spy Island and West Dock, Alaska, 8 August 2001.

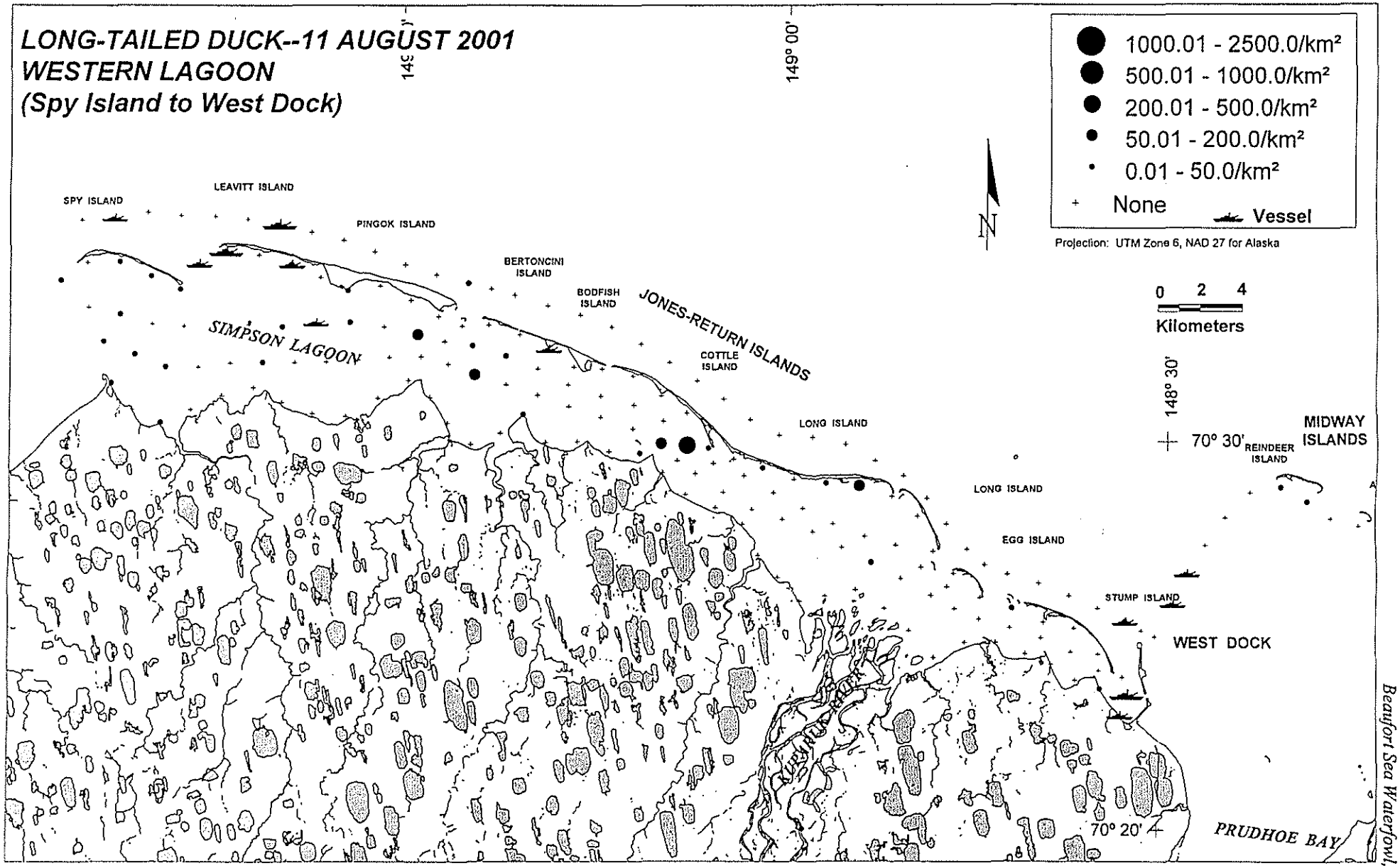


Figure B3. Summary of density for long-tailed ducks by 30-s time period segments in the barrier island-lagoon system between Spy Island and West Dock, Alaska, 11 August 2001.

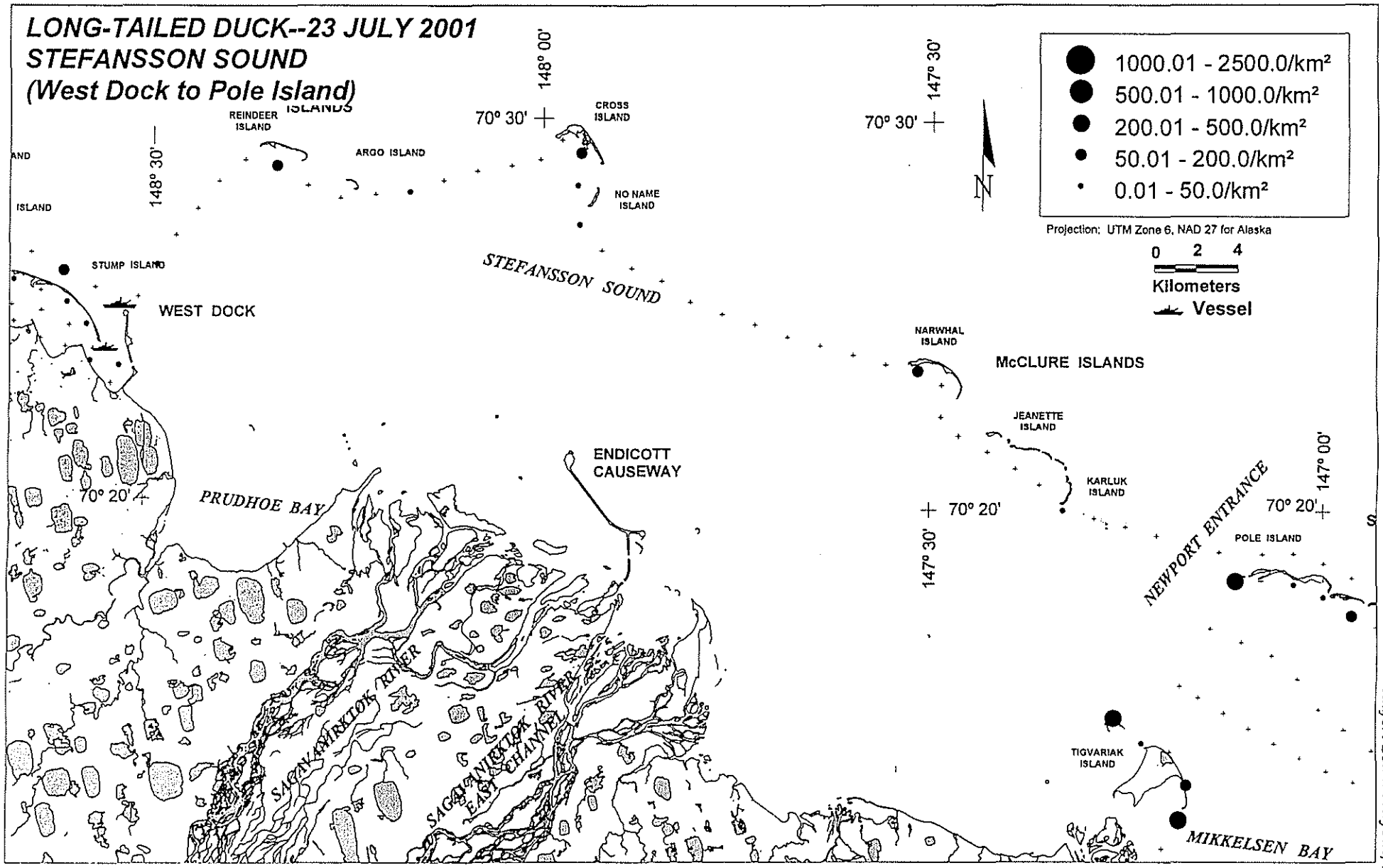


Figure B4. Summary of density for long-tailed ducks by 30-s time period segments in the barrier island-lagoon system between West Dock and Pole Island, Alaska, 23 July 2001.

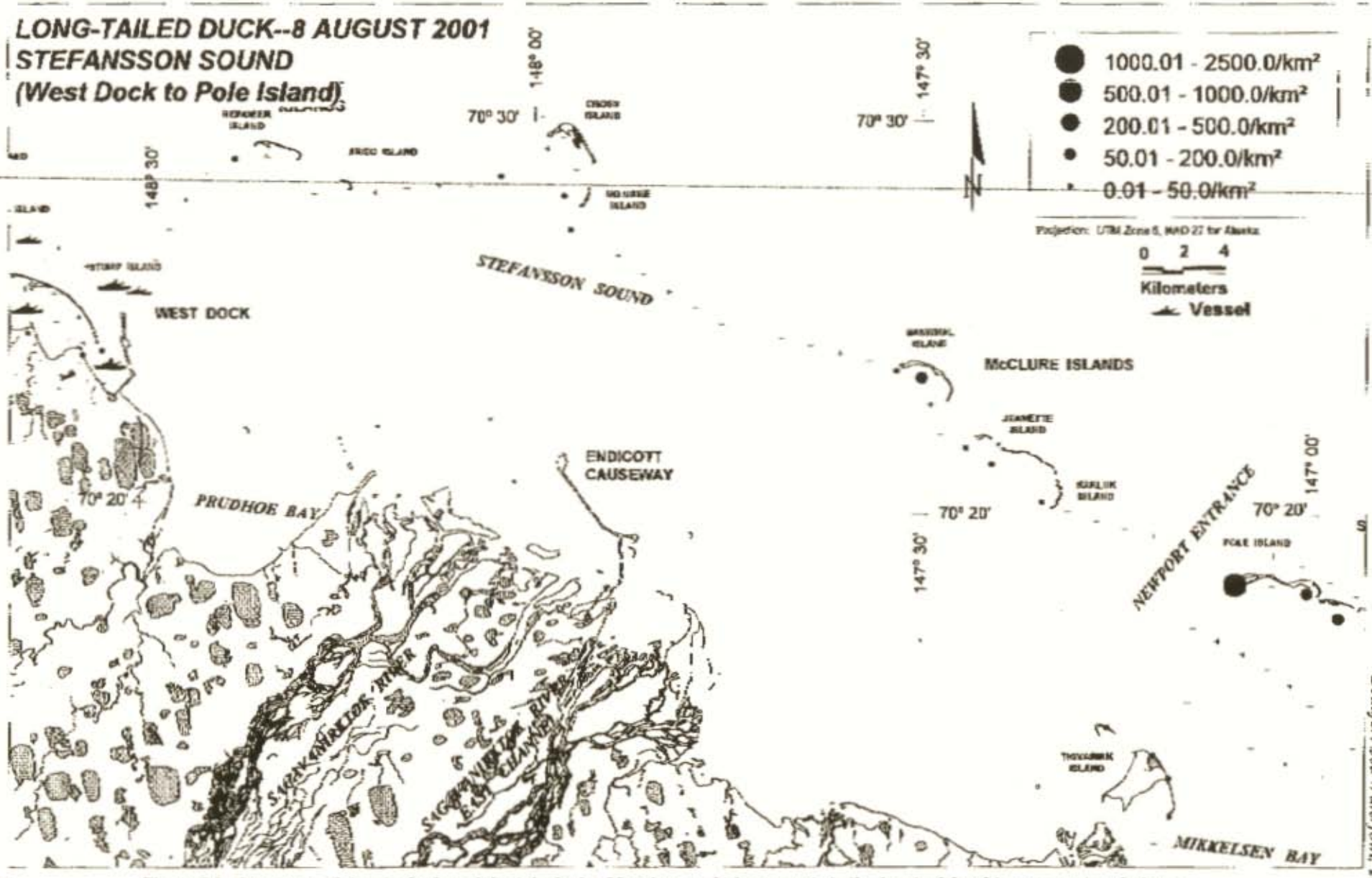


Figure B5. Summary of density for long-tailed ducks by 30-s time period segments in the barrier island-lagoon system between West Dock and Pole Island, Alaska, 8 August 2001.

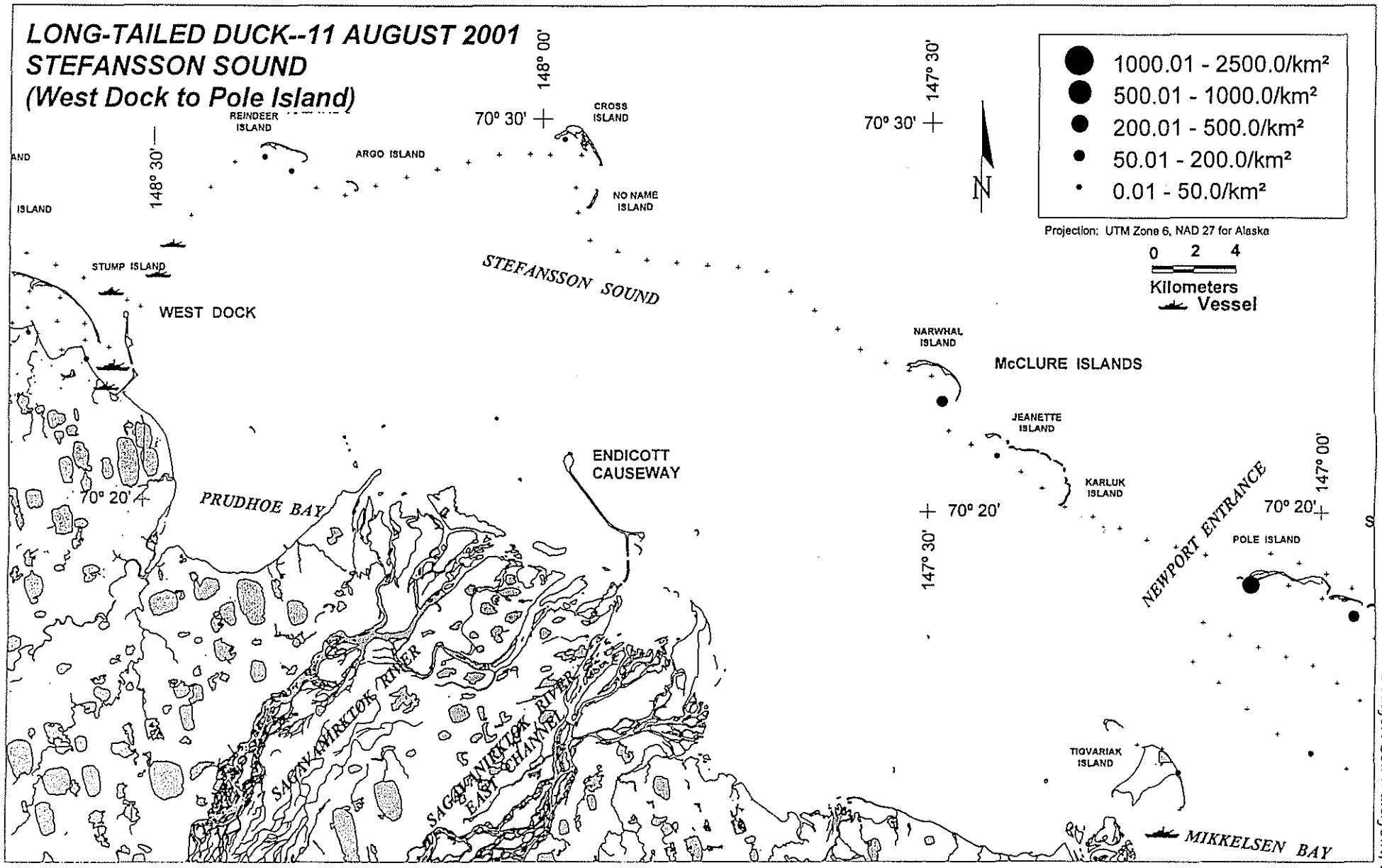


Figure B6. Summary of density for long-tailed ducks by 30-s time period segments in the barrier island-lagoon system between West Dock and Pole Island, Alaska, 11 August 2001.

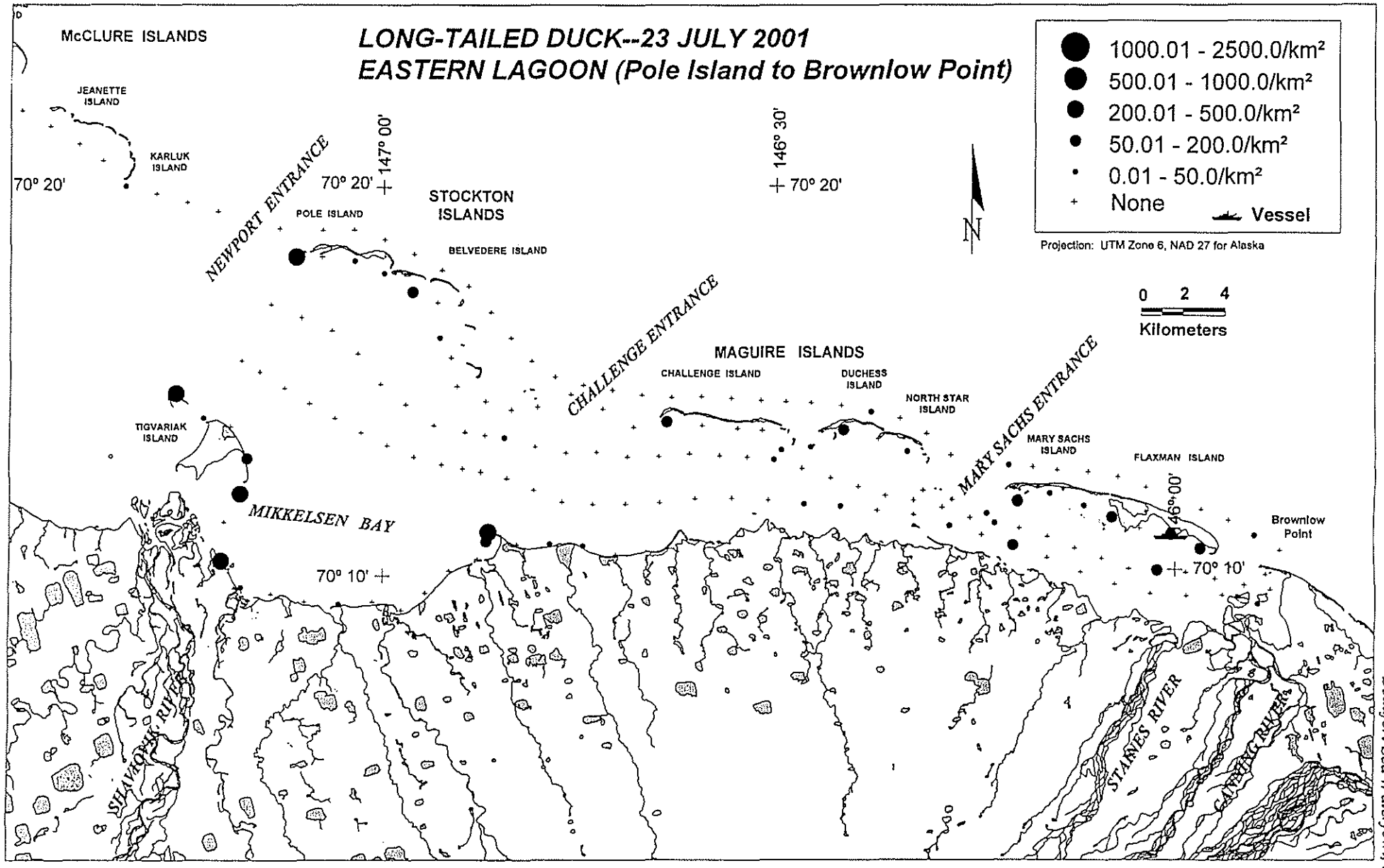


Figure B7. Summary of density for long-tailed ducks by 30-s time period segments in the barrier island-lagoon system between Pole Island and Brownlow Point, Alaska, 23 July 2001.

