U.S. Department of the Interior
Bureau of Land Management

BLM-Alaska Technical Report 41
BLM/AK/ST-02/014+6500+931
September 2002

Ducks Unlimited, Inc.

Waterfowl Earth Cover Selection Analysis within the National Petroleum Reserve- Alaska

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The cover photo: Oldsquaw flying over a tundra lake.

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Acknowledgements

This project was funded under a cooperative agreement between the United States Department of the Interior, Bureau of Land Management and Ducks Unlimited, Inc. The U.S. Fish and Wildlife Service provided waterfowl species information and review. The project was administered by John Payne (BLM).

Thanks to Alex Morton (DU) who provided modeling expertise and statistical analysis. Ground cover data was collected by John Payne, Dick Kempka, Greg Balogh (FWS), Carl Markon (USGS), John Schmidt (DU), Dave Yokel (BLM), Fritz Reid (DU), and Jim Sisk (BLM). Special thanks are extended to those who assisted in the field, with map preparation, field site selection and organizing logistical details. Thanks to Marc Johnston, pilot from Kenia Air Alaska, Marty Stauber, pilot from Tundra Copters, and Bill Merkley from Trans-Alaska Helicopter for safe air service.

In addition we would like to acknowledge the efforts of those who have technically reviewed this report. John Payne and Ed Bovy offered important suggestions.

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Abstract

The intent of this study was to investigate the correlation between the earth cover classes mapped by Alaska Bureau of Land Management (BLM) and Ducks Unlimited, Inc., (DU) within the National Petroleum Reserve-Alaska (NPR-A) with the locations of seven waterfowl species collected by the U.S. Fish and Wildlife Service (FWS). The FWS has been conducting aerial surveys of spectacled eider populations over the Arctic Coastal Plain since 1992, and has also collected valuable information on 35 other avian species. The earth cover map was created by DU and BLM using Landsat Thematic Mapper (TM) and *System Pour l'Observation de la Terre* Multispectral (SPOT XS) satellite imagery acquired between 1992 and 1994. Both the earth cover classification and the breeding bird survey methodology were developed to collect data over a large area. The project area included the entire extent of the NPR-A to the east and west, but extended south only to the limit of the waterfowl surveys conducted by FWS, which roughly corresponds to the Arctic Coastal Plain physiographic province.

The seven species of waterfowl included in this study are spectacled eider *(Somateria fischeri)*, Steller's eider *(Polysticta stelleri)*, king eider *(Somateria spectabilis)*, oldsquaw *(Clangula hyemalis)*, Canada goose *(Branta canadensis)*, brant *(Branta bernicla)*, and white-fronted goose *(Anser albifrons)*. Two of the species, the spectacled eider and the Steller's eider, have been declining in numbers and are listed as Threatened under the Endangered Species Act of 1973 (as amended). In the first phase of the analysis, earth cover type selection indices are described for all seven species of waterfowl. The selection index analysis compares the proportions of available earth cover types to the proportions selected by the observed waterfowl. Upon finding a correlation between the distribution of observed spectacled eider locations and selected earth cover types, the second phase of the analysis went on to model resource selection. A logistic regression function was used to produce relative probability of occurrence surfaces for the spectacled eider.

The results of the resource selection analyses lead us to conclude that the NPR-A earth cover data can be used in conjunction with waterfowl point data to study the distribution of waterfowl across the Arctic Coastal Plain. This conclusion is supported by several factors; 1) there are definite, non-random differences between the earth cover types selected by different species, 2) the logistic regression model test results indicate the model does have predictive ability, and; 3) the earth cover types selected by the waterfowl species studied largely coincided with the findings of previous and more intensive studies.

The possibility of expanded petroleum and natural gas resource exploration and development is currently being analyzed for a portion of the NPR-A. Baseline earth cover and wildlife data provide a basis for planning the multiple-use management of this vast and remote area in the event that development in the Arctic Coastal Plain expands. The methods outlined in this paper provide a relatively fast and efficient way to analyze the baseline data that have been gathered to date in a macro-analysis of this arctic landscape.

Waterfowl Earth Cover Selection Analysis Within the National Petroleum Reserve-Alaska

Introduction

The National Petroleum Reserve-Alaska (NPR-A) was established in 1923 by Presidential declaration. In 1976, the Alaska Bureau of Land Management (BLM) was charged with managing the land resources. Oil exploration and development has been ongoing principally to the east of the NPR-A in the vicinity of Prudhoe Bay. Now, with the possibility of expanded development in other parts of the North Slope, an Environmental Impact Statement is being prepared for the Northeastern Planning Area of the NPR-A (Figure 1).

The NPR-A encompasses 23.4 million acres, the northern half of which falls within the Arctic Coastal Plain physiographic province. It has been estimated that 50% of the coastal plain (Hussey and Michelson 1966) is made up of lake and emergent marsh coverage. The interspersed tundra habitats are used by caribou, brown bear, polar bear, fox, lemming, ptarmigan, passerines, and raptors. This is an area of enormous importance to waterfowl, shorebirds, loons and other avifauna. Many of the species included in this study are restricted in breeding to the arctic (Bergman, *et al.* 1977). For other species, the Arctic Coastal Plain represents important molting habitat (Troy, 1991). Two of the species included in the study, the spectacled eider and the Steller's eider, have been declining in numbers and are listed as Threatened under the Endangered Species Act of 1973 (as amended).

The BLM in cooperation with Ducks Unlimited (DU) developed a digital earth cover database to support habitat and wildlife management of the NPR-A. The U.S. Fish and Wildlife Service (FWS) has been conducting annual aerial surveys of breeding eider populations over the Arctic Coastal Plain since 1992, and has also collected valuable information on 35 other avian species. Like the earth cover mapping effort, the breeding surveys were designed to provide information over a large area, rather than intensively studying selected sites.

The intent of this study is to investigate the correlation between the earth cover classes mapped by BLM and DU with the observed distribution of seven waterfowl species. The seven species of waterfowl included in this study are spectacled eider *(Somateria fischeri)*, Steller's eider *(Polysticta stelleri)*, king eider *(Somateria spectabilis)*, oldsquaw *(Clangula hyemalis)*, Canada goose *(Branta canadensis)*, brant *(Branta bernicla)*, and white-fronted goose *(Anser albifrons)*. In the first phase of the analysis, earth cover type selection indices are described for all seven species of waterfowl. The selection index analysis compares the proportions of available earth cover types to the proportions selected by the observed waterfowl. Upon finding a correlation between the distribution of observed spectacled eider locations and selected earth cover types, the second phase of the analysis went on to model resource selection for the spectacled eider.

This study is the first to examine the habitat preferences of waterfowl across the Arctic Coastal Plain. Previous research has been

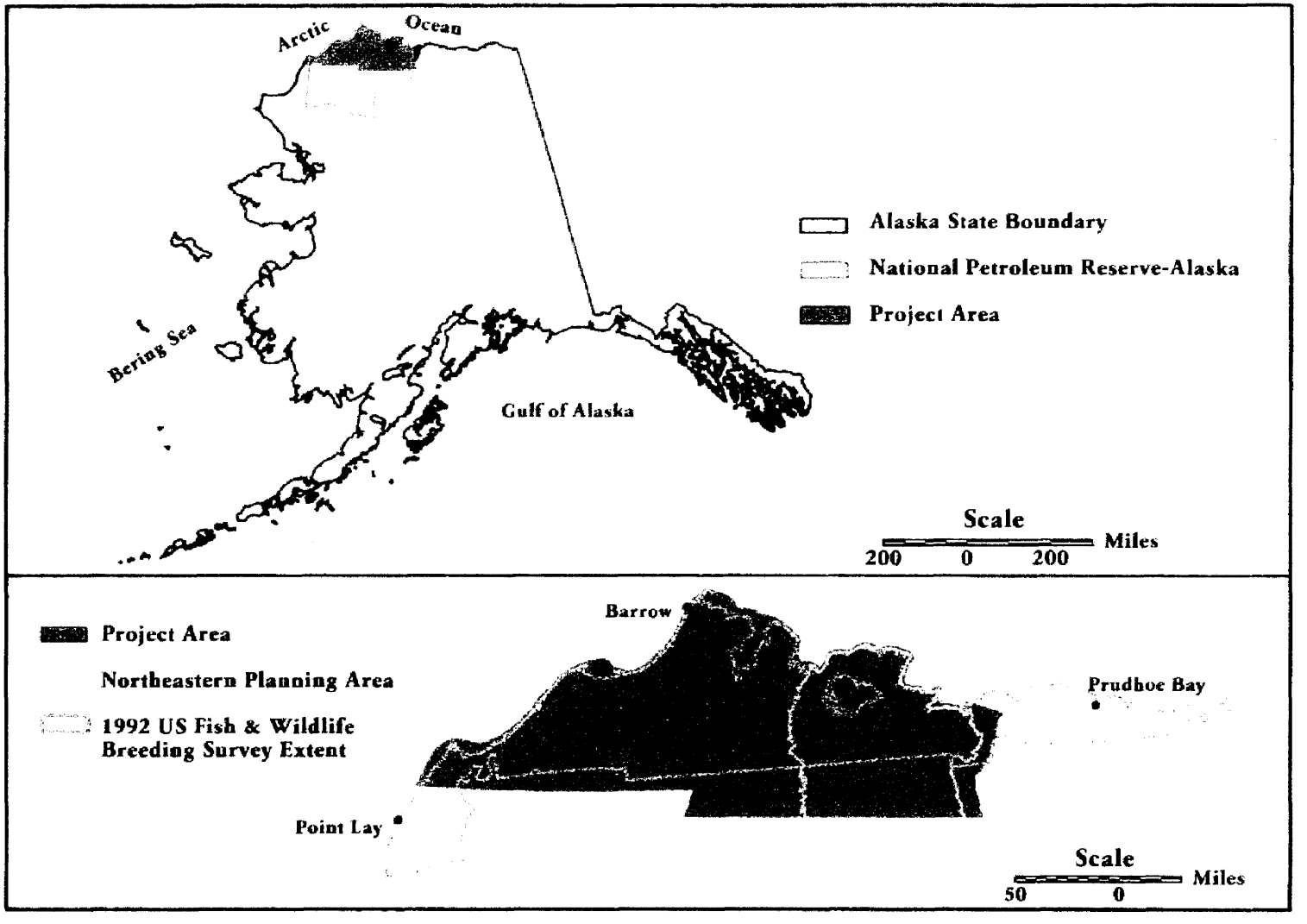

Figure 1. The project location for the NPR-A Waterfowl Earth Cover Selection Analysis.

limited to smaller areas and hence has produced more detailed, but localized, analysis both of waterfowl and of cover types. The landscape level maps and analysis produced by the current study provide a means of extending and linking the findings of more intensive studies. This analysis, in turn, is strengthened or qualified by finer-scaled studies. Used in combination with previous studies, the current analysis can provide a basis for region-wide policy decisions affecting waterfowl.

Funding for this project was provided by the BLM under a Challenge Cost Share agreement with DU. FWS has provided waterfowl species information and review.

Project Objective

The objective of this project was to study the correlation between earth cover types previously mapped within the NPR-A and waterfowl species point locations. There are two phases to the analysis; the first phase produces earth cover selection indices for the seven species of waterfowl selected, the second phase models the relative probability of earth cover selection for the species of most concern: the spectacled eider. The results of the first phase are tabular summaries for each species, while the second phase of the analysis produced a map in raster format.

Project Area

The project area includes the entire extent of the NPR-A to the east and west, but extends to the south only to the limit of the waterfowl surveys conducted by FWS. It is located on the Arctic Coastal Plain; bordered on the north by the Arctic Ocean, it is an area with characteristically long cold winters and short cool summers (Carson and Hussey, 1962). Shallow soils remain frozen from mid-September to mid-May and are underlain by continuous permafrost, which contains marine silts, sands, and gravels of the Pleistocene Gubik Formation (Felix and Binney, 1989; Carson and Hussey, 1962). In areas near the coast, snow remains on the ground until late June and ice is on the deeper lakes until the latter part of July. This region has little or no relief and mimics desert precipitation levels with approximately 14 cm precipitation in an average year. The cool summer growing season is approximately six weeks in length with continuous, 24 hour daylight. Despite low levels of precipitation, the Coastal Plain remains moist throughout the summer because the frozen ground and peaty soils are very poorly drained. The region is treeless and characterized by graminoid herbaceous communities under wet soil conditions or dwarf shrub communities where slight rises in the micro-topography create better drained soils (Gallant *et al.* 1995). Micro-topographic changes affecting soil drainage are the main determinants of the distribution of vegetation communities. The most prominent features of the Arctic Coastal Plain are the numerous oriented-thaw lakes (Black and Barksdale, 1949; Walker and Acevedo, 1987; Markon and Derksen, 1994).

NPR-A Earth Cover Data

BLM-Alaska and DU cooperatively developed the digital earth cover types for the NPR-A using satellite imagery (Kempka *et al.* 1995). Both terrain corrected Landsat Thematic Mapper (TM) satellite imagery from 1992 and *System Pour l'Observation de la Terre* Multispectral (SPOT XS) satellite images from 1994 were used for the earth cover classification. Field data were

collected during the summers of 1994-1996. The image processing, classification and accuracy assessment were carried out by DU. The earth cover data are in Erdas Imagine raster format, with a spatial resolution of 30 meters (DU 1998, in press). The classification scheme for the earth cover inventory was developed through site specific work and a series of meetings with biologists familiar with the vegetation (Markon and Derksen, 1994). The classification scheme consisted of seven major categories and seventeen subcategories (Table 1 and Figure 2). The definitions for the classification scheme and a decision tree were developed to be repeatable for future change detection.

Table 1. The earth cover classification scheme.

1.0 Water	5.0 Moist Tundra
1.1 Clear	5.1 Sedge/Grass Meadow
1.2 Turbid	5.2 Tussock Tundra
1.3 Ice	5.3 Moss/Peat/Lichen
2.0 Aquatic/Emergent	6.0 Shrub
2.1 Sedge (*Carex aquatilis)*	6.1 Dwarf
2.2 Grass (*Arctophila fulva)*	6.2 Low
	6.3 Tall
3.0 Flooded Tundra	
3.1 Low-centered Polygons	7.0 Barren Ground
3.2 Non-patterned	7.1 Dunes/Dry Sand
	7.2 Sparsely Vegetated
4.0 Wet Tundra	7.3 Other

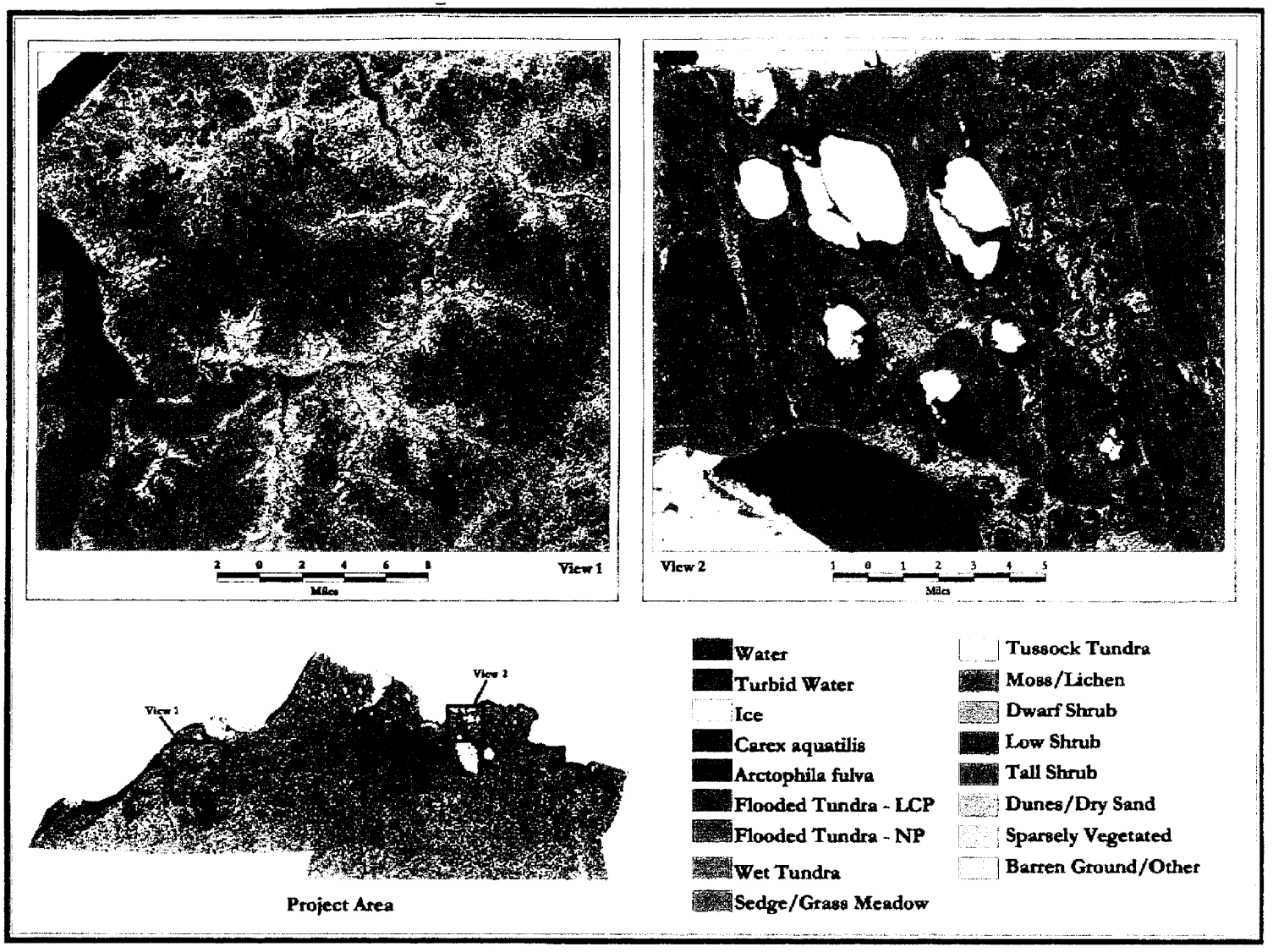

Figure 2. NPR-A Earth Cover Classification

Earth Cover Class Descriptions

Clear Water - Fresh or saline waters with little or no particulate matter. Clear water areas are typically deep (greater than one meter).

Turbid Water - Waters that contain particulate matter. May also occur in shallow water bodies (less than one meter deep). Turbid water typically occurs in shallow lake shelves, deltaic plumes, and rivers and lakes with high sediment loads. The turbid water class may contain small amounts of *Arctophila fulva* or *Carex aquatilis* but generally less than 10% surface coverage of these species.

Ice - May last into late summer on lakes and larger ponds. Ice is present year round in many of the larger lakes.

Carex aquatilis - Associated with lake or pond shorelines and composed of 50 - 80% clear or turbid water that was less than 10 centimeters deep. The dominant species was *Carex aquatilis*. A small percentage of *Arctophila fulva, Hippuris vulgaris, Potentilla palustris,* and *Caltha palustris* may be present.

Arctophila fulva - Associated with lake or pond shorelines and composed of 50 - 80% clear or turbid water that was greater than 10 centimeters deep. The dominant species was *Arctophila fulva*. A small percentage of *Carex aquatilis, Hippuris vulgaris, Potentilla palustris,* and *Caltha palustris* may also be present.

Flooded Tundra-Low Centered Polygons - Polygon features that retain water throughout the summer. This class is composed of 25-50% water; *Carex aquatilis* is the dominant species in the permanently flooded areas. The dryer ridges of the polygons are composed mostly of *Eriophorum russeolum, Eriophorum vaginatum, Sphagnum* spp., *Salix* spp., *Betula nana, Arctostaphylos* spp., and *Ledum palustre*.

Flooded Tundra-Non-pattern - Continuously flooded areas composed of 25-50% water. *Carex aquatilis* was the dominant species. Other species may include *Hippuris vulgaris, Potentilla palustris,* and *Caltha palustris*. Non-pattern is distinguished from low centered polygons by the lack of polygon features and associated shrub species that grow on the dry ridges of low centered polygons.

Wet Tundra - Associated with areas of super saturated soils and standing water. Wet tundra often floods in early summer and generally drains of excess water during dry periods but remains saturated throughout the summer. It is composed of 10-20% water; *Carex aquatilis* is the dominant species. Other species may include *Eriophorum angustifolium*, and other sedges, grasses, and forbs.

Sedge/Grass Meadow - Dominated by the sedge family. This class commonly consists of a continuous mat of sedges and grasses with a moss and lichen understory. The dominant species were *Carex aquatilis, Eriophorum angustifolium, Eriophorum russeolum, Arctagrostis latifolia* and *Poa arctica*. Associated genera include *Cassiope* spp., *Ledum* spp., and *Vaccinium* spp..

Tussock Tundra - Dominated by the tussock-forming sedge *Eriophorum*

vaginatum. Tussock tundra is common throughout the Arctic Foothills and may be found on well-drained sites in all areas of the NPR-A. Cottongrass tussocks are the dominant landscape elements, while moss is the common understory. Lichen, forbs, and shrubs are also present in varying densities. Associated genera include *Salix* spp., *Betula nana*, *Ledum palustre*, and *Carex* spp..

Moss/Lichen - Associated with low lying lakeshores and dominated by moss and lichen species. As this class grades into a sedge community, graminoids such as *Carex aquatilis* may increase in cover, forming an intermediate zone.

Dwarf Shrub - Associated with ridges and well drained soils and dominated by shrubs less than 30 centimeters in height. Because of the relative dryness of the sites on which this cover type occurs, it is the most species diverse. Major species included *Salix* spp., *Betula nana, Ledum palustre, Dryas* spp., *Vaccinium* spp., *Arctostaphylos* spp., *Eriophorum vaginatum, and Carex aquatilis.*

Low Shrub - Associated with small streams and rivers, but also occurring on hillsides in the southern portion of the NPR-A. This class is dominated by shrubs between 30 centimeters and 1.5 meters in height. Major species included *Salix* spp., *Betula nana*, *Alnus crispa*, and *Ledum palustre.*

Tall Shrub - Found only along the Colville River and dominated by *Salix* spp. over 1.5 meters in height.

