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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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Environmental Studies Group
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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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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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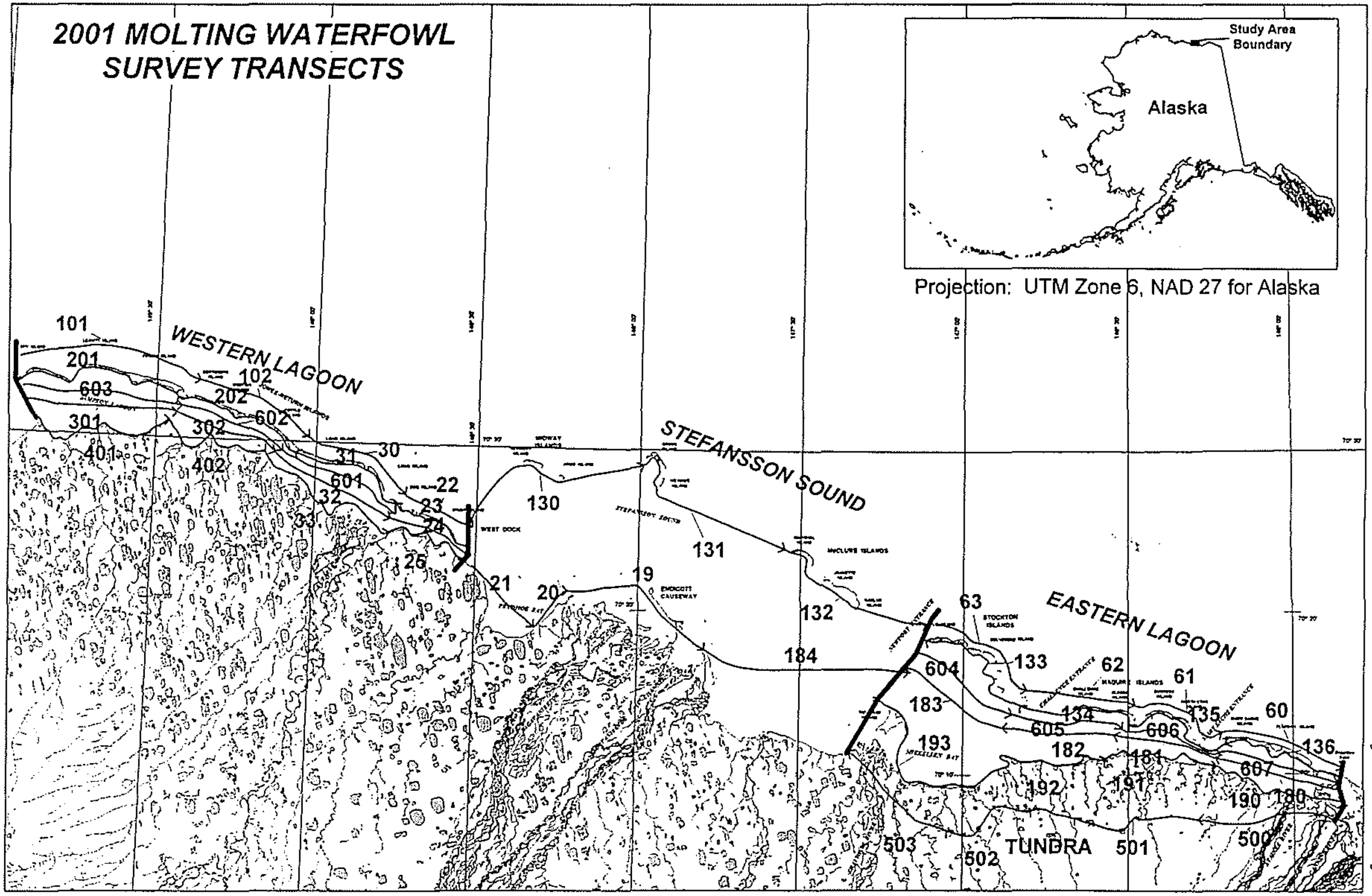
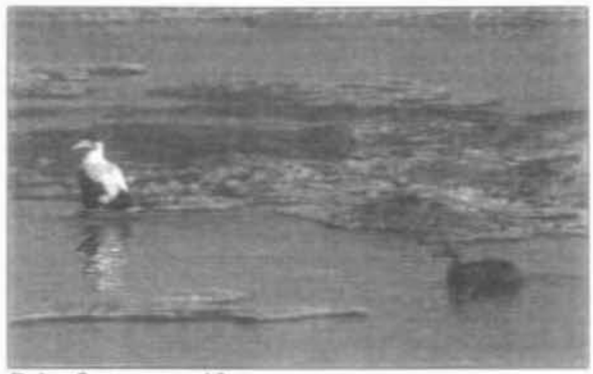


Figure 1. Locations and numbers for aerial survey transects and survey regions in the barrier island-lagoon systems between Spy Island and Brownlow Point, Alaska. Transect numbering is consistent with Johnson and Gazey (1992).

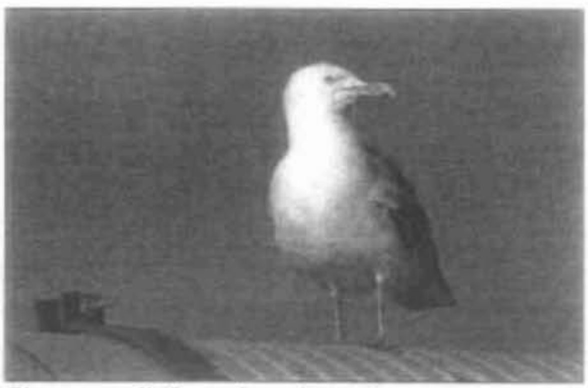
Male long-tailed duck (*Clangula hyemalis*).
Photo by John Warden

Pair of long-tailed ducks.
Photo BPXA file

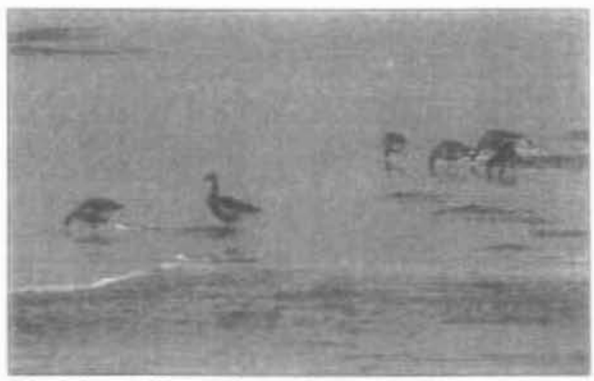
Nesting female common eider (*Somateria mollissima v-nigrum*). *Photo by John Warden*



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.

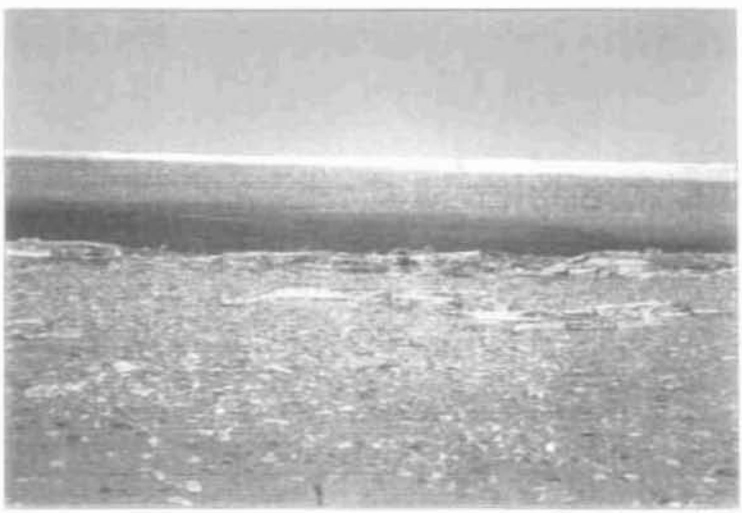


Photo by Lynn Noel

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.