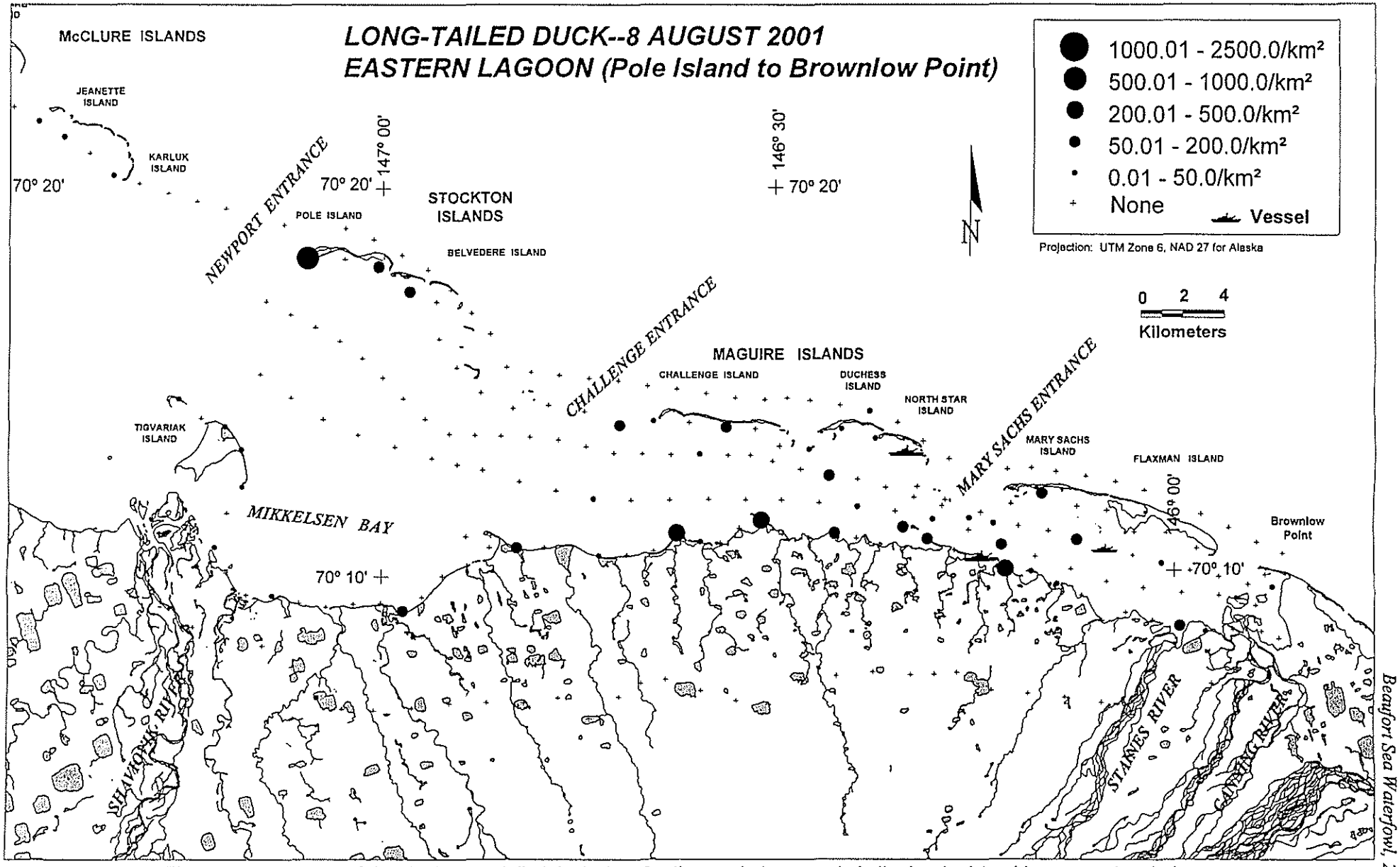


Figure B8. Summary of density for long-tailed ducks by 30-s time period segments in the barrier island-lagoon system between Pole Island and Brownlow Point, Alaska, 8 August 2001.

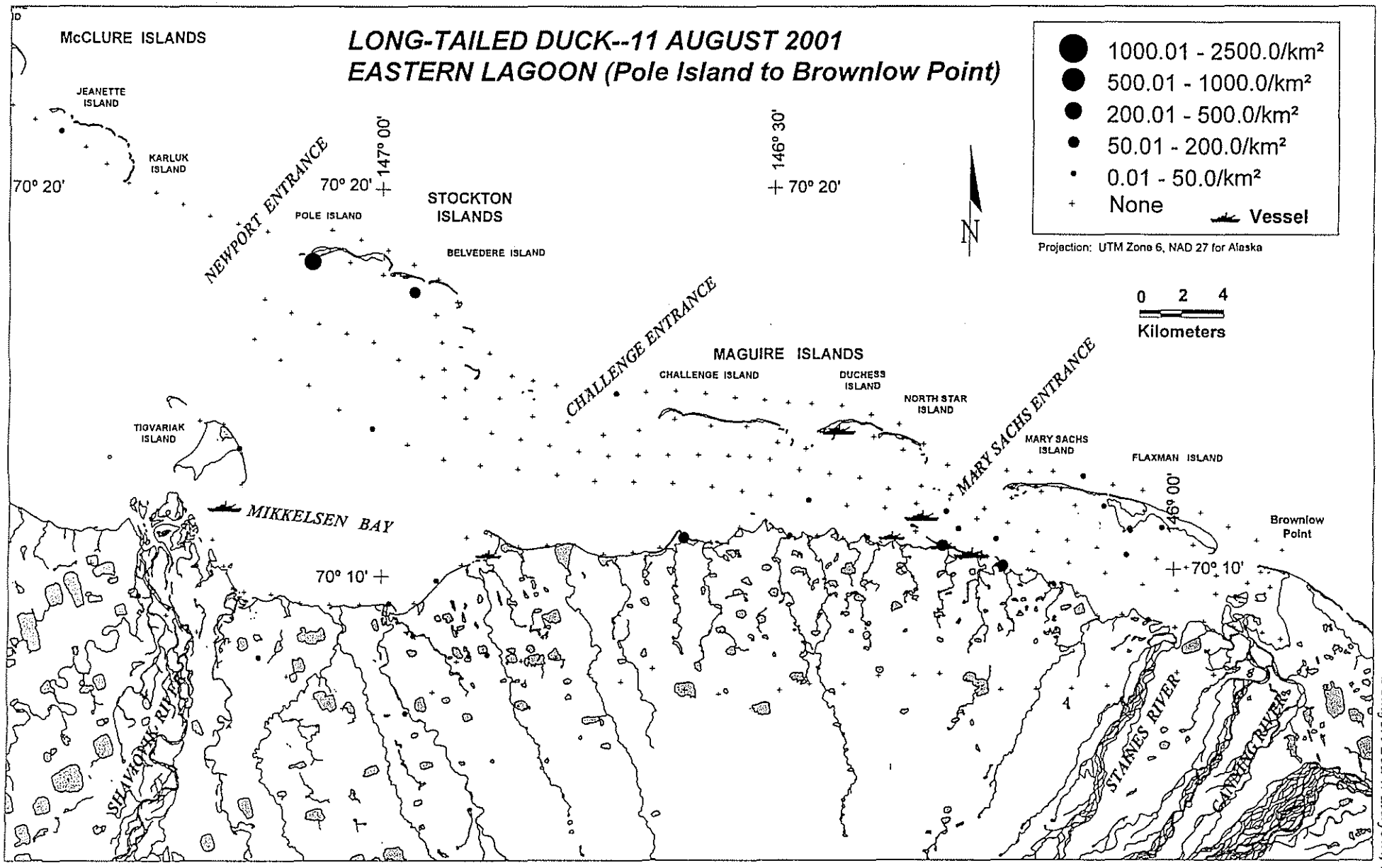


Figure B9. Summary of density for long-tailed ducks by 30-s time period segments in the barrier island-lagoon system between Pole Island and Brownlow Point, Alaska, 11 August 2001.

Table B1. Numbers and percentages of long-tailed ducks counted during aerial surveys in nearshore waters of the central Alaska Beaufort Sea, 1977–1984; 1989–1991; 1998–2001 (Johnson and Gazey 1992; Noel et al. 1999, 2002). Data for 1998 include only the eastern lagoon, 1999-2001 include western and eastern lagoons exclusive of 600 series mid-lagoon transects.

	Survey Year															
Category*	1977	1978	1979	1980	1981	1982	1983	1984	1989	1990	1991	1998	1999	2000	2001	All Years
Numbers																
1	20,695	111,594	28,598	22,777	30,597	31,927	-	21,998	102,968	163,915	31,316	24,455	26,478	17,836	7,355	642,509
2	58,310	141,801	36,157	27,826	48,711	46,964	6,144	28,399	110,975	220,758	61,441	41,344	52,663	35,618	17,560	934,671
3	94,461	215,199	49,456	37,549	65,768	66,794	-	33,987	138,729	277,327	120,397	43,639	57,834	40,862	21,119	1,263,121
4	104,318	231,307	54,049	38,364	71,104	69,775	-	34,972	149,408	312,073	138,408	48,979	67,427	50,787	27,175	1,398,146
Percentages																
5	90.55	93.04	91.50	97.88	92.50	95.73	-	97.18	92.85	88.87	86.99	89.10	85.77	80.46	77.71	91.83
6	55.90	61.30	66.90	72.53	68.51	67.31	-	81.20	74.28	70.74	44.39	84.41	78.10	70.13	64.62	68.80
7	21.91	51.86	57.83	60.66	46.52	47.80	-	64.72	74.22	59.11	26.01	56.04	45.78	43.65	34.83	51.04
8	19.84	48.24	52.91	59.37	43.03	45.76	-	62.90	68.92	52.52	22.63	49.93	39.27	35.12	27.07	47.11
9	61.73	65.89	73.11	74.11	74.06	70.31	-	83.56	79.99	79.60	51.03	94.74	91.06	87.17	83.15	74.93
10	35.49	78.70	79.09	81.86	62.81	67.98	-	77.46	92.78	74.25	50.97	59.15	50.28	50.08	41.88	67.57

* 1 = No. of long-tailed ducks on-transect only on barrier island transects during all surveys
2 = No. of long-tailed ducks on-transect on all lagoon transects during all surveys
3 = No. of long-tailed ducks on- and off-transect on all lagoon transects during all surveys
4 = No. of all birds of all species on- and off-transect on all lagoon transects during all surveys
5 = Cat. 3/Cat. 4
6 = Cat. 2/Cat. 4
7 = Cat. 1/Cat. 3
8 = Cat.1/Cat.4
9 = Cat.2/Cat.3
10 = Cat.1/Cat.2

Table B2. Individual on-transect long-tailed duck densities for transects between Spy Island and Brownlow Point, Beaufort Sea, Alaska, 5 June–23 September 1977–1984; 1989–1991; 1998–2001. Transect areas for 1998 to 2001 data in column 2 are totals of transect areas listed in header row 3, transect area based on GPS recorded transect lengths are presented in density calculations for individual transects.

Survey Date	Overall Study Area*			Barrier Island Transect Nos. and Areas Sampled (km²)											Non-barrier Island Transect Nos. and Areas Sampled (km²)									
Transect Number	Total Area (km²)	Total No.	Overall Dens.	23	31	201	202	130	131	132	133	134	135	136	10	11	12	13	19	20	21	22	24	25
Transect Area	On-transect	On-transect	No. km²	4.52	5.68	8.48	6.08				6.08	4.84	5.40	6.28	9.48	6.04	5.56	3.48				3.64	4.40	4.80
5 Jun.77	54.08	3	0.06			0.00	0.00																	
20 Jun.77	54.08	34	0.63			7.55	2.30																	
5 Jul.77	54.08	745	13.78			50.00	61.18																	
28-29 Jul.77	54.08	35350	653.66			1090.80	545.07																	
15 Aug.77	28.32	18001	635.63			1894.34	1496.71																	
30 Aug.77	54.08	4287	79.27			443.40	48.68																	
22 Sep.77	54.08	14937	276.20			75.71	0.56																	
23 Jun.78	74.40	107	1.44	15.93	1.76	2.24	0.00																0.00	
5 Jul.78	112.08	3305	29.49	8.85	6.87	92.22	264.14				1.81	10.54	2.22	0.80									0.00	
15 Jul.78	74.40	32771	440.47	86.95	1159.74	1655.90	1148.68																0.45	
25 Jul.78	111.44	9695	87.00	0.00	465.49	330.07	236.84				23.19	0.00	48.15	165.45									0.00	
5-6 Aug.78	117.72	12141	103.13	36.50	457.04	375.59	271.55				10.53	3.86	464.81	589.17									0.00	
15 Aug.78	74.40	18307	246.06	91.81	352.82	1785.97	60.53																45.45	
25 Aug.78	111.44	19369	173.81	606.19	546.13	578.89	18.91				12.99	294.63	1025.00										2.73	
5-6 Sep.78	117.72	19951	169.48	23.45	251.94	39.03	313.32				113.98	17.77	244.26	702.55									76.82	
15 Sep.78	68.68	4393	63.96	34.07	0.35	11.06	99.01																74.32	
23 Sep.78	117.72	21762	184.86	357.52	13.03	11.79	7.73				125.99	1577.69	364.26	129.62									84.55	
22 Jun.79	74.40	388	5.22	18.81	44.37	3.66	0.99																0.23	
28 Jul.79	117.72	24539	208.45	0.44	700.18	404.83	702.30				353.95	22.73	382.22	607.32									3.64	
31 Aug.-1 Sep.79	64.28	5560	86.50	5.97	237.85	76.77	84.87																	
22 Sep.79	74.40	5670	76.21	18.36	58.27	280.28	170.23																5.12	
2 Aug.80	117.72	27826	236.37	63.50	1205.63	812.62	438.65				291.45	20.66	162.04	586.62									0.00	
18 Jul.81	65.36	1775	27.16	15.49		103.88																1.65	85.23	0.15
29 Jul.81	71.44	10751	150.49	98.45		247.64	892.93															0.00	0.00	0.62
2 Aug.81	95.12	15267	160.50	71.02	154.05	335.61	225.00				106.09	263.43	238.15	294.11									74.55	
12 Aug.81	59.96	1090	18.18	67.92		12.38	91.45															0.00	1.38	0.00
29 Aug.81	71.44	1432	20.04	2.03		91.51	52.30															34.07	13.86	0.00
11 Sep.81	71.44	19976	279.62	1596.24		123.00	117.27															137.22	1469.09	510.42
18 Jul.82	95.36	3817	40.03	44.03	124.47	144.34	102.80															6.32	25.45	0.21
31 Jul.82	71.44	9214	128.98	126.99		212.97	383.88															104.40	42.73	2.92
14 Aug.82	77.12	19416	251.76	161.50	1602.46	838.44	1053.62															98.08	10.23	2.08
28 Aug.82	95.36	5650	59.25	141.81	281.51	142.69	73.68															4.40	42.05	72.92
23 Sep.82	95.36	6867	92.98	38.27	15.85	157.31	29.63															0.00	4.09	50.21
29 Jul.83	72.73	6305	86.69	84.96																			10.45	
8 Aug.84	133.88	28399	212.12	693.81	263.73	285.73	736.35				347.20	308.26	254.81	872.93								100.00	63.64	0.00
6 Aug.89	176.96	31304	176.90	84.73	1366.90	92.02	13.65				739.64	321.49	703.70	1131.21	0.00	2.48	0.00	0.00				0.00	0.00	
8 Aug.89	176.96	35060	198.12	230.53	2060.21	817.02	505.43				592.43	23.76	269.07	1005.25	0.21	0.00	0.00	0.00				0.00	0.00	
9 Aug.89	176.96	44611	252.10	467.92	2025.00	628.17	370.23				731.25	450.83	435.19	2000.80	0.00	1.82	0.00	0.00				96.15	7.95	
18 Jul.90	186.36	19400	104.10	97.79	156.87	124.77	55.61				234.54	223.55	244.63	396.83								15.38	3.41	1.25
20 Jul.90	186.36	19097	102.47	50.88	151.94	110.33	210.20				353.95	155.79	486.67	434.55								12.36	1.14	1.04
23 Jul.90	186.36	26540	142.41	99.78	394.19	590.38	397.53				281.91	259.30	448.11	599.68								6.87	1.14	0.00
3 Aug.90	186.36	42596	228.57	33.85	264.08	612.91	872.20				532.07	556.61	1146.48	1416.08								0.00	3.18	1.25
4 Aug.90	166.28	20614	123.97	17.04	62.68	188.15	247.20				256.09	52.89	139.44	1218.31								0.00	2.73	0.00
9 Aug.90	143.20	16953	118.39	36.73	91.37	111.74	81.41				888.98	333.47	431.05	348.73									22.73	0.00
16 Aug.90	72.28	6657	92.10	26.11	249.30	671.60	18.09																4.09	0.00
20 Aug.90	186.36	34820	186.84	97.57	230.28	211.74	90.79				953.62	1347.11	1285.19	933.92								0.82	31.59	6.25
2 Sep.90	186.36	8685	46.60	4.42	3.52	9.15	35.69				451.48	437.81	129.44	262.26								0.00	0.00	0.00
4 Sep.90	143.20	6728	46.98	0.44	34.15	29.46	17.76				199.51	67.56	165.56	196.18									0.23	2.71
5 Sep.90	143.20	18668	130.36	5.09	19.19	27.58	11.18				727.30	244.21	116.67	1466.40									4.32	3.75
18 Jul.91	73.42	3759	51.20	17.70	104.05	170.75	238.98																2.05	0.00
19 Jul.91	115.60	7153	61.86	75.00	76.06	174.29	162.99				78.13	20.45	92.04	195.22									9.55	0.00
20 Jul.91	115.60	6963	60.23	60.25	105.62	31.26	212.25				29.77	15.91	21.67	108.12									9.55	0.21
22 Jul.91	115.60	9673	83.68	67.04	112.68	252.38	83.72				80.43	36.78	149.81	185.19									3.41	0.00
4 Aug.91	115.60	8670	75.00	90.27	91.73	98.23	136.68				97.37	113.64	115.00	63.54									7.05	2.08
10 Aug.91	115.60	6628	57.34	25.44	28.35	109.91	88.82				131.58	36.16	73.33	39.01									1.38	1.46
14 Aug.91	139.00	6883	49.52	21.90	144.19	168.98	162.83				87.17	48.69	35.19	30.00									9.32	3.13
16 Aug.91	158.76	6464	40.72	6.19	36.33	86.79	25.00				190.30	12.81	49.63	35.51								2.75	2.27	3.75
21 Aug.91	158.76	5248	33.06	12.83	57.64	35.61	63.82				154.61	30.79	25.56	7.32								5.22	6.36	0.42
5 Aug. 98	70.92	5302	74.76								14.77	50.36	88.18	299.69										
14 Aug. 98	70.92	9736	137.28								110.58	163.17	253.25	247.65										
16 Aug.98	70.92	12162	171.49								389.61	157.88	181.25	358.55										
31 Aug.98	70.92	4427	62.42								106.63	1.27	34.55	173.84										
3 Sept.98	70.92	14345	202.27								813.70	193.30	271.35	41.56										
30 Jul.99	186.36	18239	97.87	13.79	99.00	214.27	39.07	33.76	43.23	54.15	171.55	300.59	248.79	142.12								0.80	1.52	0.00
1 Aug.99	186.36	14051	75.40	4.81	103.30	114.68	113.32	3.40	70.58	70.39	190.07	106.71	351.03	206.88								10.17	0.24	0.00
4-Aug-99																			2.13	17.80	0.00			
5 Aug. 99	186.36	10406	55.84	10.58	63.83	9.11	96.72	15.70	80.71	56.25	21.38	214.17	224.50	17.45								0.00	0.00	0.00
11 Aug. 99	95.36	6732	70.60	131.38	267.43	204.19	310.88												31.65	0.00	0.00	56.82	1.46	7.48
26 Aug. 99	186.36	3887	20.86	0.00	24.51	23.42	5.94	4.92	87.11	121.59	97.60	68.25	42.04	57.05								0.00	4.08	1.67
1 Aug. 00	186.36	8514	45.69	5.28	67.02	20.20	69.50	8.33	10.53	5.23	151.67	128.88	105.34	38.78								0.00	5.00	0.00
8 Aug. 00	186.36	15888	85.25	8.33	416.73	102.86	205.96				152.00	149.81	117.32	228.08					35.95	98.08	0.00	0.60	0.00	0.00
12 Aug. 00	186.36	5378	28.86	16.24	66.72	11.02	27.32				50.96	70.47	39.63	131.48					3.77	0.00	11.52	0.62	12.98	1.94
14 Aug. 00	95.36	2300	24.12	7.43	109.09	30.36	73.33	1.71	37.55	23.49												1.45	6.37	1.60
24 Aug. 00	186.36	3854	20.68	1.02	84.46	83.37	67.00	5.71	42.60	15.10	13.85	15.87	13.99	65.17								1.52	0.48	3.26
23 Jul.01	175.60	6697	38.14	15.50	124.44	41.25	34.18	9.32	43.01	11.31	133.22	49.80	42.19	95.92								24.06	3.29	0.44
8 Aug.01	186.36	9283	49.81	21.36	218.39	36.84	27.04	2.05	12.66	15.53	211.25	56.65	5.87	28.08								0.00	0.72	6.53
11 Aug.01	186.36	1906	10.23	1.25	34.79	4.13	0.97	4.27	3.11	32.61	68.35	0.00	0.00	10.78								1.58	0.00	2.16
n =	76	76	76	64	57	70	69	10	10	10	47	47	47	46	3	3	3	3	4	4	4	36	63	44
Mean =	116.67	12597.12	118.86	99.65	306.83	270.93	216.01	8.92	43.11	40.57	252.69	192.22	250.37	394.91	0.07	1.43	0.00	0.00	18.38	28.97	2.88	20.09	38.60	15.73
s.d. =	49.12	10554.09	120.51	231.03	476.33	400.35	301.39	9.67	29.30	35.93	256.28	304.37	287.09	461.11	0.12	1.28	0.00	0.00	17.91	46.83	5.76	37.67	184.84	77.42
c.v. =	0.42	0.84	1.01	2.32	1.55	1.48	1.40	1.08	0.68	0.89	1.01	1.58	1.15	1.17	1.73	0.90			0.97	1.62	2.00	1.87	5.05	4.92

*Overall study area includes eastern and western lagoon transects only

Table B2. Continued.