Dunes/Dry Sand - Associated with streams, rivers, lakes and coastal beaches. Dominated by dry sand with less than 10% vegetation. Plant species may include *Poa* spp., *Salix* spp., *Astragulus* spp., *Carex* spp., *Stellaria* spp., *Arctostaphylos* spp., and *Puccinellia phryganodes.*

Sparsely Vegetated - Occurred primarily along the coast in areas affected by high or storm tides, in recently drained lake or pond basins, and where there is bare mineral soil that is being re-colonized with vegetation. Dominated by non-vegetated material with 10-30% vegetation. The vegetation in these areas may include rare plants but some of the more commonly found species included *Stellaria* spp., *Poa* spp., *Salix* spp., *Astragulus* spp., *Carex* spp., *Stellaria* spp., *Arctostaphylos* spp., and *Puccinellia phryganodes.*

Barren Ground/Other - Associated with river and stream gravel bars, mountainous areas and urban areas. Includes less than 10% vegetation. May incorporate dead vegetation associated with salt burn from ocean water.

Wetland types were represented by *Carex aquatilis*, *Arctophila fulva*, Flooded Tundra and Wet Tundra. Sedge/Grass Meadow, Tussock Tundra, Moss/Lichen, Shrub, Dunes/Dry Sand and Sparsely Vegetated are relatively dry earth cover types.

Waterfowl Observation Points

For this project, seven of the 36 species of birds observed by the FWS were selected for analysis. The seven species of waterfowl included in this study are spectacled eider *(Somateria fischeri*), Steller's eider *(Polysticta stelleri),* king eider *(Somateria spectabilis),* oldsquaw *(Clangula hyemalis),* Canada goose *(Branta canadensis),* brant *(Branta bernicla)*, and white-fronted goose

(Anser albifrons) (Figures 3 and 4). The number of observations per species varied from just 17 for Steller's eider to over 4000 for white-fronted goose and oldsquaw (Table 2). Since the project study area is smaller than the total area surveyed, the number of observations used in the present analysis may be smaller than the total number of birds surveyed.

The waterfowl observation points were collected by the FWS between 1992 and 1997 as part of an ongoing eider breeding population study (Larned and Balogh, 1997). The annual survey is timed to match the spectacled eider's early incubation period before male departure. This time period is also opportune for the observation of other avian species. Survey transects are oriented east-west at intervals of 2.3 km. Every fourth transect is flown each year, so that the survey completes a 17% sample of the arctic coastal plain every four years. The breeding population survey extends further east and west than the boundary of the NPR-A (Figure 1); beyond Prudhoe Bay to the east and Point Lay to the west.

Waterfowl locations were collected by flying along a transect at a fixed altitude and speed (35-45 meters altitude, 150 kilometers/hour) while recording all waterfowl within 200 meters to either side of the aircraft on continuously running cassette tape recorders. The location of waterfowl observations was derived from the time of observation by equating the proportion of time along the transect with the proportion of distance between the start and end of the transect.

All waterfowl point locations were placed on the transect, which was assumed to be a straight line between the start and end points of the flightline. The actual bird location, therefore, could be anywhere within a 200m radius of the transect. In 1997, the geographic position at the moment of observation was recorded with the aircraft's GPS receiver. On that year the observations were offset 100 meters to either side of the transect depending on which side of the aircraft the observation had been made in an effort to more accurately pinpoint the location of the surveyed waterfowl.

The same observers conducted the survey from 1992-1996. However, there was some variation between survey years, both in natural factors and in survey techniques. The first year the survey was flown, 1992, was considered to be badly timed because many spectacled eider males had departed before completion of the survey. The spring thaw of 1996 was very early and so the breeding survey timing is also somewhat suspect. The 1997 survey reduced positional error due to the use of GPS. The 1992 and 1996 survey transects overlap, as do 1993 and 1997.

Population density contours were interpolated from the observed waterfowl point locations by the FWS (Butler, Stehn, and Balogh, 1995). The population density estimates are split into quartiles for each species and labeled high, medium, low and zero contours. These density contours illustrate the overall distribution of observations for each species and facilitate between species comparisons (Figures 5 and 6). The waterfowl observation point data also has a tabular database attached, recording transect number, survey year, observer, whether the birds were single or in pairs, and other data.

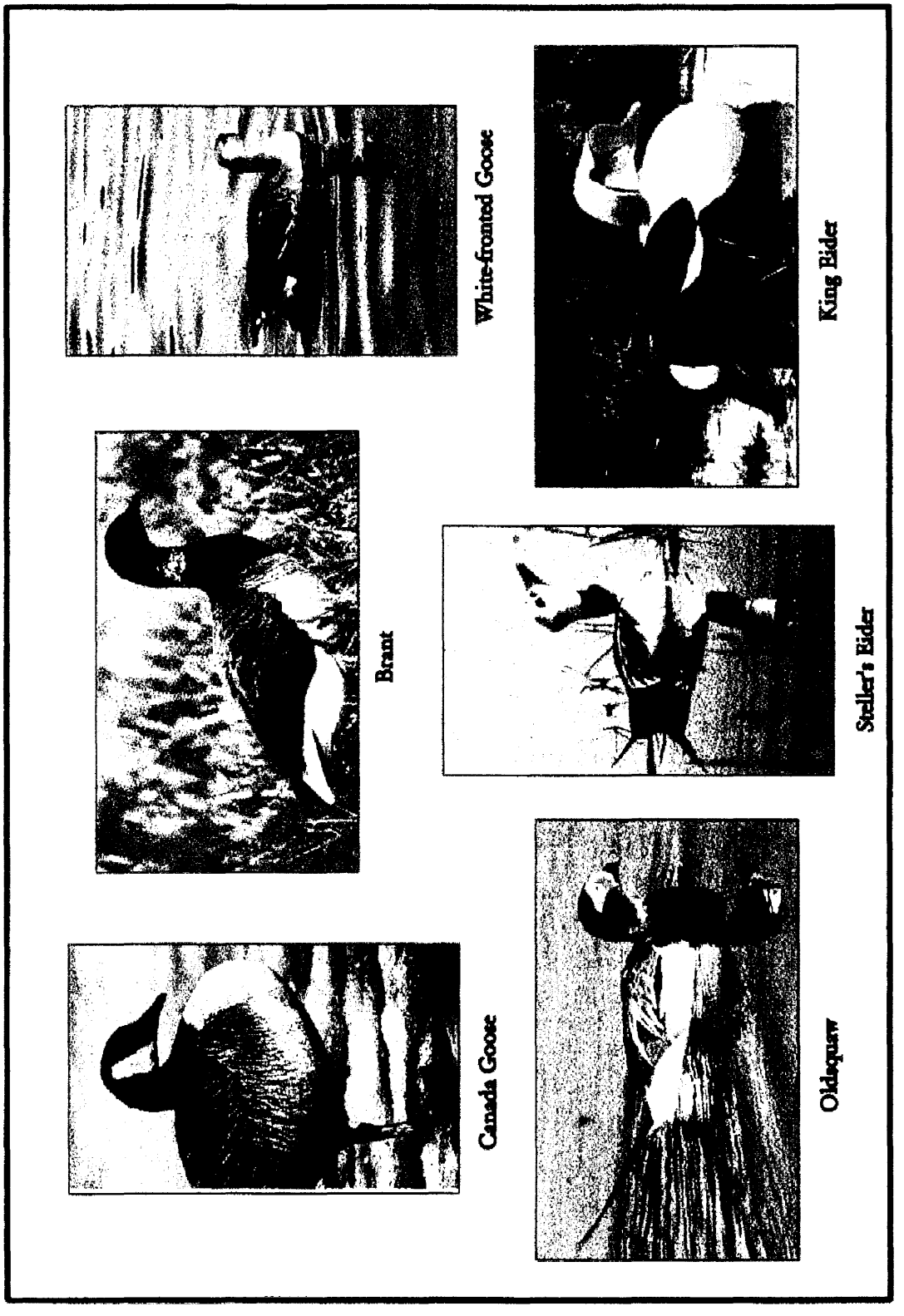

Figure 3. Waterfowl species studied for the earth cover selection analysis.

Figure 4. The Spectacled Eider.

Table 2. Waterfowl sample sizes by species.

Species	Within Project Area	Total Survey
SPECTACLED EIDER	651	770
KING EIDER	953	1371
STELLAR'S EIDER	17	17
OLDSQUAW	3812	4922
BRANT	257	334
CANADA GOOSE	313	443
WHITE-FRONTED GOOSE	4595	5977

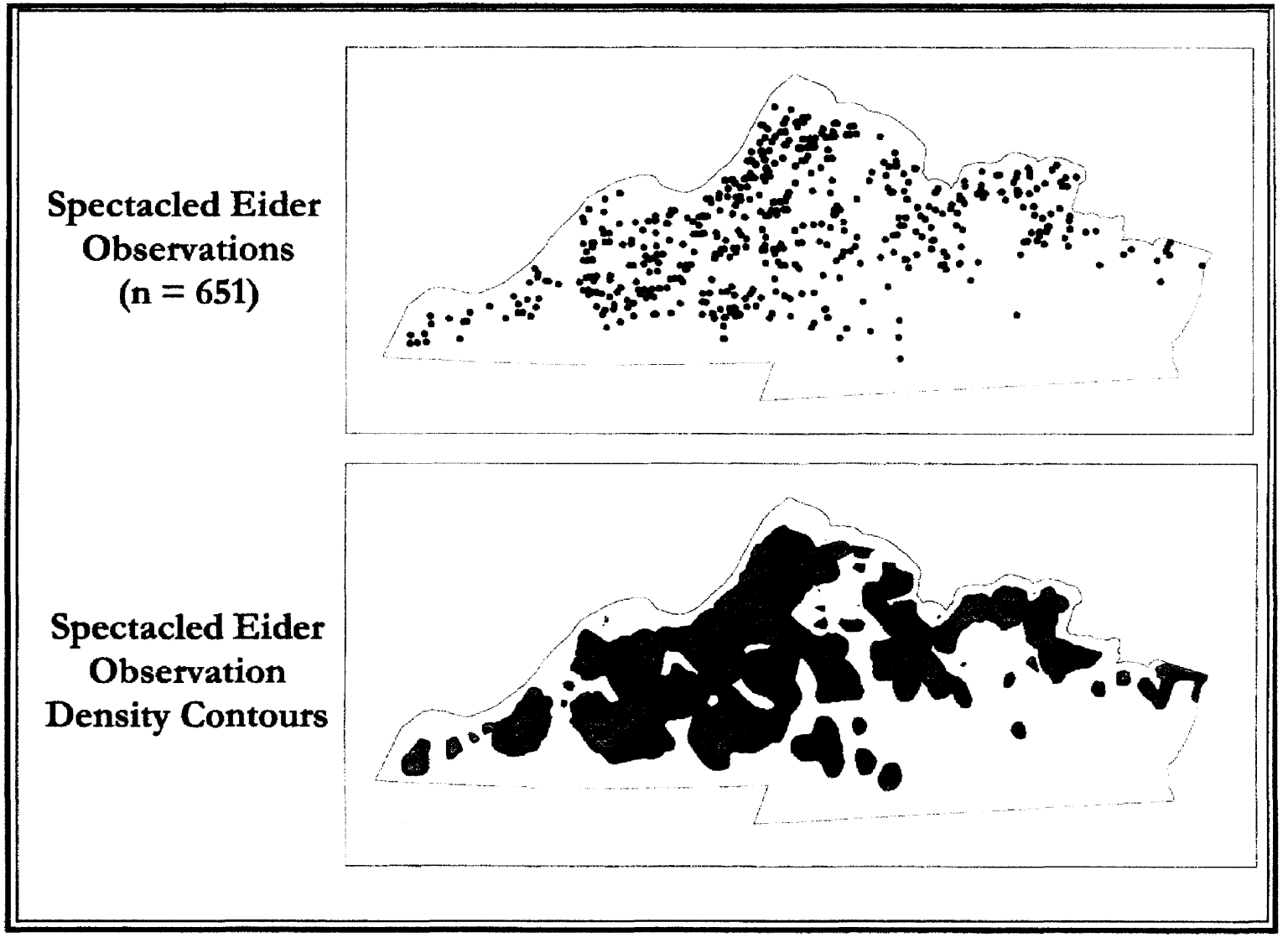

Figure 5. Spectacled Eider observations and density contours.

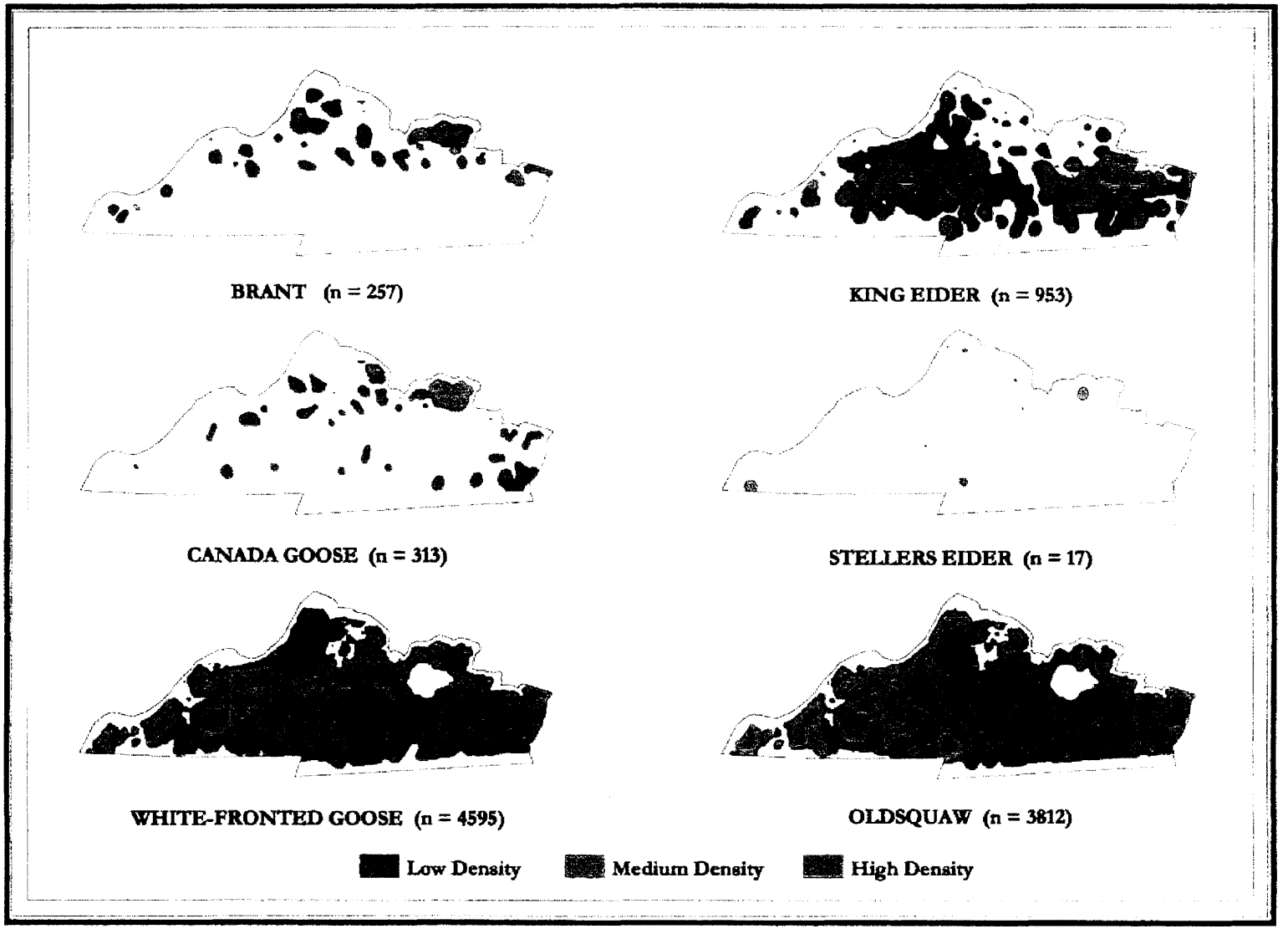

Figure 6. Observation density contours.

Methods

Buffered Waterfowl Observation Points

Given that the waterfowl survey technique placed the location of waterfowl observations at best within a 200m radius of the survey transect, it was considered inappropriate to use the point data as exact locations. Instead, waterfowl location points were buffered by varying radii; 200m, 400m, 1000m, and 2000m (Figure 7). The minimum buffer of 200m represents the maximum locational accuracy of the point data. The next buffer size, 400, represents the probable locational error of the point data given the survey techniques used between 1992 and 1996. The 1000m and 2000m buffer sizes were chosen to test the limits of correlation between waterfowl point data and earth cover data.

Many of the points are within 200m of each other, and so the buffers for each point often overlap. If the buffers of adjacent points are allowed to merge into a single polygon, we lose the ability to distinguish between the earth cover type selection differences of each waterfowl point. Since we intended to stratify the resource selection analysis by survey year, we decided to count the acreage of earth cover types for each point's buffer independently of overlap. As a result, area that is within the buffers of more than one waterfowl point will be counted multiple times. No straightforward methodology existed within the available commercial software to produce a tabular output of earth cover data by each individual buffered point while still retaining the point's unique identification number. Accordingly, a C program was developed to buffer the points, overlay the buffered points with the earth cover map, and produce a tabular output in ASCII format (Appendix A). The developed program utilizes point data and an earth cover map in binary format to compare the two layers by row and column number. The output is a table listing the number of pixels in each earth cover class found within the various buffer sizes for each point. This output was then summarized by earth cover type (using commercial database software) to yield acreage of earth cover types selected by waterfowl species.

Selection Indices

The resource selection index (Manly *et al.* 1993) was used to analyze the patterns of earth cover class selection by waterfowl species (Figure 8). This approach examines the relative probability of resource selection by comparing the proportions of available resource units (flightline sampled area) to the proportions of selected resource (buffered points). The null hypothesis is that the birds are selecting earth cover types in direct proportion to their availability. Confidence intervals were subsequently calculated for each selection ratio. A selection ratio of one indicates usage of an earth cover class in exact proportion to its availability (neither selection for, nor avoidance of, the earth cover class). Therefore, selection for, or avoidance of, an earth cover class was implied where the selection ratio confidence interval did not include the value one. We calculated selection ratios for each species for each year in addition to pooling observations across years. This selection ratio analysis was conducted for all seven species of

Figure 7. Waterfowl observation point buffers over NPR-A earth cover types.

If,

$o_i = u_i / u_+$ the proportion of used resource units in category i

where:

u_i = # of sampled resource units in category i

u_+ = total resource units sampled

$\pi_i = A_i / A_+$ the proportion of available resource units that are in category i

where:

A_i = # of resource units in i

A_+ = size of the total population of available resource units

the selection ratio ($\hat{w}_i$) is calculated as:

$$\hat{w}_i = o_i / \pi_i \quad \text{or}$$

$$\hat{w}_i = \frac{u_i / u_+}{A_i / A_+} \quad \text{or}$$

$$\hat{w}_i = \frac{\text{Area of landcover type } i \text{ in buffer}}{\text{Total area in buffer}} \Big/ \frac{\text{Area of landcover type } i \text{ in study area}}{\text{Total study area}}$$

Figure 8. Selection index.

waterfowl, and for all four buffer sizes, as well as for the waterfowl density contours. In addition, the acreage figures were broken down by survey year to test for annual variability. A standardized selection ratio is included with the results of the density contour selection analysis. The standardization consists of dividing each selection ratio by the sum of selection ratios; this figure is included for ease of interpretation of results.

The standard tests for significant differences in frequency distribution between the available resource units and the selected resource units are the Chi-square, or the closely related Chi-square log likelihood (G-test). These tests were designed to evaluate frequencies of independently sampled resource units. Since the accuracy of the survey data was, at best, within a 200m radius, the analysis was conducted with buffered points and relative pixel counts.

This sampling design changes the sample unit from 'number of spectacled eider locations' to 'number of pixels' and falsely produces a huge increase in the sample size. Because of the extremely large sample sizes, the calculated Chi-square and G-test values are improbably high, in some cases over 100,000. As a result, the Chi-square was deemed an inappropriate test for significance given the current sample design. Instead, we rely upon confidence intervals of selection indices to indicate significant selection for or against a particular class. Variance was based on differences between individual buffered locations (Design II, sampling protocol A, Manly *et al.* 1993).

Used Versus Available Land

There was some question of whether the placement of the survey transects was limiting the selection of earth cover by waterfowl. Available land could be considered to be the whole project area, or it could be defined as the area within a 200m radius from the flightline. Accordingly, we tested the assumption that the proportion of earth cover types in the whole project area was the same as in the area within 200m of the flightline. Earth cover type acreage figures were produced for the area surrounding the transects flown in each year and compared to the entire study area with a Student's T-test. There was no significant difference in the distribution of earth cover types between the buffered flightline and the whole survey area. Nevertheless, we elected to define available land as the area within 200m from the annual flightlines since this estimate was theoretically the most accurate.

Unsupervised Classification

Earth cover mapping always entails a certain amount of lumping of cover types. The NPR-A earth cover map was not developed to describe the habitat of any one particular species but rather to provide base line data for the entire North Slope. As a result, it is possible that a wildlife species could select for a subset of a given earth cover type. In some situations, that could mean that while a bird is selecting for a particular cover type in one area, that same cover type may not be important elsewhere in the project area. It is also possible that a species is selecting for habitat that falls near the transition between types, so that the selected habitat could actually be found in more than one earth cover type.