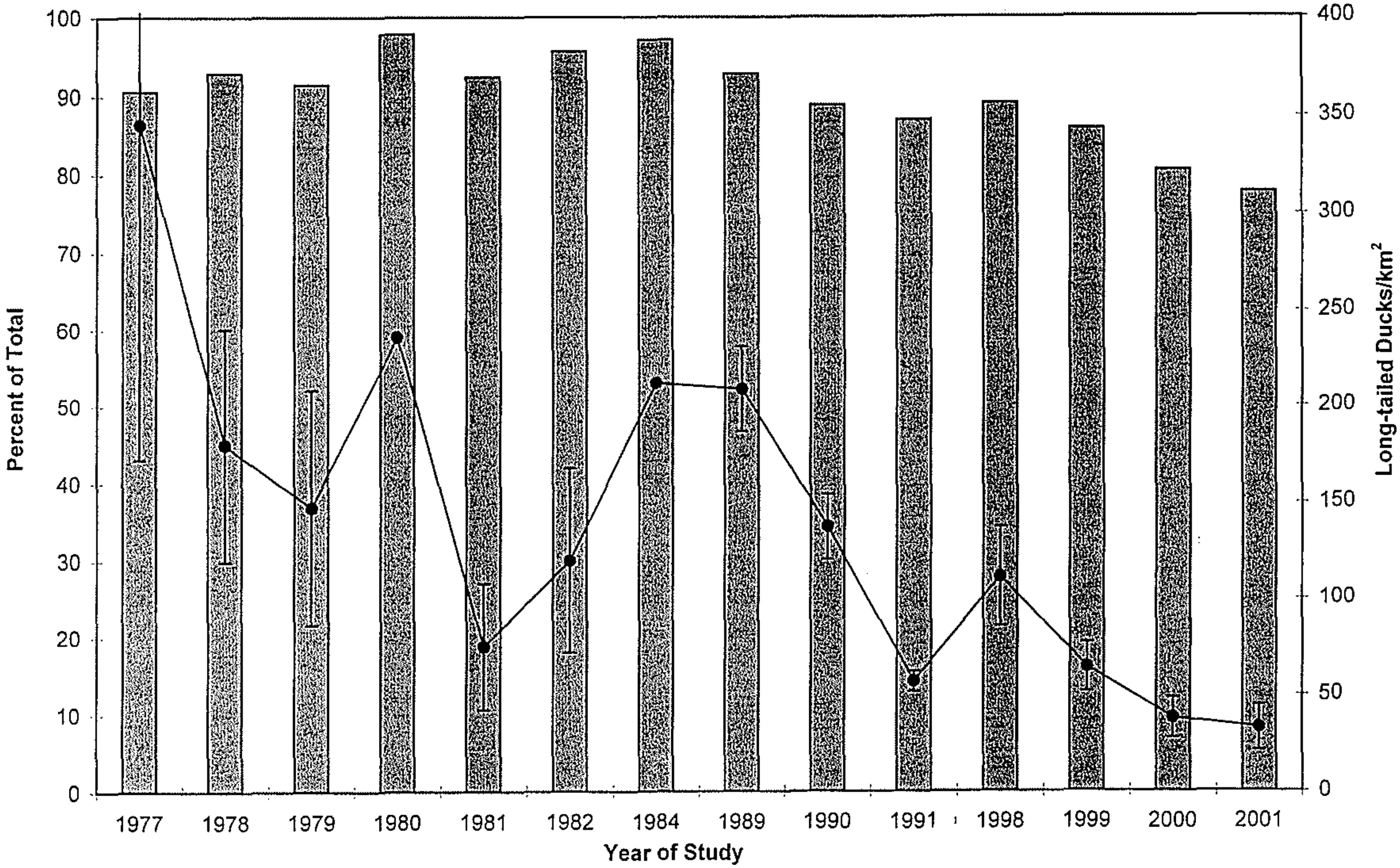


Figure 4. Long-tailed duck sightings as percentage of all bird sightings for aerial surveys with annual mean densities showing standard error in nearshore waters of the central Alaska Beaufort Sea, 1977-2001 (Table B1. Johnson and Gazey 1992; Noel et al. 1999, 2000, 2001).

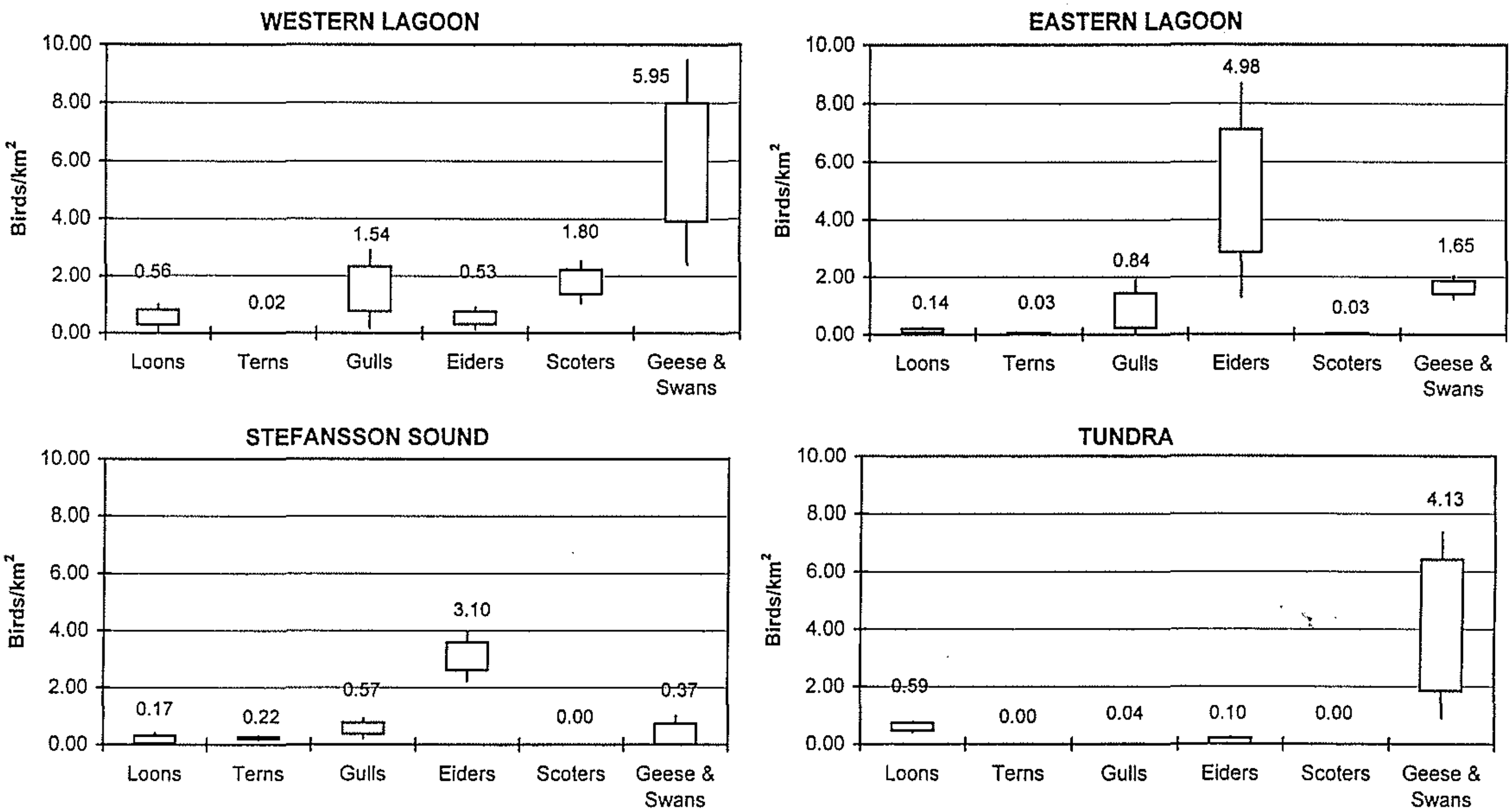


Figure 5. Mean with standard error bar and standard deviation line for areal density of avian groups among survey regions for 2 or 3 aerial survey replicates between Spy Island and Brownlow Point, Alaska, 23 July-11 August 2001. Western lagoon and Stefansson Sound regions were surveyed on 3 dates. Two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