Survey Date	Non-barrier Island Transect Nos. and Areas Sampled (km²)																										
Transect Number	30	32	33	50	51	52	53	60	61	62	63	101	102	301	302	401	402	180	181	182	183	184	190	191	192	193	601
Transect Area	5.00	5.72	7.52	4.72	4.24	4.28	5.64	5.76	4.44	4.52	5.36	8.44	6.00	6.92	5.24	7.28	5.64	5.68	4.24	5.16	5.64		6.28	4.48	7.00	9.84	4.24
5 Jun.77												0.00	0.00	0.00	0.00	0.00	2.13										
20 Jun.77												0.00	0.00	0.00	0.00	0.82	2.84										
5 Jul.77												0.12	5.00	4.91	0.38	119.23	44.68										
28-29 Jul.77												0.12	6.67	72.25	1505.73	1550.55	2741.41										
15 Aug.77																1124.73	35.46										
30 Aug.77												5.45	0.17	143.35	244.08	428.57	71.63										
22 Sep.77												5.21	0.83	626.45	1458.78	276.53	1334.04										
23 Jun.78		1.05										0.00	0.00	0.00	0.00	0.41	0.00										
5 Jul.78		11.71										0.24	0.00	3.90	7.44	3.43	0.53	24.47	107.78	0.00	0.00						
15 Jul.78		6.47										2.96	1.67	14.74	72.14	29.69	111.03										
25 Jul.78		3.50										18.26	2.17	62.80	62.02	28.43	7.09	4.40	11.79	0.00	0.00						
5-6 Aug.78		8.04										0.36	0.53	53.76	75.76	11.40	0.00	183.10	117.62	0.00	0.00						
15 Aug.78		14.86										0.00	0.00	4.77	10.88	0.00	0.00										
25 Aug.78		54.37										52.37	45.33	24.86	45.42	0.00	1.77	1.07	0.00	0.00	0.00						
5-6 Sep.78		38.64										23.70	14.50	11.13	14.12	0.14	0.00	309.15	1354.01	206.59	18.97						
15 Sep.78												163.15	229.50	33.24	25.57	2.06	13.65										
23 Sep.78		29.10										2.61	0.00	369.36	56.30	157.69	114.54	438.03	79.01	0.00	152.30						
22 Jun.79		2.62										0.00	0.00	0.00	0.00	0.00	0.53										
28 Jul.79		4.55										0.00	9.43	131.21	136.45	41.48	17.73	18.84	104.01	23.26	0.00						
31 Aug.-1 Sep.79												6.57	45.83	98.70	640.29	0.00	0.00										
22 Sep.79		21.50										19.79	9.50	5.76	0.57	76.10	162.59										
2 Aug.80		71.68										0.00	0.00	250.87	61.83	134.71	213.48	0.00	16.98	0.00	0.00						
18 Jul.81												107.94	0.00	53.28	26.39	9.75	8.76										
29 Jul.81												0.00	0.17	129.48	177.67	0.00	0.35										
2 Aug.81		122.03										0.00	0.00	51.16	233.59	37.23	27.66	32.22	20.05	0.00	0.00						
12 Aug.81												0.00	0.00	7.37	6.87	0.27	4.79										
29 Aug.81												8.06	0.33	15.32	8.02	0.00	0.00										
11 Sep.81												71.56	18.00	194.87	20.42	0.69	1.24										
18 Jul.82	2.40	73.43	2.66									0.12	0.00	12.86	55.34	5.91	9.04										
31 Jul.82												0.12	0.00	386.99	193.51	22.80	11.70										
14 Aug.82												1.18	0.00	28.12	0.38	0.00	0.00										
28 Aug.82	8.00	7.69	19.95									10.31	1.50	58.09	94.08	0.00	0.00										
23 Sep.82	0.20	47.90	419.68									8.53	0.00	254.77	197.90	17.17	73.58										
29 Jul.83																											
8 Aug.84	12.00	70.28	0.00									7.94	0.00	209.54	387.60	0.00	0.00	101.76	227.19	113.37	7.80						
6 Aug.89	0.00	10.49		3.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	276.01	318.70			0.00	0.00	322.29	0.00						
8 Aug.89	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	79.48	0.57			4.40	23.58	23.45	0.00						
9 Aug.89	1.41	0.00		0.00	7.08	5.79	0.00	0.00	0.00	0.00	0.00	0.00	0.33	14.45	0.57			0.00	0.00	211.24	39.01						
18 Jul.90	1.81	24.65	0.00					36.89	41.52	0.00	0.00	8.29	0.00	227.75	26.72	7.28	0.00	62.68	195.52	34.88	0.00		490.03	372.32	165.29	63.62	
20 Jul.90	9.68	15.56	1.20					0.35	1.56	0.22	0.56	18.84	0.00	147.40	83.21	7.01	0.00	144.72	66.75	34.30	21.28		200.32	242.63	160.14	77.95	
23 Jul.90	0.00	15.03	0.00					0.00	2.23	0.00	0.00	0.59	0.00	59.39	17.75	2.47	0.35	22.18	2.36	0.19	2.66		387.64	452.46	216.57	53.25	
3 Aug.90	0.00	123.95	1.06					0.00	0.00	0.00	0.00	13.63	2.50	130.64	26.72	0.00	4.26	67.61	54.25	4.84	0.00		187.03	802.23	153.00	100.00	
4 Aug.90	0.00	156.99	0.00									0.00	0.00	112.86	34.35	0.96	0.00	13.20	29.25	26.74	2.66		319.30	277.01	150.57	32.01	
9 Aug.90		54.55	1.20											59.97	56.30	0.14	0.18	31.16	41.04	14.15	0.00		36.23	189.06	56.00	25.91	
16 Aug.90		0.17	0.27											7.23	4.39	2.61	0.00										
20 Aug.90	3.23	14.18	2.93					0.00	0.00	2.21	0.00	4.27	0.00	19.51	222.14	4.95	1.06	0.35	0.00	27.52	0.00		45.09	406.92	234.43	2.13	
2 Sep.90	0.00	0.52	14.10					0.00	0.22	0.00	0.00	0.00	0.00	15.46	1.34	69.00	0.18	44.54	13.21	0.97	1.95		18.20	40.85	35.00	4.27	
4 Sep.90		7.52	5.98											19.94	6.11	0.00	0.35	37.32	8.02	237.21	3.72		24.21	71.65	31.00	5.18	
5 Sep.90		0.00	14.63											1.59	3.24	1.10	0.53	0.00	0.47	62.02	192.73		3.01	140.40	48.86	20.83	
18 Jul.91		1.22	0.13											12.43	5.73	5.22	2.84										
19 Jul.91		15.03	4.65											22.40	12.60	7.42	0.18	23.06	7.55	6.78	0.00		45.70	108.04	23.29	4.57	
20 Jul.91		25.00	14.38											30.35	15.48	11.40	4.96	5.11	7.78	4.84	0.35		11.78	70.76	33.00	8.84	
22 Jul.91		33.22	0.66											27.89	10.69	19.23	0.18	66.90	63.44	116.67	0.00		67.20	101.34	30.71	50.81	
4 Aug.91		41.96	13.96											76.59	86.28	16.48	13.48	36.44	34.67	61.24	0.35		49.52	78.13	83.14	44.31	
10 Aug.91		144.58	10.24											69.94	10.31	13.32	1.77	30.11	16.04	67.44	0.53		39.65	94.64	38.43	17.28	
14 Aug.91		55.94	0.00						4.50	0.00	0.00	0.59	0.00	41.47	16.41	2.34	14.18	0.00	28.30	75.39	0.00		101.43	10.71	65.71	5.89	
16 Aug.91	0.60	36.89	1.33					23.44	65.99	23.23	1.31	0.47	1.67	138.87	147.52	1.92	0.00	35.21	23.35	83.72	0.18		19.90	9.60	9.71	8.94	
21 Aug.91	17.20	17.48	1.73					9.20	4.50	11.06	30.22	0.47	10.33	217.77	9.16	3.57	0.18	10.21	30.66	46.32	0.00		10.19	33.26	2.86	2.44	
5 Aug. 98																		8.09	9.11	0.00	0.00		122.97	87.41	65.03	0.57	
14 Aug. 98																		17.36	0.00	0.00	0.00		173.15	333.93	200.89	20.77	
16 Aug.98																		20.50	1.00	1.35	0.00		157.93	298.29	211.57	51.53	
31 Aug.98																		0.68	1.88	30.43	0.00		4.69	28.37	35.29	17.03	
3 Sept.98																		8.78	61.67	401.55	1.89		36.88	118.79	87.89	33.67	
30 Jul.99	0.00	40.77	0.00					0.00	1.60	0.00	0.00	0.00	2.52	149.29	76.64	0.00	0.00	79.28	26.39	0.38	0.21		241.72	291.43	311.13	303.13	57.55
1 Aug.99	10.26	217.11	0.28					10.50	10.83	6.20	0.00	0.00	3.47	102.47	51.41	3.99	0.00	82.92	46.22	0.19	0.00		101.88	115.58	145.98	134.51	277.65
4-Aug-99																						0.00					
5 Aug. 99	0.00	0.00	1.85					0.97	0.58	0.21	1.12	0.23	0.86	43.85	32.26	0.00	0.00	136.89	6.25	0.00	0.00		176.11	223.83	242.44	102.86	39.03
11 Aug. 99	3.57	2.61	0.00									0.00	0.00	83.86	0.21	20.65	0.00					21.33					3.92
26 Aug. 99	0.00	29.82	0.00					14.36	0.00	8.01	0.00	0.36	1.61	19.07	101.19	9.27	0.00	2.67	59.90	34.96	0.00		18.79	10.08	24.21	5.88	103.80
1 Aug. 00	0.00	4.11	0.00					0.00	0.00	0.00	0.00	0.00	0.00	28.57	106.91	0.70	0.00	70.36	0.60	58.14	0.00		147.78	133.66	164.47	68.75	119.97
8 Aug. 00	0.00	163.40	0.00					0.00	0.00	0.80	0.36	0.00	0.00	58.76	35.83	14.48	17.24	40.11	0.62	0.48	0.00	0.00	160.69	304.03	95.24	235.75	248.32
12 Aug. 00	7.22	18.35	9.71					0.00	0.39	0.68	0.00	3.54	4.90	33.33	97.90	3.46	10.99	11.52	20.90	49.62	0.21	1.82	65.15	31.72	69.16	45.13	137.25
14 Aug. 00	0.00	10.62	10.11									0.00	0.00	20.28	67.38	17.57	20.89										73.32
24 Aug. 00	13.08	3.27	0.00					0.00	0.20	11.59	4.01	5.20	0.00	32.40	7.20	4.01	15.24	3.21	5.40	5.88	0.00		12.12	54.40	37.63	27.05	5.00
23 Jul.01	7.46	32.57	0.00					4.88	9.00	0.00	0.00	2.67	3.15	27.92	28.48	3.69	0.71	35.46	9.96	0.00	0.00				118.75	206.34	55.21
8 Aug.01	0.38	68.18	0.53					0.00	0.20	0.00	0.00	2.75	0.00	45.08	182.79	9.39	45.18	20.95	5.20	7.96	0.00		133.59	235.64	123.63	44.35	91.03
11 Aug.01	0.00	0.84	0.00					11.54	0.00	0.61	0.00	0.12	0.00	9.04	34.76	6.93	6.08	3.08	8.61	0.00	0.20		25.31	34.20	42.11	9.09	0.00
4	29	54	37	3	3	3	3	22	23	23	23	59	59	69	69	67	67	47	47	47	47	4	33	33	34	34	13
Mean =	3.40	36.59	14.95	1.06	2.36	1.93	0.00	5.10	6.23	2.82	1.63	9.81	7.16	84.02	112.45	64.93	77.21	48.73	62.73	50.99	9.51	5.79	110.16	175.86	103.92	53.96	93.23
s.d. =	4.93	48.19	68.61	1.84	4.09	3.34	0.00	9.51	15.72	5.73	6.29	27.18	30.73	109.84	261.17	237.51	369.52	81.56	198.43	87.64	35.67	10.40	116.59	169.15	79.61	70.50	87.24
c.v. =	1.45	1.32	4.59	1.73	1.73	1.73		1.87	2.52	2.03	3.85	2.77	4.29	1.31	2.32	3.66	4.79	1.67	3.16	1.72	3.75	1.80	1.06	0.96	0.77	1.31	0.94

Table B2. Continued.

Survey Date	Non-barrier Island Transect Nos. and Areas Sampled (km²)																									
Transect Number	30	32	33	50	51	52	53	60	61	62	63	101	102	301	302	401	402	180	181	182	183	184	190	191	192	193	601
Transect Area	5.00	5.72	7.52	4.72	4.24	4.28	5.64	5.76	4.44	4.52	5.36	8.44	6.00	6.92	5.24	7.28	5.64	5.68	4.24	5.16	5.64		6.28	4.48	7.00	9.84	4.24
5 Jun.77												0.00	0.00	0.00	0.00	0.00	2.13										
20 Jun.77												0.00	0.00	0.00	0.00	0.82	2.84										
5 Jul.77												0.12	5.00	4.91	0.38	119.23	44.68										
28-29 Jul.77												0.12	6.67	72.25	1505.73	1550.55	2741.41										
15 Aug.77																1124.73	35.46										
30 Aug.77												5.45	0.17	143.35	244.08	428.57	71.63										
22 Sep.77												5.21	0.83	626.45	1458.70	276.53	1334.04										
23 Jun.78		1.05										0.00	0.00	0.00	0.00	0.41	0.00										
5 Jul.78		11.71										0.24	0.00	3.90	7.44	3.43	0.53	24.47	107.78	0.00	0.00						
15 Jul.78		6.47										2.96	1.67	14.74	72.14	29.69	111.03										
25 Jul.78		3.50										18.26	2.17	82.80	62.02	28.43	7.09	4.40	11.79	0.00	0.00						
5-6 Aug.78		8.04										0.36	0.53	53.76	75.76	11.40	0.00	183.10	117.62	0.00	0.00						
15 Aug.78		14.86										0.00	0.00	4.77	10.88	0.00	0.00										
25 Aug.78		54.37										52.37	45.33	24.86	45.42	0.00	1.77	1.07	0.00	0.00	0.00						
5-6 Sep.78		38.64										23.70	14.50	11.13	14.12	0.14	0.00	309.15	1354.01	206.59	18.97						
15 Sep.78												163.15	229.50	33.24	25.57	2.06	13.65										
23 Sep.78		29.10										2.61	0.00	369.36	56.30	157.69	114.54	438.03	79.01	0.00	152.30						
22 Jun.79		2.62										0.00	0.00	0.00	0.00	0.00	0.53										
28 Jul.79		4.55										0.00	9.43	131.21	136.45	41.48	17.73	18.84	104.01	23.26	0.00						
31 Aug.-1 Sep.79												6.57	45.83	98.70	640.29	0.00	0.00										
22 Sep.79		21.50										19.79	9.50	5.76	0.57	76.10	162.59										
2 Aug.80		71.68										0.00	0.00	250.87	61.83	134.71	213.48	0.00	16.98	0.00	0.00						
18 Jul.81												107.94	0.00	53.28	26.39	9.75	8.76										
29 Jul.81												0.00	0.17	129.48	177.67	0.00	0.35										
2 Aug.81		122.03										0.00	0.00	51.16	233.59	37.23	27.66	32.22	20.05	0.00	0.00						
12 Aug.81												0.00	0.00	7.37	6.87	0.27	4.79										
29 Aug.81												8.06	0.33	15.32	8.02	0.00	0.00										
11 Sep.81												71.56	18.00	194.87	20.42	0.69	1.24										
18 Jul.82	2.40	73.43	2.66									0.12	0.00	12.88	55.34	5.91	9.04										
31 Jul.82												0.12	0.00	386.99	193.51	22.80	11.70										
14 Aug.82												1.16	0.00	28.12	0.38	0.00	0.00										
28 Aug.82	8.00	7.69	19.95									10.31	1.50	58.09	94.08	0.00	0.00										
23 Sep.82	0.20	47.90	419.68									8.53	0.00	254.77	197.90	17.17	73.58										
29 Jul.83																											
8 Aug.84	12.00	70.28	0.00									7.94	0.00	209.54	387.60	0.00	0.00	101.76	227.19	113.37	7.80						
6 Aug.89	0.00	10.49		3.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	276.01	318.70			0.00	0.00	322.29	0.00						
8 Aug.89	0.00	0.00		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	79.48	0.57			4.40	23.58	23.45	0.00						
9 Aug.89	1.41	0.00		0.00	7.08	5.79	0.00	0.00	0.00	0.00	0.00	0.00	0.33	14.45	0.57			0.00	0.00	211.24	39.01						
18 Jul.90	1.81	24.65	0.00					36.89	41.52	0.00	0.00	8.29	0.00	227.75	26.72	7.28	0.00	62.68	195.52	34.88	0.00		490.03	372.32	165.29	63.62	
20 Jul.90	9.68	15.56	1.20					0.35	1.56	0.22	0.56	18.84	0.00	147.40	83.21	7.01	0.00	144.72	66.75	34.30	21.28		200.32	242.63	160.14	77.95	
23 Jul.90	0.00	15.03	0.00					0.00	2.23	0.00	0.00	0.59	0.00	59.39	17.75	2.47	0.35	22.18	2.36	0.19	2.66		387.64	452.46	216.57	53.25	
3 Aug.90	0.00	123.95	1.06					0.00	0.00	0.00	0.00	13.63	2.50	130.64	26.72	0.00	4.26	67.61	54.25	4.84	0.00		187.03	802.23	153.00	100.00	
4 Aug.90	0.00	156.99	0.00									0.00	0.00	112.86	34.35	0.96	0.00	13.20	29.25	26.74	2.66		319.30	277.01	150.57	32.01	
9 Aug.90		54.55	1.20											59.97	56.30	0.14	0.18	31.16	41.04	14.15	0.00		36.23	189.06	56.00	25.91	
16 Aug.90		0.17	0.27											7.23	4.39	2.61	0.00										
20 Aug.90	3.23	14.16	2.93					0.00	0.00	2.21	0.00	4.27	0.00	19.51	222.14	4.95	1.06	0.35	0.00	27.52	0.00		45.09	406.92	234.43	2.13	
2 Sep.90	0.00	0.52	14.10					0.00	0.22	0.00	0.00	0.00	0.00	15.46	1.34	69.00	0.18	44.54	13.21	0.97	1.95		18.20	40.85	35.00	4.27	
4 Sep.90		7.52	5.98											19.94	6.11	0.00	0.35	37.32	8.02	237.21	3.72		24.21	71.65	31.00	5.18	
5 Sep.90		0.00	14.63											1.59	3.24	1.10	0.53	0.00	0.47	62.02	192.73		3.01	140.40	48.86	20.83	
18 Jul.91		1.22	0.13											12.43	5.73	5.22	2.84										
19 Jul.91		15.03	4.65											22.40	12.60	7.42	0.18	23.06	7.55	6.78	0.00		45.70	108.04	23.29	4.57	
20 Jul.91		25.00	14.36											30.35	15.46	11.40	4.96	5.11	7.78	4.84	0.35		11.78	70.76	33.00	8.84	
22 Jul.91		33.22	0.66											27.89	10.69	19.23	0.18	66.90	63.44	116.67	0.00		67.20	101.34	30.71	50.81	
4 Aug.91		41.96	13.96											76.59	86.26	16.48	13.48	36.44	34.67	61.24	0.35		49.52	78.13	83.14	44.31	
10 Aug.91		144.58	10.24											69.94	10.31	13.32	1.77	30.11	16.04	67.44	0.53		39.65	94.64	38.43	17.28	
14 Aug.91		55.94	0.00						4.50	0.00	0.00	0.59	0.00	41.47	16.41	2.34	14.18	0.00	28.30	75.39	0.00		101.43	10.71	65.71	5.89	
18 Aug.91	0.60	36.89	1.33					23.44	65.99	23.23	1.31	0.47	1.67	138.87	147.52	1.92	0.00	35.21	23.35	83.72	0.18		19.90	9.60	9.71	8.94	
21 Aug.91	17.20	17.48	1.73					9.20	4.50	11.06	30.22	0.47	10.33	217.77	9.16	3.57	0.18	10.21	30.66	46.32	0.00		10.19	33.26	2.86	2.44	
5 Aug. 98																		8.09	9.11	0.00	0.00		122.97	87.41	85.03	0.57	
14 Aug. 98																		17.36	0.00	0.00	0.00		173.15	333.93	200.89	20.77	
18 Aug.98																		20.50	1.00	1.35	0.00		157.93	298.29	211.57	51.53	
31 Aug.98																		0.68	1.88	30.43	0.00		4.69	28.37	35.29	17.03	
3 Sept.98																		8.78	61.67	401.55	1.89		36.88	118.79	87.89	33.67	
30 Jul.99	0.00	40.77	0.00					0.00	1.60	0.00	0.00	0.00	2.52	149.29	76.64	0.00	0.00	79.28	26.39	0.38	0.21		241.72	291.43	311.13	303.13	57.55
1 Aug.99	10.26	217.11	0.28					10.50	10.83	6.20	0.00	0.00	3.47	102.47	51.41	3.99	0.00	82.92	46.22	0.19	0.00		101.88	115.58	145.98	134.51	277.65
4-Aug-99																						0.00					
5 Aug. 99	0.00	0.00	1.85					0.97	0.58	0.21	1.12	0.23	0.86	43.85	32.26	0.00	0.00	136.89	6.25	0.00	0.00		176.11	223.83	242.44	102.86	39.03
11 Aug. 99	3.57	2.61	0.00									0.00	0.00	83.86	0.21	20.65	0.00					21.33					3.92
26 Aug. 99	0.00	29.82	0.00					14.38	0.00	8.01	0.00	0.36	1.61	19.07	101.19	9.27	0.00	2.67	59.90	34.96	0.00		18.79	10.08	24.21	5.88	103.80
1 Aug. 00	0.00	4.11	0.00					0.00	0.00	0.00	0.00	0.00	0.00	28.57	106.31	0.70	0.00	70.36	0.60	58.14	0.00		147.78	133.66	164.47	68.75	119.97
8 Aug. 00	0.00	163.40	0.00					0.00	0.00	0.80	0.36	0.00	0.00	58.76	35.83	14.48	17.24	40.11	0.62	0.48	0.00	0.00	160.69	304.03	95.24	235.75	248.32
12 Aug. 00	7.22	18.35	9.71					0.00	0.39	0.68	0.00	3.54	4.90	33.33	97.90	3.46	10.99	11.52	20.90	49.62	0.21	1.82	65.15	31.72	69.16	45.13	137.25
14 Aug. 00	0.00	10.62	10.11									0.00	0.00	20.28	67.38	17.57	20.89										73.32
24 Aug. 00	13.08	3.27	0.00					0.00	0.20	11.59	4.01	5.20	0.00	32.40	7.20	4.01	15.24	3.21	5.40	5.88	0.00		12.12	54.40	37.63	27.05	5.00
23 Jul.01	7.46	32.57	0.00					4.88	9.00	0.00	0.00	2.67	3.15	27.92	28.48	3.69	0.71	35.46	9.96	0.00	0.00				118.75	206.34	55.21
8 Aug.01	0.38	68.18	0.53					0.00	0.20	0.00	0.00	2.75	0.00	45.08	182.79	9.39	45.18	20.95	5.20	7.96	0.00		133.59	235.64	123.63	44.35	91.03
11 Aug.01	0.00	0.84	0.00					11.54	0.00	0.61	0.00	0.12	0.00	9.04	34.76	6.93	6.08	3.08	8.61	0.00	0.20		25.31	34.20	42.11	9.09	0.00
4	29	54	37	3	3	3	3	22	23	23	23	59	59	69	69	67	67	47	47	47	47	4	33	33	34	34	13
Mean =	3.40	36.59	14.95	1.06	2.36	1.93	0.00	5.10	6.23	2.82	1.63	9.81	7.16	84.02	112.45	64.93	77.21	48.73	62.73	50.99	9.51	5.79	110.16	175.86	103.92	53.96	93.23
s.d. =	4.93	48.19	68.61	1.84	4.09	3.34	0.00	9.51	15.72	5.73	6.29	27.18	30.73	109.84	261.17	237.51	369.52	81.56	198.43	87.64	35.67	10.40	116.59	169.15	79.61	70.50	87.24
c.v. =	1.45	1.32	4.59	1.73	1.73	1.73		1.87	2.52	2.03	3.85	2.77	4.29	1.31	2.32	3.68	4.79	1.67	3.16	1.72	3.75	1.80	1.06	0.96	0.77	1.31	0.94