To test for selection of land types outside the classification developed for the NPR-A, an unsupervised classification of 50 classes was created and overlain with the buffered spectacled eider locations. Selection indices were calculated for the 50 unsupervised classes. The unsupervised classes that showed the highest selection ratios were extracted and matrixed with the NPR-A earth cover map. Due to time and budget constraints, confidence intervals were not calculated, and the selection ratio analysis was performed for only one of the three Landsat TM satellite images that cover the study area. The analysis of the unsupervised classification was intended as an exploration of the possibility that additional information might be extracted from the unclassified satellite image data, but it is by no means an exhaustive study.

Spectacled Eider Resource Selection Model

Logistic Regression

Once it had been shown that spectacled eider do select more strongly for some earth cover types than others, the next step is to model the distribution of the waterfowl

based on resource selection. Logistic regression was identified as a useful method for identifying and mapping resource selection. This method was chosen for several reasons; 1) the logistic function can be used to produce a surface describing relative probability of use; 2) multivariate analysis can adjust for the interaction of variables; 3) interpretation of the calculated coefficients is relatively straightforward; and, 4) the software for calculating logistic regression functions is readily available (Manly *et al.* 1993; Hosmer and Lemeshow, 1989; MathSoft 1997). The logistic regression model evaluates resource selection based on the presence or absence of the variable being studied, in this study, spectacled eider. The observed spectacled eider point locations indicate presence. Points randomly selected from areas that were surveyed but where spectacled eider were not observed represent available but theoretically unused habitat. All observed spectacled eider points receive a value of 1, while randomly selected points denoting unused areas receive a value of 0. A constant is calculated along with coefficients for each of the input layers that represent the independent variables used to predict the dependent variable. The resulting logistic function produces a surface describing the relative probability of resource selection with values between zero and one, where higher values denote habitat with a high probability of being selected. Low values imply less use by spectacled eiders.

Random Available Locations

Known absence as well as known presence locations are available under some conditions, in a plant community distribution study, for example, but in any study involving mobile subjects such as waterfowl, absence locations merely denote non-observation, at best. The estimation of non-use is further complicated in this case because spectacled eider populations are thought to be well below the carrying capacity of the landscape. It is possible, therefore, that some of the random available locations could be in areas suitable for spectacled eider. Given the limitations inherent in the available data, randomly selected available locations are the closest possible approximation of absence points.

The number of random available locations used in logistic regression is generally at least equal to the number of selected points, and is often greater than the number of selected points (Pereira and Itami, 1997). Because of the large extent of the study area, an equally large number of random locations were needed to provide a representative sample of the available but unused landscape. For this study, 5000 random locations were selected from surveyed but unused areas. Unused areas are defined as that area which is outside of the 200m buffers around spectacled eider observation points. The GIS tools available for this study made it more feasible to produce a large number of random points than would have been possible using traditional tools.

Input Variables

The model input layers available for this analysis were mainly earth cover types. In future research, additional input layers (soils, green-up indices, detailed hydrology, etc) would likely be informative. In addition to the earth cover types, two other layers were examined for inclusion to the logistic regression model. A layer was necessary to distinguish between large bays or inlets and smaller ponds or lakes which otherwise are labeled as the same cover type under the current classification. This distinction is important because spectacled eiders are found in proximity to smaller water bodies

but seem to avoid the largest lakes, bays and inlets. For this layer, the Turbid, Clear Water and Ice classes were combined and water bodies were ranked by size. The population density contours for oldsquaw were also included to test the idea that oldsquaw and spectacled eider population distributions are similar and somehow related, perhaps because of similar habitat preferences (pers. comm. R. Stehn 1997).

The inclusion of variables into the model was based on availability, statistical tests (Hosmer and Lemshow, 1993) and what was known of the biology of the spectacled eider. A process of backward stepwise elimination was employed where all available variables were included and then those that were the least significant were eliminated one by one. Variables were included if the *t*-value calculated along with the coefficients was greater than a critical value of 1.96 at a 95% confidence level. The deviance of each variable was also examined and variables with high deviances were judged to be relatively significant. Finally, the relative probability surface produced by the logistic function was visually reviewed for consistency with the recorded spectacled eider distribution after each iteration of the model building process.

GIS Analysis

The manipulation of the input layers and the relative probability surface was performed in the raster module of ArcInfo, GRID (ESRI 1997). The logistic regression calculations were done in the statistical software, SPLUS (MathSoft 1997). Various spreadsheet and database software packages were used to transfer the data from map format to tabular format and back.

The 200 meter buffer around each point constituted the sample unit since this buffer size represents the minimum error in location. The use of buffered points greatly complicated the analysis both conceptually and technically. Since the *percentage* of each earth cover type found within a 200m radius of each waterfowl location actually constituted the sample, the same treatment had to be given to the earth cover layers used as inputs to the logistic function. Accordingly, a new layer was generated for each earth cover type where the value assigned to each pixel represented the percentage of the earth cover type within a 200m radius of that pixel. These layers were generated by first separating the earth cover type map into 17 dichotomous maps representing the presence or absence of a single class. Each single cover type map was then scanned with a circular, seven pixel window (equivalent to a 200m buffer at a 30x30m pixel size). The number of pixels of a given cover type within a seven pixel circular neighborhood was summed and divided by the total number of pixels within a 200m buffer to create a percentage cover type map for each class.

The C program described at the beginning of the methods section, was used to generate an ASCII file recording the percentage of input variables present within each selected or available buffered point. This file was loaded into SPLUS where the input variable coefficients and constant were calculated. The coefficients and constant were assembled into a logistic function that was then built in the ArcInfo GRID module, where the coefficients were applied to the raster input variable layers. The resulting relative probability layer is a raster map with values between zero and one indicating the relative probability of spectacled eider occurrence.

Accuracy Assessment

A random sample of one third of the surveyed spectacled eider locations and an equal number of random, available locations were reserved to assess the accuracy of the resource selection model. These accuracy assessment locations were overlain with the relative probability surface output by the logistic function. Given that the actual spectacled eider point location could fall anywhere within the 200m radius, it follows that an accuracy assessment location could be correctly classified even though only a portion of the buffered accuracy assessment location contains high relative probability pixels. Available and surveyed accuracy assessment locations were sorted into three classes, >50%, >25% and >10%, according to the percentage of high relative probability pixels contained within each 200m buffer. The high relative probability threshold was set at .90 based on the overall distribution of probabilities found in the model output. For example, known spectacled eider location buffers that contained >50% relative probability of >.90 were tallied and contrasted with random point locations containing >50% high relative probability pixels. The comparison between random and known spectacled eider locations was repeated for accuracy assessment locations with >10% and >25% high relative probability pixels. The model is assumed to be predicting suitable habitat if a greater number of observed spectacled eider locations fall within areas of high relative probability than did the random points.

The model output was checked for errors of commission as well as omission. If the model is highly inclusive and a large percentage of the study area is classed as suitable this may result in a high percentage of accuracy, even though there may be areas that are classified as being suitable that do not fall within the distribution pattern of the spectacled eider. An overly inclusive model would result in a large (>50%) number of random, available accuracy assessment points being classed as suitable habitat. Conversely, if the model is too exclusive, it may correctly classify areas as unsuitable because they are outside the distribution pattern of the spectacled eider, but still result in a lower accuracy rate.

Results

Selection Indices for Buffered Points

Figures 9 and 10 present a summary of the selection ratio analysis for the 200m buffer. Selection ratios for each waterfowl species and all buffer sizes are given in Appendices B-H. The largest selection values are in boldface in each table.

Spectacled Eider

The selection index analysis shows that spectacled eider are selecting most strongly for *Arctophila fulva*, Flooded Tundra-Non Pattern and *Carex aquatilis* (Appendix B). They are also selecting strongly for Flooded Tundra-Low Centered Polygon, and Moss/Lichen. The spectacled eiders seem to be avoiding Ice, Turbid Water, Dwarf Shrub and Tussock Tundra. Both Tussock Tundra and Dwarf Shrub are relatively dry cover types and that probably explains their exclusion. The avoidance of Ice exhibited by most of the waterfowl probably reflects avoidance of the deep lakes where ice is more prevalent. This selection distribution is largely consistent with what is known of spectacled eider biology, particularly since *Arctophila fulva* and *Carex aquatilis* wetlands have been linked to the distribution of the spectacled eiders in other studies (Derksen *et al.* 1981, Bergman *et al.* 1977).

King Eider

King eider are selecting most strongly for *Carex aquatilis* and *Arctophila fulva* (Appendix C). Unlike the spectacled eider, they do not show a preference for Moss/Lichen or Flooded Tundra-LCP. King eider show a nearly equal preference for Wet Tundra and Flooded Tundra-Non Pattern. They are also avoiding Ice, Tussock Tundra, Dwarf Shrub, Dry Sand, Sparsely Vegetated and Barren Ground. Overall their habitat preferences appear to be less specific than the spectacled eider's (Larned and Balogh, 1997).

Steller's Eider

Since the sample size for Steller's eider is only 17 points, the results of the resource selection index cannot be given much weight. Steller's eider appear to be selecting significantly only for Sedge/Grass Meadow at the 200m and 400m buffer sizes, though they also show a preference for *Arctophila fulva* at the 1000m and 2000m buffer sizes (Appendix D).

Oldsquaw

Oldsquaw show the strongest preference for *Arctophila fulva*, followed by Flooded Tundra-Non Pattern, and *Carex aquatilis* (Appendix E). They seem to avoid Ice, Tussock Tundra, Dwarf Shrub and Dunes/Dry Sand. Oldsquaw are the most evenly distributed and extend the furthest south of the seven species studied. Like the white-fronted goose, its selection ratio distribution is relatively flat.

Brant

The brant selection ratio distribution is the most differentiated of the seven birds studied. They are selecting most strongly for *Carex aquatilis*, followed in order of preference by Barren Ground/Other,

Figure 9. Selection ratios with 95% confidence interval bars;
Eider species and oldsquaw - 200 m buffer

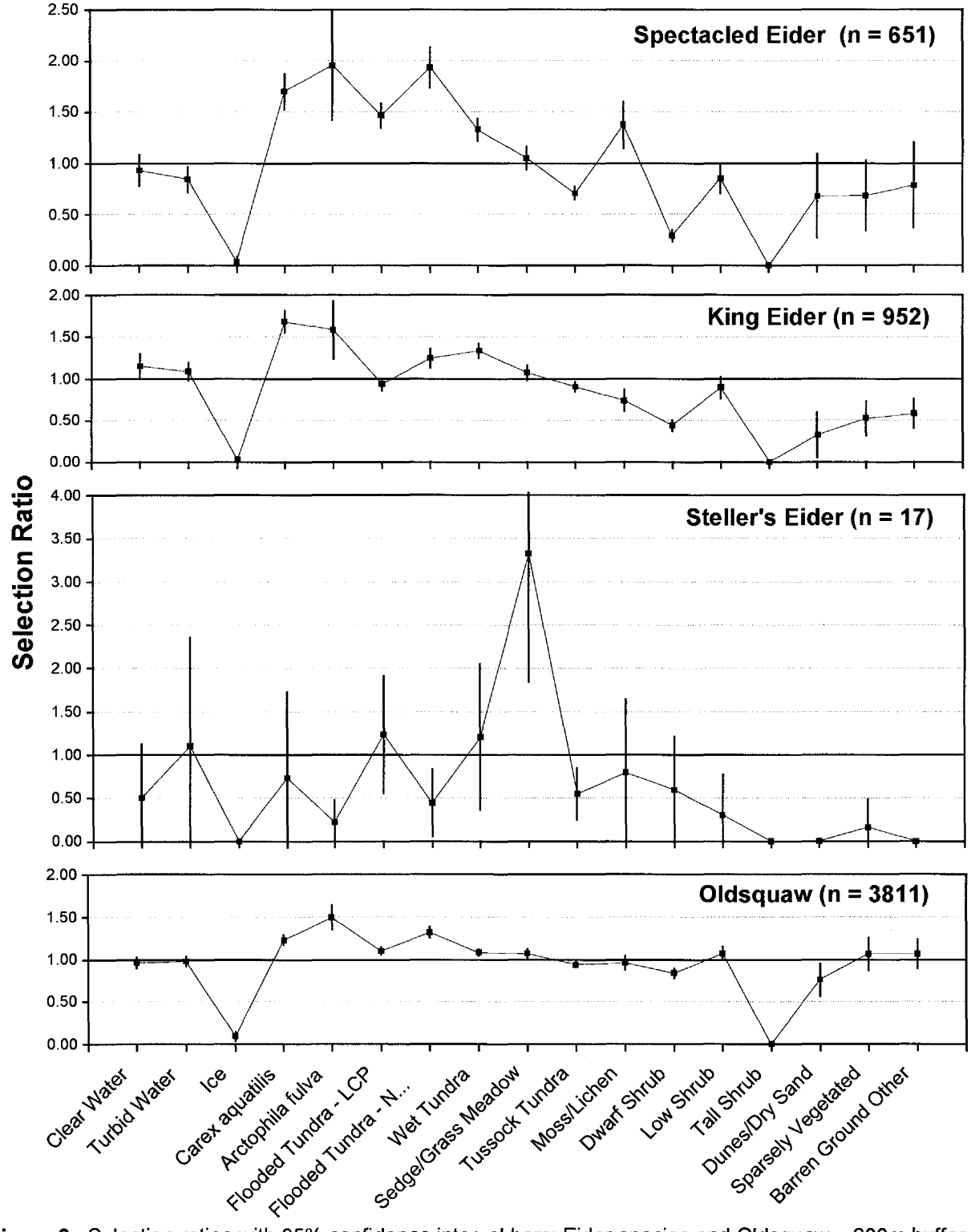

Figure 9. Selection ratios with 95% confidence interval bars; Eider species and Oldsquaw – 200m buffer.

Figure 10. Selection ratios with 95% confidence interval bar;
Goose species and brant - 200 m buffer

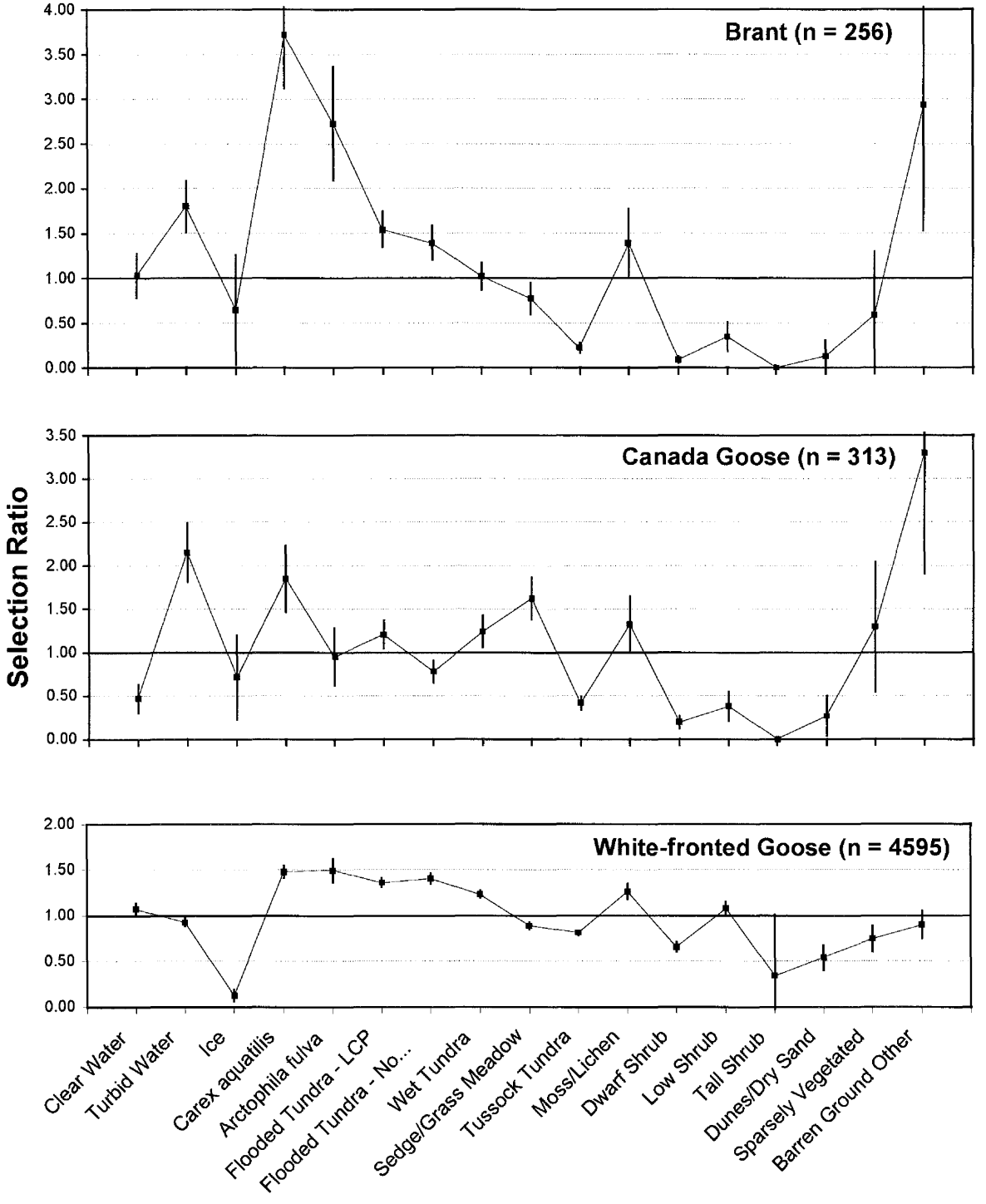

Figure 10. Selection ratios with 95% confidence interval bars; Goose species and Brant – 200m buffer.

Arctophila fulva, Turbid Water, the Flooded Tundra classes, and Moss/Lichen (Appendix F). It seems likely that the habitat they are selecting for in Barren Ground/Other is marine or freshwater shorelines. The Moss/Lichen type is often associated with lake shores and this factor probably explains its selection. The classes that the brant seem to be avoiding most are the Shrub classes, Dunes/Dry Sand and Tussock Tundra.

Canada Goose

The Canada goose selects most strongly for Barren Ground/Other (Appendix G). Like the brant, the Canada goose is probably selecting for the marine or freshwater shorelines that are a subset of this cover type. It is also selecting for Turbid Water and *Carex aquatilis* and somewhat less strongly for Sedge/Grass Meadow. Like many of the species studied, it seems not to prefer Shrub, Dunes/Dry Sand or Tussock Tundra. Other than the Steller's eider, Canada goose is the only species that exhibits avoidance of Flooded Tundra Non-pattern. Of all the species studied, Canada goose shows the highest degree of selection for Turbid Water.

White-fronted Goose

The white-fronted goose sample size is the largest of the seven species studied. The abundance and relatively wide distribution of the white-fronted goose results in a flatter selection ratio (Appendix H). The somewhat less specific habitat preferences apparent in this analysis is consistent with other observations of white-fronted geese (Derksen *et al.* 1981). They appear to be selecting most strongly for *Arctophila fulva*, followed by *Carex aquatilis*, Flooded Tundra, Moss/Lichen and Wet Tundra. White-fronted goose is the only species selecting for Low Shrub. Low Shrub is associated with the beaded streams and rivers that this species tends to prefer.

Summary

Overall, the selection ratios for the 200m buffer size are the most informative. The 2000m buffer selection ratios are surprisingly consistent with the smaller buffer sizes but show a much flatter distribution. The differences between selection rates for the different sizes of buffers can in some cases be explained by the juxtaposition of earth cover types on the ground. For example, if a point is located near the shore of a lake that has ice in the middle, the 200m buffer will include less of the ice than the 2000m buffer. Conversely, cover types that are localized and fragmented will appear to be less selected in the larger buffers than in the smaller buffers. This is often the case for the *Carex aquatilis* and *Arctophila fulva* classes that are rarely present in great quantities within a 1000 or 2000m buffered area (Figure 7).

Selection Indices for the Population Density Contours

The resource selection ratio for the population density contours are purely descriptive and cannot be statistically tested for significance with confidence intervals because there is no sample size for this data set. However, these figures are very useful for illustrating the distribution of a waterfowl species across the landscape (Figures 5 and 6).

For all species, the resource selection ratios for the population density contours are very

similar to the analysis results from the buffered points, especially if the high density results are compared to the 200m buffer figures (Appendix I). The differences in selection ratio for the high, medium and low density contours may help to distinguish between earth cover types that are really important to waterfowl, from earth cover types that are adjacent to, or associated with important areas.

The spectacled eider population density contour selection ratios (Appendix Table I1) are very similar to the results of the buffered point analysis. Unlike the results for most species, the same land types are selected for in all three density contours. Flooded Tundra-Non Pattern is particularly consistent across the density contour zones reflecting the very strong preference spectacled eider show for this type. King eider density polygon selection ratios are also similar to the buffered point ratios, except for Sedge/Grass Meadow, which is highly selected in the medium and high population density contours (Appendix Table I2). The Steller's eider density polygon selection ratios indicate the same preference for Sedge/Grass Meadow found in the buffered point analysis (Appendix Table I3). The high selection ratio for Dwarf Shrub and Tussock Tundra is surprising, but perhaps not very significant given the Steller's Eider extremely small (n=17) sample size. Oldsquaw density polygons show selection for *Arctophila fulva*, Flooded Tundra-Non Pattern and Sedge/Grass Meadow, and deviate from the buffered point selection ratios in the higher preference for Low Shrub, a cover type usually associated with riparian corridors (Appendix Table I4). The brant density contour selection ratios are relatively dissimilar between contour zones while selection ratio values are relatively high. These figures may reflect the smaller sample size gathered for brant rather than stronger cover type preferences (Appendix Table I5). Although brant selection ratios are consistently high for Moss/Lichen and Flooded Tundra LCP, the strong preference for Barren Ground reflected in the buffered point selection ratio does not appear except in the medium density contour. The Canada goose density polygon selection ratios show the same preference for Turbid Water and Barren Ground/Other land types that appeared in the buffered point selection ratios (Appendix Table I6). The Canada goose density polygon selection ratio for Barren Ground/Other increases dramatically as the density increases, probably reflecting the concentration of the sampled population near the ocean shore, north of Teshekpuk Lake (Figure 5). The white-fronted goose density contour selection ratios (Appendix Table I7) closely match the buffered point selection ratio results, showing a preference for *Carex aquatilis*, *Arctophila fulva*, Flooded Tundra and Wet Tundra in both the high and medium density zones. The Moss/Lichen cover type is also being selected by the white-fronted goose.