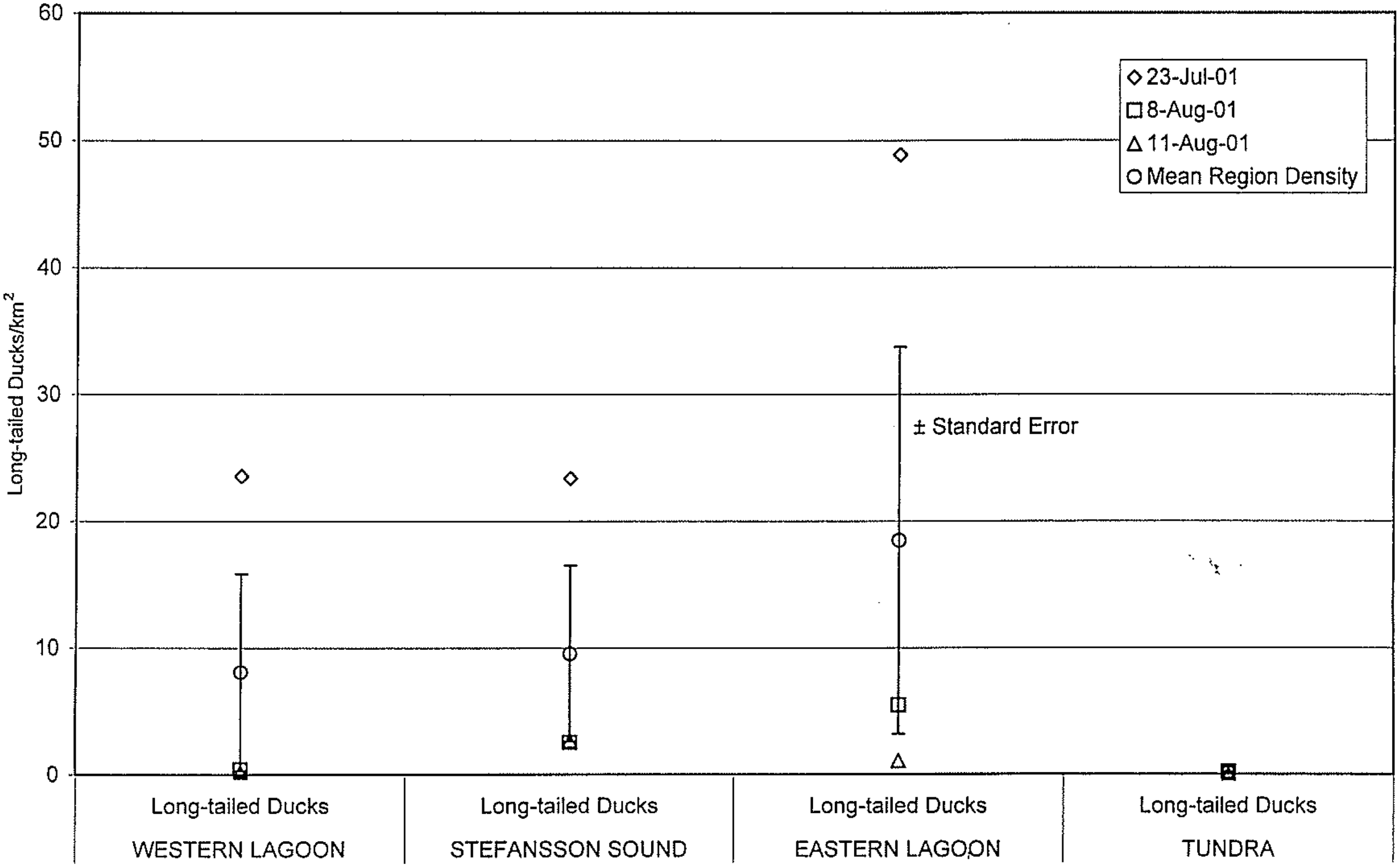


Figure 6. Areal density of long-tailed ducks for 3 aerial surveys during 23 July-11 August 2001, and mean areal density with standard error for all surveys by region between Spy Island and Brownlow Point, Alaska. On 23 July 2001, two mainland transects in the eastern lagoon and all tundra transects were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