Table B2. Continued.

Survey Date							Tundra Transect Nos. and Areas Sampled (km²)			
Transect Number	602	603	604	605	606	607	500	501	502	503
Transect Area	5.16	5.64	6.28	4.48	7.00	9.84	6.56	5.42	6.91	5.52
5 Jun.77										
20 Jun.77										
5 Jul.77										
28-29 Jul.77										
15 Aug.77										
30 Aug.77										
22 Sep.77										
23 Jun.78										
5 Jul.78										
15 Jul.78										
25 Jul.78										
5-6 Aug.78										
15 Aug.78										
25 Aug.78										
5-8 Sep.78										
15 Sep.78										
23 Sep.78										
22 Jun.79										
28 Jul.79										
31 Aug.-1 Sep.79										
22 Sep.79										
2 Aug.80										
18 Jul.81										
29 Jul.81										
2 Aug.81										
12 Aug.81										
29 Aug.81										
11 Sep.81										
18 Jul.82										
31 Jul.82										
14 Aug.82										
28 Aug.82										
23 Sep.82										
29 Jul.83										
8 Aug.84										
6 Aug.89										
8 Aug.89										
9 Aug.89										
18 Jul.90										
20 Jul.90										
23 Jul.90										
3 Aug.90										
4 Aug.90										
9 Aug.90										
16 Aug.90										
20 Aug.90										
2 Sep.90										
4 Sep.90										
5 Sep.90										
18 Jul.91										
19 Jul.91										
20 Jul.91										
22 Jul.91										
4 Aug.91										
10 Aug.91										
14 Aug.91										
16 Aug.91										
21 Aug.91										
5 Aug. 98							0.00	0.00	0.00	0.00
14 Aug. 98							0.00	0.00	0.00	0.00
16 Aug.98							0.00	0.00	0.00	0.00
31 Aug.98							0.00	5.79	0.00	0.00
3 Sept.98							0.00	9.11	0.00	0.00
30 Jul.99	19.51	35.70	76.96	65.98	21.23	188.73	0.00	5.76	0.76	6.16
1 Aug.99	118.21	75.14	0.00	16.60	5.17	151.63	0.00	0.88	0.00	0.00
4 Aug. 99										
5 Aug. 99	30.66	100.54	0.75	9.23	8.33	31.99	0.00	0.00	0.00	0.00
11 Aug. 99	33.01	109.57								
26 Aug. 99	16.60	13.83	47.20	111.07	1.87	31.08	0.00	0.00	0.00	0.00
1 Aug. 00	8.54	53.16	38.67	39.42	25.41	34.12	0.00	6.41	0.00	2.82
8 Aug. 00	75.99	122.22	14.66	31.35	5.28	96.08	0.00	0.00	0.00	1.03
12 Aug. 00	41.86	26.12	3.70	17.42	41.60	21.17	0.00	4.17	0.00	2.41
14 Aug. 00	60.63	9.19								
24 Aug. 00	0.19	50.29	0.00	5.58	19.01	29.41	0.00	3.40	0.00	4.43
23 Jul.01	10.66	32.43	0.00	0.38	2.89	34.38				
8 Aug.01	119.04	40.61	0.00	7.63	73.16	40.26	0.00	0.00	0.00	0.18
11 Aug.01	67.31	29.70	0.00	0.00	11.65	4.46	0.00	0.00	0.92	8.15
3	13	13	11	11	11	11	15	15	15	15
Mean =	46.17	53.73	16.54	27.70	19.60	60.30	0.00	2.37	0.11	1.68
s.d. =	39.34	36.90	26.20	33.97	21.42	59.27	0.00	3.12	0.30	2.63
c.v. =	0.85	0.69	1.58	1.23	1.09	0.98		1.32	2.65	1.56

Table B3. Database records for sightings of human activity during aerial surveys in the barrier island-lagoon systems between Spy Island and Brownlow Point, Alaska, 23 July - 11 August 2001.

proj_code	record	trans_cd	trans_no	sdate	loc_site	obs_no	position	visibil	assoc	species_cd	species	no_individ	gr_type	behaviour	s_habitat	g_habitat	on_or_off	time_per	adults	sub_adults	yg_of_yr	males	females	ice	repeat	time	remarks
P598	449	12	23	7/23/2001	001	LN	FR	1		8000	HUMAN	3	04	99	10	11	0	6	0	0	0	0	0	0			SEVERAL PEOPLE AT C
P598	456	12	23	7/23/2001	001	LN	FR	1		8000	HUMAN	2	04	23	14	11	0	7	0	0	0	0	0	0			2 CONNEXS
P598	479	13	31	7/23/2001	001	LN	FR	1		8000	HUMAN	1	01	99	14	11	0	1	0	0	0	0	0	0			ONE CONNEX
P598	561	14	202	7/23/2001	001	LN	FR	1		8000	HUMAN	1	01	99	14	11	1	7	0	0	0	0	0	0			CAMP W/BUNCH OF TEN
P598	1780	44	25	8/8/2001	001	LN	RF	1		8000	HUMAN	1	01	15	15	27	1	3	0	0	0	0	0	0		135743	NORTHSTAR PIPELINE
P598	1793	44	25	8/8/2001	001	LN	RF	1		8000	HUMAN	1	01	07	15	27	0	7	0	0	0	0	0	0		135953	FYKE NET
P598	2188	53	31	8/8/2001	001	LN	RF	1		8000	HUMAN	1	01	15	15	11	0	5	0	0	0	0	0	0		144435	NET-CAPTURE-USGSBRD
P598	2239	54	202	8/8/2001	001	LN	RF	1		8000	HUMAN	1	01	15	15	11	0	1	0	0	0	0	0	0		144647	NET-CAPTURE-USGSBRD
P598	2243	54	202	8/8/2001	001	LN	RF	1		8000	HUMAN	1	01	15	15	11	1	2	0	0	0	0	0	0		144729	TOWER W/BLIND?
P598	2247	54	202	8/8/2001	001	LN	RF	1		8000	HUMAN	1	01	15	15	11	1	3	0	0	0	0	0	0		144755	TOWER W/BLIND?
P598	2254	54	202	8/8/2001	001	LN	RF	1		8000	HUMAN	1	01	15	15	11	1	7	0	0	0	0	0	0		144940	USGSBRD CAMP, 6-8 T
P598	2255	54	202	8/8/2001	001	LN	RF	1	1	8000	HUMAN	6	04	15	15	11	0	7	0	0	0	0	0	0		144953	6 PEOPLE & BOAT SET
P598	2320	55	201	8/8/2001	001	LN	RF	1		8000	HUMAN	1	01	15	15	11	1	10	0	0	0	0	0	0		145648	TOWER-TELEMETRY
P598	2421	57	102	8/8/2001	001	LN	RF	1		8000	HUMAN	1	01	15	08	13	1	3	0	0	0	0	0	0		150758	DOT BRD CAMP (OFF)
P598	3617	90	25	8/11/2001	001	LN	RF	1		8000	HUMAN	1	01	15	15	27	1	3	0	0	0	0	0	0		140028	NORTHSTAR PIPELINE
P598	3628	90	25	8/11/2001	001	LN	RF	1		8000	HUMAN	1	01	15	15	27	0	7	0	0	0	0	0	0		140245	FYKE NET
P598	3895	99	31	8/11/2001	001	LN	RF	1		8000	HUMAN	1	01	15	15	11	1	1	0	0	0	0	0	0			BOXES AND ORANGE CO
P598	3898	99	31	8/11/2001	001	LN	RF	1		8000	HUMAN	1	01	15	15	11	1	2	0001	0	0	0	0	0			FISH BOX AT END OF
P598	3911	99	31	8/11/2001	001	LN	RF	1		8000	HUMAN	2	04	15	15	11	0	5	0	0	0	0	0	0			TELEMETRY TOWER & C
P598	3919	99	31	8/11/2001	001	LN	RF	1		8000	HUMAN	1	01	15	15	11	1	8	0	0	0	0	0	0		144755	TELEMETRY TOWER W/T
P598	3941	100	202	8/11/2001	001	LN	RF	1		8000	HUMAN	1	01	15	15	11	1	1	0	0	0	0	0	0		144920	TELEMETRY ANTENNA
P598	3943	100	202	8/11/2001	001	LN	RF	1		8000	HUMAN	1	01	15	15	11	1	2	0	0	0	0	0	0		144948	ANTENNA WITH BLIND
P598	3954	100	202	8/11/2001	001	LN	RF	1		8000	HUMAN	2	04	15	15	11	1	6	0	0	0	0	0	0			USGSBRD CAMP, 2 PEO
P598	3985	101	201	8/11/2001	001	LN	RF	1		8000	HUMAN	1	01	15	15	11	1	5	0	0	0	0	0	0		145533	TELEMETRY ANTENNA
P598	4004	101	201	8/11/2001	001	LN	RF	1		8000	HUMAN	1	01	15	15	11	1	10	0	0	0	0	0	0		145808	TELEMETRY ANTENNA
P598	1084	27	136	7/23/2001	003	LN	FR	1		8000	HUMAN	1	01	15	15	11	1	2	0	0	0	0	0	0			BRD CAMP ON FLAXMAN
P598	1092	27	136	7/23/2001	003	LN	FR	1		8000	HUMAN	1	01	15	15	11	0	4	0	0	0	0	0	0		165013	CAMP
P598	1097	27	136	7/23/2001	003	LN	FR	1		8000	HUMAN	2	04	21	11	11	0	7	0	0	0	0	0	0			
P598	1547	39	193	7/23/2001	003	LN	FR	1		8000	HUMAN	1	01	99	15	27	1	10	0	0	0	0	0	0			BADAMI CAMP
P598	2708	65	61	8/8/2001	003	LN	RF	1		8000	HUMAN	1	01	15	08	13	1	4	0	0	0	0	0	0		164755	MONITORING STATION
P598	2710	65	61	8/8/2001	003	LN	RF	1		8000	HUMAN	1	01	15	08	13	1	5	0	0	0	0	0	0		164807	ANOTHER ANTENNA
P598	2739	66	60	8/8/2001	003	LN	RF	1		8000	HUMAN	1	01	15	08	13	1	4	0	0	0	0	0	0			USGS BRD CAMP
P598	2740	66	60	8/8/2001	003	LN	RF	1		8000	HUMAN	1	01	15	08	13	1	7	0	0	0	0	0	0			TELEMETRY TOWER E E
P598	2794	68	135	8/8/2001	003	LN	RF	1		8000	HUMAN	1	01	15	15	11	1	6	0	0	0	0	0	0		170248	MONITORING STATION
P598	3276	81	191	8/8/2001	003	LN	RF	1		8000	HUMAN	1	01	15	15	27	1	5	0	0	0	0	0	0		180647	MONITORING STATION
P598	3280	81	191	8/8/2001	003	LN	RF	1		8000	HUMAN	1	01	15	15	27	0	6	0	0	0	0	0	0		180731	FYKE NET
P598	3295	81	191	8/8/2001	003	LN	RF	1		8000	HUMAN	1	01	15	15	27	1	9	0	0	0	0	0	0			FYKE NET IN MAINLAN
P598	3330	82	190	8/8/2001	003	LN	RF	1		8000	HUMAN	1	01	15	15	27	0	1	0	0	0	0	0	0		181019	FYKE NET
P598	3336	82	190	8/8/2001	003	LN	RF	1		8000	HUMAN	1	01	15	15	27	0	3	0	0	0	0	0	0		181115	FYKE NET
P598	3342	82	190	8/8/2001	003	LN	RF	1		8000	HUMAN	1	01	15	15	27	1	6	0	0	0	0	0	0		181238	RADIO ANTENNA
P598	4402	113	136	8/11/2001	003	LN	RF	1		8000	HUMAN	1	01	15	15	11	1	3	0	0	0	0	0	0		165401	TELEMETRY TOWER W/B
P598	4406	113	136	8/11/2001	003	LN	RF	1		8000	HUMAN	1	01	15	15	11	1	5	0	0	0	0	0	0		165501	TELEMETRY STATION W
P598	4414	113	136	8/11/2001	003	LN	RF	1		8000	HUMAN	10	04	15	15	11	1	4	0	0	0	0	0	0			CAMP W/10 TENTS, CL
P598	4562	119	606	8/11/2001	003	LN	RF	1		8000	HUMAN	1	01	15	09	09	1	8	0	0	0	0	0	0		172308	PT THOMSON FISH CAM
P598	4727	125	193	8/11/2001	003	LN	RF	1		8000	HUMAN	1	01	15	15	27	0	13	0	0	0	0	0	0		175126	BADAMI DOCK-NO ACTI
P598	4759	126	192	8/11/2001	003	LN	RF	1		8000	HUMAN	1	01	15	15	27	0	2	0	0	0	0	0	0		175331	FYKE NET
P598	4807	127	191	8/11/2001	003	LN	RF	1		8000	HUMAN	1	01	15	15	27	1	4	0	0	0	0	0	0			TELEMETRY TOWER W/T
P598	4811	127	191	8/11/2001	003	LN	RF	1		8000	HUMAN	1	01	15	15	27	0	6	0	0	0	0	0	0		180155	FYKE NET
P598	4818	127	191	8/11/2001	003	LN	RF	1		8000	HUMAN	1	01	15	15	27	1	9	0	0	0	0	0	0		180321	FYKE NET IN LAGOON
P598	4823	127	191	8/11/2001	003	LN	RF	1		8000	HUMAN	2	04	22	15	27	0	10	0	0	0	0	0	0		180352	2 PEOPLE WALK SHORE
P598	4846	128	190	8/11/2001	003	LN	RF	1		8000	HUMAN	1	01	15	15	27	0	1	0	0	0	0	0	0		180440	FYKE NET
P598	4850	128	190	8/11/2001	003	LN	RF	1		8000	HUMAN	1	01	15	15	27	0	3	0	0	0	0	0	0		180537	FYKE NET
P598	4854	128	190	8/11/2001	003	LN	RF	1		8000	HUMAN	1	01	15	15	27	1	6	0	0	0	0	0	0		180659	TELEMETRY TOWER W/B
P598	478	13	31	7/23/2001	001	LN	FR	1		8001	BOAT	1	01	99	15	11	0	1	0	0	0	0	0	0			
P598	482	13	31	7/23/2001	001	LN	FR	1		8001	BOAT	1	01	02	15	11	0	1	0	0	0	0	0	0			
P598	562	14	202	7/23/2001	001	LN	FR	1		8001	BOAT	1	01	02	14	11	0	7	0	0	0	0	0	0			ANCHORED ZODIAC
P598	791	16	30	7/23/2001	001	LN	FR	1		8001	BOAT	1	01	21	08	13	0	8	0	0	0	0	0	0		150915	RUNNING THROUGH BAR
P598	1692	42	402	8/8/2001	001	LN	RF	1		8001	BOAT	1	01	07	15	27	1	2	0	0	0	0	0	0	1	134706	BOAT WAKE, USFWS BO
P598	1714	42	402	8/8/2001	001	RR	LR	1		8001	BOAT	1	01	07	15	27	0	2	0	0	0	0	0	0		134700	SMALL MOTOR BOAT MO
P598	2256	54	202	8/8/2001	001	LN	RF	1	1	8001	BOAT	1	01	07	15	11	0	7	0	0	0	0	0	0		144953	
P598	2472	58	30	8/8/2001	001	RR	LR	1		8001	BOAT	2	04	07	08	13	0	9	0	0	0	0	0	0			1 DORY, 1 ZODIAK &
P598	2476	59	22	8/8/2001	001	LN	RF	1		8001	BOAT	1	01	07	08	13	1	2	0	0	0	0	0	0			
P598	3529	90	25	8/11/2001	001	LN	RF	1		8001	BOAT	1	01	07	15	27	0	7	0	0	0	0	0	0			
P598	3547	91	24	8/11/2001	001	LN	RF	1		8001	BOAT	1	01	07	09	09	0	1	0	0	0	0	0	0			BOAT OUT FROM BARGE
P598	3789	95	603	8/11/2001	001	LN	RF	1		8001	BOAT	1	01	07	09	09	1	8	0	0	0	0	0	0			BRD CREW OUT WITH B