Selection Indices for an Unsupervised Classification and Spectacled Eider Locations

Three unsupervised classes showed relatively higher selection ratios (Appendix Tables J1-J4). These three classes were extracted and matrixed with the NPR-A classification (Appendix J5). Unsupervised Class 14 was split among several shallow water or wet earth cover types. Class 18 was evenly split between the two Flooded Tundra types. Class 26 was mostly Flooded Tundra Low Centered Polygon mixed with Wet Tundra, Flooded Tundra Non-pattern, and Moss/Lichen. The results of this test are encouraging in that only types that are

known to be of special interest to the spectacled eider were selected. However, since the eiders did not seem to select very strongly for any one unsupervised class we cannot conclude from this particular test that there is a subset of one of the NPR-A earth cover types that is of particular importance to the spectacled eider.

Results of the Logistic Regression Model

Model Building

Many combinations of the available variables were tested and rejected in the process of building the final list of input variables. In the end, two models were produced; Model A has lower accuracy assessment results but somewhat less errors of commission, while Model B has a higher accuracy but does not conform quite as well to the overall distribution of the sampled spectacled eider population. The two models share most of the same variables (Table 3), but Model A includes Moss/Lichen with Moss/Lichen squared, while Model B includes Dwarf Shrub. All of the variables included have a t-value greater than the critical value of 1.96 at the 95% confidence level.

Table 3. Variables included in the logistic regression Model A.

Model A		
Variable Name	**Coefficient**	**t-Value (a = .05)**
Intercept	-3.0188805	-19.941240
Large Water Bodies	-1.5946525	-4.039646
Oldsquaw-Medium Density	0.5481938	4.624107
Oldsquaw-High Density	1.1846399	7.417442
Carex aquatilis	2.4464031	3.288811
Arctophila fulva	3.3397433	2.864816
Flooded Tundra-Non pattern	1.9223229	3.771614
Flooded Tundra-LCP	1.2745935	2.759114
Sedge/Grass Meadow	1.1118672	3.371510
Tussock Tundra	-1.0254270	-3.595676
Moss/Lichen	6.9379791	3.170183
Moss/Lichen squared	-17.2654090	-2.560059

Table 4. Variables included in the logistic regression Model B.

Model B		
Variable Name	**Coefficient**	**t-Value (a = .05)**
Intercept	-2.5602113	-17.596962
Large Water Bodies	-2.0698374	-4.886568
Oldsquaw-Medium Density	0.4813508	4.052840
Oldsquaw-High Density	1.1799088	7.354433
Carex aquatilis	1.6320285	2.199557
Arctophila fulva	3.0230068	2.582457
Flooded Tundra-Non pattern	1.3956142	3.667714
Flooded Tundra-LCP	1.2801605	2.538916
Sedge/Grass Meadow	0.8097703	2.476621
Tussock Tundra	-0.7101195	-2.638986
Dwarf Shrub	-9.2410723	-6.400781

Generally, the distribution of the spectacled eider seems to coincide with high concentrations of Flooded Tundra, *Carex aquatilis*, *Arctophila fulva* and smaller water bodies, and to be negatively associated with concentrations of Tussock Tundra, Dwarf Shrub, Ice and large water bodies such as bays, large lakes or inlets. Moderate amounts of Moss/Lichen are positively associated with spectacled eider, but if this class dominates an area then the association becomes negative; a quadratic term was added to compensate for this effect. Tussock Tundra was also more negatively correlated where it occurred in larger concentrations. Wet Tundra, Dunes/Dry Sand, Sparsely Vegetated and Barren Ground did not appear to significantly affect the distribution of the eiders. High and medium density contours of oldsquaw distribution were very highly correlated with spectacled eider distribution.

Accuracy Assessment Results

Table 4 presents the results of the accuracy assessment. The reserved spectacled eider buffered point locations and random available point locations were overlaid with the relative probability surfaces output by the two models. Point buffers that contained high probability pixels (>.90 relative probability of selection) were extracted. In Model B, 93% of the spectacled eider buffered points consisted of at least 10% high relative probability pixels, while in Model A, 78% of the spectacled eider buffered points had at least 10% high relative probability pixels. The random accuracy assessment points in both models contained about the same amount of high relative probability pixels. Considering that the actual spectacled eider point locations could fall anywhere within the 200m buffers, these accuracy assessment results are very encouraging.

Discussion

The results of the logistic regression analysis (Figure 11) have pointed out a few of the difficulties of building a model for a large area like the Arctic Coastal Plain. For example, north of Teshekpuk Lake, large patches of the Moss/Lichen cover type coincide with a high concentration of spectacled eiders. But between Admiralty Bay and Smith Bay, where spectacled eider are largely absent, there are also large amounts of the Moss/Lichen cover type. In Model A, the Moss/Lichen cover type was used to exclude the area between Admiralty and Smith Bay simply because this variable was the only available factor to explain the scarcity of spectacled eider in this area. However, the quadratic term for Moss/Lichen is so highly negative that it has the effect of excluding areas adjacent to the Moss/Lichen concentrations that are being selected for by the spectacled eiders and thereby results in an overly exclusive model output. In Model B, the Moss/Lichen type is not included, resulting in more high relative probability areas north of Teshekpuk Lake (Figure 12). The high accuracy of Model B suggests that Moss/Lichen was not of significance to the spectacled eiders in and of itself, but instead was adjacent to other earth cover types that were of significance. South of Teshekpuk Lake, there were almost no spectacled eiders surveyed. This region is characterized by numerous small lakes but it has very little Flooded Tundra and a high concentration of Tussock Tundra. Both models produce some areas of high relative probability of selection in this region indicating that further work should be done to determine why spectacled eiders and other species avoid this area. Other factors that may explain the distribution of spectacled eider in this region and in the region between Smith and Admiralty Bay could be included at some future date to strengthen the current model.

Limitations of the Study Data

One limitation of this combination of data is that the earth cover classification represents the status of the land during a single point in time (one year), while the waterfowl point data spans six years. In addition, the breeding survey was conducted in the spring, whereas the satellite imagery was acquired in the summer. Further, minute changes in the morphology of the tundra (Troy 1991, Gallant *et al.* 1995) that are not detectable with Landsat TM satellite imagery may affect water levels that in turn affect the choice of habitat by waterfowl. As a result, it is possible that some of the wet earth cover types that the birds are selecting for are components of the wider earth cover type discerned by the earth cover classification. Many of the mapped earth cover types are continually changing with the annual cycle of thaw and freeze which shapes the landscape processes of the arctic coastal plain. Ice is just one example of a class that will change from year to year. Another offset factor is that birds were often flushed by the approaching aircraft, so that their location could have been recorded at some distance from the habitat the birds were actually using. Finally, the results of the resource selection analysis should not be interpreted as representing nesting habitat, though it may well reflect breeding habitat. The breeding survey uses the presence of lone drakes as an indication of females that have initiated nesting (Larned and Balogh, 1997), however, male spectacled eiders are usually seen at some distance from the actual nest site (Troy 1996). The availability of input layers for the spectacled eider logistic regression model was limited for two reasons. First, the NPR-A is a vast

Table 5. Accuracy assessment locations containing relative probability >.90 within the 200m radius.

Model A

Selected (n = 215)	**Number of Observations**	**Percent of Observations**
>10% of Buffer Area > .90 Probability	167	78%
>25% of Buffer Area > .90 Probability	155	72%
>50% of Buffer Area > .90 Probability	127	59%
Random (n = 216)		
>10% of Buffer Area > .90 Probability	110	51%
>25% of Buffer Area > .90 Probability	97	45%
>50% of Buffer Area > .90 Probability	79	37%

Model B

Selected (n = 215)	**Number of Observations**	**Percent of Observations**
>10% of Buffer Area > .90 Probability	200	93%
>25% of Buffer Area > .90 Probability	188	87%
>50% of Buffer Area > .90 Probability	181	84%
Random (n = 216)		
>10% of Buffer Area > .90 Probability	107	50%
>25% of Buffer Area > .90 Probability	96	44%
>50% of Buffer Area > .90 Probability	86	40%

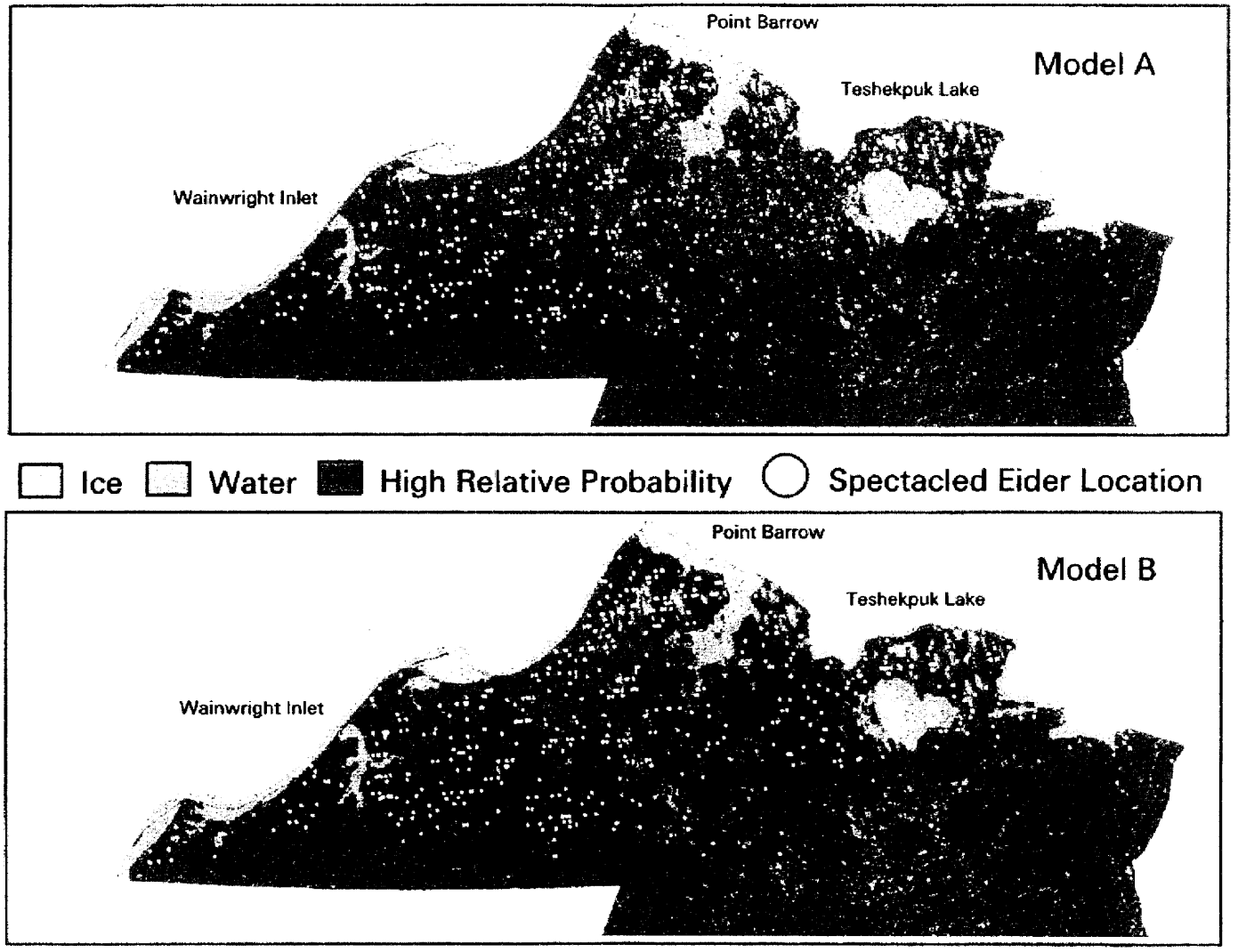

Figure 11. Spectacled Eider relative probability of resource selection surfaces; comparison of Model A with Model B.

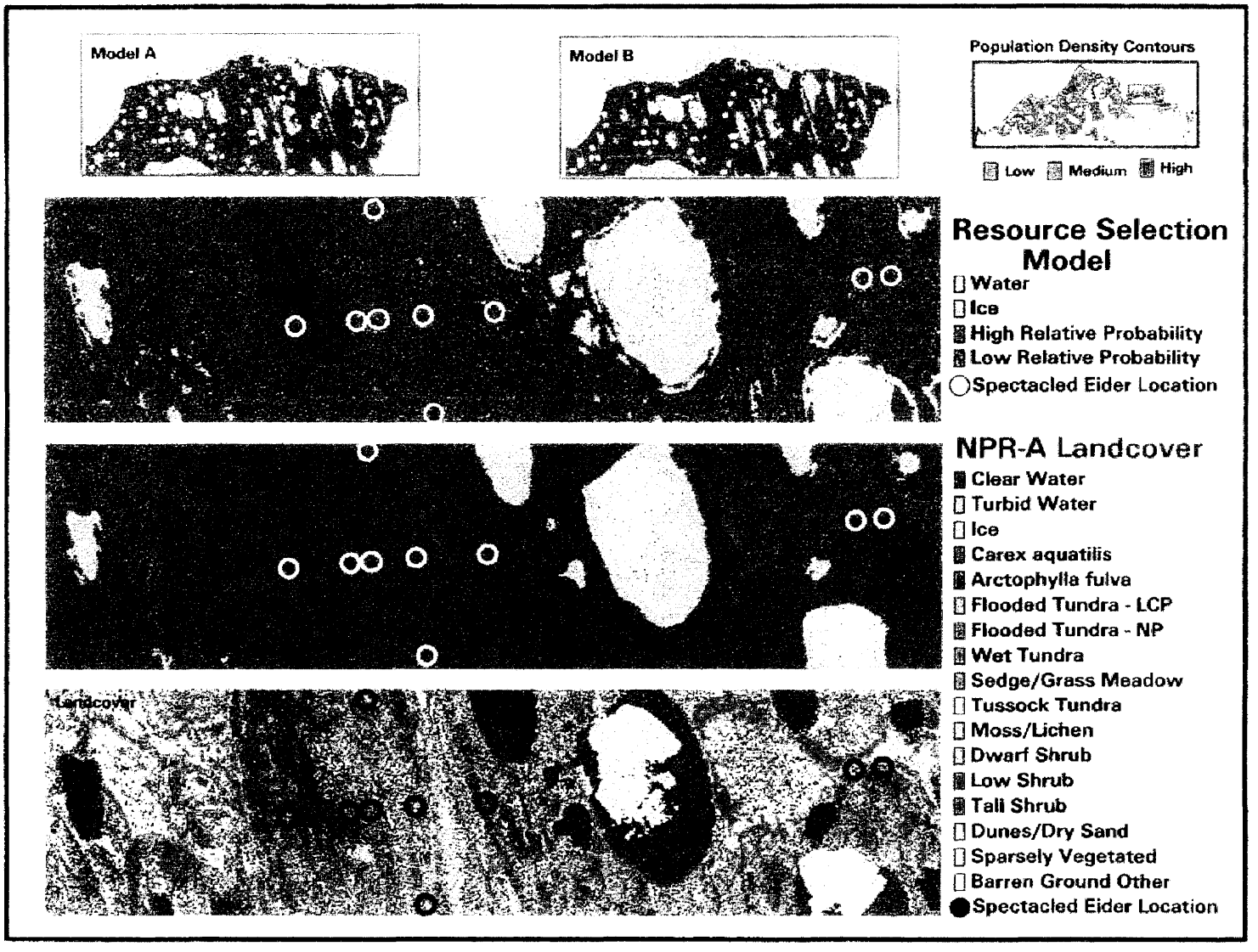

Figure 12. Spectacled Eider relative probability of resource selection model; vicinity of Teshekpuk Lake.

and remote area, and common baseline data are often available only for subsets of the study area. Second, relatively little is published about the biology of the spectacled eider, so it is difficult to know which factors in the environment are most influential in the eider's habitat selection. Further research is needed to find other relevant layers, but a preliminary assessment of the distribution of spectacled eider suggests several promising avenues of investigation.

Spectacled eiders seem to prefer large shallow lakes or wetlands with convoluted edges and/or lots of islands (Bergman *et al.* 1977; Derksen *et al.* 1981; Larned and Balogh, 1997). A layer representing lakeshores where the perimeter to area ratio is large could be generated from a detailed hydrology map. Vegetation type is a valuable indicator of micro-topographic differences in soil drainage (Gallant *et al.* 1995), but more general maps of soils or geology might explain broader scaled patterns. The timing of snow melt on land, ice melt in ponds or lakes and the break up of sea ice are all factors that influence the behavior and distribution of spectacled eiders (Larned and Balogh, 1997). Slight differences in the timing of snow melt across the Arctic Coastal Plain could explain patterns in the distribution of spectacled eiders that the distribution of vegetation cannot explain. Maps describing the trend of prevailing weather patterns, therefore, could be useful for modeling spectacled eider resource selection.

It is likely that the spectacled eider and indeed most species select for a combination of earth cover types that together form suitable habitat. Measures of the diversity of earth cover types within specified neighborhoods were calculated and tested along with the other model input layers. Since no significant correlation with spectacled eider distribution was found, the diversity layers were omitted from the final model. However, the possibility remains that spectacled eider do select for a combination of earth cover types, but perhaps the combination of types of habitat occur at a finer scale than Landsat TM pixels can record.

Conclusions

The results of the resource selection analysis lead us to conclude that the NPR-A earth cover data can be used in conjunction with waterfowl point data to study the distribution of waterfowl across the Arctic Coastal Plain. This conclusion is supported by several factors; 1) the spectacled eider logistic regression model accurately predicts the presence of spectacled eiders in 200, out of 216, cases;2) the earth cover types selected by the waterfowl species studied largely coincided with the findings of previous studies, and; 3) there were definite, non-random differences between the earth cover types selected by different waterfowl species.

The earth cover selection index analysis results suggest that the *Carex aquatilis*, *Arctophila fulva* and Flooded Tundra-Non Pattern earth cover types are used by most of the waterfowl species studied. *Carex aquatilis* is selected for by six of the seven species studied, while *Arctophila fulva* and Flooded Tundra-Non Pattern are selected for by every species except Steller's eider and Canada goose. The Sedge/Grass Meadow class also seems to be of interest mainly to the Steller's eider and the Canada goose. Barren Ground appears to be important only for brant and Canada goose. The Moss/Lichen class was selected by the spectacled eider, brant, Canada goose and white-fronted goose, while Wet Tundra was selected for by every species studied except brant and Steller's eider. All of the waterfowl species studied exhibited some avoidance of Tussock Tundra, Dwarf Shrub, Dunes/Dry Sand and Sparsely Vegetated.

The results of the spectacled eider logistic regression model accuracy assessment indicate that the general distribution pattern of this waterfowl species can be successfully modeled using principally earth cover data. One of the applications of resource selection modeling would be to predict areas of suitable but unused habitat, since the spectacled eider population is thought to be well below the carrying capacity of the landscape. However, other data sets are needed to refine the model output. Clearly, variations in spectacled eider distribution that are independent of earth cover cannot be explained by the current relative probability surface. The distribution of the spectacled eider is certainly affected by other factors, including nest fidelity (Troy 1996), predation, small differences in the timing of the spring thaw over the Arctic Coastal Plain (Larned and Balogh, 1997), or other unknown factors. Further research is needed to determine what factors influence the distribution of the waterfowl species studied and how these factors can be represented in spatial data format.

It is possible that the NPR-A will undergo expanded exploration and development of petroleum and natural gas resources during the next decade. Baseline digital earth cover and wildlife data are critical to the multiple-use management of this vast and remote area. The methods outlined in this paper provide a relatively fast and efficient way to analyze the baseline digital data that has been gathered to date. While the spectacled eider resource selection model cannot be used for micro-analysis such as locating probable nest sites, it can be used to stratify a large area in order to maximize the efficiency of a ground survey. This macro-analysis also puts the more intensive field surveys of wildlife and wetland habitat that

have already been done in the Arctic Coastal Plain into a larger context, and provides a means of generalizing some of the trends that are being observed in the waterfowl populations of the Arctic Coastal Plain.