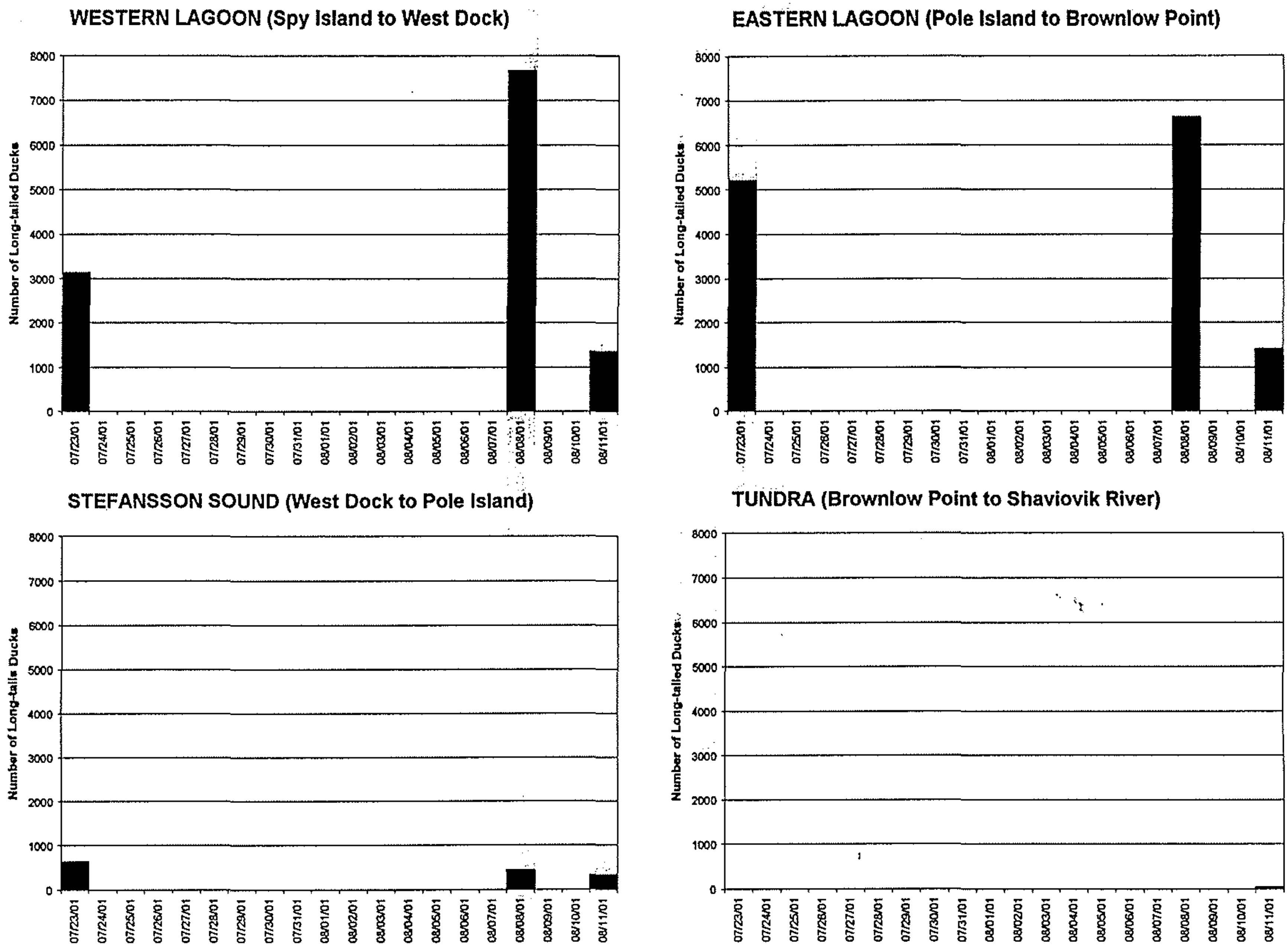


Figure 7. Total number of long-tailed ducks on- and off-transect during aerial surveys in the barrier island-lagoon systems between Spy Island and Brownlow Point, Alaska, 23 July – 11 August 2001. Surveys were flown on 23 July, 8 August and 11 August 2001.

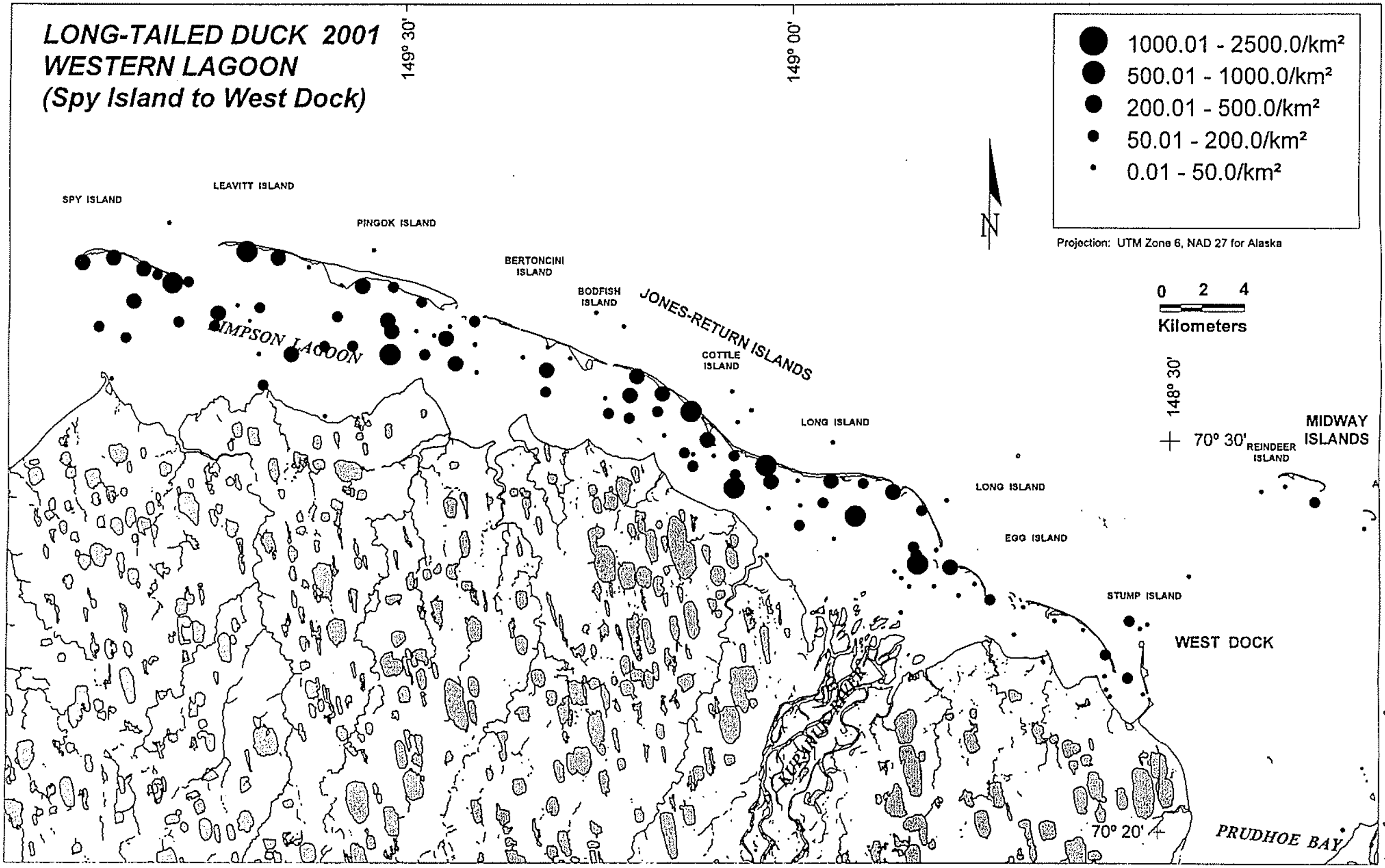


Figure 8. Summary of density for long-tailed ducks by 30-s time period segments in the barrier island-lagoon system between Spy Island and West Dock, Alaska, 23 July-11 August 2001.