Table B3. Continued.

proj code	record	trans_cd	trans_no	sdate	loc site	obs no	position	visibil	assoc	species cd	species	no individ	gr type	behaviour	s habitat	g habitat	on or off	time per	adults	sub adults	yg of yr	males	females	ice	repeat	time	remarks
P598	3956	100	202	8/11/2001	001	LN	RF	1		8001	BOAT	1	01	15	15	11	0	7	0	0	0	0	0	0		145139	NET AND BOAT AT TRA
P598	1106	27	136	7/23/2001	003	LN	FR	1		8001	BOAT	1	01	07	15	11	0	4	0	0	0	0	0	0		165013	BOAT ANCHORED ON SH
P598	2786	68	135	8/8/2001	003	LN	RF	1		8001	BOAT	1	01	15	15	11	0	4	0	0	0	0	0	0			ZODIAK AT MONITORIN
P598	3024	74	607	8/8/2001	003	RR	LR	1		8001	BOAT	1	01	07	09	09	0	4	0	0	0	0	0	0		172855	SMALL BOAT W/3 PEOP
P598	3298	81	191	8/8/2001	003	LN	RF	1		8001	BOAT	2	04	07	15	27	0	11	0	0	0	0	0	0			ZODIAKS ANCHORED
P598	4434	114	135	8/11/2001	003	LN	RF	1		8001	BOAT	1	01	15	15	11	0	4	0	0	0	0	0	0		165912	TELEMETRY WITH BOAT
P598	4437	114	135	8/11/2001	003	LN	RF	1		8001	BOAT	1	01	15	15	11	0	6	0	0	0	0	0	0		170001	TELEMETRY TOWER WIT
P598	4710	125	193	8/11/2001	003	LN	RF	1		8001	BOAT	2	04	07	15	11	0	6	0	0	0	0	0	0		174608	2 AIRBOATS ALONG SH
P598	4813	127	191	8/11/2001	003	LN	RF	1		8001	BOAT	1	01	07	15	27	1	7	0	0	0	0	0	0			OFFSHORE AT PT THOM
P598	4824	127	191	8/11/2001	003	LN	RF	1		8001	BOAT	2	04	15	15	27	0	10	0	0	0	0	0	0			2 ZODIAKS ON BEACH
P598	4836	127	191	8/11/2001	003	PJ	LR	1		8001	BOAT	1	01	99	15	27	1	9	0	0	0	0	0	0			
P598	814	19	22	7/23/2001	001	LN	FR	1		8002	MBOAT	2	04	23	08	13	0	5	0	0	0	0	0	0			ALASKA CLEAN SEAS
P598	815	19	22	7/23/2001	001	LN	FR	1		8002	MBOAT	2	04	21	08	13	0	5	0	0	0	0	0	0			
P598	1606	45	24	8/8/2001	001	LN	RF	1		8002	MBOAT	4	04	07	09	09	0	1	0	0	0	0	0	0			2 BOOM BARGES, 2 BA
P598	2480	59	22	8/8/2001	001	LN	RF	1		8002	MBOAT	1	01	07	08	13	0	3	0	0	0	0	0	0		151613	SPEEDY TUG
P598	2489	59	22	8/8/2001	001	RR	LR	1		8002	MBOAT	5	04	07	08	13	0	5	0	0	0	0	0	0			3 BOATS AT BARGE, B
P598	4638	122	181	8/11/2001	003	LN	RF	1		8002	MBOAT	1	01	07	09	09	1	2	0	0	0	0	0	0			HEADED OUT THROUGH
P598	4761	126	192	8/11/2001	003	LN	RF	1		8002	MBOAT	1	01	07	15	27	0	3	0	0	0	0	0	0		175405	BOAT PULLING IN TO
P598	4766	126	192	8/11/2001	003	LN	RF	1		8002	MBOAT	1	01	07	15	27	0	5	0	0	0	0	0	0	1	175508	BOAT ABOVE-CROSSED
P598	816	19	22	7/23/2001	001	LN	FR	1		8003	SEISMC	1	01	21	08	13	0	5	0	0	0	0	0	0			
P598	1611	45	24	8/8/2001	001	LN	RF	1		8003	SEISMC	3	04	07	09	09	0	4	0	0	0	0	0	0			1 SEISMIC BARGE, 2
P598	1928	48	301	8/8/2001	001	LN	RF	1		8003	SEISMC	1	01	07	09	09	1	8	0	0	0	0	0	0			
P598	2148	52	23	8/8/2001	001	LN	RF	1		8003	SEISMC	1	01	07	15	11	1	6	0	0	0	0	0	0			N OF ISLAND
P598	2317	55	201	8/8/2001	001	LN	RF	1		8003	SEISMC	3	04	07	15	11	1	9	0	0	0	0	0	0		145559	SEISMIC SOURCE BOAT
P598	2383	56	101	8/8/2001	001	LN	RF	1		8003	SEISMC	3	04	07	08	13	0	4	0	0	0	0	0	0		150210	
P598	2401	56	101	8/8/2001	001	RR	LR	1		8003	SEISMC	1	01	07	08	13	1	4	0	0	0	0	0	0	1		MOVING WEST
P598	2403	56	101	8/8/2001	001	RR	LR	1		8003	SEISMC	1	01	07	08	13	1	5	0	0	0	0	0	0	1		WESTERN ENDEAVOR
P598	3990	101	201	8/11/2001	001	LN	RF	1		8003	SEISMC	1	01	07	15	11	1	6	0	0	0	0	0	0			OFF SHORE TO NORTH
P598	3995	101	201	8/11/2001	001	LN	RF	1		8003	SEISMC	2	04	07	15	11	1	8	0	0	0	0	0	0			200M NORTH OF ISLAN
P598	4000	101	201	8/11/2001	001	LN	RF	1		8003	SEISMC	1	01	07	15	11	1	9	0	0	0	0	0	0		145733	SEISMIC OFFSHORE FR
P598	4011	101	201	8/11/2001	001	LN	RF	1		8003	SEISMC	1	01	07	15	11	1	12	0	0	0	0	0	0	1	145854	SEISMIC SHIP 1-2 KM
P598	4052	102	101	8/11/2001	001	LN	RF	1		8003	SEISMC	1	01	07	08	13	1	5	0	0	0	0	0	0			WITH BOOM, OFF TO S
P598	4067	102	101	8/11/2001	001	PJ	LR	1		8003	SEISMC	1	01	07	08	13	1	2	0	0	0	0	0	0			BARGE
P598	4072	102	101	8/11/2001	001	PJ	LR	1		8003	SEISMC	1	01	07	08	13	1	6	0	0	0	0	0	0			BOAT
P598	4074	102	101	8/11/2001	001	PJ	LR	1		8003	SEISMC	1	01	07	08	13	1	7	0	0	0	0	0	0			BARGE
P598	4153	105	22	8/11/2001	001	PJ	LR	1		8003	SEISMC	1	01	07	08	13	1	5	0	0	0	0	0	0			BARGE
P598	409	12	23	7/23/2001	001	LN	FR	1		8004	SHIP	1	01	99	15	11	0	1	0	0	0	0	0	0			TUG
P598	3646	91	24	8/11/2001	001	LN	RF	1		8004	SHIP	2	04	07	09	09	0	1	0	0	0	0	0	0			2 BOOM BARGES-NOT M
P598	2498	60	130	8/8/2001	002	LN	RF	1		8004	SHIP	2	04	07	09	13	1	96	0	0	0	0	0	0			AT WEST DOCK-2 BOOM
P598	2500	60	130	8/8/2001	002	LN	RF	1		8004	SHIP	1	01	07	09	13	1	1	0	0	0	0	0	0		161419	BARGE TO WEST
P598	4163	106	130	8/11/2001	002	LN	RF	1		8004	SHIP	1	01	07	09	13	1	3	0	0	0	0	0	0			BARGE AND MODULE 1
P598	4188	106	130	8/11/2001	002	PJ	LR	1		8004	SHIP	1	01	07	09	13	0	2	0	0	0	0	0	0			LARGE BARGE
P598	517	13	31	7/23/2001	001	LN	FR	1		8005	PLANE	1	01	11	15	11	1	9	0	0	0	0	0	0	001	144022	FLOAT PLANE NEAR AN
P598	1252	30	133	7/23/2001	003	LN	FR	1		8005	PLANE	1	01	11	15	11	1	97	0	0	0	0	0	0			
P598	1408	35	180	7/23/2001	003	LN	FR	1		8005	PLANE	1	01	11	09	09	1	1	0	0	0	0	0	0			
P598	1486	38	183	7/23/2001	003	LN	FR	1		8005	PLANE	1	01	11	15	11	1	97	0	0	0	0	0	0			USFWS PLANE ON SHOR
P598	2372	55	201	8/8/2001	001	RR	LR	1		8007	BOUY	1	01	07	15	11	0	14	0	0	0	0	0	0			
P598	2381	56	101	8/8/2001	001	LN	RF	1		8007	BOUY	1	01	07	08	13	0	3	0	0	0	0	0	0		150143	
P598	2387	56	101	8/8/2001	001	LN	RF	1		8007	BOUY	0	01	07	08	13	0	7	0	0	0	0	0	0		150327	
P598	2392	56	101	8/8/2001	001	LN	RF	1		8007	BOUY	1	01	07	08	13	0	10	0	0	0	0	0	0		150514	
P598	2399	56	101	8/8/2001	001	RR	LR	1		8007	BOUY	1	01	07	08	13	0	3	0	0	0	0	0	0			
P598	4059	102	101	8/11/2001	001	LN	RF	1		8007	BOUY	1	01	07	08	13	0	10	0	0	0	0	0	0			

Table B4. Habitat associations of long-tailed ducks during aerial surveys in the barrier island-lagoon systems and tundra transects between Spy Island and Brownlow Point, Alaska, 23 July-11 August 2001.

General Habitat Type	Specific Habitat Type	Number of Sightings 23 July 01	Number of Sightings 8 Aug 01	Number of Sightings 11 Aug 01	Total All Surveys	Percent of Total
Lagoon (9)	Smooth fast ice (1)	1	-	-	1	0.1
	Lagoon (9)	91	145	69	305	35.6
	Shoreline (land side) (14)	1	-		1	0.1
Barrier Island (11)	Lagoon (9)	2	-	-	2	0.2
	Smooth fast ice (1)	3	-	-	3	0.4
	Island (11)	1	-	-	1	0.1
	Shoreline (land side; 14)	5	-	-	5	0.6
	Shoreline (water side; 15)	166	150	40	356	41.5
Artifical Structure (79)	Shoreline (land side) (14)	1	-	-	1	0.1
	Shoreline (15)	1	-	-	1	0.1
Nearshore Sea <3 mi. (13)	Smooth fast ice (1)	1	-	-	1	0.1
	Ocean (8)	17	7	6	30	3.5
	Lagoon (9)	12	4	-	16	1.9
Unclassified Tundra (24)	Shoreline (waterside) (15)	1	-	-	1	0.1
Wet Tundra (25)	Completely vegetated (25)	-	1	-	1	0.1
	Pond (47)	-	-	1	1	0.1
	Medium lake (51)	-	-	3	3	0.4
Mainland Coast (27)	Spit (10)	1	-	-	1	0.1
	Island (11)	1	-	-	1	0.1
	Shoreline (water side; 15)	21	73	31	125	14.6
River Delta (92)	Tidal flat (13)	-	1	-	1	0.1
ALL HABITATS		326	381	150	857	100

Table B5. Long-tailed duck behavior during aerial surveys in the barrier island-lagoon systems and tundra transects between Spy Island and Browlow Point, Alaska, 23 July-11 August 2001.

Specific Behaviors	Sightings 23 July 01	Sightings 8 Aug 01	Sightings 11 Aug 01	Total All Surveys	Percent of Total
Hauled out on ice (01)	-	-	1	1	0.1
Hauled out on land (02)	1	3	-	4	0.5
Hauled out (general) (03)	-	12	4	16	1.9
Hauled out on land-swim/dive (06)	-	-	-	0	0.0
Swimming (07)	277	359	110	746	87.0
Swimming then diving (08)	12	2	4	18	2.1
Swimming then flying (09)	-	1	-	1	0.1
Flying (11)	2	-	-	2	0.2
Standing (15)	2	1	1	4	0.5
Rest (23)	9	-	-	9	1.1
Incubate (30)	1	-	-	1	0.1
Unknown or unrecorded (99)	22	3	30	55	6.4
TOTAL	326	381	150	857	100

APPENDIX C:

2001 DISTRIBUTION MAPS FOR SELECTED SPECIES

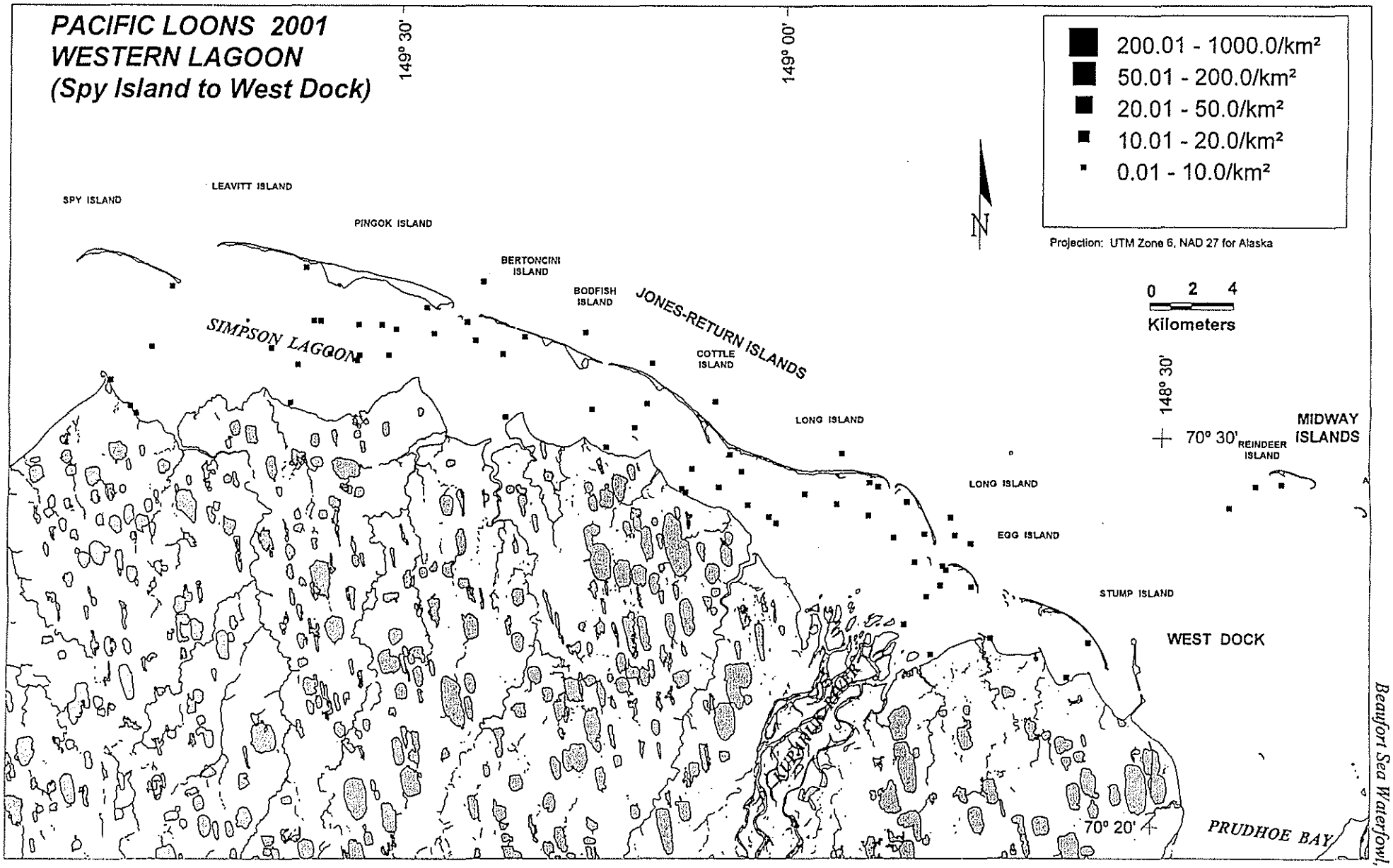


Figure C1. Summary of density for Pacific loons by 30-s time period segments in the barrier island-lagoon system between Spy Island and West Dock, Alaska, 23 July-11 August 2001.

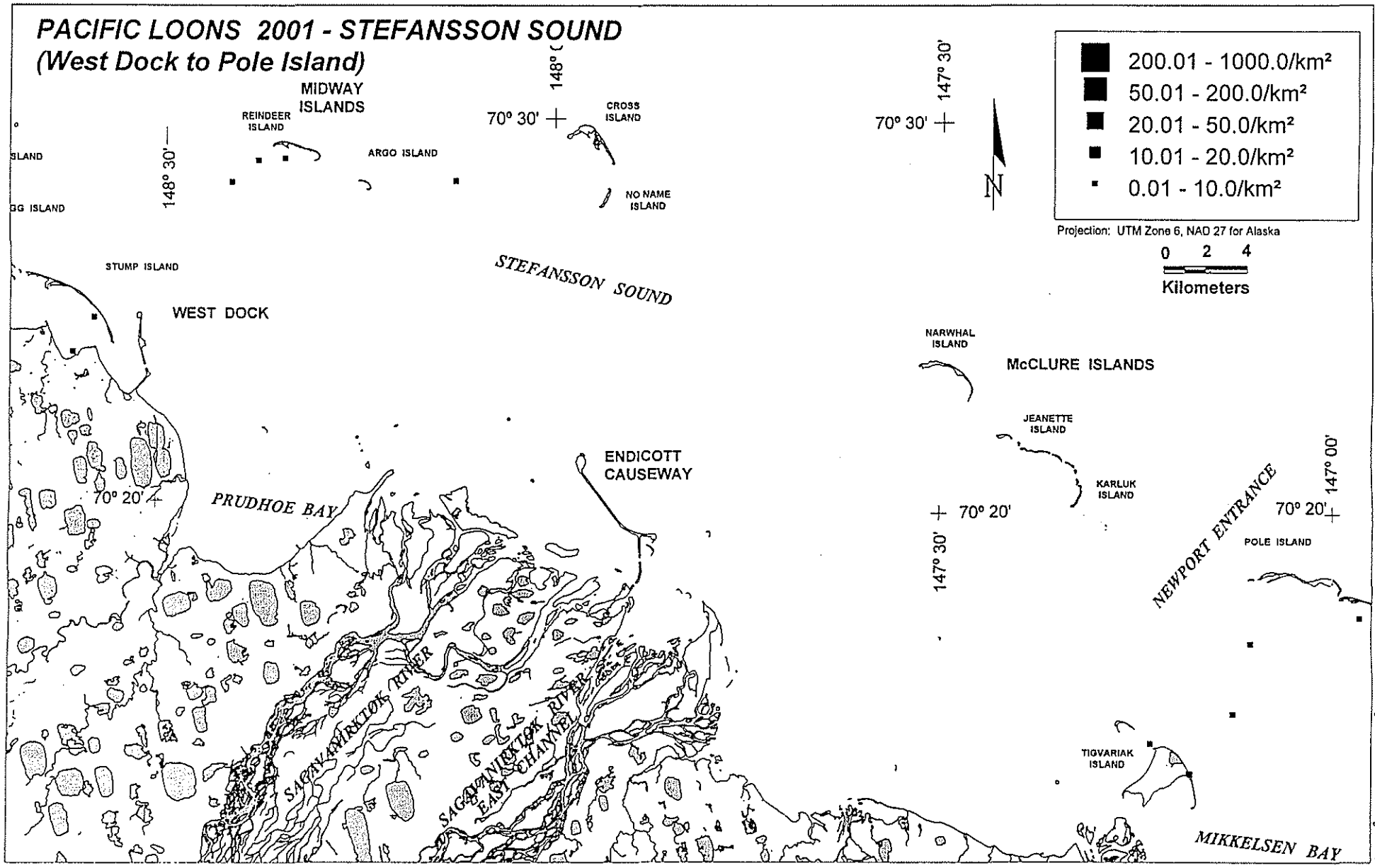


Figure C2. Summary of density for Pacific loons by 30-s time period segments in the barrier island-lagoon system between West Dock and Pole Island, Alaska, 23 July-11 August 2001.