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APPENDICES

Appendix A

C Program developed to buffer observation points, overlay buffered points with earth cover, and produce tabular ASCII output.

```
/* This program reads a land cover image and a point pattern image with */
/*same extension. The type and number of pixels of the land cover on each point*/
/*within a specific buffer distance  are recorded. Output file contains point ID, */
/*buffer distance, land cover type, and number of pixels belonging to the type. */
/*
/*
/* Author: Jing Huang,  September 27, 1997.          */
/* Ducks Unlimited Inc.          */

#include <stdio.h>
#include <stdlib.h>
#include <string.h>

/* Input data defination    */
#define ImgDataType 1                    /* for 8-bit data structure  */
#define PntDataType 1                    /* for 16-bit data structure   */
/* #define pixelSize 30*/         /* pixel size for the image   */
#define bufferType 10      /* Maximum of 5 different buffering distances  */

/* Array memory allocation   */
#define ARRAY_SIZE 100

/* Boolean defination   */
#define true 1
#define false 0

FILE* gfopen();            /* A grace file open  */
int Statistics();          /* Statistics function  */

int main(int argc, char* argv[])
{
       int i = 0;
       char yesNo;
       int distance[bufferType];
       int val;

       if (argc != 4)
       {
              printf("nprasum                  User Command\n");
              printf("Name\n");
              printf("     nprasum - function to calculate the number of pixels of a
specific\n");
              printf("class type in one image within a buffer distance around \n");
              printf("a point in another overlayed point image\n");
              return true;
       }

       /* check to see if the output file exist to prevent overwriting the file*/
       /* if (gfopen(argv[3], "r") != NULL)
       {
              printf("File %s exists. Do you want to overwrite this file (y/n)?\n");
              yesNo = getc(stdin);
              if (yesNo == 'n' || yesNo == 'N')
                     return true;
       }*/
```

```
	printf("Input your buffer distance in meters. End by typing -1 \n");
	printf("WARNING: Too large buffer size could crash your process. Maximum limit
= 2000 meters\n");

	for(i = 0; i < bufferType; i++)		/* Initialize distance array	*/
		distance[i] = 0;
	i = 0;
	while (i < bufferType)
	{
		printf(">");
		scanf("%d", &val );
		if (val == -1 )
			break;
		else if ( (val > 2000) || (val <= 0) )
		{
			printf("Invalid input for buffer distance, Please input
again.\n");
			continue;
		}
		else
			distance[i++] = val;
	}
	if ( !Statistics(argv[1], argv[2], argv[3], distance))
	{
		printf("Process execution error, abort ...\n");
		return false;
	}
	printf("Process successfully finished. Bye, bye!\n");
	return true;
}


int Statistics(char* ImgInPath, char* PntInPath, char* OutPath, int* buffer)
{
	FILE	*ImgInFile,
		*PntInFile,
		*OutFile;

	long	skipByte,	/* number of bytes to skip for header	*/
		pntID[3];	/* point ID number	*/
	int	imgID[3],		/* Image class type on this point	*/
		pixel[3],		/* a pixel read from the land cover image	*/
		coverType[ARRAY_SIZE], /* Land cover type array inside a moving window
*/
		diversity[ARRAY_SIZE], /* total number of pixels in each cover type in
each window	*/
		*windowPixel,	/* dynamic memory location for all pixel values in a
moving window	*/
		pixelID;	/* ID for each pixel inside a moving window	*/
	int	i = 0, /* Beginning from column number 1	*/
		j = 0,		/* Beginning from row number 1	*/
		RowN,		/* Row Number at the current location */
		ColN,		/* Column number of the current location */
		windowSize,	/* moving window size	*/
		typeID = 0;	/* Land cover type unique ID on a window	*/
	char	str[10];
	int m;
	int n;
	int b;
	int p;
	int cellSize;		/* the cell size of the image	*/
```

```
int    wfulx,              /* Window filter upper left x coordinate */
       wfuly,        /* Window filter upper left y coordinate */
       wflrx,              /* Window filter low right x coordinate */
       wflry;        /* Window filter low right y coordinate */
long   offset;             /* offset for fseek in a file  */


/* Get the number of rows and the number of columns   */
printf("Enter the number of rows for the input images.\n");
scanf("%d", &RowN);
if (RowN <= 0 )
{
       printf("Illegal number of rows, abort...\n");
       return false;
}
printf("Enter the number of columns for the input images.\n");
scanf("%d", &ColN);
if (ColN <= 0 )
{
       printf("Illegal number of columns, abort...\n");
       return false;
}


OutFile = gfopen(OutPath, "w");          /* write ASCII  */
ImgInFile = gfopen(ImgInPath, "rb");           /* Read binary  */
PntInFile = gfopen(PntInPath, "rb");     /* read binary  */


/* Get the header information */
printf("How many bytes of header information to skip ?\n");
scanf("%ld", &skipByte);
/* skipByte = 512L + 1024L*bands + 4096L;    Skip byte calculations  */

/* Skip the header information   */
if(fseek(ImgInFile, skipByte, SEEK_SET))
{
       printf("Incorrect header skip for land cover image, abort!!!\n");
       return false;
}
if(fseek(PntInFile, skipByte, SEEK_SET))
{
       printf("Incorrect header skip for Point Image, abort!!!\n");
       return false;
}
/* Get the cell size  */
printf("Input the cell size:  ");
scanf("%d", &cellSize);

/* Reading the image file  */
while (!(feof(PntInFile)) && !(feof(ImgInFile)))
{
       /* Read two bytes each time for point image  */
       if (fread(&pntID[0], 1, PntDataType, PntInFile) == 0)
       {
              printf("File reading error in land cover file, error #00001,
abort!\n");
              return false;
       }

       if (++j >= ColN )    /* increment column number and check for end of line
*/
```

```
            {
                    j = 0;              /* reset column to 0 if at the end if a line
*/
                    /* Increment current row number. If larger than total row, at the
end of the file, return  */
                    if (++i > RowN )
                    {
                            printf("File reading at the end!\n");
                            fclose(ImgInFile);
                            fclose(PntInFile);
                            fclose(OutFile);
                            return true;
                    }
            }

            if (pntID[0] > 0)           /* a point pixel encountered   */
            {
                    /* get the land cover class type  at this point  */
                    offset = (i * ColN + j) * ImgDataType;
                    if (fseek(ImgInFile, offset, SEEK_SET))
                    {
                            printf("fseek failed for land cover image, error #00002,
abort\n");
                            return false;
                    }
                    if (fread(&imgID[0], 1, ImgDataType, ImgInFile) == 0)
                    {
                            printf("File reading error in land cover file, error
#00003, abort!\n");
                            return false;
                    }

                    /* set the scanning window with different buffereing distance  */
                    for(b = 0; b < bufferType; b++ )  /* for different buffer distance
*/
                    {
                            if (buffer[b] == 0)
                                    break;              /* end of buffer operation   */
                            else if (buffer[b] % cellSize > 5 )      /* round the
buffer distance into number of pixels */
                                    windowSize = buffer[b] / cellSize + 1;
                            else
                                    windowSize = buffer[b] / cellSize;
                            /* Define the square moving window    */
                            wfulx = j - windowSize + 1;
                            wfuly = i - windowSize + 1;
                            wflrx = j + windowSize;
                            wflry = i + windowSize;

                            /* Check to see if the current point is on the edge of the
image, If yes, skip the point, otherwise continue  */
                            if ((wfulx<0) || (wfuly<0) || (wflrx<0) || (wflry<0))
                            {
                                    printf("The %d meters buffer area of the point with
ID %ld is out of the image, one point skipped.\n", buffer[b], pntID[0]);
                                    continue;
                            }

                            /* allocate the memorry for all pixel values in a moving
window to calculate the statistics  */
                            if ((windowPixel = calloc((2*windowSize +
1)*(2*windowSize+1), sizeof(int)))== NULL)
                            {
```

```
                                printf("Memorry allocation failed, abort...\n");
                                return false;
                        }

                        /* initialize the pixel ID inside each circular filter  */
                        pixelID = 0;

                        /* Start to scanning the moving window on land cover image
*/
                        for (m = wfuly; m <= wflry; m++)        /* n is the column
number    */
                        {
                                /* seek the offset fror this line  */
                                if (m == 0)
                                        offset = wfulx;
                                else
                                        offset = (wfulx + (m -1) * ColN) *
ImgDataType;
printf("offset = %d\n", offset);
                                if (fseek(ImgInFile, offset, SEEK_SET))
                                {
                                        printf("fseek failed for land cover image,
error #00004, abort.n");
                                        return false;
                                }
                                for (n = wfuly; n <= wflry; n++ ) /* m is the row
number now   */
                                {

                                        /* find the circular area inside this window
*/
                                        if ( (m-j)*(m-j)+(n-i)*(n-i) <=
windowSize*windowSize )
                                        {
                                                if (fread(pixel[0], 1, ImgDataType,
ImgInFile) == 0)
                                                {
                                                        printf("File reading error in
land cover file, error #00005, abort!\n");
                                                        return false;
                                                }
                                                else
                                                {
                                                        windowPixel[pixelID] = pixel[0];
                                                        for (p=0; p <= pixelID; p++)
                                                        {
                                                                if( pixel[0] ==
windowPixel[p] )
                                                                {

        diversity[typeID]++;
                                                                        coverType[typeID] =
pixel[0];
                                                                }
                                                                else
                                                                {
                                                                        typeID++;  /* new
type found */

        diversity[typeID]++;
                                                                        coverType[typeID] =
pixel[0];
                                                                }
```

```
                                                        }
                                                        pixelID++;
                                                }
                                        }
                                        else
                                                if (fseek(ImgInFile, ImgDataType,
SEEK_CUR) == 0)
                                                {
                                                        printf("fseek failed for land
cover image, eoor #00006, abort!\n");
                                                        return false;

                                }
                                        }
                                }
                                /* Write out the results for this window filter  */
                                for (m=0; m <= pixelID; m++)
                                        fprintf(OutFile, "%5d\t\%5d\t%5d\t%5d\t%8d\n",
pntID[0], imgID[0], buffer[b], coverType[m], diversity[m]);
                                typeID = 0;                     /* Reset typeID for a new window
*/
                        }
                }
        }
        fclose(ImgInFile);
        fclose(PntInFile);
        fclose(OutFile);
        printf("Statistics calculation finished, files are closed.\n");
        return true;
}

/* File open */
FILE *gfopen(char* fn, char* mode)
{
        FILE *fp;
        if ((fp = fopen(fn, mode)) == NULL) {
                fprintf(stderr, "Cannot open %s - bye!\n", fn);
                return false;
        }
        return fp;
}
```

Appendices B-H

Earth Cover Selection Ratios for Spectacled Eider, King Eider, Steller's Eider, Oldsquaw, Brant, Canada Goose, and White-fronted Goose

Figure B1. Spectacled eider earth cover use vs. availability for 200 m. buffer.

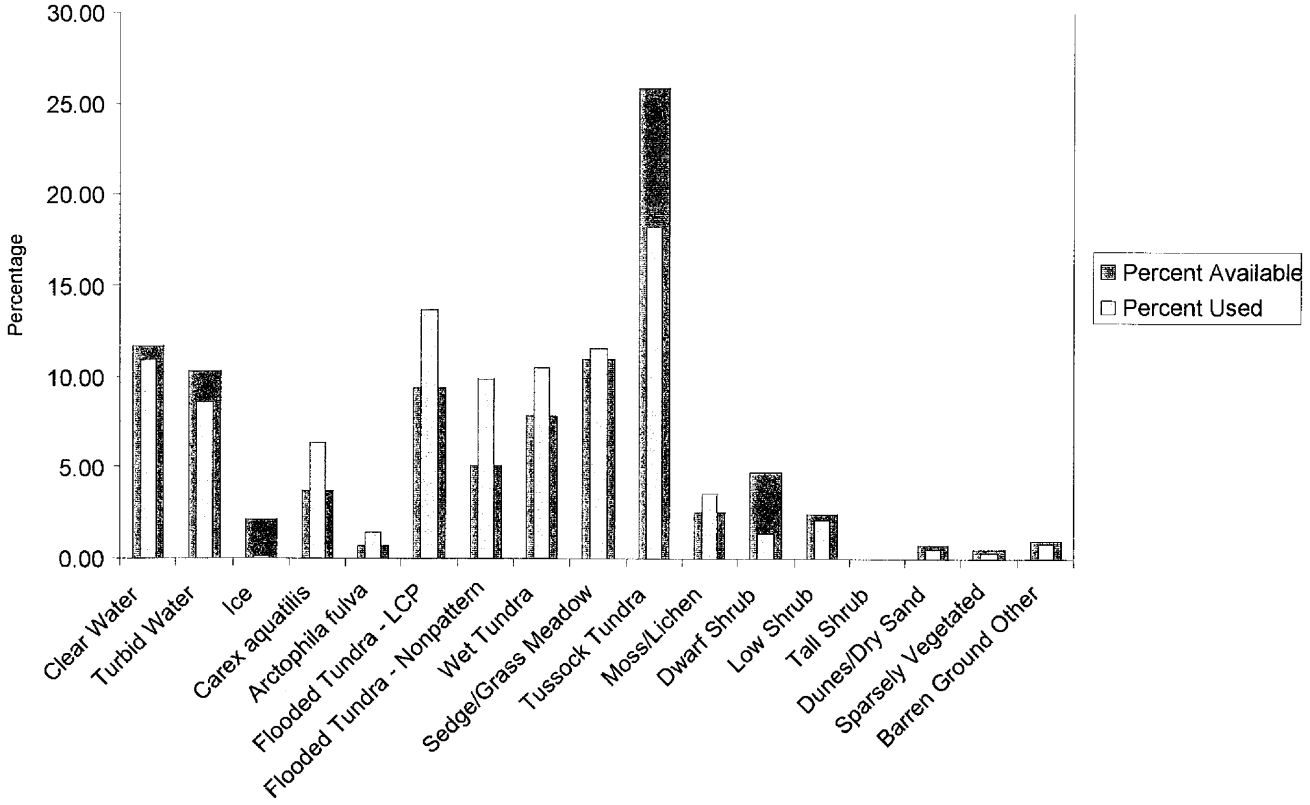

Figure B2. Spectacled eider earth cover selection ratios (n=651).

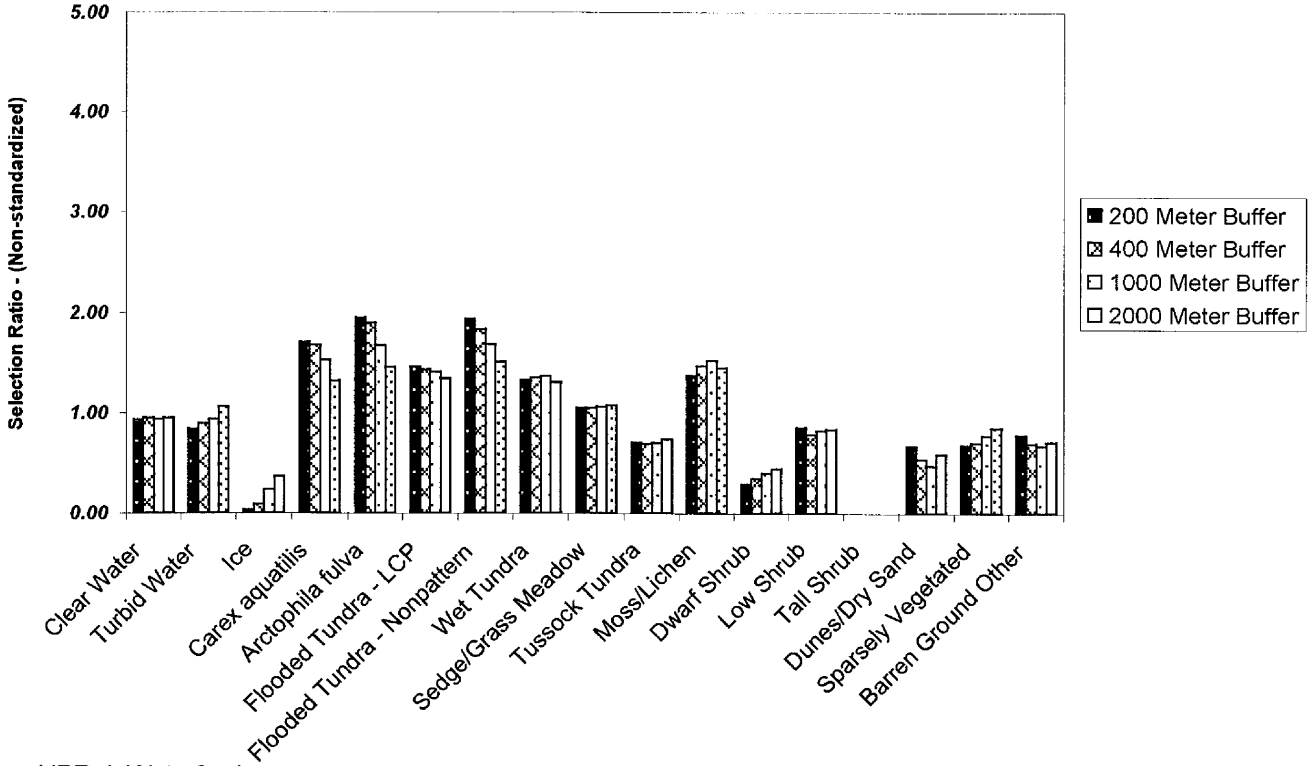

Table B1. Spectacled eider selection/avoidance of earth cover classes indicated by confidence intervals around 200 m buffer selection ratios.

200 Meter Buffer	Percentage of Acres in Buffer	Percentage of Available Acres	Selection Ratio	+/-	Confidence Interval	*
Clear Water	10.91	11.72	0.93	0.151	0.78 ≤ x ≤ 1.08	
Turbid Water	8.65	10.29	0.84	0.123	0.72 ≤ x ≤ 0.96	-
Ice	0.08	2.14	0.04	0.047	-0.01 ≤ x ≤ 0.08	-
Carex aquatilis	6.41	3.77	1.70	0.172	1.53 ≤ x ≤ 1.87	+
Arctophila fulva	1.41	0.72	1.95	0.529	1.42 ≤ x ≤ 2.48	+
Flooded Tundra - LCP	13.68	9.35	1.46	0.116	1.35 ≤ x ≤ 1.58	+
Flooded Tundra - Nonpattern	9.88	5.11	1.93	0.194	1.74 ≤ x ≤ 2.13	+
Wet Tundra	10.45	7.87	1.33	0.103	1.22 ≤ x ≤ 1.43	+
Sedge/Grass Meadow	11.56	11.01	1.05	0.111	0.94 ≤ x ≤ 1.16	
Tussock Tundra	18.26	25.87	0.71	0.063	0.64 ≤ x ≤ 0.77	-
Moss/Lichen	3.54	2.58	1.37	0.225	1.15 ≤ x ≤ 1.60	+
Dwarf Shrub	1.40	4.81	0.29	0.058	0.23 ≤ x ≤ 0.35	-
Low Shrub	2.11	2.49	0.85	0.145	0.71 ≤ x ≤ 0.99	-
Tall Shrub	0.00	0.01	0.00	0.000		
Dunes/Dry Sand	0.51	0.75	0.68	0.409	0.27 ≤ x ≤ 1.09	
Sparsely Vegetated	0.33	0.49	0.68	0.341	0.34 ≤ x ≤ 1.02	
Barren Ground Other	0.82	1.04	0.78	0.412	0.37 ≤ x ≤ 1.20	

* + indicates selection for the earth cover class, - indicates avoidance of the earth cover class

Table B2. Spectacled eider selection/avoidance of earth cover classes indicated by confidence intervals around 400 m buffer selection ratios.

400 Meter Buffer	Percentage of Acres in Buffer	Percentage of Available Acres	Selection Ratio	+/-	Confidence Interval	*
Clear Water	11.13	11.72	0.95	0.126	0.82 ≤ x ≤ 1.08	
Turbid Water	9.18	10.29	0.89	0.106	0.79 ≤ x ≤ 1.00	-
Ice	0.18	2.14	0.09	0.071	0.00 ≤ x ≤ 0.16	-
Carex aquatilis	6.31	3.77	1.68	0.144	1.53 ≤ x ≤ 1.82	+
Arctophila fulva	1.37	0.72	1.90	0.401	1.49 ≤ x ≤ 2.30	+
Flooded Tundra - LCP	13.41	9.35	1.44	0.101	1.33 ≤ x ≤ 1.54	+
Flooded Tundra - Nonpattern	9.36	5.11	1.83	0.155	1.68 ≤ x ≤ 1.99	+
Wet Tundra	10.65	7.87	1.35	0.083	1.27 ≤ x ≤ 1.44	+
Sedge/Grass Meadow	11.58	11.01	1.05	0.093	0.96 ≤ x ≤ 1.14	
Tussock Tundra	17.96	25.87	0.69	0.052	0.64 ≤ x ≤ 0.75	-
Moss/Lichen	3.79	2.58	1.47	0.197	1.27 ≤ x ≤ 1.66	+
Dwarf Shrub	1.67	4.81	0.35	0.049	0.30 ≤ x ≤ 0.40	-
Low Shrub	1.94	2.49	0.78	0.100	0.68 ≤ x ≤ 0.88	-
Tall Shrub	0.00	0.01	0.00	0.000		
Dunes/Dry Sand	0.40	0.75	0.54	0.291	0.00 ≤ x ≤ 0.83	-
Sparsely Vegetated	0.34	0.49	0.71	0.280	0.00 ≤ x ≤ 0.99	-
Barren Ground Other	0.73	1.04	0.70	0.337	0.00 ≤ x ≤ 1.04	

* + indicates selection for the earth cover class, - indicates avoidance of the earth cover class

Table B3. Spectacled eider selection/avoidance of earth cover classes indicated by confidence intervals around 1000 m buffer selection ratios.

1000 Meter Buffer	Percentage of Acres in Buffer	Percentage of Available Acres	Selection Ratio	+/-	Confidence Interval	*
Clear Water	10.93	11.72	0.93	0.085	0.85 ≤ x ≤ 1.02	
Turbid Water	9.66	10.29	0.94	0.088	0.85 ≤ x ≤ 1.03	
Ice	0.50	2.14	0.23	0.122	0.11 ≤ x ≤ 0.35	-
Carex aquatilis	5.75	3.77	1.53	0.104	1.42 ≤ x ≤ 1.63	+
Arctophila fulva	1.21	0.72	1.67	0.210	1.46 ≤ x ≤ 1.88	+
Flooded Tundra - LCP	13.19	9.35	1.41	0.083	1.33 ≤ x ≤ 1.49	+
Flooded Tundra - Nonpattern	8.61	5.11	1.69	0.108	1.58 ≤ x ≤ 1.79	+
Wet Tundra	10.74	7.87	1.37	0.059	1.31 ≤ x ≤ 1.43	+
Sedge/Grass Meadow	11.74	11.01	1.07	0.074	0.99 ≤ x ≤ 1.14	
Tussock Tundra	18.36	25.87	0.71	0.040	0.67 ≤ x ≤ 0.75	-
Moss/Lichen	3.92	2.58	1.52	0.175	1.34 ≤ x ≤ 1.69	+
Dwarf Shrub	1.91	4.81	0.40	0.047	0.35 ≤ x ≤ 0.44	-
Low Shrub	2.05	2.49	0.82	0.083	0.74 ≤ x ≤ 0.91	-
Tall Shrub	0.00	0.01	0.00			
Dunes/Dry Sand	0.36	0.75	0.48	0.193	0.29 ≤ x ≤ 0.67	-
Sparsely Vegetated	0.38	0.49	0.78	0.234	0.54 ≤ x ≤ 1.01	
Barren Ground Other	0.70	1.04	0.67	0.252	0.42 ≤ x ≤ 0.92	-

* + indicates selection for the earth cover class, - indicates avoidance of the earth cover class

Table B4. Spectacled eider selection/avoidance of earth cover classes indicated by confidence intervals around 2000 m buffer selection ratios.