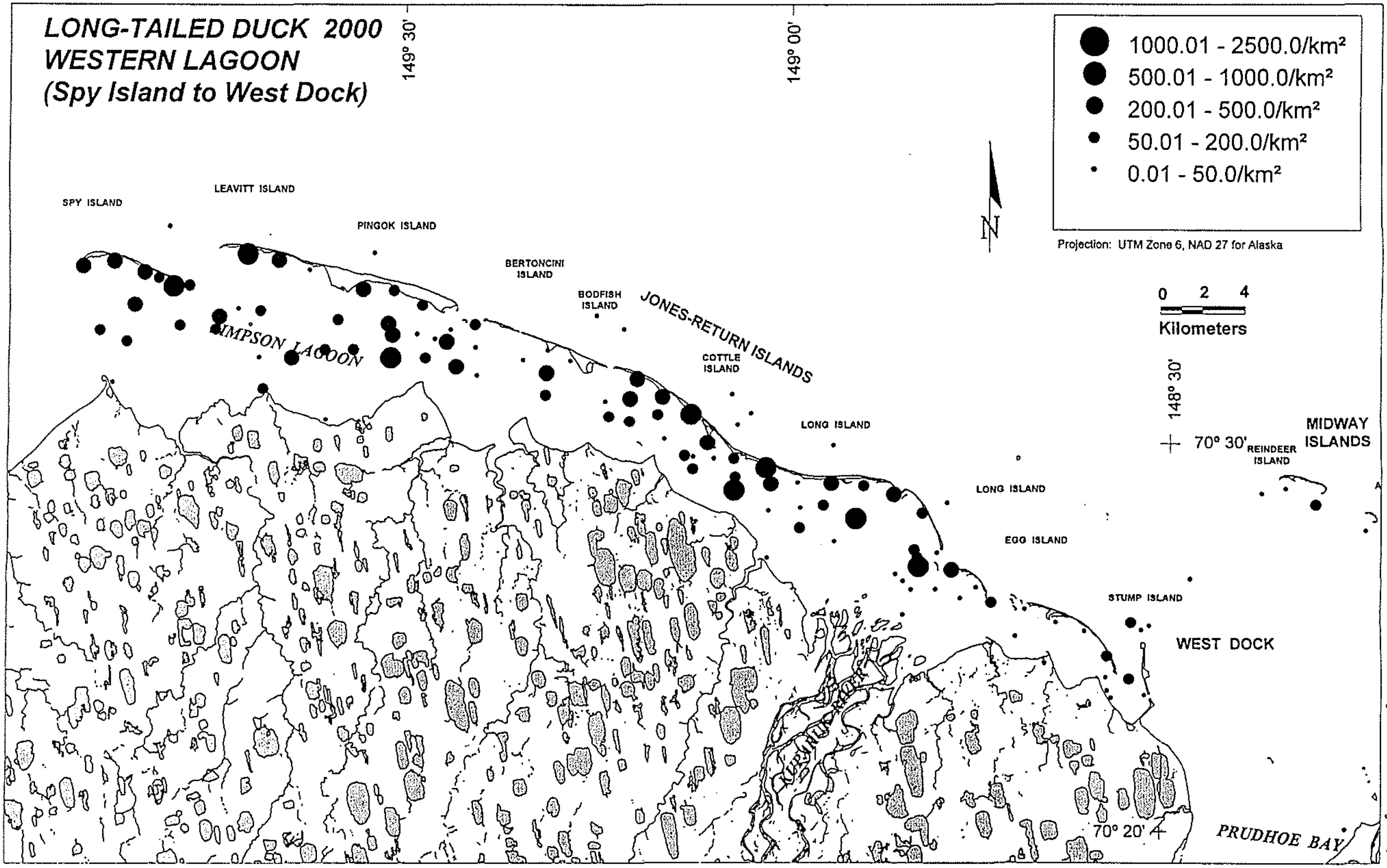


Figure 9. Summary of density for long-tailed ducks by 30-s time period segments in the barrier island-lagoon system between Spy Island and West Dock, Alaska, 1-24 August 2000.

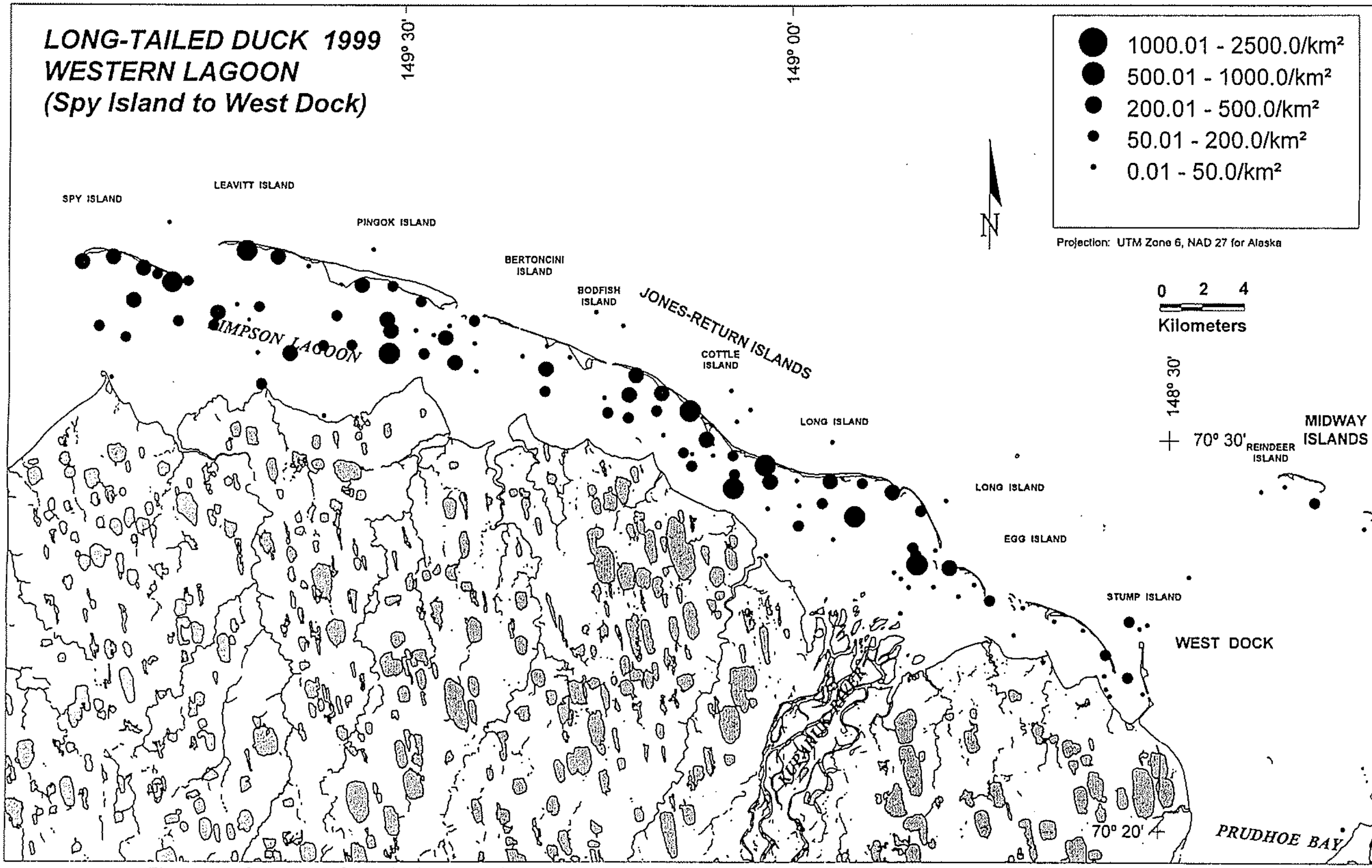


Figure 10. Summary of density for long-tailed ducks by 30-s time period segments in the barrier island-lagoon system between Spy Island and West Dock, Alaska, 30 July-26 August 1999.