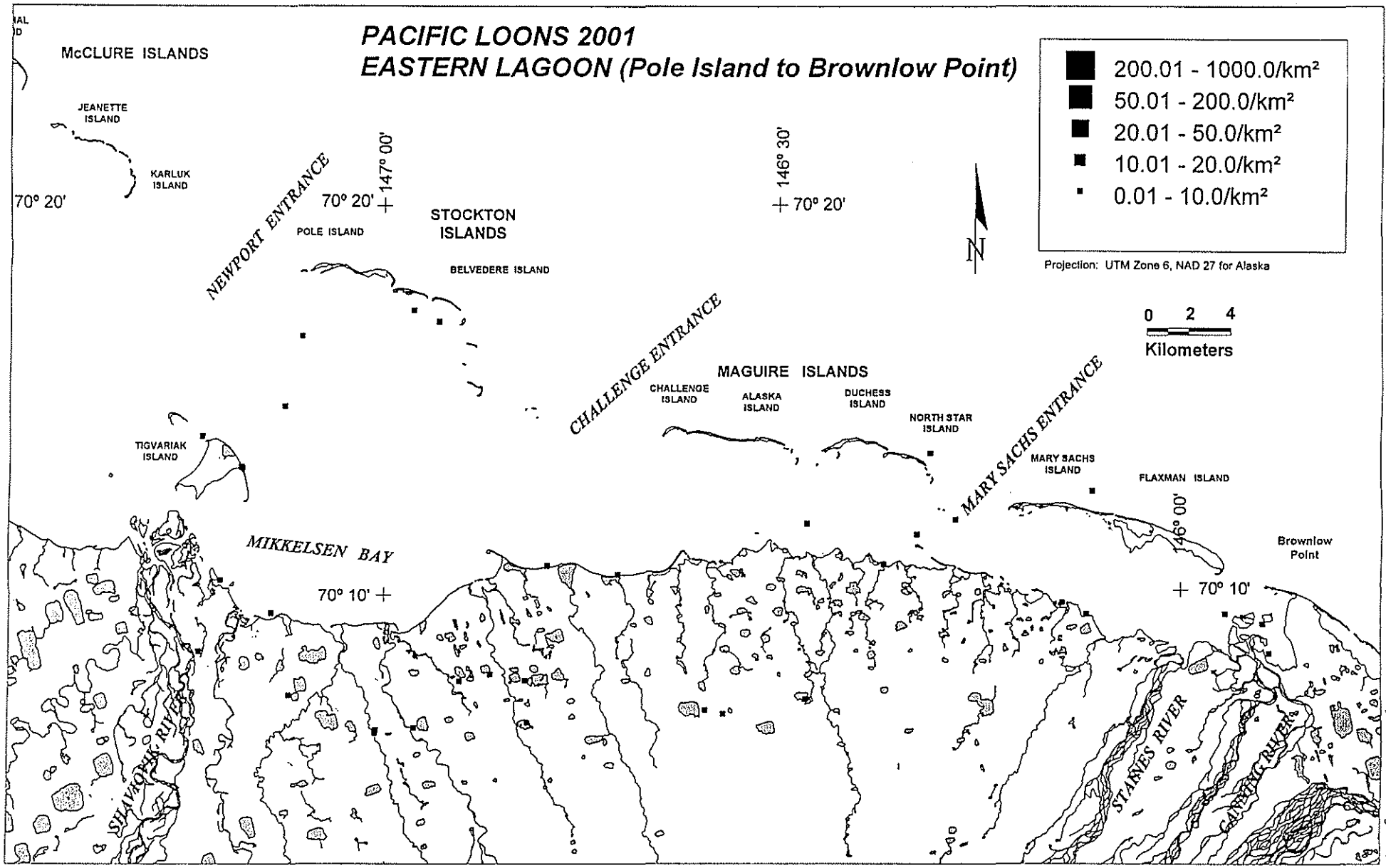


Figure C3. Summary of density for Pacific loons by 30-s time period segments in the barrier island-lagoon system between Pole Island and Brownlow Point, Alaska, 23 July-11 August 2001.

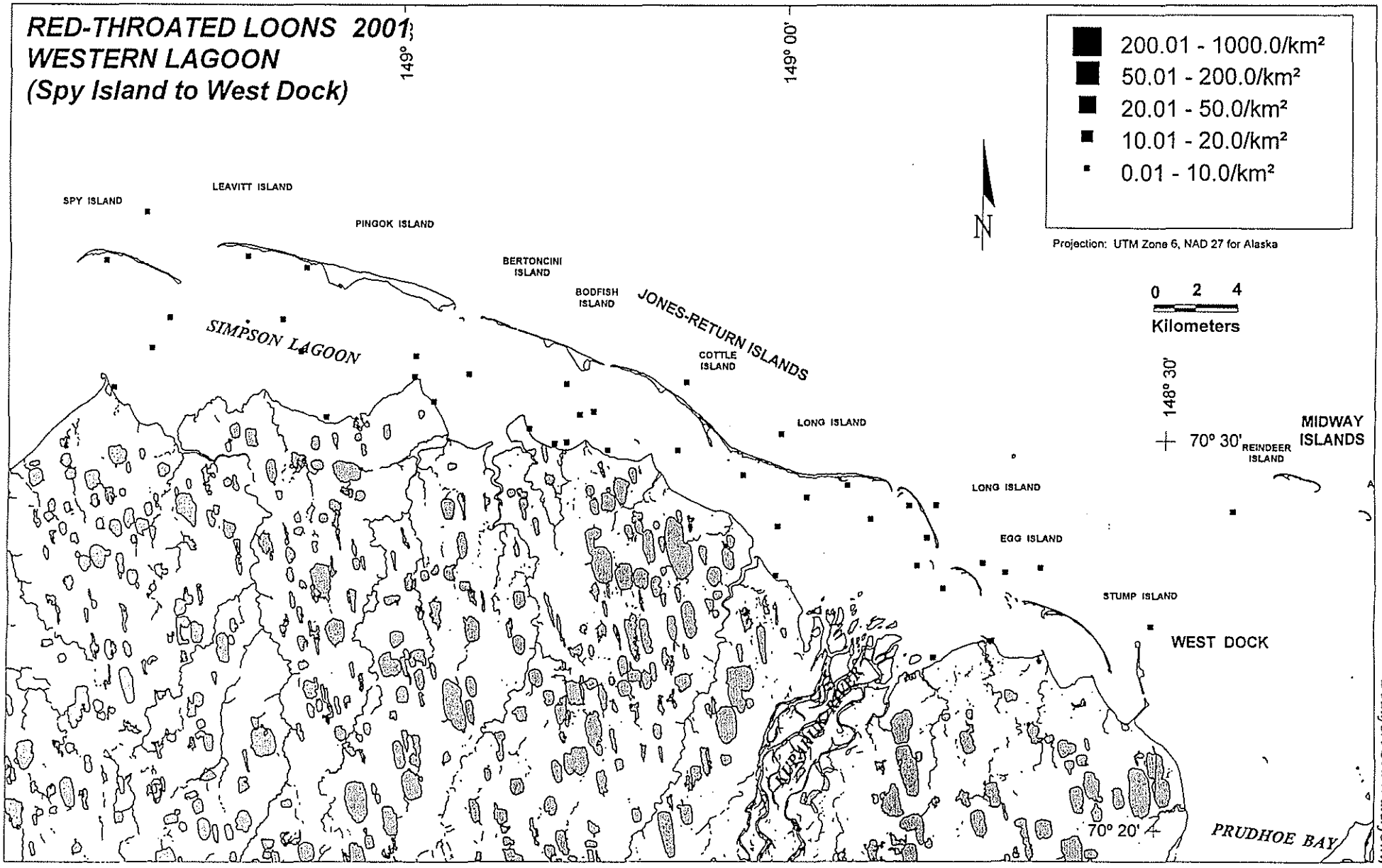


Figure C4. Summary of density for red-throated loons by 30-s time period segments in the barrier island-lagoon system between Spy Island and West Dock, Alaska, 23 July-11 August 2001.

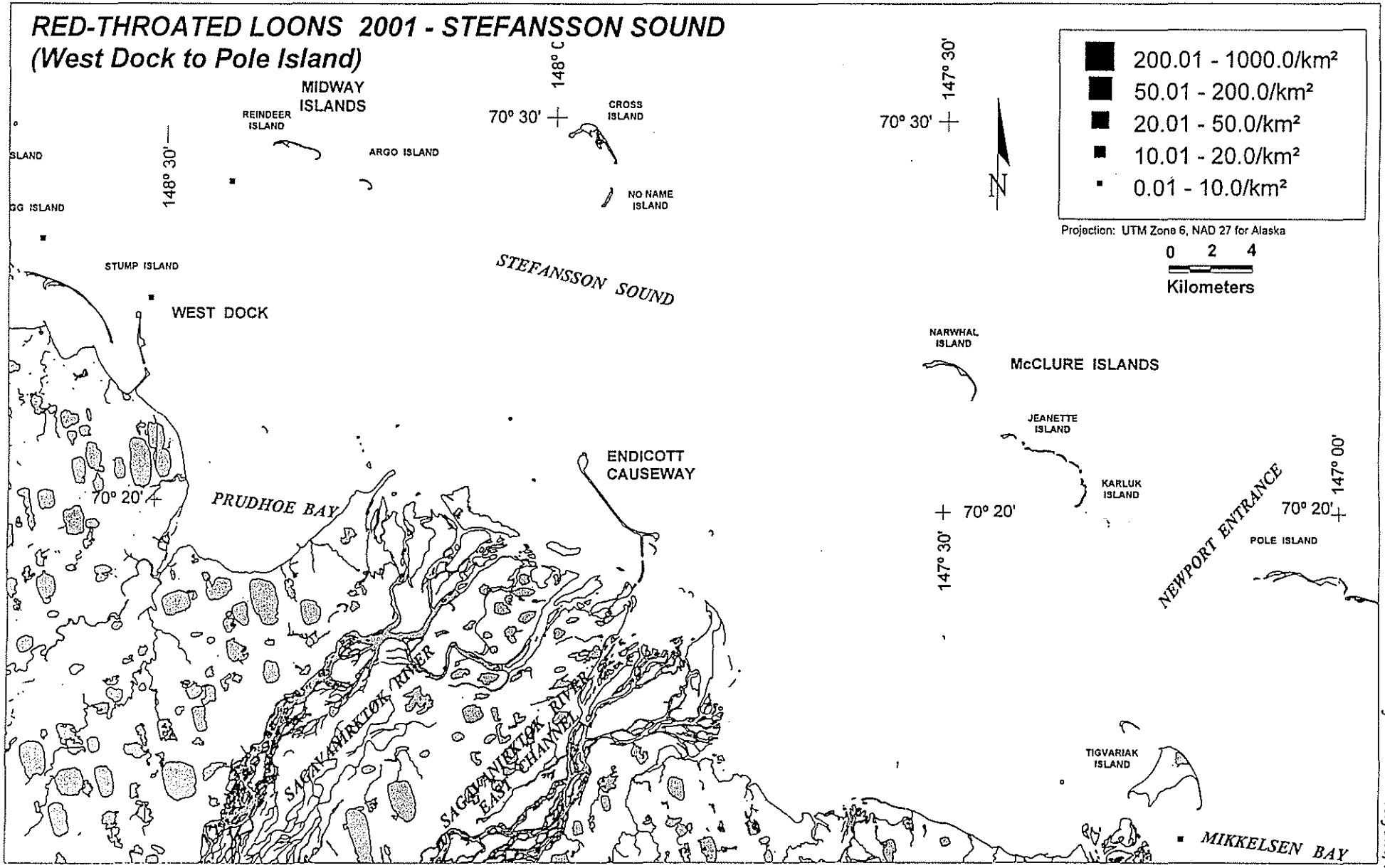


Figure C5. Summary of density for red-throated loons by 30-s time period segments in the barrier island-lagoon system between West Dock and Pole Island, Alaska, 23 July-11 August 2001.

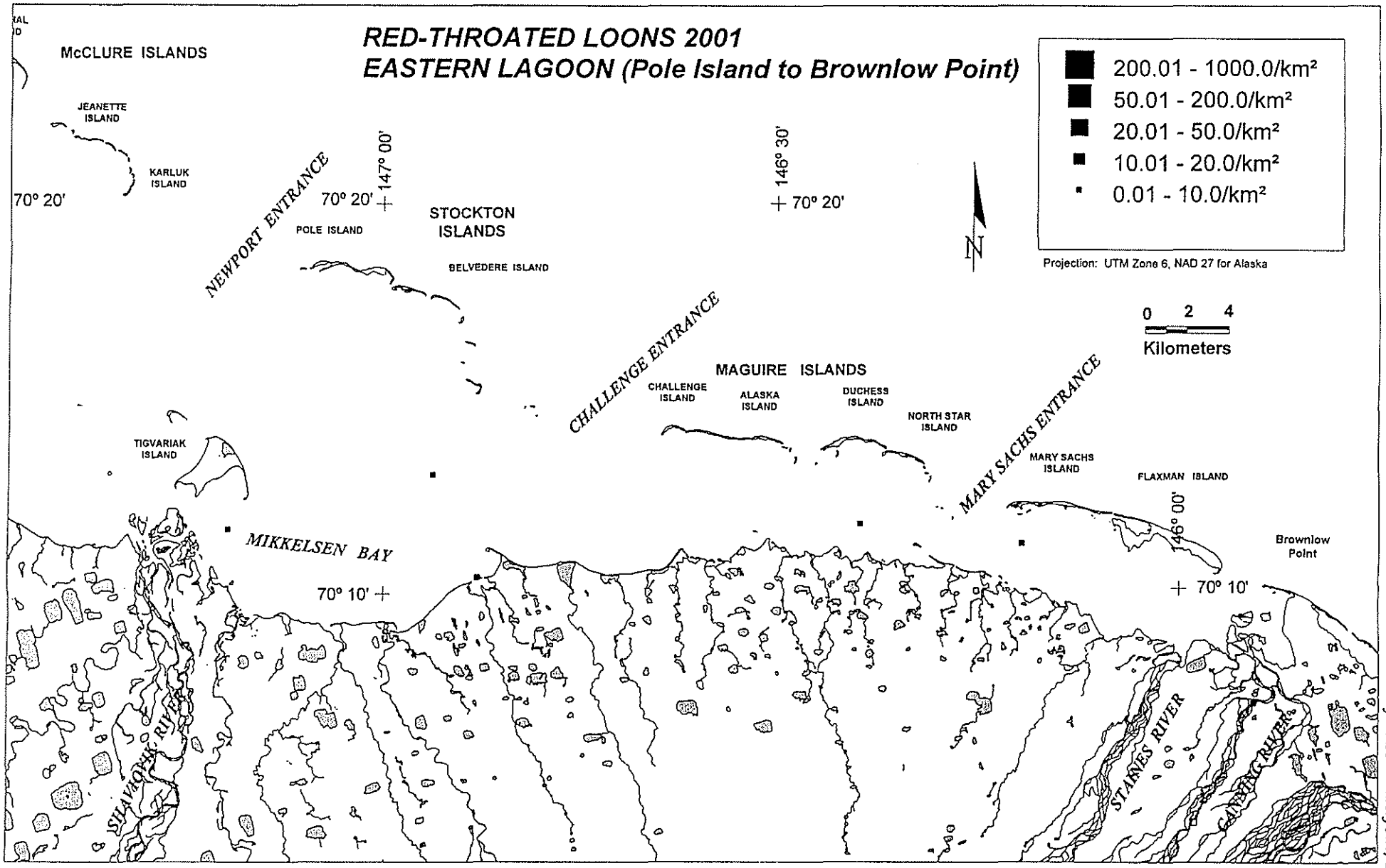


Figure C6. Summary of density for red-throated loons by 30-s time period segments in the barrier island-lagoon system between Pole Island and Brownlow Point, Alaska, 23 July-11 August 2001.

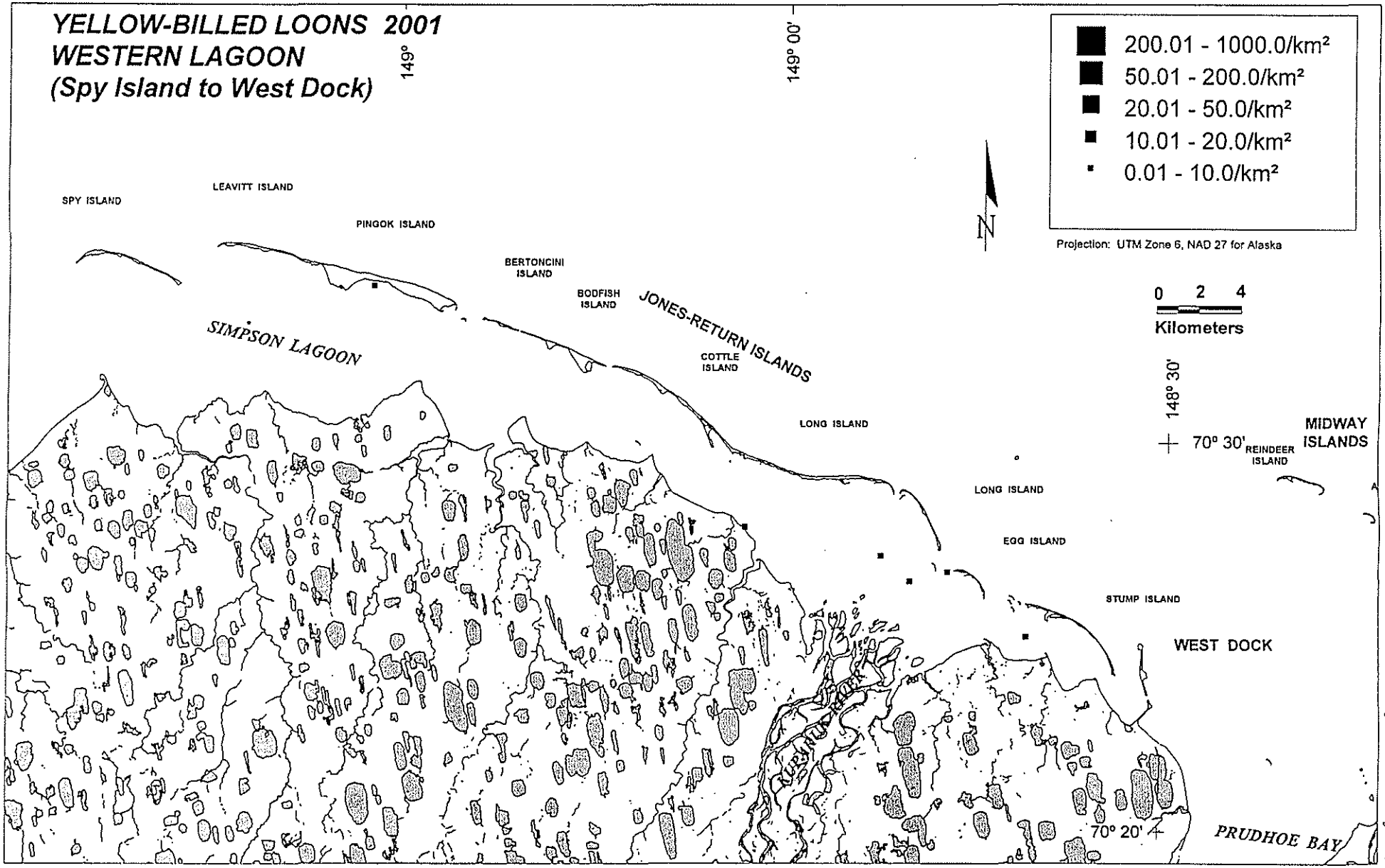


Figure C7. Summary of density for yellow-billed loons by 30-s time period segments in the barrier island-lagoon system between Spy Island and West Dock, Alaska, 23 July-11 August 2001.