2000 Meter Buffer	Percentage of Acres in Buffer	Percentage of Available Acres	Selection Ratio	+/-	Confidence Interval	*
Clear Water	11.16	11.72	0.95	0.066	0.89 ≤ x ≤ 1.02	
Turbid Water	10.88	10.29	1.06	0.079	0.98 ≤ x ≤ 1.14	
Ice	0.79	2.14	0.37	0.140	0.00 ≤ x ≤ 0.51	-
Carex aquatilis	4.98	3.77	1.32	0.067	1.25 ≤ x ≤ 1.39	+
Arctophila fulva	1.05	0.72	1.46	0.135	0.00 ≤ x ≤ 1.59	
Flooded Tundra - LCP	12.60	9.35	1.35	0.070	1.28 ≤ x ≤ 1.42	+
Flooded Tundra - Nonpattern	7.74	5.11	1.51	0.083	1.43 ≤ x ≤ 1.60	+
Wet Tundra	10.28	7.87	1.31	0.047	1.26 ≤ x ≤ 1.35	+
Sedge/Grass Meadow	11.85	11.01	1.08	0.067	1.01 ≤ x ≤ 1.14	+
Tussock Tundra	19.13	25.87	0.74	0.037	0.70 ≤ x ≤ 0.78	-
Moss/Lichen	3.74	2.58	1.45	0.145	1.30 ≤ x ≤ 1.59	+
Dwarf Shrub	2.13	4.81	0.44	0.050	0.39 ≤ x ≤ 0.49	-
Low Shrub	2.07	2.49	0.83	0.074	0.76 ≤ x ≤ 0.91	-
Tall Shrub	0.00	0.01	0.00			
Dunes/Dry Sand	0.44	0.75	0.59	0.183	0.00 ≤ x ≤ 0.77	-
Sparsely Vegetated	0.42	0.49	0.86	0.200	0.00 ≤ x ≤ 1.06	
Barren Ground Other	0.74	1.04	0.71	0.205	0.00 ≤ x ≤ 0.92	-

* + indicates selection for the earth cover class, - indicates avoidance of the earth cover class

Figure C1. King eider earth cover use vs. availability for 200m buffer.

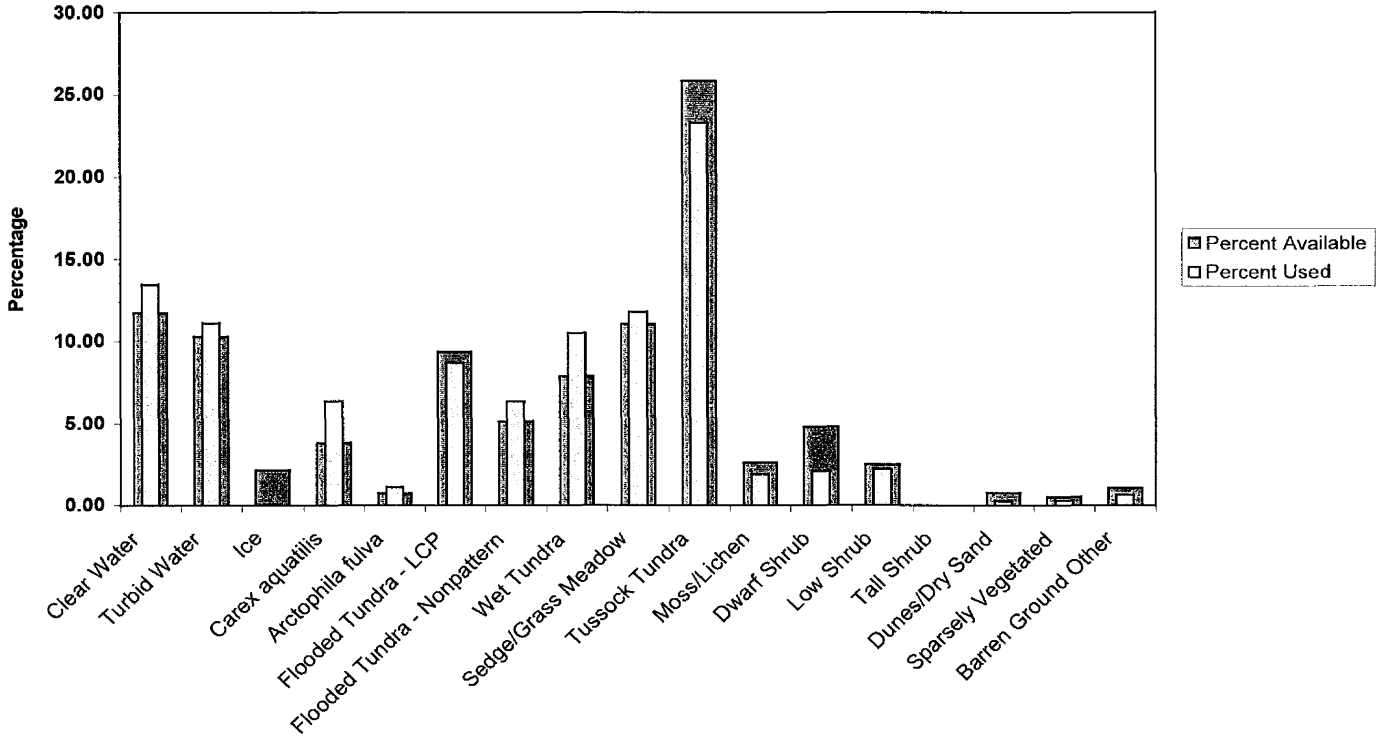

Figure C2. King eider earth cover selection ratios (n= 953)

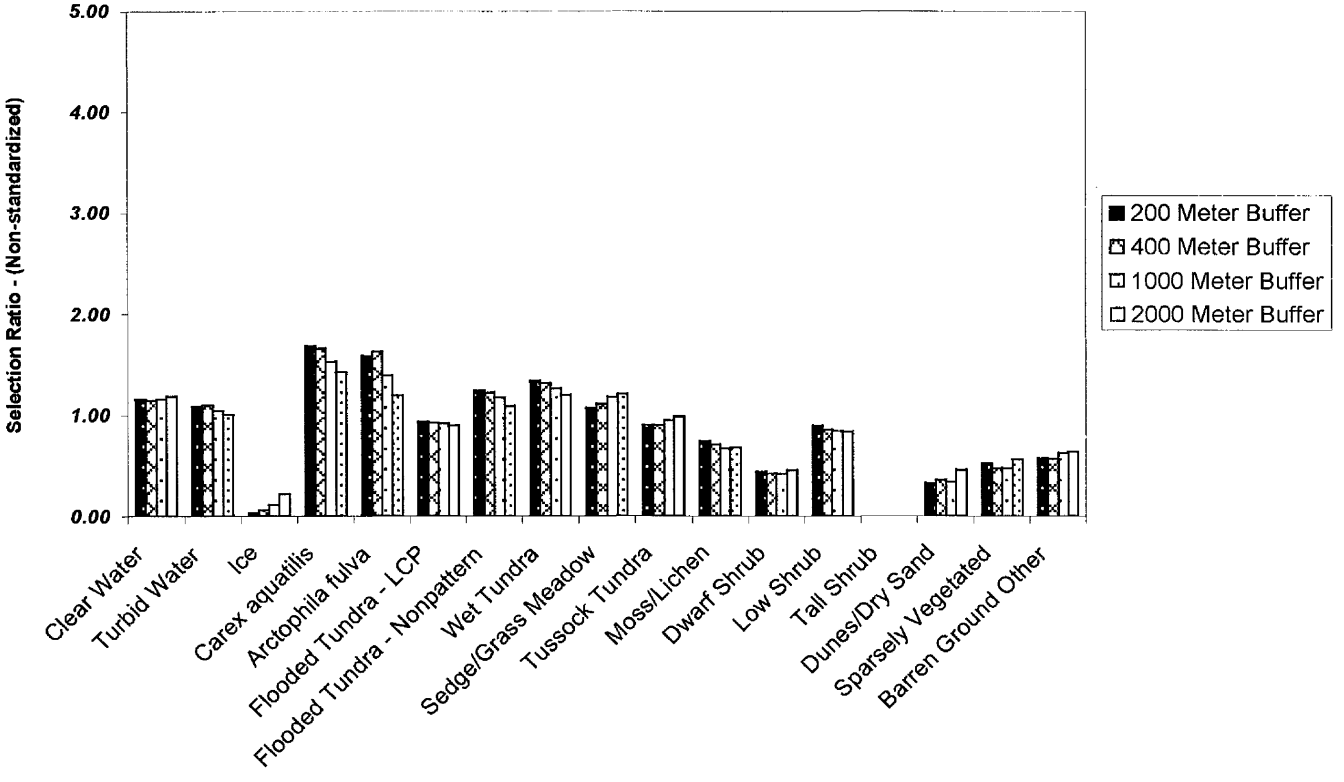

Table C1. King eider selection/avoidance of earth cover classes indicated by confidence intervals around 200 m buffer selection ratios.

200 Meter Buffer	Percentage of Acres in Buffer	Percentage of Available Acres	Selection Ratio	+/-	Confidence Interval	*
Clear Water	13.461	11.717	1.15	0.1423	1.007 ≤ x ≤ 1.291	+
Turbid Water	11.109	10.286	1.08	0.1068	0.973 ≤ x ≤ 1.187	
Ice	0.061	2.141	0.03	0.0287	0.000 ≤ x ≤ 0.057	-
Carex aquatilis	6.323	3.766	1.68	0.1295	1.549 ≤ x ≤ 1.808	+
Arctophila fulva	1.142	0.721	1.58	0.3446	1.239 ≤ x ≤ 1.928	+
Flooded Tundra - LCP	8.679	9.347	0.93	0.0656	0.863 ≤ x ≤ 0.994	-
Flooded Tundra - Nonpattern	6.350	5.108	1.24	0.1114	1.132 ≤ x ≤ 1.355	+
Wet Tundra	10.498	7.867	1.33	0.0827	1.252 ≤ x ≤ 1.417	+
Sedge/Grass Meadow	11.788	11.015	1.07	0.0847	0.985 ≤ x ≤ 1.155	
Tussock Tundra	23.278	25.867	0.90	0.0562	0.844 ≤ x ≤ 0.956	-
Moss/Lichen	1.900	2.583	0.74	0.1224	0.613 ≤ x ≤ 0.858	-
Dwarf Shrub	2.104	4.813	0.44	0.0607	0.377 ≤ x ≤ 0.498	-
Low Shrub	2.211	2.488	0.89	0.1275	0.761 ≤ x ≤ 1.016	
Tall Shrub	0.000	0.005	0.00		≤ x ≤	
Dunes/Dry Sand	0.242	0.748	0.32	0.2732	0.050 ≤ x ≤ 0.596	-
Sparsely Vegetated	0.253	0.486	0.52	0.2021	0.318 ≤ x ≤ 0.723	-
Barren Ground Other	0.601	1.044	0.58	0.1742	0.402 ≤ x ≤ 0.750	-

* + indicates selection for the earth cover class, - indicates avoidance of the earth cover class

Table C2. King eider selection/avoidance of earth cover classes indicated by confidence intervals around 400 m buffer selection ratios.

400 Meter Buffer	Percentage of Acres in Buffer	Percentage of Available Acres	Selection Ratio	+/-	Confidence Interval	*
Clear Water	13.407	11.717	1.14	0.1117	1.033 ≤ x ≤ 1.256	+
Turbid Water	11.292	10.286	1.10	0.0896	1.008 ≤ x ≤ 1.187	+
Ice	0.133	2.141	0.06	0.0505	0.011 ≤ x ≤ 0.113	-
Carex aquatilis	6.228	3.766	1.65	0.1007	1.553 ≤ x ≤ 1.754	+
Arctophila fulva	1.170	0.721	1.62	0.3023	1.321 ≤ x ≤ 1.926	+
Flooded Tundra - LCP	8.605	9.347	0.92	0.0538	0.867 ≤ x ≤ 0.974	-
Flooded Tundra - Nonpattern	6.249	5.108	1.22	0.0901	1.133 ≤ x ≤ 1.314	+
Wet Tundra	10.336	7.867	1.31	0.0654	1.248 ≤ x ≤ 1.379	+
Sedge/Grass Meadow	12.235	11.015	1.11	0.0747	1.036 ≤ x ≤ 1.185	+
Tussock Tundra	23.273	25.867	0.90	0.0462	0.853 ≤ x ≤ 0.946	-
Moss/Lichen	1.823	2.583	0.71	0.0923	0.614 ≤ x ≤ 0.798	-
Dwarf Shrub	2.038	4.813	0.42	0.0456	0.378 ≤ x ≤ 0.469	-
Low Shrub	2.121	2.488	0.85	0.1026	0.750 ≤ x ≤ 0.955	-
Tall Shrub	0.000	0.005	0.00		≤ x ≤	
Dunes/Dry Sand	0.268	0.748	0.36	0.2032	0.156 ≤ x ≤ 0.562	-
Sparsely Vegetated	0.230	0.486	0.47	0.1420	0.331 ≤ x ≤ 0.615	-
Barren Ground Other	0.590	1.044	0.57	0.1499	0.415 ≤ x ≤ 0.715	-

* + indicates selection for the earth cover class, - indicates avoidance of the earth cover class

Table C3. King eider selection/avoidance of earth cover classes indicated by confidence intervals around 1000 m buffer selection ratios.

1000 Meter Buffer	Percentage of Acres in Buffer	Percentage of Available Acres	Selection Ratio	+/-	Confidence Interval	*
Clear Water	13.475	11.717	1.15	0.0766	1.073 ≤ x ≤ 1.227	+
Turbid Water	10.721	10.286	1.04	0.0685	0.974 ≤ x ≤ 1.111	
Ice	0.230	2.141	0.11	0.0708	0.037 ≤ x ≤ 0.178	-
Carex aquatilis	5.765	3.766	1.53	0.0670	1.464 ≤ x ≤ 1.598	+
Arctophila fulva	0.999	0.721	1.39	0.1820	1.203 ≤ x ≤ 1.567	+
Flooded Tundra - LCP	8.558	9.347	0.92	0.0434	0.872 ≤ x ≤ 0.959	-
Flooded Tundra - Nonpattern	6.001	5.108	1.17	0.0659	1.109 ≤ x ≤ 1.241	+
Wet Tundra	9.910	7.867	1.26	0.0468	1.213 ≤ x ≤ 1.306	+
Sedge/Grass Meadow	13.003	11.015	1.18	0.0647	1.116 ≤ x ≤ 1.245	+
Tussock Tundra	24.367	25.867	0.94	0.0345	0.908 ≤ x ≤ 0.976	-
Moss/Lichen	1.725	2.583	0.67	0.0651	0.603 ≤ x ≤ 0.733	-
Dwarf Shrub	2.032	4.813	0.42	0.0404	0.382 ≤ x ≤ 0.463	-
Low Shrub	2.079	2.488	0.84	0.0783	0.757 ≤ x ≤ 0.914	-
Tall Shrub	0.000	0.005	0.00		≤ x ≤	
Dunes/Dry Sand	0.256	0.748	0.34	0.1146	0.228 ≤ x ≤ 0.457	-
Sparsely Vegetated	0.229	0.486	0.47	0.1050	0.366 ≤ x ≤ 0.576	-
Barren Ground Other	0.652	1.044	0.62	0.1231	0.501 ≤ x ≤ 0.748	-

* + indicates selection for the earth cover class, - indicates avoidance of the earth cover class

Table C4. King eider selection/avoidance of earth cover classes indicated by confidence intervals around 2000 m buffer selection ratios.

2000 Meter Buffer	Percentage of Acres in Buffer	Percentage of Available Acres	Selection Ratio	+/-	Confidence Interval	*
Clear Water	13.875	11.717	1.18	0.0588	1.125 ≤ x ≤ 1.243	+
Turbid Water	10.253	10.286	1.00	0.0514	0.945 ≤ x ≤ 1.048	
Ice	0.461	2.141	0.22	0.0952	0.120 ≤ x ≤ 0.310	-
Carex aquatilis	5.341	3.766	1.42	0.0500	1.368 ≤ x ≤ 1.468	+
Arctophila fulva	0.861	0.721	1.19	0.1117	1.082 ≤ x ≤ 1.305	+
Flooded Tundra - LCP	8.383	9.347	0.90	0.0390	0.858 ≤ x ≤ 0.936	-
Flooded Tundra - Nonpattern	5.541	5.108	1.08	0.0494	1.035 ≤ x ≤ 1.134	+
Wet Tundra	9.401	7.867	1.20	0.0355	1.160 ≤ x ≤ 1.230	+
Sedge/Grass Meadow	13.238	11.015	1.20	0.0614	1.140 ≤ x ≤ 1.263	+
Tussock Tundra	25.374	25.867	0.98	0.0301	0.951 ≤ x ≤ 1.011	
Moss/Lichen	1.748	2.583	0.68	0.0591	0.618 ≤ x ≤ 0.736	-
Dwarf Shrub	2.174	4.813	0.45	0.0429	0.409 ≤ x ≤ 0.495	-
Low Shrub	2.069	2.488	0.83	0.0695	0.762 ≤ x ≤ 0.901	-
Tall Shrub	0.000	0.005	0.00		≤ x ≤	
Dunes/Dry Sand	0.345	0.748	0.46	0.0982	0.363 ≤ x ≤ 0.560	-
Sparsely Vegetated	0.274	0.486	0.56	0.0925	0.471 ≤ x ≤ 0.656	-
Barren Ground Other	0.662	1.044	0.63	0.0918	0.542 ≤ x ≤ 0.726	-

* + indicates selection for the earth cover class, - indicates avoidance of the earth cover class

Figure D1. Steller's eider earth cover use vs. availability for 200m buffer.

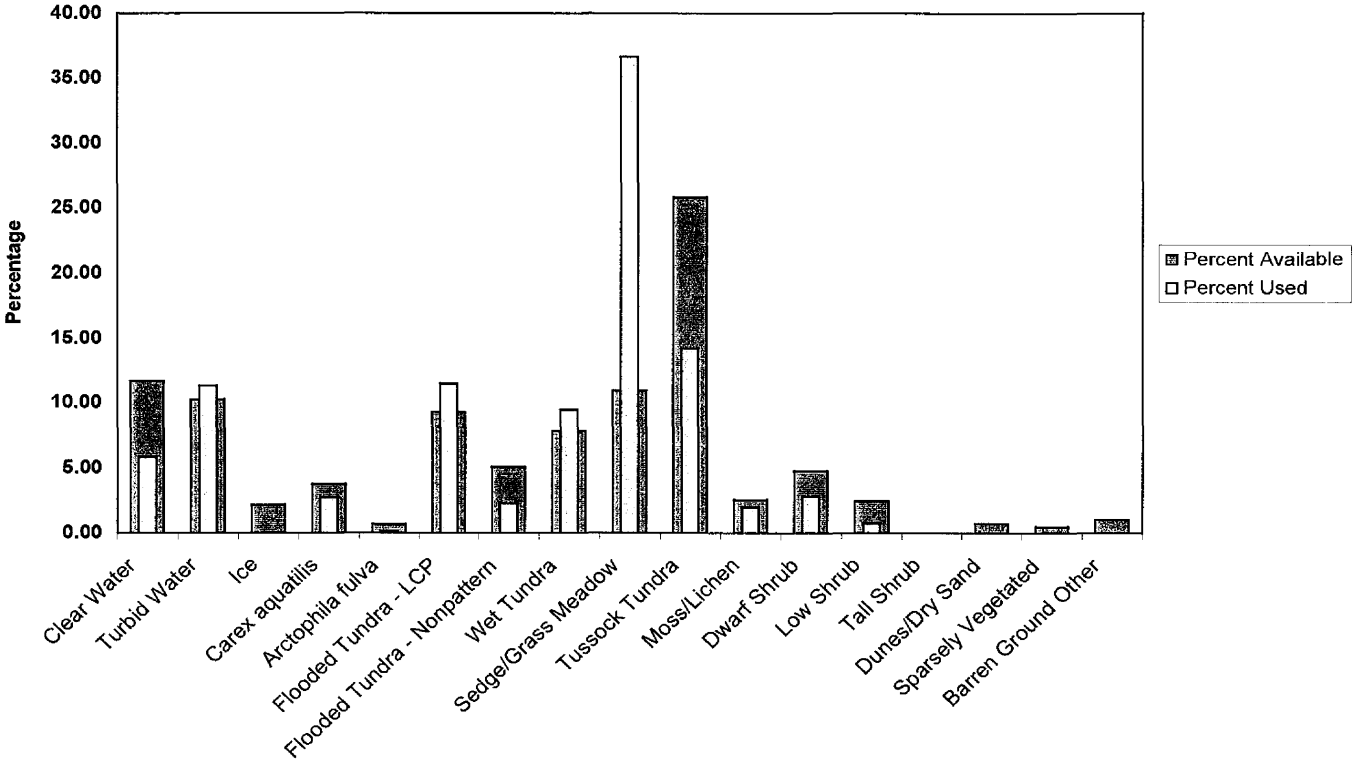

Figure D2. Steller's eider earth cover selection ratios (n= 17).