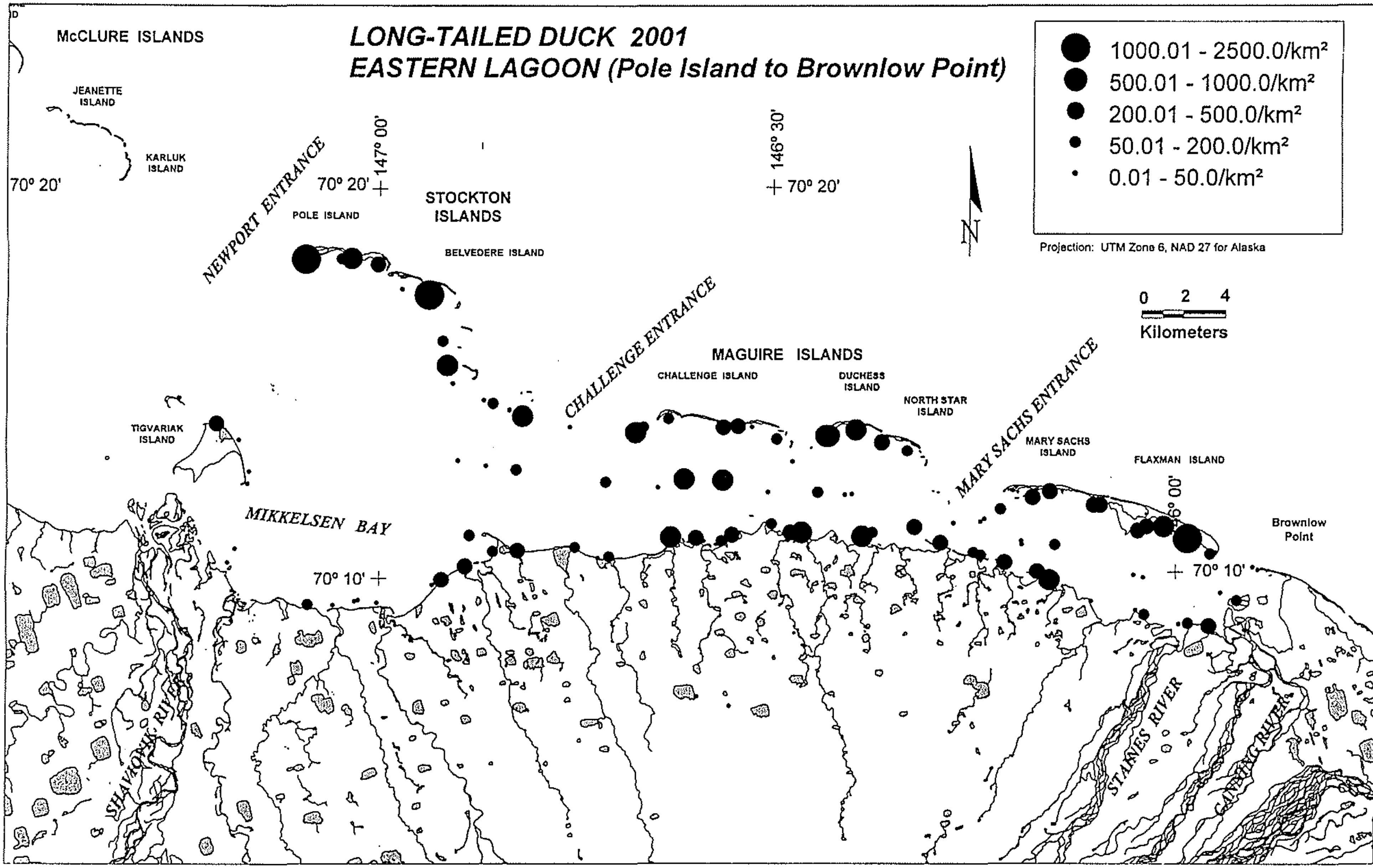


Figure 11. Summary of density for long-tailed ducks by 30-s time period segments in the barrier island-lagoon system between Pole Island and Brownlow Point, Alaska, 23 July-11 August 2001.

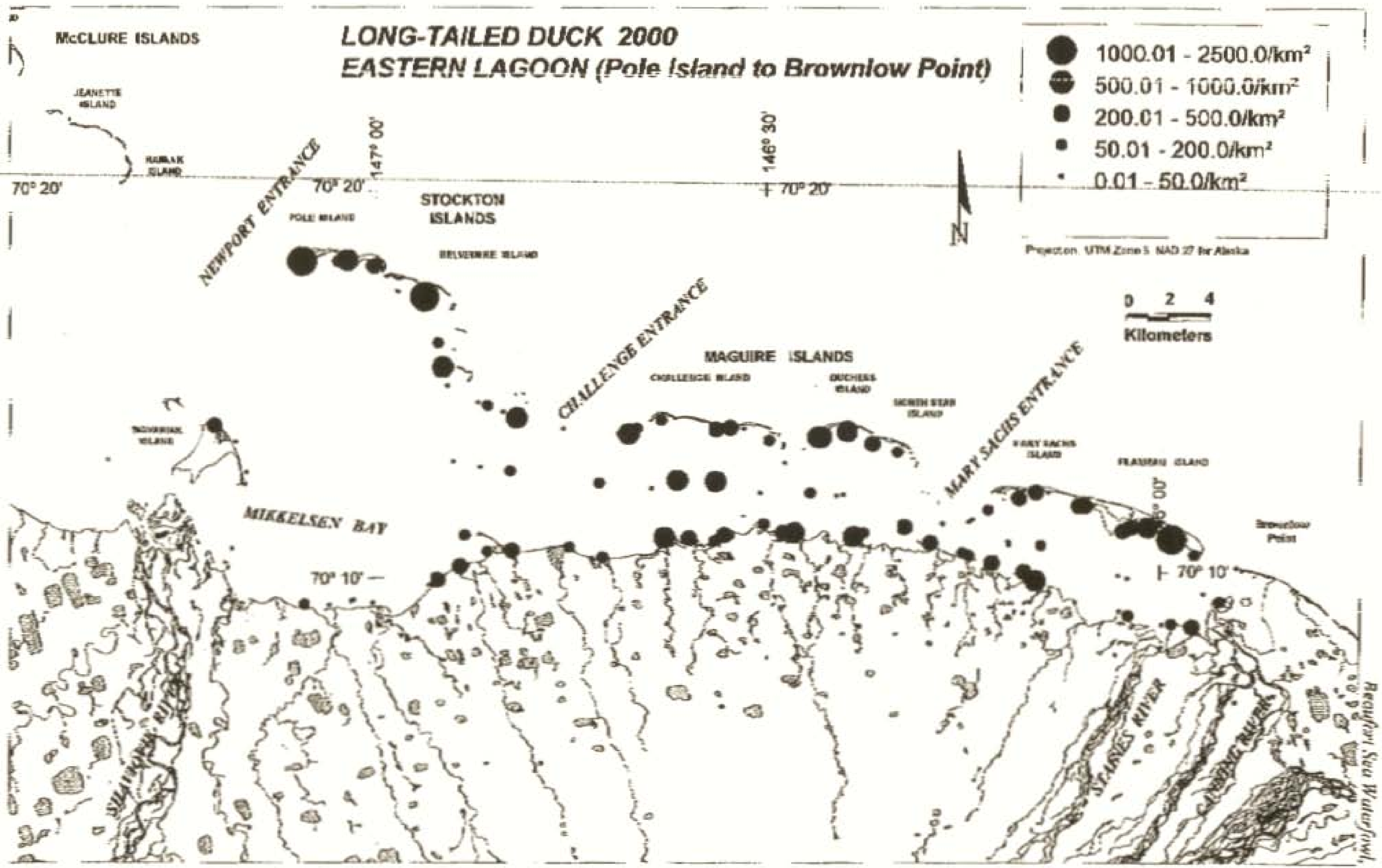


Figure 12. Summary of density for long-tailed ducks by 30-s time period segments in the barrier island-lagoon system between Pole Island and Brownlow Point, Alaska, 1-24 August 2000.