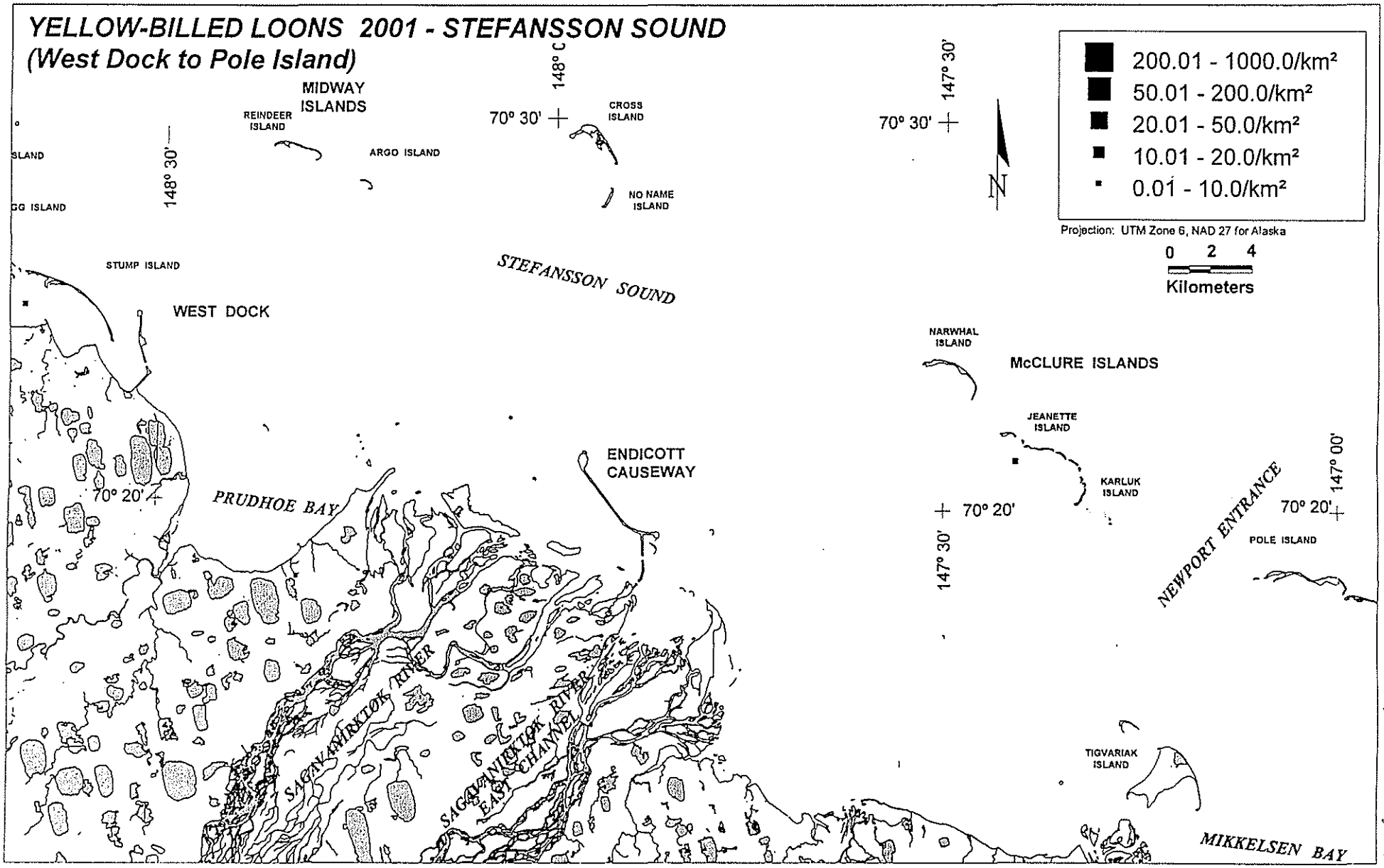


Figure C8. Summary of density for yellow-billed loons by 30-s time period segments in the barrier island-lagoon system between West Dock and Pole Island, Alaska, 23 July-11 August 2001.

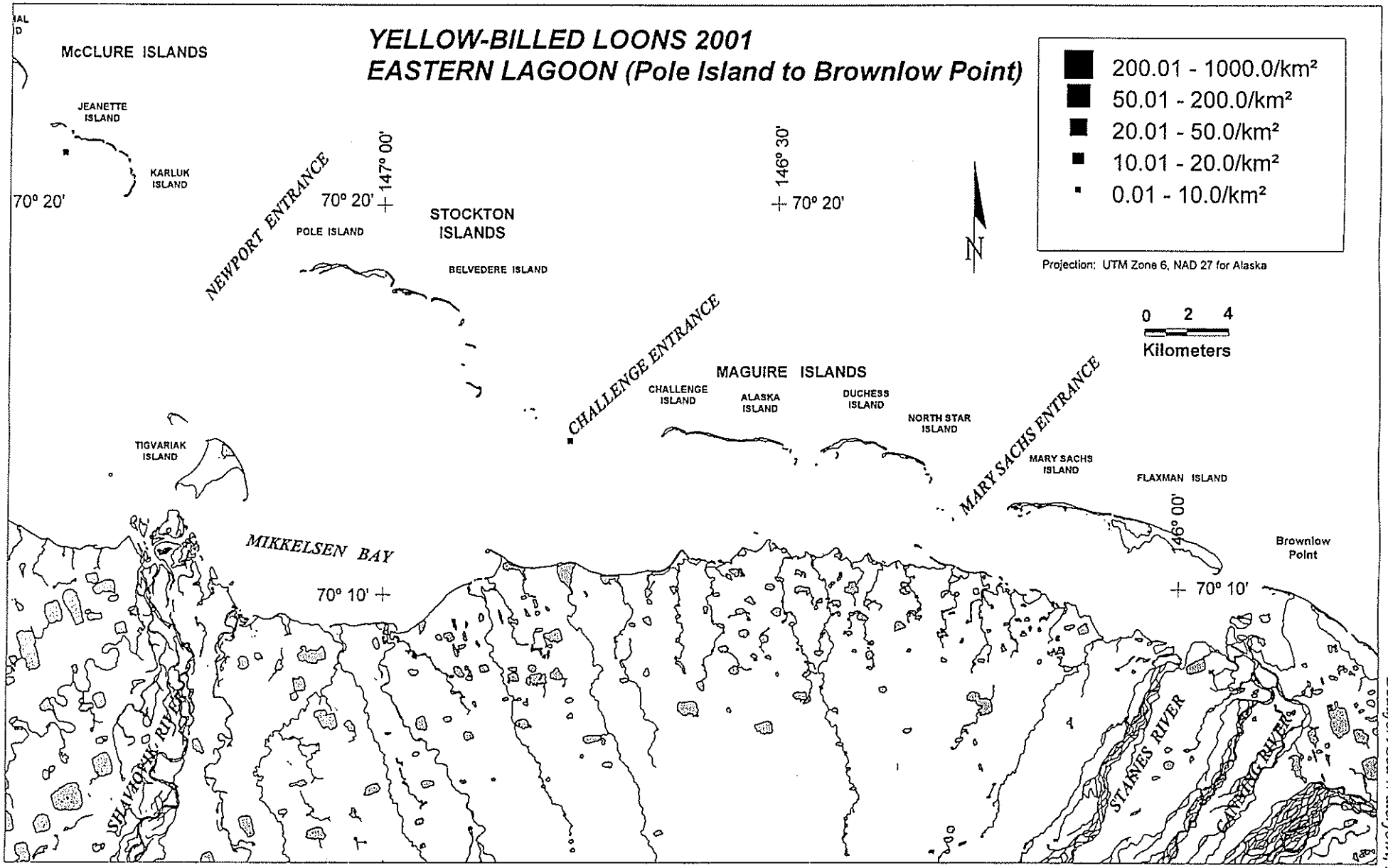


Figure C9. Summary of density for yellow-billed loons by 30-s time period segments in the barrier island-lagoon system between Pole Island and Brownlow Point, Alaska, 23 July-11 August 2001.

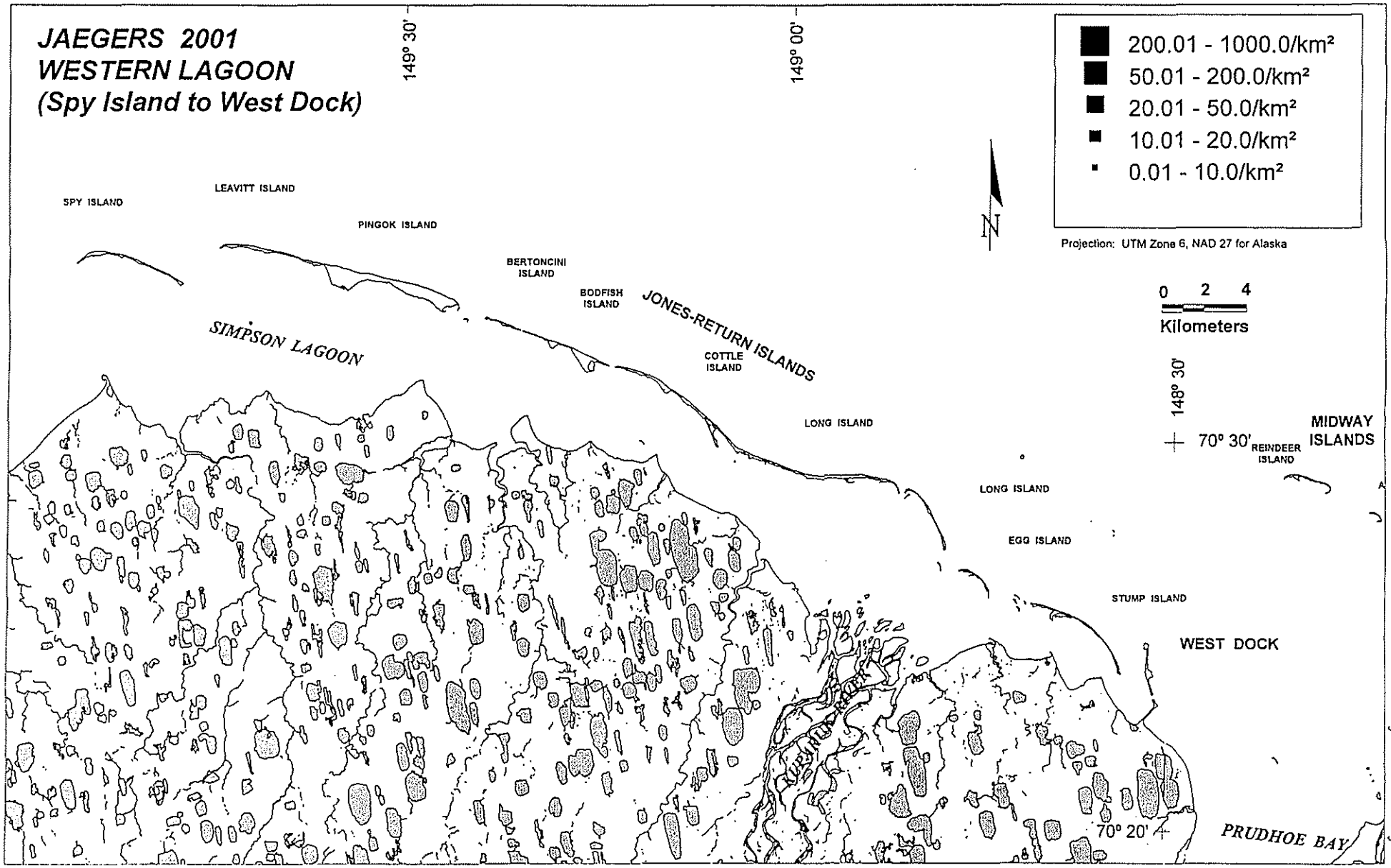


Figure C10. Summary of density for jaegers by 30-s time period segments in the barrier island-lagoon system between Spy Island and West Dock, Alaska, 23 July-11 August 2001.

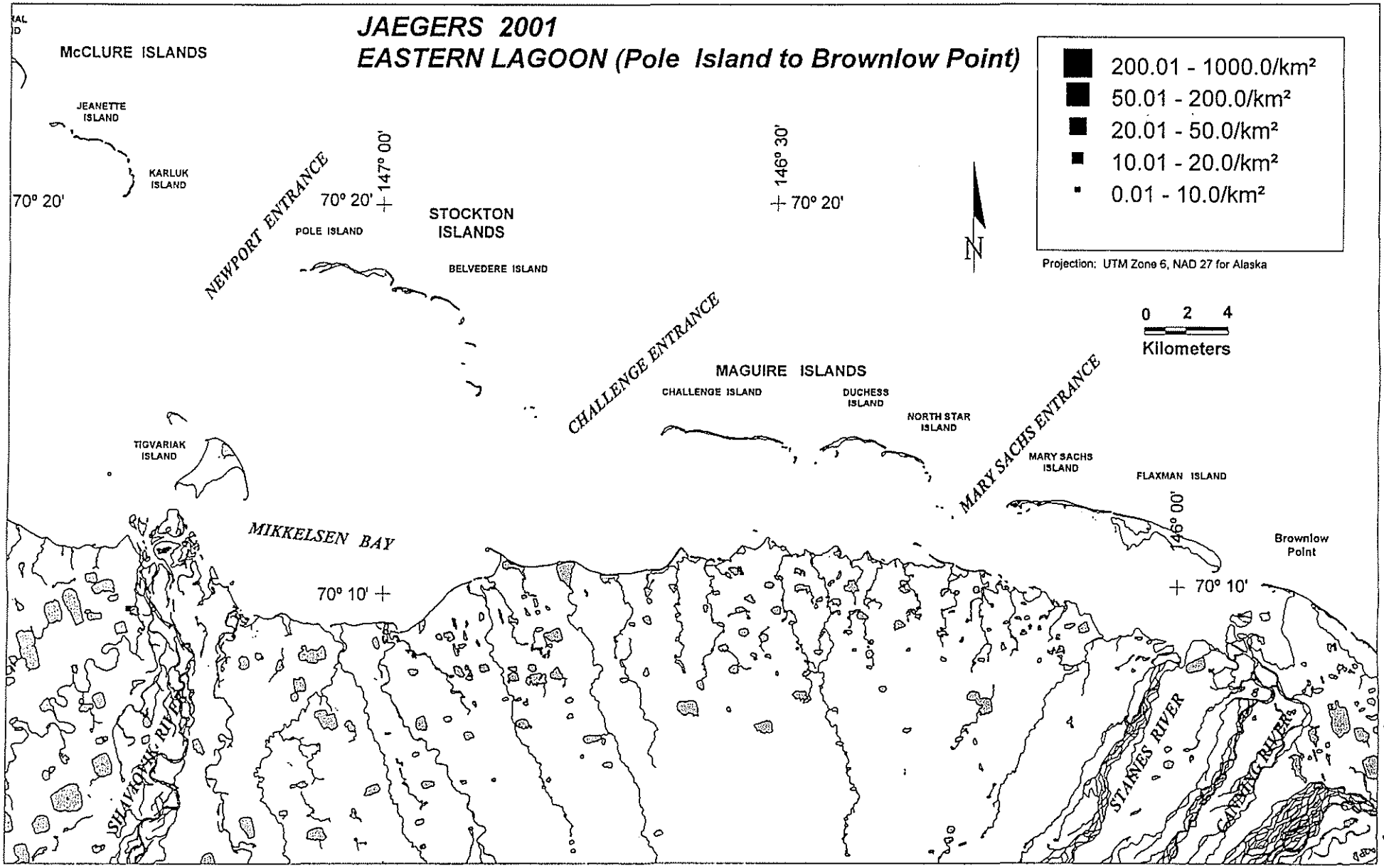


Figure C11. Summary of density for jaegers by 30-s time period segments in the barrier island-lagoon system between Pole Island and Brownlow Point, Alaska, 23 July-11 August 2001.

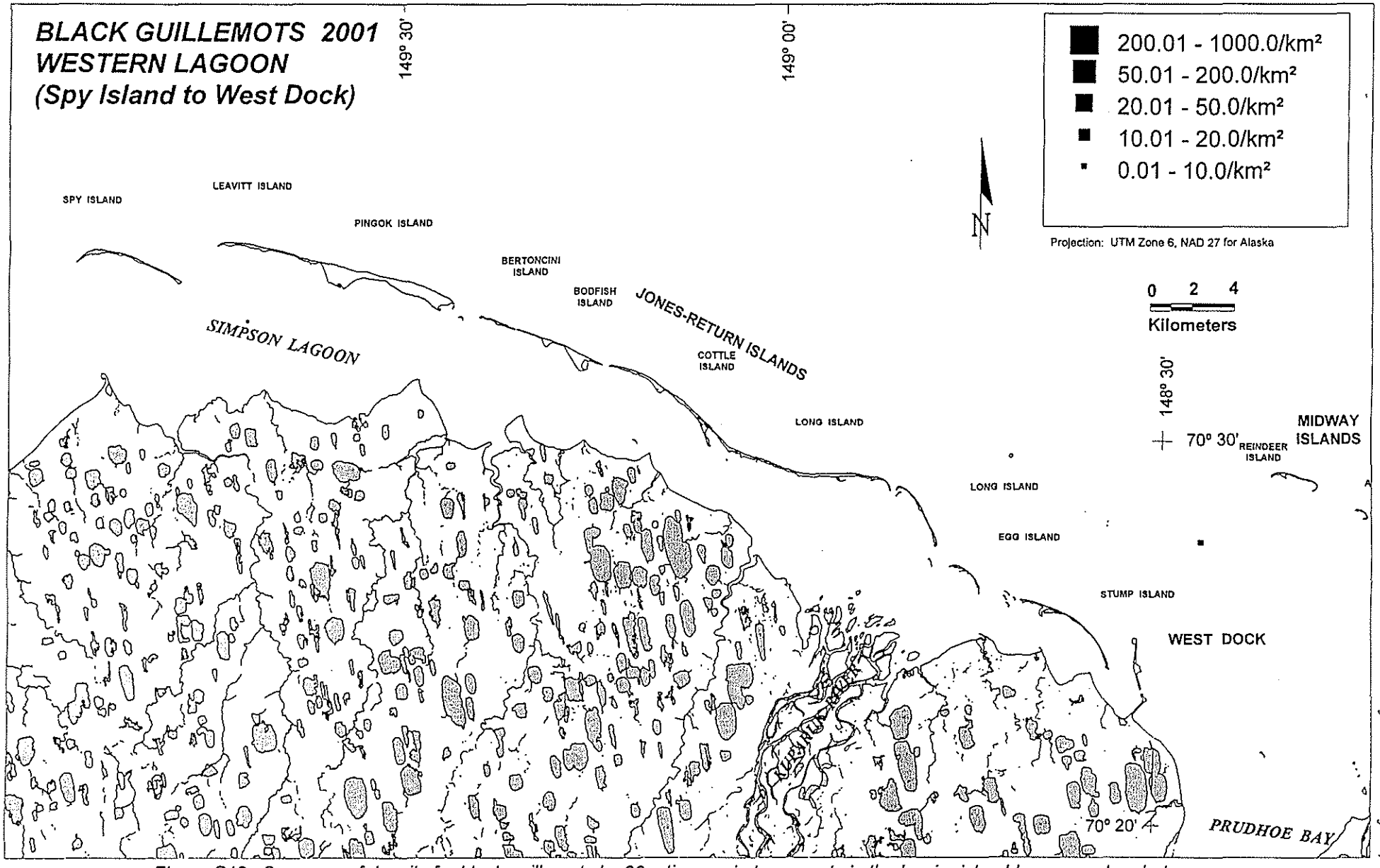


Figure C12. Summary of density for black guillemots by 30-s time period segments in the barrier island-lagoon system between Spy Island and West Dock, Alaska, 23 July-11 August 2001.