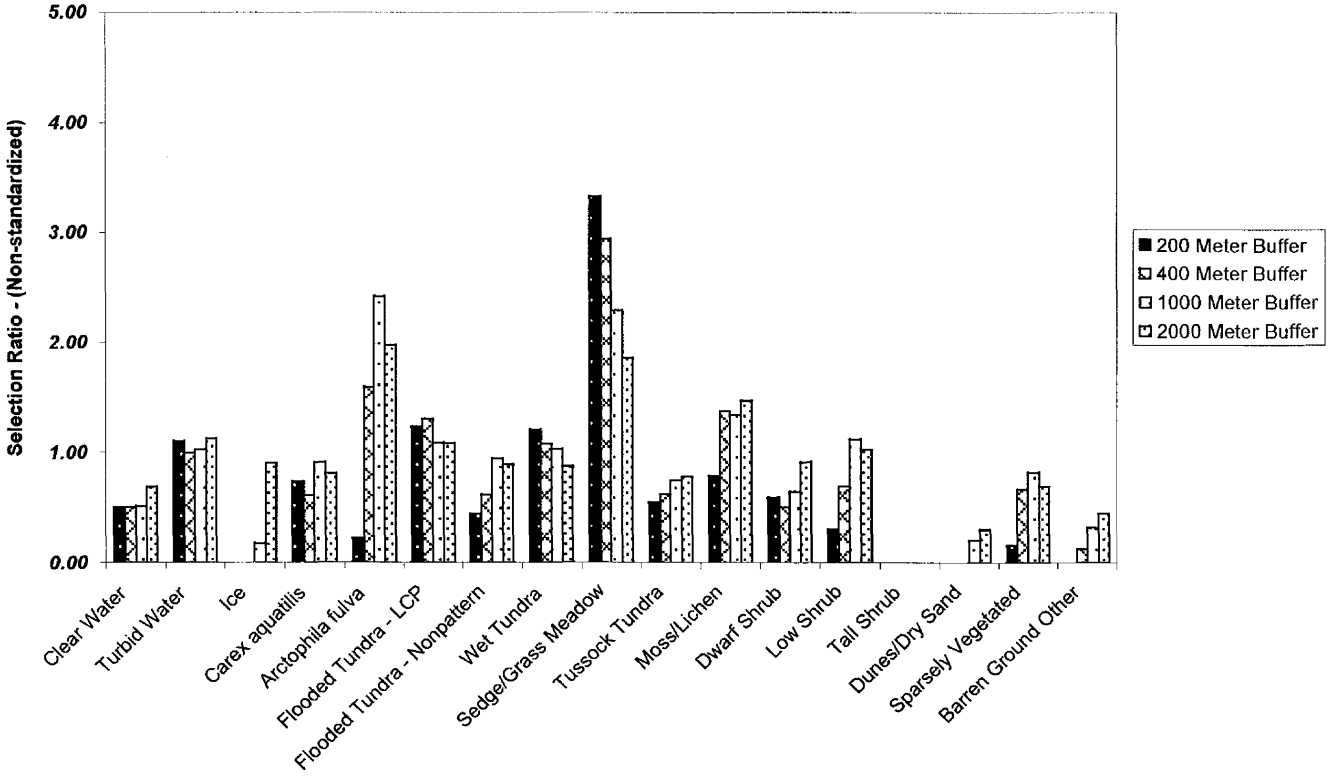

Table D1. Steller's eider selection/avoidance of earth cover classes indicated by confidence intervals around 200 m buffer selection ratios.

200 Meter Buffer	Percentage of Acres in Buffer	Percentage of Available Acres	Selection Ratio	+/-	Confidence Interval	*
Clear Water	5.88	11.72	0.50	0.616	0.00 ≤ x ≤ 1.12	
Turbid Water	11.33	10.29	1.10	1.249	0.00 ≤ x ≤ 2.35	
Ice	0.00	2.14	0.00			
Carex aquatilis	2.76	3.77	0.73	0.994	0.00 ≤ x ≤ 1.73	
Arctophila fulva	0.16	0.72	0.22	0.249	0.00 ≤ x ≤ 0.47	-
Flooded Tundra - LCP	11.53	9.35	1.23	0.677	0.56 ≤ x ≤ 1.91	
Flooded Tundra - Nonpattern	2.25	5.11	0.44	0.386	0.05 ≤ x ≤ 0.83	-
Wet Tundra	9.47	7.87	1.20	0.838	0.37 ≤ x ≤ 2.04	
Sedge/Grass Meadow	36.64	11.01	3.33	1.481	1.84 ≤ x ≤ 4.81	+
Tussock Tundra	14.25	25.87	0.55	0.295	0.26 ≤ x ≤ 0.85	-
Moss/Lichen	2.05	2.58	0.79	0.836	0.00 ≤ x ≤ 1.63	
Dwarf Shrub	2.84	4.81	0.59	0.616	0.00 ≤ x ≤ 1.21	
Low Shrub	0.75	2.49	0.30	0.469	0.00 ≤ x ≤ 0.77	-
Tall Shrub	0.00	0.01	0.00			
Dunes/Dry Sand	0.00	0.75	0.00			
Sparsely Vegetated	0.08	0.49	0.16	0.319	0.00 ≤ x ≤ 0.48	-
Barren Ground Other	0.00	1.04	0.00			

* + indicates selection for the earth cover class, - indicates avoidance of theearthcover class

Table D2. Steller's eider selection/avoidance of earth cover classes indicated by confidence intervals around 400 m buffer selection ratios.

400 Meter Buffer	Percentage of Acres in Buffer	Percentage of Available Acres	Selection Ratio	+/-	Confidence Interval	*
Clear Water	5.83	11.72	0.50	0.604	0.00 ≤ x ≤ 1.10	
Turbid Water	10.21	10.29	0.99	1.170	0.00 ≤ x ≤ 2.16	
Ice	0.00	2.14	0.00			
Carex aquatilis	2.30	3.77	0.61	0.541	0.07 ≤ x ≤ 1.15	
Arctophila fulva	1.15	0.72	1.60	0.783	0.81 ≤ x ≤ 2.38	
Flooded Tundra - LCP	12.23	9.35	1.31	0.626	0.68 ≤ x ≤ 1.93	
Flooded Tundra - Nonpattern	3.16	5.11	0.62	0.249	0.37 ≤ x ≤ 0.87	-
Wet Tundra	8.48	7.87	1.08	0.585	0.49 ≤ x ≤ 1.66	
Sedge/Grass Meadow	32.39	11.01	2.94	1.280	1.66 ≤ x ≤ 4.22	+
Tussock Tundra	16.06	25.87	0.62	0.247	0.37 ≤ x ≤ 0.87	-
Moss/Lichen	3.56	2.58	1.38	0.860	0.52 ≤ x ≤ 2.24	
Dwarf Shrub	2.44	4.81	0.51	0.412	0.09 ≤ x ≤ 0.92	-
Low Shrub	1.73	2.49	0.69	0.767	0.00 ≤ x ≤ 1.46	
Tall Shrub	0.00	0.01	0.00		0.00	
Dunes/Dry Sand	0.00	0.75	0.00		0.00	
Sparsely Vegetated	0.33	0.49	0.67	1.276	0.00 ≤ x ≤ 1.95	
Barren Ground Other	0.13	1.04	0.13	0.169	0.00 ≤ x ≤ 0.30	-

* + indicates selection for the earth cover class, - indicates avoidance of the earth cover class

Table D3. Steller's eider selection/avoidance of earth cover classes indicated by confidence intervals around 1000 m buffer selection ratios.

1000 Meter Buffer	Percentage of Acres in Buffer	Percentage of Available Acres	Selection Ratio	+/-	Confidence Interval	*
Clear Water	6.00	11.72	0.51	0.382	0.13 ≤ x ≤ 0.89	-
Turbid Water	10.51	10.29	1.02	0.901	0.12 ≤ x ≤ 1.92	
Ice	0.37	2.14	0.17	0.241	0.00 ≤ x ≤ 0.41	-
Carex aquatilis	3.43	3.77	0.91	0.476	0.43 ≤ x ≤ 1.39	
Arctophila fulva	1.74	0.72	2.42	0.808	1.61 ≤ x ≤ 3.22	+
Flooded Tundra - LCP	10.19	9.35	1.09	0.376	0.71 ≤ x ≤ 1.47	
Flooded Tundra - Nonpattern	4.81	5.11	0.94	0.264	0.68 ≤ x ≤ 1.21	
Wet Tundra	8.11	7.87	1.03	0.376	0.65 ≤ x ≤ 1.41	
Sedge/Grass Meadow	25.24	11.01	2.29	0.879	1.41 ≤ x ≤ 3.17	+
Tussock Tundra	19.35	25.87	0.75	0.252	0.50 ≤ x ≤ 1.00	-
Moss/Lichen	3.46	2.58	1.34	0.810	0.53 ≤ x ≤ 2.15	
Dwarf Shrub	3.11	4.81	0.65	0.538	0.11 ≤ x ≤ 1.18	
Low Shrub	2.79	2.49	1.12	0.771	0.35 ≤ x ≤ 1.89	
Tall Shrub	0.00	0.01	0.00			
Dunes/Dry Sand	0.15	0.75	0.20	0.306	0.00 ≤ x ≤ 0.51	-
Sparsely Vegetated	0.40	0.49	0.82	0.843	0.00 ≤ x ≤ 1.66	
Barren Ground Other	0.34	1.04	0.32	0.302	0.02 ≤ x ≤ 0.62	-

* + indicates selection for the earth cover class, - indicates avoidance of the earthcover class

Table D4. Steller's eider selection/avoidance of earth cover classes indicated by confidence intervals around 2000 m buffer selection ratios.

2000 Meter Buffer	Percentage of Acres in Buffer	Percentage of Available Acres	Selection Ratio	+/-	Confidence Interval	*
Clear Water	8.00	11.72	0.68	0.373	0.31 ≤ x ≤ 1.06	
Turbid Water	11.58	10.29	1.13	0.717	0.41 ≤ x ≤ 1.84	
Ice	1.94	2.14	0.91	0.871	0.03 ≤ x ≤ 1.78	
Carex aquatilis	3.05	3.77	0.81	0.293	0.52 ≤ x ≤ 1.10	
Arctophila fulva	1.43	0.72	1.98	0.607	1.37 ≤ x ≤ 2.58	+
Flooded Tundra - LCP	10.12	9.35	1.08	0.360	0.72 ≤ x ≤ 1.44	
Flooded Tundra - Nonpattern	4.56	5.11	0.89	0.188	0.71 ≤ x ≤ 1.08	
Wet Tundra	6.90	7.87	0.88	0.261	0.62 ≤ x ≤ 1.14	
Sedge/Grass Meadow	20.50	11.01	1.86	0.651	1.21 ≤ x ≤ 2.51	+
Tussock Tundra	20.12	25.87	0.78	0.284	0.49 ≤ x ≤ 1.06	
Moss/Lichen	3.81	2.58	1.48	0.869	0.61 ≤ x ≤ 2.34	
Dwarf Shrub	4.41	4.81	0.92	0.652	0.26 ≤ x ≤ 1.57	
Low Shrub	2.55	2.49	1.02	0.697	0.33 ≤ x ≤ 1.72	
Tall Shrub	0.00	0.01	0.00			
Dunes/Dry Sand	0.22	0.75	0.30	0.411	-0.11 ≤ x ≤ 0.71	-
Sparsely Vegetated	0.34	0.49	0.69	0.651	0.04 ≤ x ≤ 1.34	
Barren Ground Other	0.47	1.04	0.45	0.272	0.18 ≤ x ≤ 0.72	-

* + indicates selection for the earth cover class, - indicates avoidance of theearthcover class

Figure E1. Oldsquaw earth cover use vs. availability for 200m buffer.

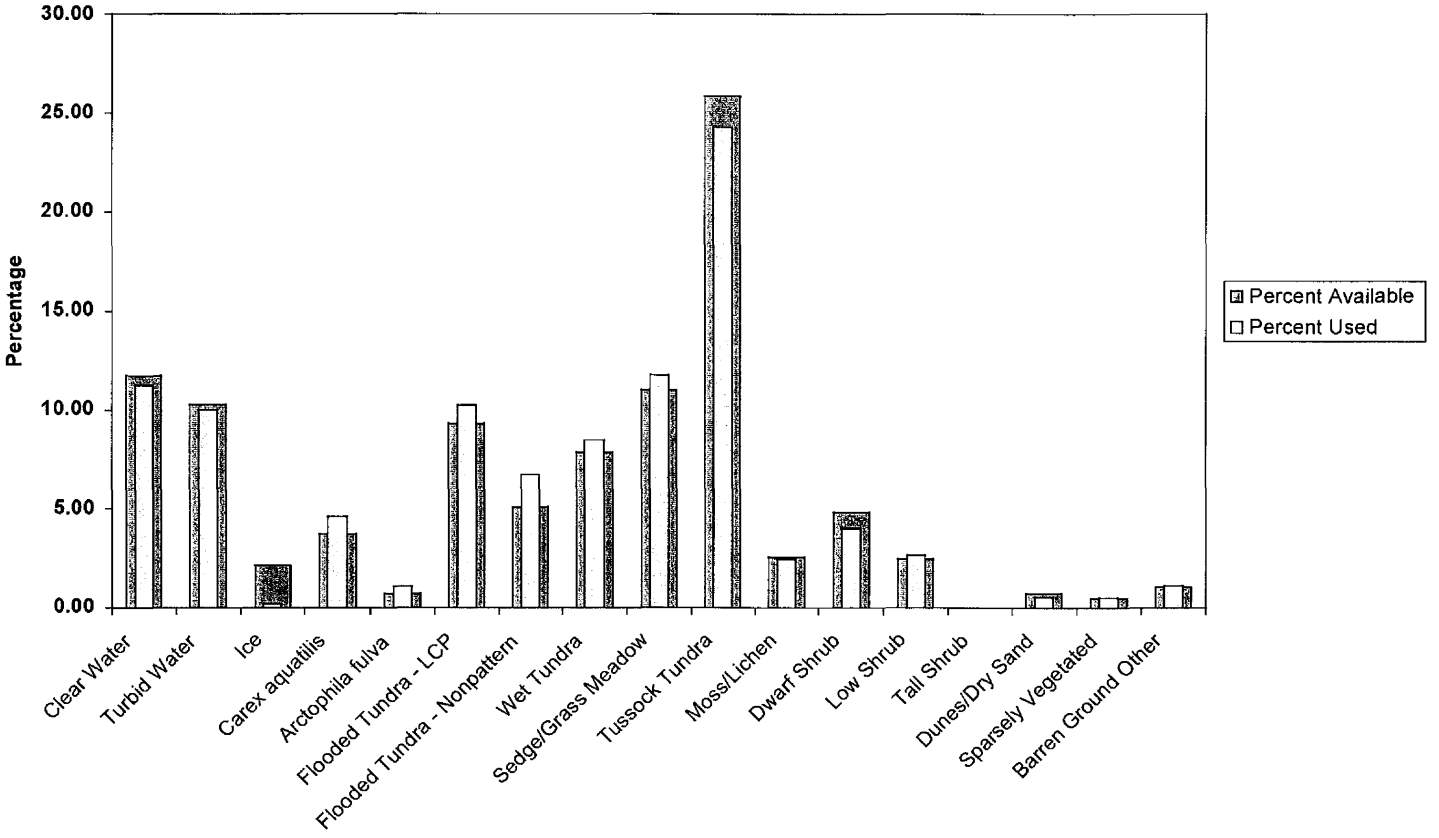

Figure E2. Oldsquaw earth cover selection ratios (n = 3812).

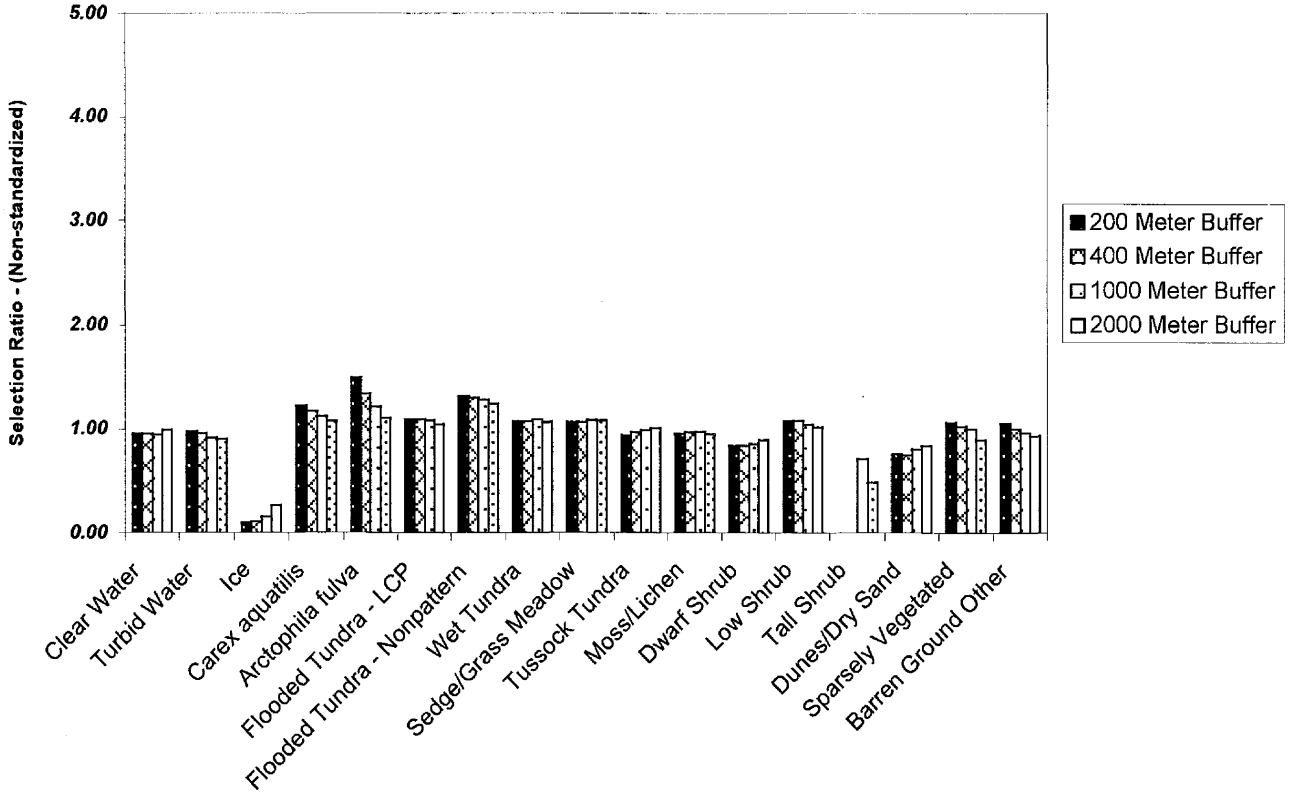

Table E1. Oldsquaw selection/avoidance of earth cover classes indicated by confidence intervals around 200 m buffer selection ratios.

200 Meter Buffer	Percentage of Acres in Buffer	Percentage of Study Area Acres	Selection Ratio	+/-	Confidence Interval	*
Clear Water	11.24	11.72	0.96	0.062	0.90 ≤ x ≤ 1.02	
Turbid Water	10.02	10.29	0.97	0.056	0.92 ≤ x ≤ 1.03	
Ice	0.20	2.14	0.09	0.051	0.04 ≤ x ≤ 0.15	-
Carex aquatilis	4.62	3.77	1.23	0.056	1.17 ≤ x ≤ 1.28	+
Arctophila fulva	1.08	0.72	1.49	0.142	1.35 ≤ x ≤ 1.64	+
Flooded Tundra - LCP	10.25	9.35	1.10	0.042	1.05 ≤ x ≤ 1.14	+
Flooded Tundra - Nonpattern	6.74	5.11	1.32	0.060	1.26 ≤ x ≤ 1.38	+
Wet Tundra	8.49	7.87	1.08	0.039	1.04 ≤ x ≤ 1.12	+
Sedge/Grass Meadow	11.75	11.01	1.07	0.044	1.02 ≤ x ≤ 1.11	+
Tussock Tundra	24.25	25.87	0.94	0.030	0.91 ≤ x ≤ 0.97	-
Moss/Lichen	2.48	2.58	0.96	0.076	0.88 ≤ x ≤ 1.04	
Dwarf Shrub	4.03	4.81	0.84	0.054	0.78 ≤ x ≤ 0.89	-
Low Shrub	2.67	2.49	1.07	0.072	1.00 ≤ x ≤ 1.14	
Tall Shrub	0.00	0.01	0.00			
Dunes/Dry Sand	0.57	0.75	0.76	0.185	0.58 ≤ x ≤ 0.95	-
Sparsely Vegetated	0.52	0.49	1.06	0.192	0.87 ≤ x ≤ 1.26	
Barren Ground Other	1.11	1.04	1.06	0.166	0.90 ≤ x ≤ 1.23	

* + indicates selection for the earth cover class, - indicates avoidance of the earth cover class

Table E2. Oldsquaw selection/avoidance of earth cover classes indicated by confidence intervals around 400 m buffer selection ratios.