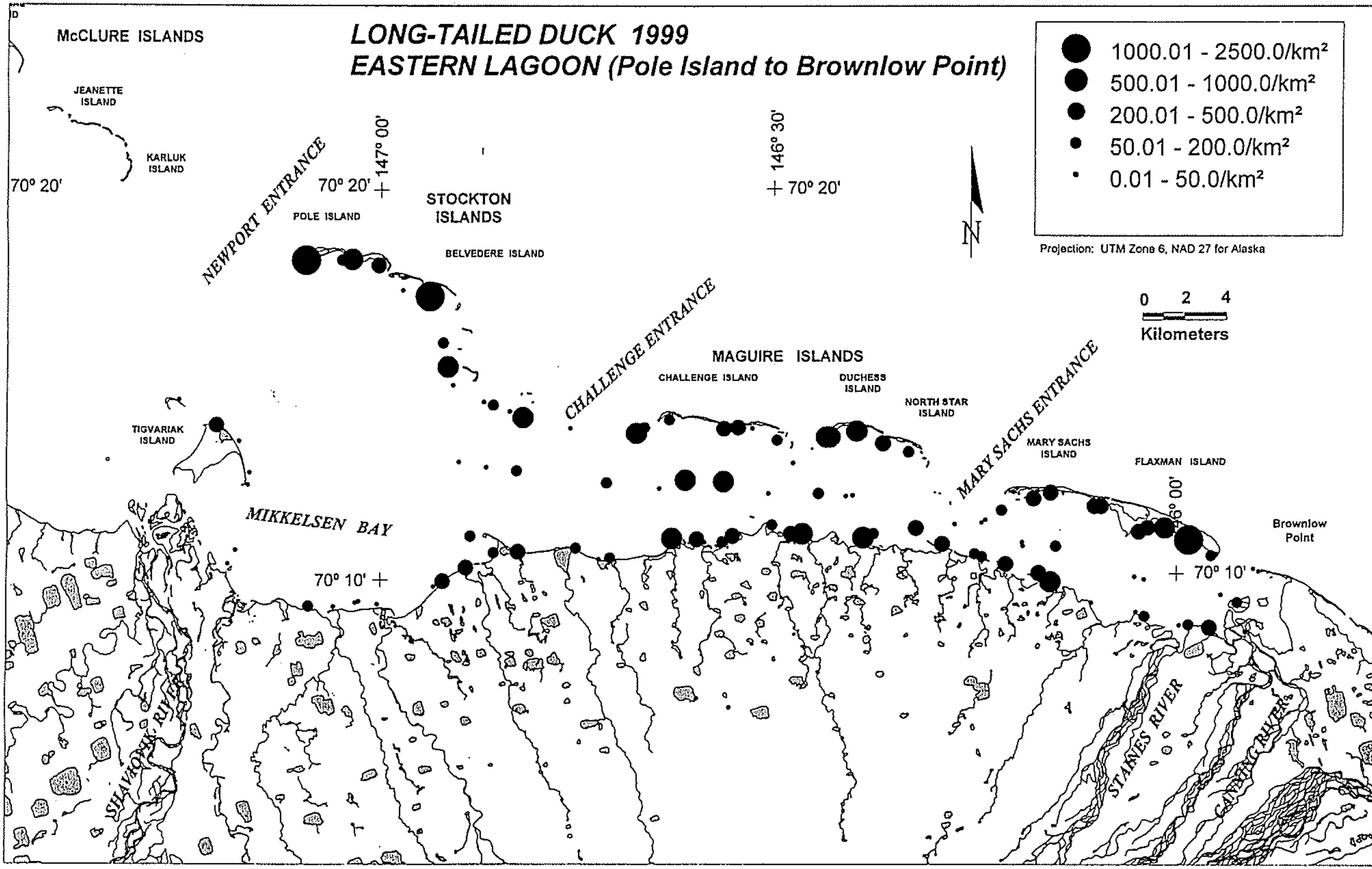


Figure 13. Summary of density for long-tailed ducks by 30-s time period segments in the barrier island-lagoon system between Pole Island and Brownlow Point, Alaska, 30 July-26 August 1999.

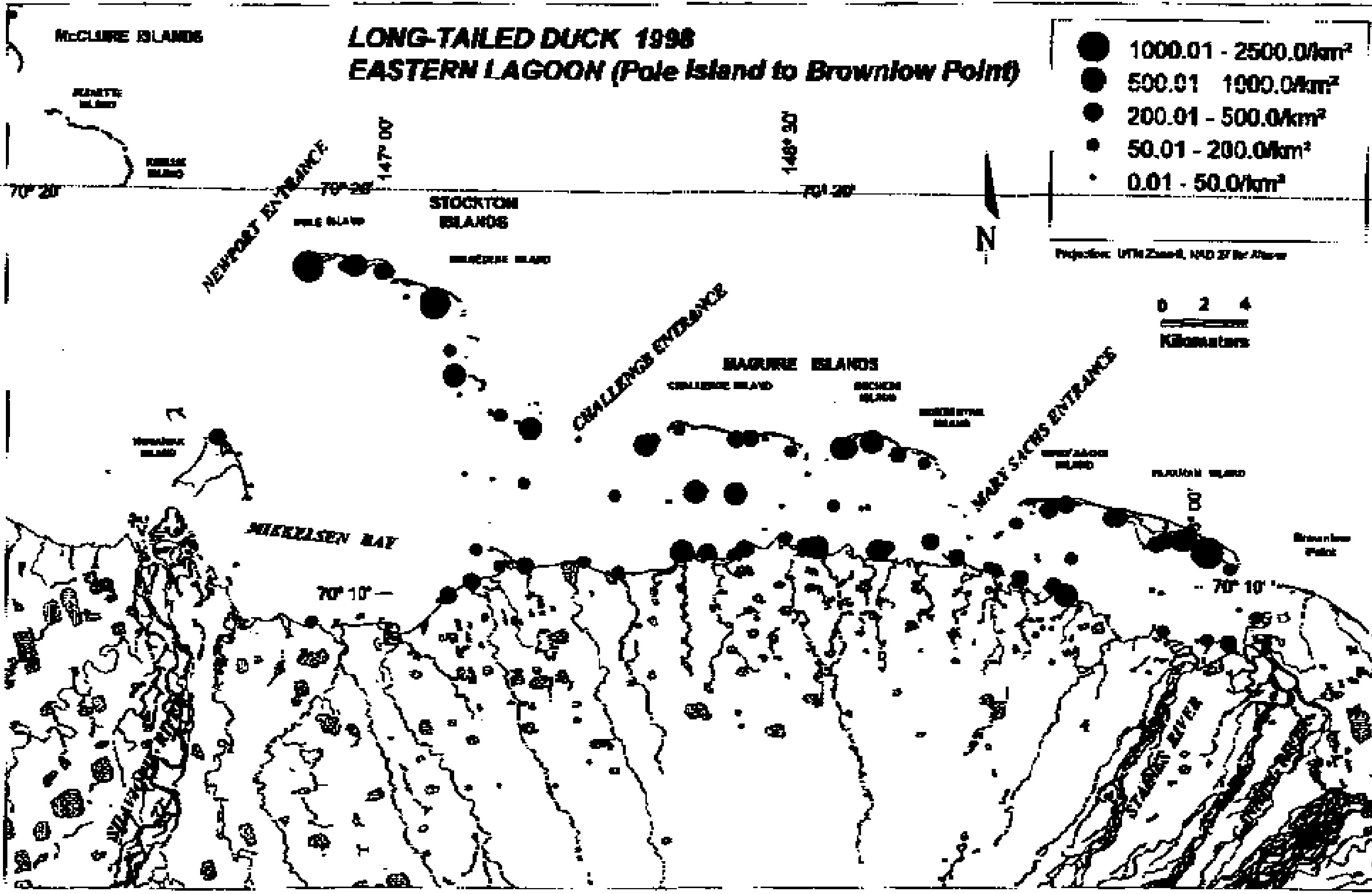


Figure 14. Summary of density for long-tailed ducks by 30-s time period segments in the barrier island-lagoon system between Pole Island and Brownlow Point, Alaska, 5 August-3 September 1998.