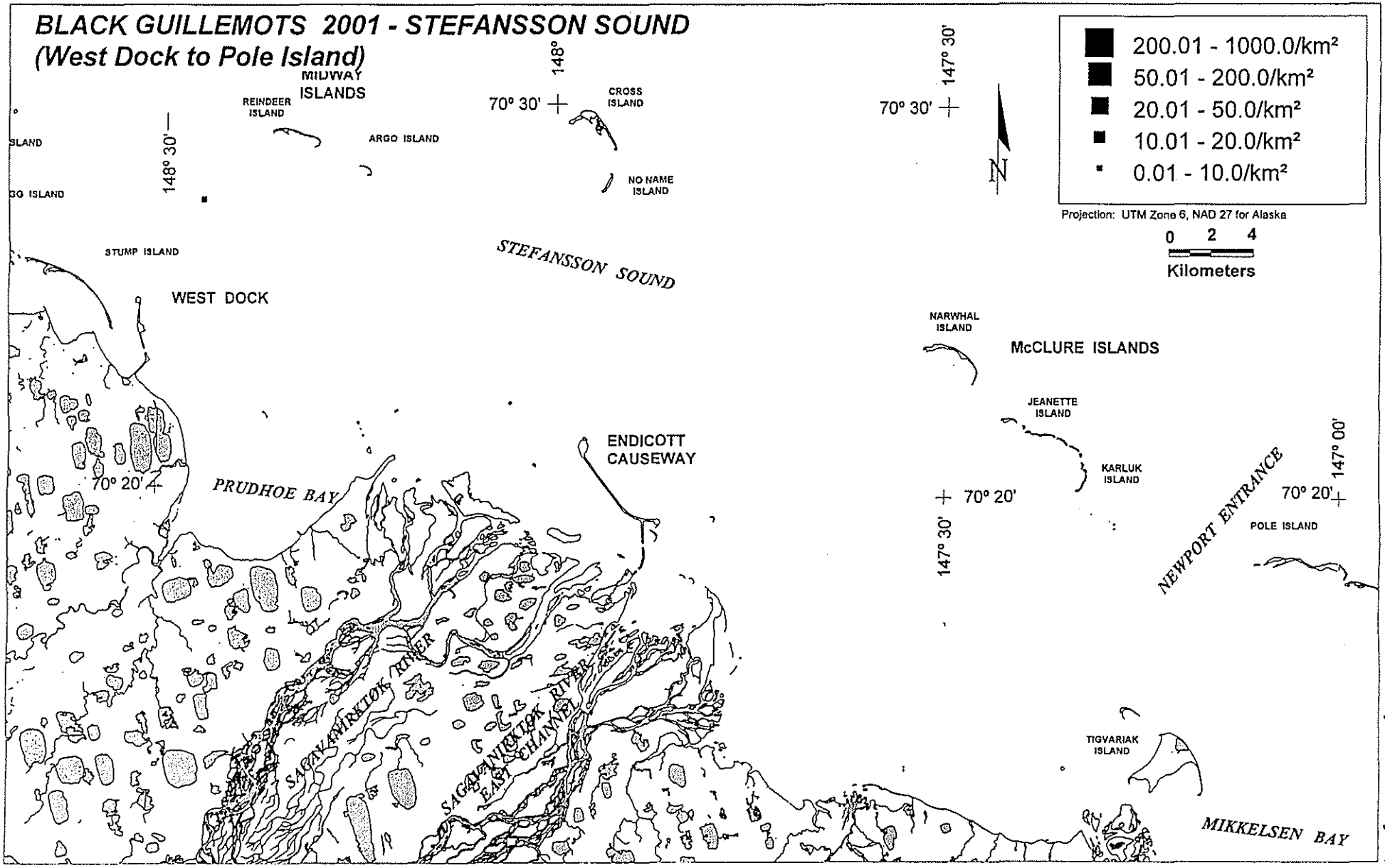


Figure C13. Summary of density for black guillemots by 30-s time period segments in the barrier island-lagoon system between West Dock and Pole Island, Alaska, 23 July-11 August 2001.

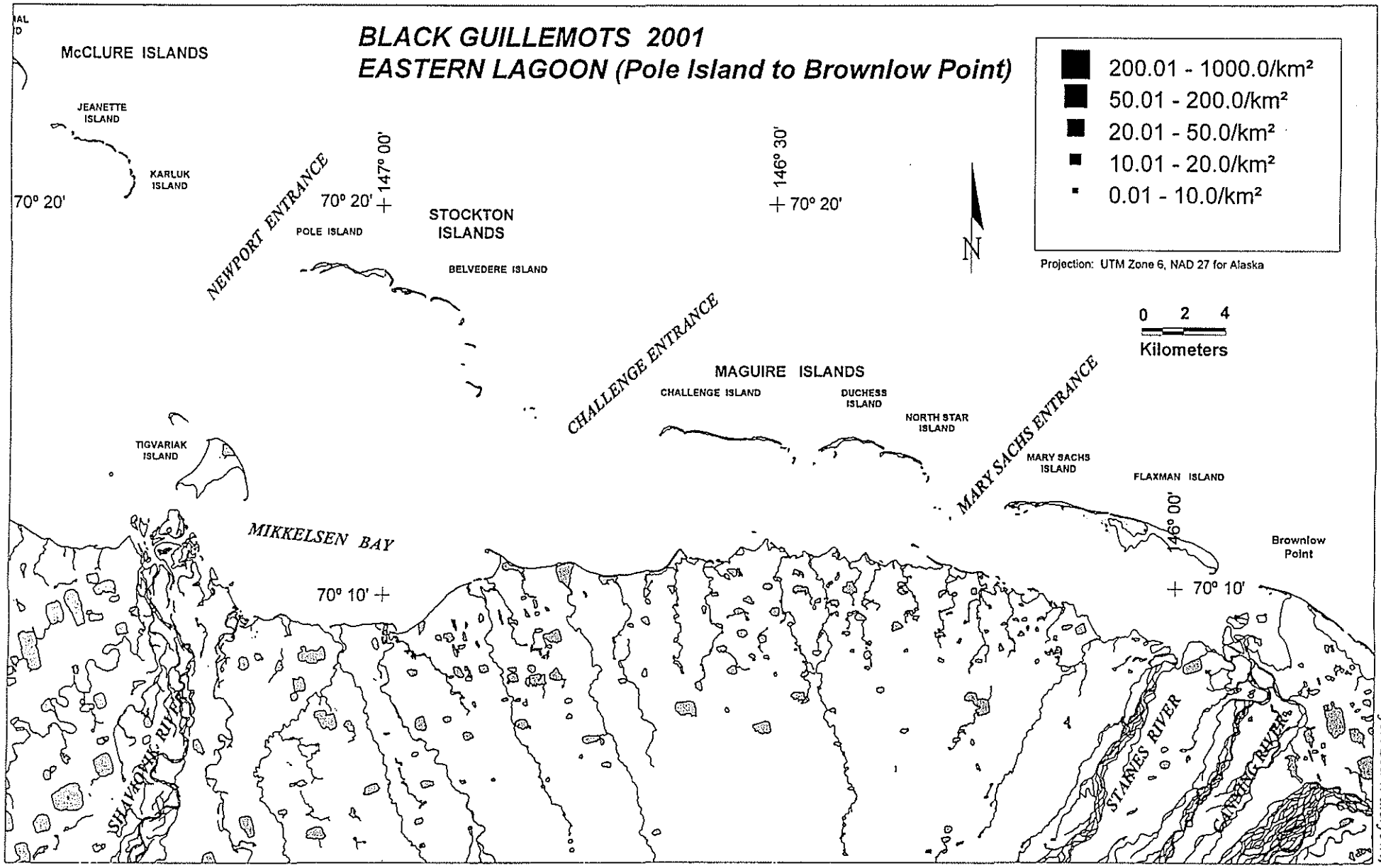


Figure C14. Summary of density for black guillemots by 30-s time period segments in the barrier island-lagoon system between Pole Island and Brownlow Point, Alaska, 23 July-11 August 2001.

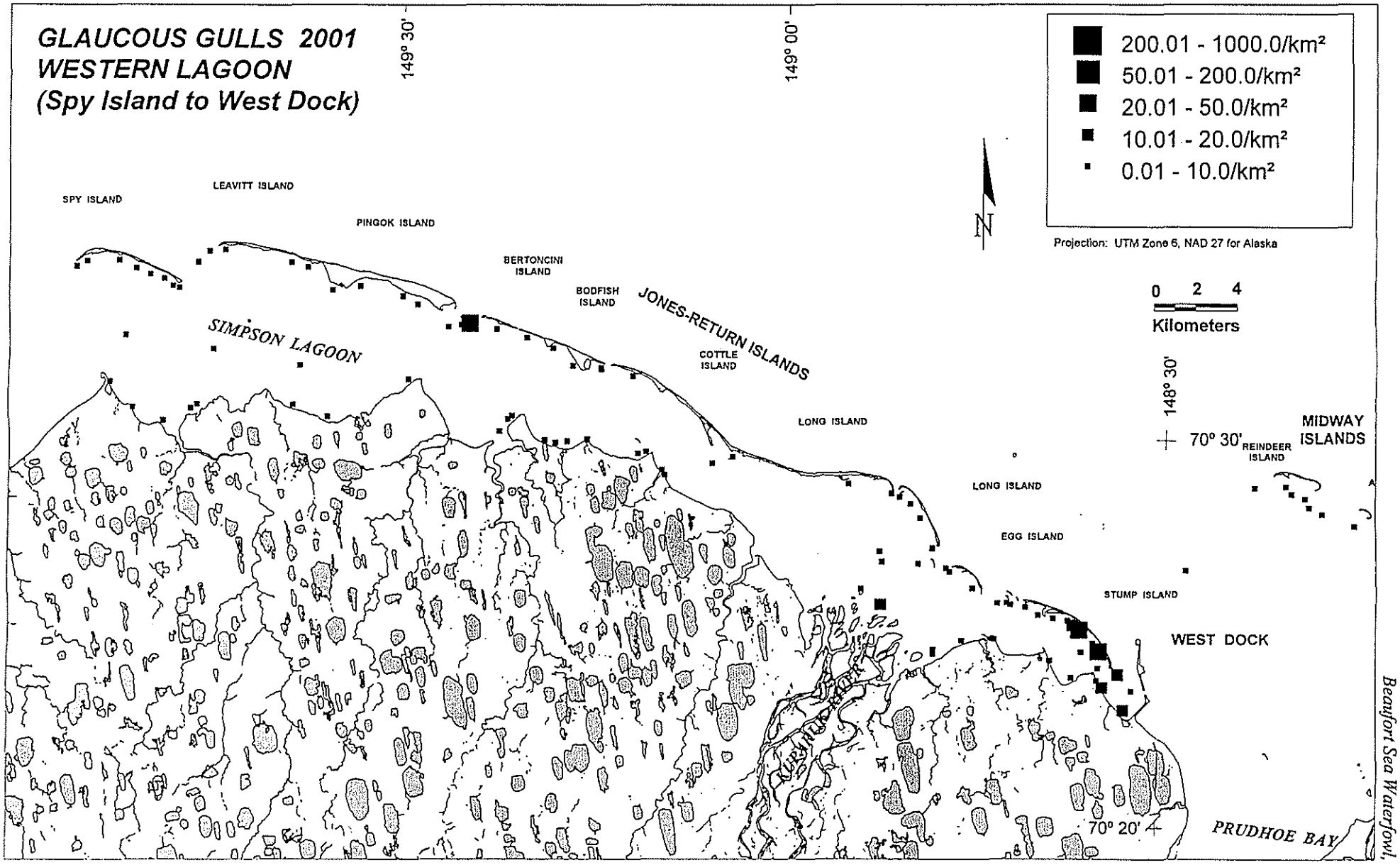


Figure C15. Summary of density for glaucous gulls by 30-s time period segments in the barrier island-lagoon system between Spy Island and West Dock, Alaska, 23 July-11 August 2001.

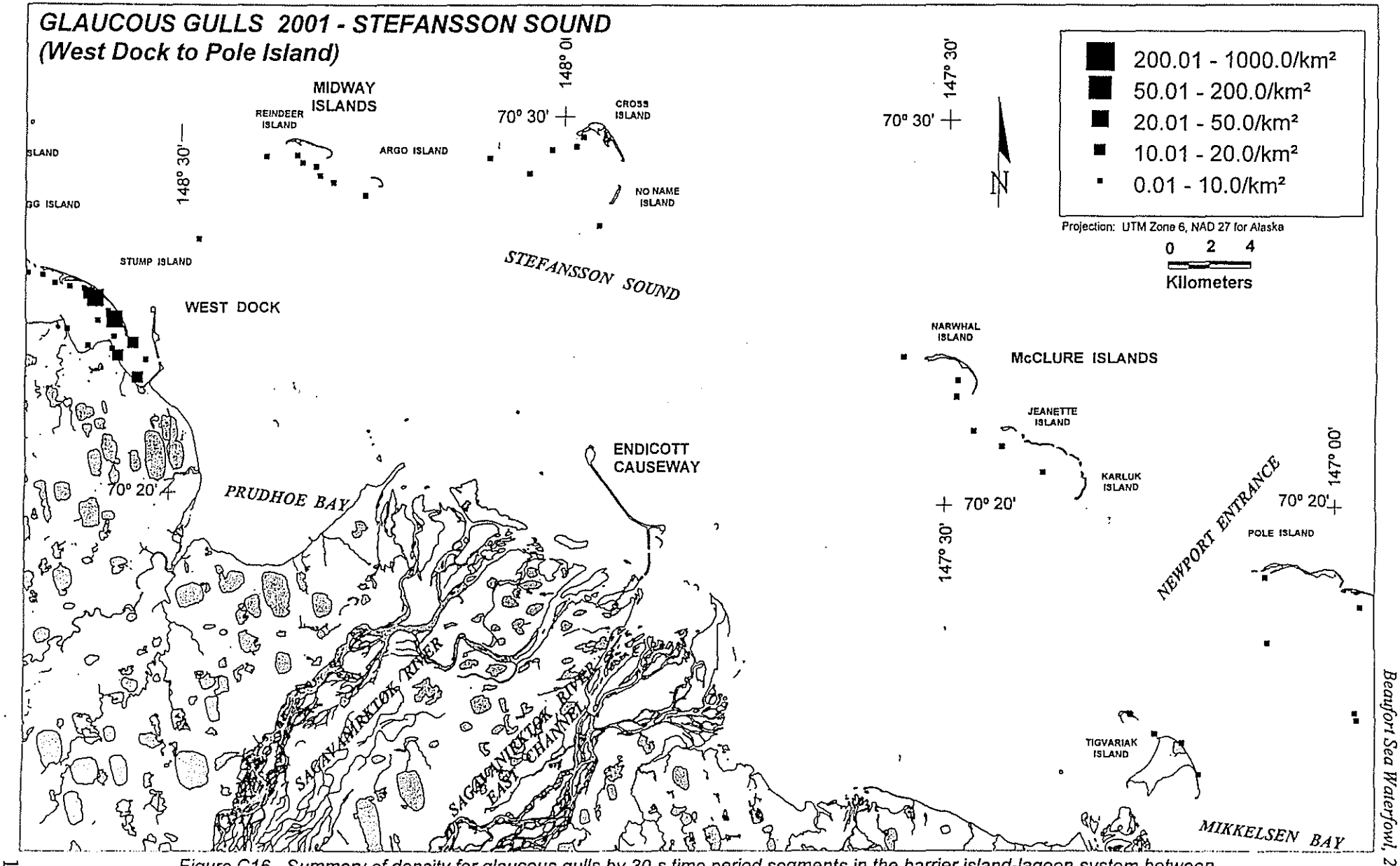


Figure C16. Summary of density for glaucous gulls by 30-s time period segments in the barrier island-lagoon system between West Dock and Pole Island, Alaska, 23 July-11 August 2001.

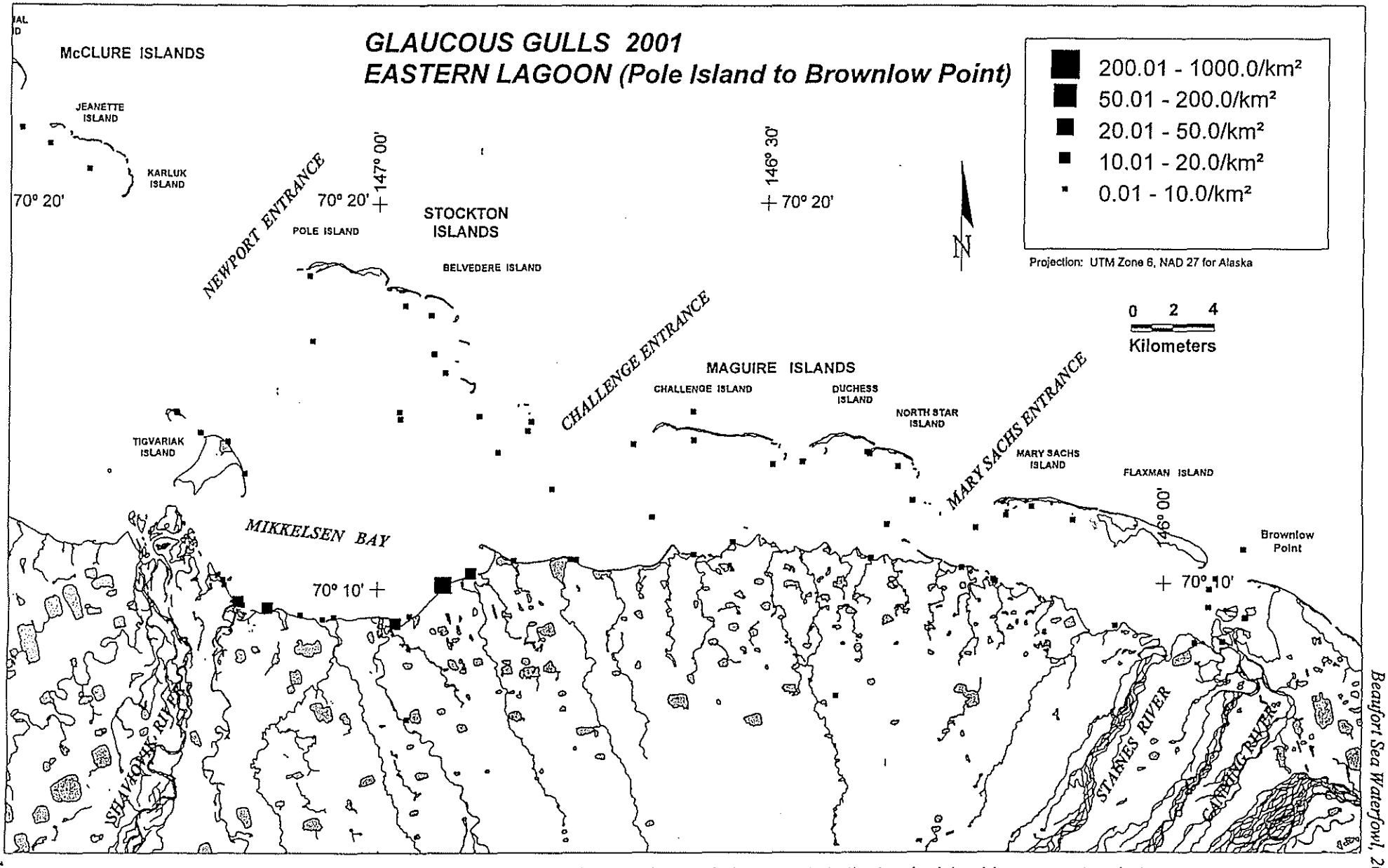


Figure C17. Summary of density for glaucous gulls by 30-s time period segments in the barrier island-lagoon system between Pole Island and Brownlow Point, Alaska, 23 July-11 August 2001.