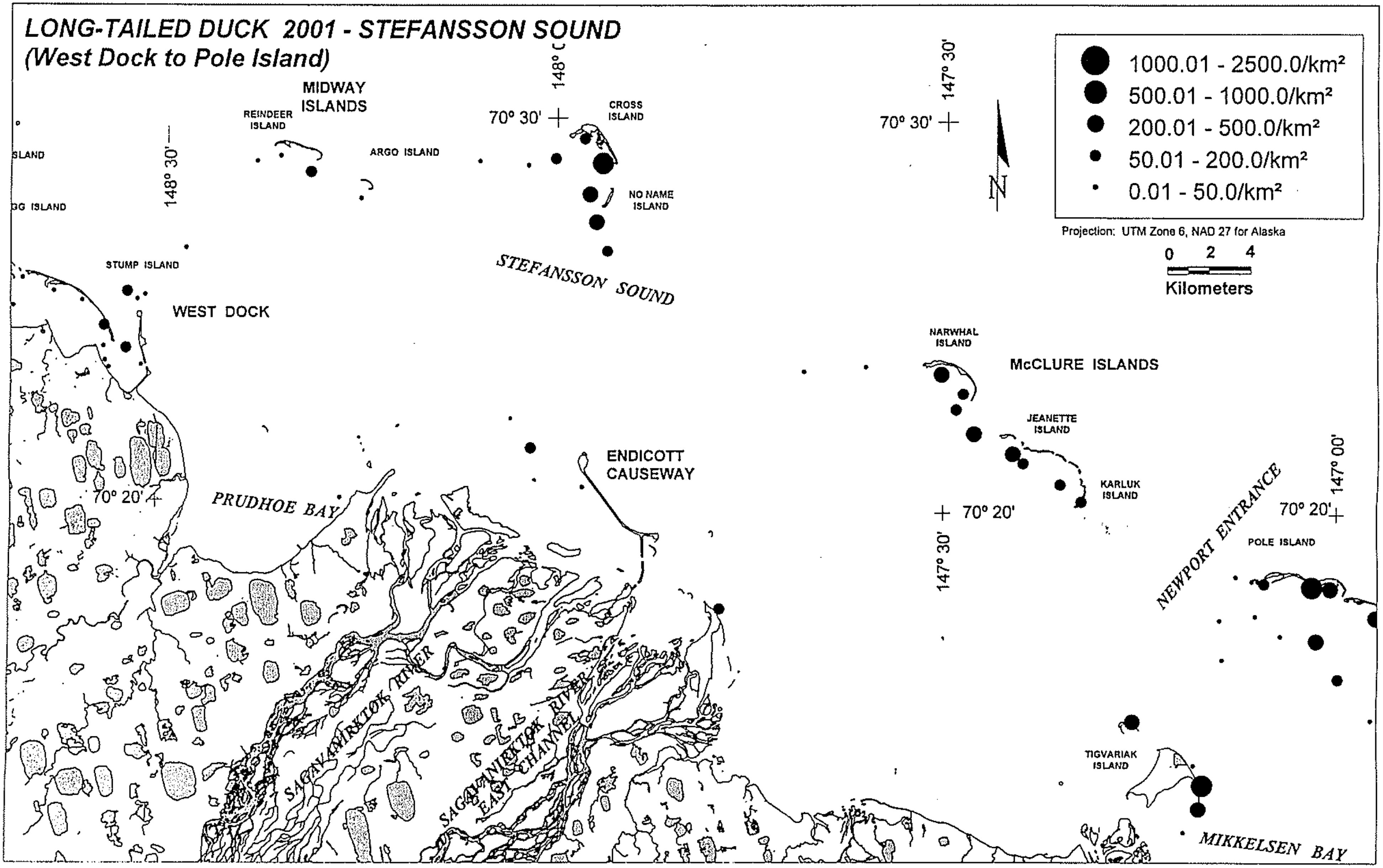


Figure 15. Summary of density for long-tailed ducks by 30-s time period segments in the barrier island-lagoon system between West Dock and Pole Island, Alaska, 23 July-11 August 2001.

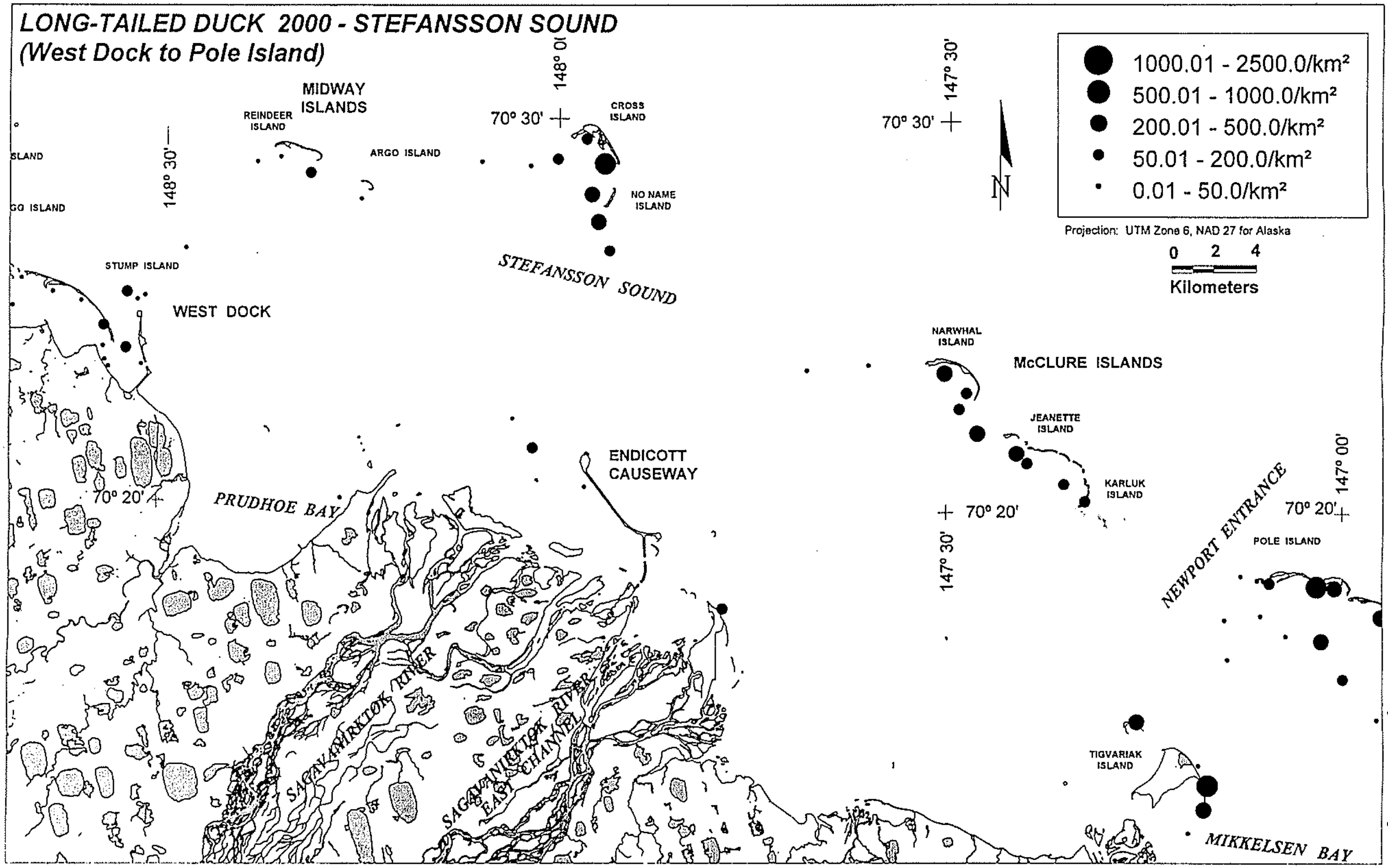


Figure 16. Summary of density for long-tailed ducks by 30-s time period segments in the barrier island-lagoon system between West Dock and Pole Island, Alaska, 1-24 August 2000.