400 Meter Buffer	Percentage of Acres in Buffer	Percentage of Study Area Acres	Selection Ratio	+/-	Confidence Interval	*
Clear Water	11.11	11.72	0.95	0.050	0.90 ≤ x ≤ 1.00	-
Turbid Water	9.84	10.29	0.96	0.046	0.91 ≤ x ≤ 1.00	
Ice	0.23	2.14	0.11	0.052	0.06 ≤ x ≤ 0.16	-
Carex aquatilis	4.39	3.77	1.17	0.041	1.12 ≤ x ≤ 1.21	+
Arctophila fulva	0.97	0.72	1.34	0.095	1.25 ≤ x ≤ 1.44	+
Flooded Tundra - LCP	10.20	9.35	1.09	0.036	1.06 ≤ x ≤ 1.13	+
Flooded Tundra - Nonpattern	6.64	5.11	1.30	0.048	1.25 ≤ x ≤ 1.35	+
Wet Tundra	8.47	7.87	1.08	0.031	1.05 ≤ x ≤ 1.11	+
Sedge/Grass Meadow	11.79	11.01	1.07	0.037	1.03 ≤ x ≤ 1.11	+
Tussock Tundra	24.99	25.87	0.97	0.025	0.94 ≤ x ≤ 0.99	-
Moss/Lichen	2.51	2.58	0.97	0.065	0.91 ≤ x ≤ 1.04	
Dwarf Shrub	4.06	4.81	0.84	0.049	0.79 ≤ x ≤ 0.89	-
Low Shrub	2.70	2.49	1.08	0.060	1.02 ≤ x ≤ 1.14	+
Tall Shrub	0.00	0.01	0.00			
Dunes/Dry Sand	0.56	0.75	0.75	0.148	0.61 ≤ x ≤ 0.90	-
Sparsely Vegetated	0.50	0.49	1.02	0.147	0.87 ≤ x ≤ 1.17	
Barren Ground Other	1.04	1.04	1.00	0.129	0.87 ≤ x ≤ 1.13	

* + indicates selection for the earth cover class, - indicates avoidance of the earth cover class

Table E3. Oldsquaw selection/avoidance of earth cover classes indicated by confidence intervals around 1000 m buffer selection ratios.

1000 Meter Buffer	Percentage of Acres in Buffer	Percentage of Study Area Acres	Selection Ratio	+/-	Confidence Interval	*
Clear Water	11.06	11.72	0.94	0.035	0.91 ≤ x ≤ 0.98	-
Turbid Water	9.40	10.29	0.91	0.035	0.88 ≤ x ≤ 0.95	-
Ice	0.35	2.14	0.16	0.051	0.11 ≤ x ≤ 0.21	-
Carex aquatilis	4.24	3.77	1.12	0.029	1.10 ≤ x ≤ 1.15	+
Arctophila fulva	0.88	0.72	1.21	0.065	1.15 ≤ x ≤ 1.28	+
Flooded Tundra - LCP	10.10	9.35	1.08	0.030	1.05 ≤ x ≤ 1.11	+
Flooded Tundra - Nonpattern	6.55	5.11	1.28	0.037	1.24 ≤ x ≤ 1.32	+
Wet Tundra	8.62	7.87	1.10	0.024	1.07 ≤ x ≤ 1.12	+
Sedge/Grass Meadow	11.95	11.01	1.08	0.031	1.05 ≤ x ≤ 1.12	+
Tussock Tundra	25.51	25.87	0.99	0.021	0.97 ≤ x ≤ 1.01	
Moss/Lichen	2.52	2.58	0.98	0.056	0.92 ≤ x ≤ 1.03	
Dwarf Shrub	4.14	4.81	0.86	0.046	0.82 ≤ x ≤ 0.91	-
Low Shrub	2.59	2.49	1.04	0.047	0.99 ≤ x ≤ 1.09	
Tall Shrub	0.00	0.01	0.71			
Dunes/Dry Sand	0.60	0.75	0.80	0.108	0.70 ≤ x ≤ 0.91	-
Sparsely Vegetated	0.49	0.49	1.00	0.108	0.89 ≤ x ≤ 1.11	
Barren Ground Other	1.01	1.04	0.96	0.105	0.86 ≤ x ≤ 1.07	

* + indicates selection for the earth cover class, - indicates avoidance of the earth cover class

Table E4. Oldsquaw selection/avoidance of earth cover classes indicated by confidence intervals around 2000 m buffer selection ratios.

2000 Meter Buffer	Percentage of Acres in Buffer	Percentage of Study Area Acres	Selection Ratio	+/-	Confidence Interval	*
Clear Water	11.60	11.72	0.99	0.028	0.96 ≤ x ≤ 1.02	
Turbid Water	9.29	10.29	0.90	0.029	0.87 ≤ x ≤ 0.93	-
Ice	0.57	2.14	0.27	0.048	0.22 ≤ x ≤ 0.31	-
Carex aquatilis	4.06	3.77	1.08	0.023	1.06 ≤ x ≤ 1.10	+
Arctophila fulva	0.80	0.72	1.11	0.043	1.06 ≤ x ≤ 1.15	+
Flooded Tundra - LCP	9.77	9.35	1.05	0.027	1.02 ≤ x ≤ 1.07	+
Flooded Tundra - Nonpattern	6.33	5.11	1.24	0.031	1.21 ≤ x ≤ 1.27	+
Wet Tundra	8.39	7.87	1.07	0.019	1.05 ≤ x ≤ 1.09	+
Sedge/Grass Meadow	11.92	11.01	1.08	0.028	1.05 ≤ x ≤ 1.11	+
Tussock Tundra	25.94	25.87	1.00	0.019	0.98 ≤ x ≤ 1.02	
Moss/Lichen	2.46	2.58	0.95	0.050	0.90 ≤ x ≤ 1.00	
Dwarf Shrub	4.32	4.81	0.90	0.046	0.85 ≤ x ≤ 0.94	-
Low Shrub	2.53	2.49	1.02	0.041	0.98 ≤ x ≤ 1.06	
Tall Shrub	0.00	0.01	0.49			
Dunes/Dry Sand	0.63	0.75	0.84	0.091	0.75 ≤ x ≤ 0.93	-
Sparsely Vegetated	0.43	0.49	0.89	0.078	0.81 ≤ x ≤ 0.97	-
Barren Ground Other	0.97	1.04	0.93	0.088	0.84 ≤ x ≤ 1.02	

* + indicates selection for the earth cover class, - indicates avoidance of the earth cover class

Figure F1. Brant earth cover use vs. availability for 200m buffer.

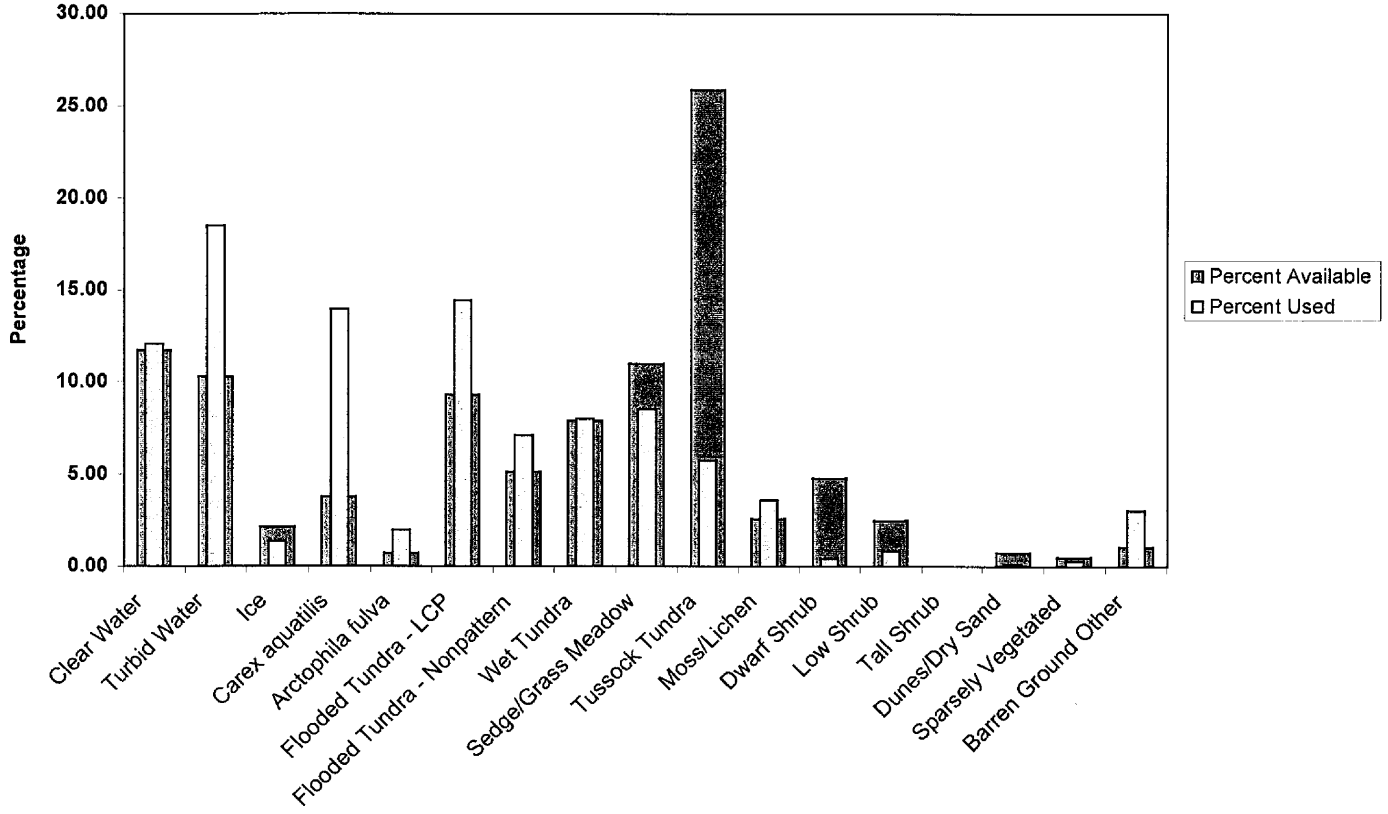

Figure F2. Brant earth cover selection ratios (n = 257)

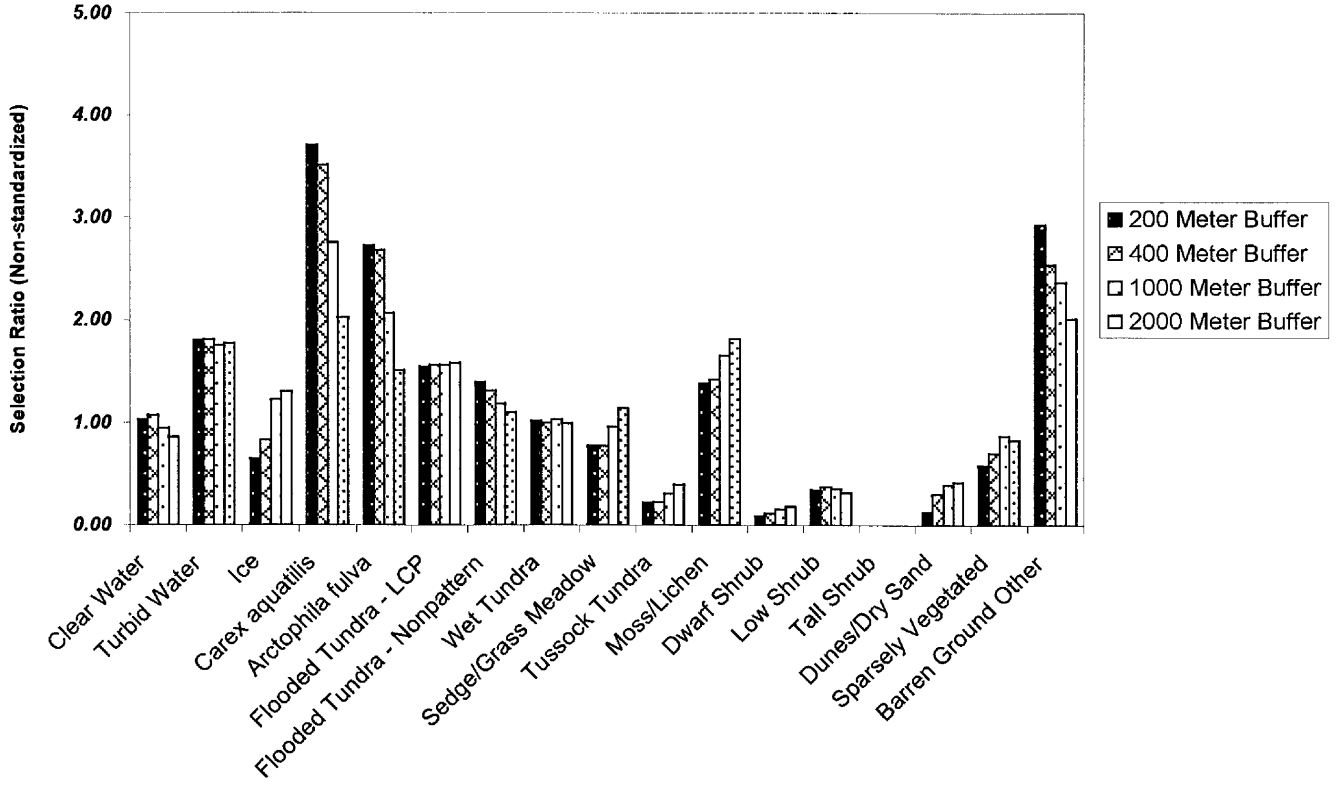

Table F1. Brant selection/avoidance of earth cover classes indicated by confidence intervals around 200 m buffer selection ratios.

200 Meter Buffer	Percentage of Acres in Buffer	Percentage of Available Acres	Selection Ratio	+/-	Confidence Interval	*
Clear Water	12.07	11.72	1.03	0.246	0.78 ≤ x ≤ 1.28	
Turbid Water	18.51	10.29	1.80	0.282	1.52 ≤ x ≤ 2.08	+
Ice	1.38	2.14	0.64	0.609	0.04 ≤ x ≤ 1.25	
Carex aquatilis	13.98	3.77	3.71	0.596	3.12 ≤ x ≤ 4.31	+
Arctophila fulva	1.96	0.72	2.72	0.634	2.09 ≤ x ≤ 3.36	+
Flooded Tundra - LCP	14.42	9.35	1.54	0.198	1.35 ≤ x ≤ 1.74	+
Flooded Tundra - Nonpattern	7.10	5.11	1.39	0.193	1.20 ≤ x ≤ 1.58	+
Wet Tundra	7.99	7.87	1.02	0.152	0.86 ≤ x ≤ 1.17	
Sedge/Grass Meadow	8.53	11.01	0.77	0.174	0.60 ≤ x ≤ 0.95	-
Tussock Tundra	5.74	25.87	0.22	0.055	0.17 ≤ x ≤ 0.28	-
Moss/Lichen	3.58	2.58	1.39	0.378	1.01 ≤ x ≤ 1.77	+
Dwarf Shrub	0.42	4.81	0.09	0.033	0.06 ≤ x ≤ 0.12	-
Low Shrub	0.86	2.49	0.34	0.163	0.18 ≤ x ≤ 0.51	-
Tall Shrub	0.00	0.01	0.00		≤ x ≤	
Dunes/Dry Sand	0.10	0.75	0.13	0.171	0.00 ≤ x ≤ 0.30	-
Sparsely Vegetated	0.28	0.49	0.59	0.704	0.00 ≤ x ≤ 1.29	
Barren Ground Other	3.06	1.04	2.93	1.404	1.53 ≤ x ≤ 4.34	+

* + indicates selection for the earth cover class, - indicates avoidance of the earth cover class

Table F2. Brant selection/avoidance of earth cover classes indicated by confidence intervals around 400 m buffer selection ratios.

400 Meter Buffer	Percentage of Acres in Buffer	Percentage of Available Acres	Selection Ratio	+/-	Confidence Interval	*
Clear Water	12.57	11.72	1.07	0.214	0.86 ≤ x ≤ 1.29	
Turbid Water	18.60	10.29	1.81	0.250	1.56 ≤ x ≤ 2.06	+
Ice	1.78	2.14	0.83	0.590	0.24 ≤ x ≤ 1.42	
Carex aquatilis	13.23	3.77	3.51	0.498	3.02 ≤ x ≤ 4.01	+
Arctophila fulva	1.94	0.72	2.68	0.545	2.14 ≤ x ≤ 3.23	+
Flooded Tundra - LCP	14.60	9.35	1.56	0.168	1.39 ≤ x ≤ 1.73	+
Flooded Tundra - Nonpattern	6.67	5.11	1.31	0.143	1.16 ≤ x ≤ 1.45	+
Wet Tundra	7.87	7.87	1.00	0.112	0.89 ≤ x ≤ 1.11	
Sedge/Grass Meadow	8.52	11.01	0.77	0.143	0.63 ≤ x ≤ 0.92	-
Tussock Tundra	5.86	25.87	0.23	0.043	0.18 ≤ x ≤ 0.27	-
Moss/Lichen	3.68	2.58	1.42	0.303	1.12 ≤ x ≤ 1.73	+
Dwarf Shrub	0.56	4.81	0.12	0.044	0.07 ≤ x ≤ 0.16	-
Low Shrub	0.91	2.49	0.37	0.126	0.24 ≤ x ≤ 0.49	-
Tall Shrub	0.00	0.01	0.00		≤ x ≤	
Dunes/Dry Sand	0.23	0.75	0.30	0.222	0.08 ≤ x ≤ 0.53	-
Sparsely Vegetated	0.34	0.49	0.70	0.555	0.14 ≤ x ≤ 1.25	
Barren Ground Other	2.66	1.04	2.54	1.142	1.40 ≤ x ≤ 3.69	+

* + indicates selection for the earth cover class, - indicates avoidance of the earth cover class

Table F3. Brant selection/avoidance of earth cover classes indicated by confidence intervals around 1000 m buffer selection ratios.

1000 Meter Buffer	Percentage of Acres in Buffer	Percentage of Available Acres	Selection Ratio	+/-	Confidence Interval	*
Clear Water	11.11	11.72	0.95	0.158	0.79 ≤ x ≤ 1.11	
Turbid Water	18.05	10.29	1.75	0.219	1.54 ≤ x ≤ 1.97	+
Ice	2.62	2.14	1.22	0.432	0.79 ≤ x ≤ 1.66	
Carex aquatilis	10.38	3.77	2.76	0.344	2.41 ≤ x ≤ 3.10	+
Arctophila fulva	1.49	0.72	2.07	0.317	1.75 ≤ x ≤ 2.38	+
Flooded Tundra - LCP	14.60	9.35	1.56	0.135	1.43 ≤ x ≤ 1.70	+
Flooded Tundra - Nonpattern	6.05	5.11	1.18	0.107	1.08 ≤ x ≤ 1.29	+
Wet Tundra	8.10	7.87	1.03	0.085	0.94 ≤ x ≤ 1.11	
Sedge/Grass Meadow	10.55	11.01	0.96	0.118	0.84 ≤ x ≤ 1.08	
Tussock Tundra	7.96	25.87	0.31	0.040	0.27 ≤ x ≤ 0.35	-
Moss/Lichen	4.29	2.58	1.66	0.287	1.37 ≤ x ≤ 1.95	+
Dwarf Shrub	0.76	4.81	0.16	0.041	0.12 ≤ x ≤ 0.20	-
Low Shrub	0.87	2.49	0.35	0.080	0.27 ≤ x ≤ 0.43	-
Tall Shrub	0.00	0.01	0.00		≤ x ≤	
Dunes/Dry Sand	0.29	0.75	0.39	0.197	0.19 ≤ x ≤ 0.59	-
Sparsely Vegetated	0.42	0.49	0.87	0.327	0.54 ≤ x ≤ 1.20	
Barren Ground Other	2.47	1.04	2.37	0.875	1.49 ≤ x ≤ 3.24	+

* + indicates selection for the earth cover class, - indicates avoidance of the earth cover class

Table F4. Brant selection/avoidance of earth cover classes indicated by confidence intervals around 2000 m buffer selection ratios.

2000 Meter Buffer	Percentage of Acres in Buffer	Percentage of Available Acres	Selection Ratio	+/-	Confidence Interval	*
Clear Water	10.05	11.72	0.86	0.120	0.74 ≤ x ≤ 0.98	-
Turbid Water	18.24	10.29	1.77	0.198	1.58 ≤ x ≤ 1.97	+
Ice	2.79	2.14	1.30	0.356	0.95 ≤ x ≤ 1.66	
Carex aquatilis	7.62	3.77	2.02	0.206	1.82 ≤ x ≤ 2.23	+
Arctophila fulva	1.09	0.72	1.51	0.201	1.31 ≤ x ≤ 1.71	+
Flooded Tundra - LCP	14.78	9.35	1.58	0.126	1.46 ≤ x ≤ 1.71	+
Flooded Tundra - Nonpattern	5.60	5.11	1.10	0.082	1.01 ≤ x ≤ 1.18	+
Wet Tundra	7.80	7.87	0.99	0.068	0.92 ≤ x ≤ 1.06	
Sedge/Grass Meadow	12.56	11.01	1.14	0.105	1.03 ≤ x ≤ 1.25	+
Tussock Tundra	10.29	25.87	0.40	0.044	0.35 ≤ x ≤ 0.44	-
Moss/Lichen	4.69	2.58	1.82	0.261	1.56 ≤ x ≤ 2.08	+
Dwarf Shrub	0.89	4.81	0.18	0.045	0.14 ≤ x ≤ 0.23	-
Low Shrub	0.78	2.49	0.31	0.065	0.25 ≤ x ≤ 0.38	-
Tall Shrub	0.00	0.01	0.00		≤ x ≤	
Dunes/Dry Sand	0.31	0.75	0.42	0.149	0.27 ≤ x ≤ 0.57	-
Sparsely Vegetated	0.40	0.49	0.83	0.213	0.62 ≤ x ≤ 1.04	
Barren Ground Other	2.11	1.04	2.02	0.570	1.45 ≤ x ≤ 2.59	+

* + indicates selection for the earth cover class, - indicates avoidance of the earth cover class

Figure G1. Canada goose earth cover use vs. availability for 200m buffer.

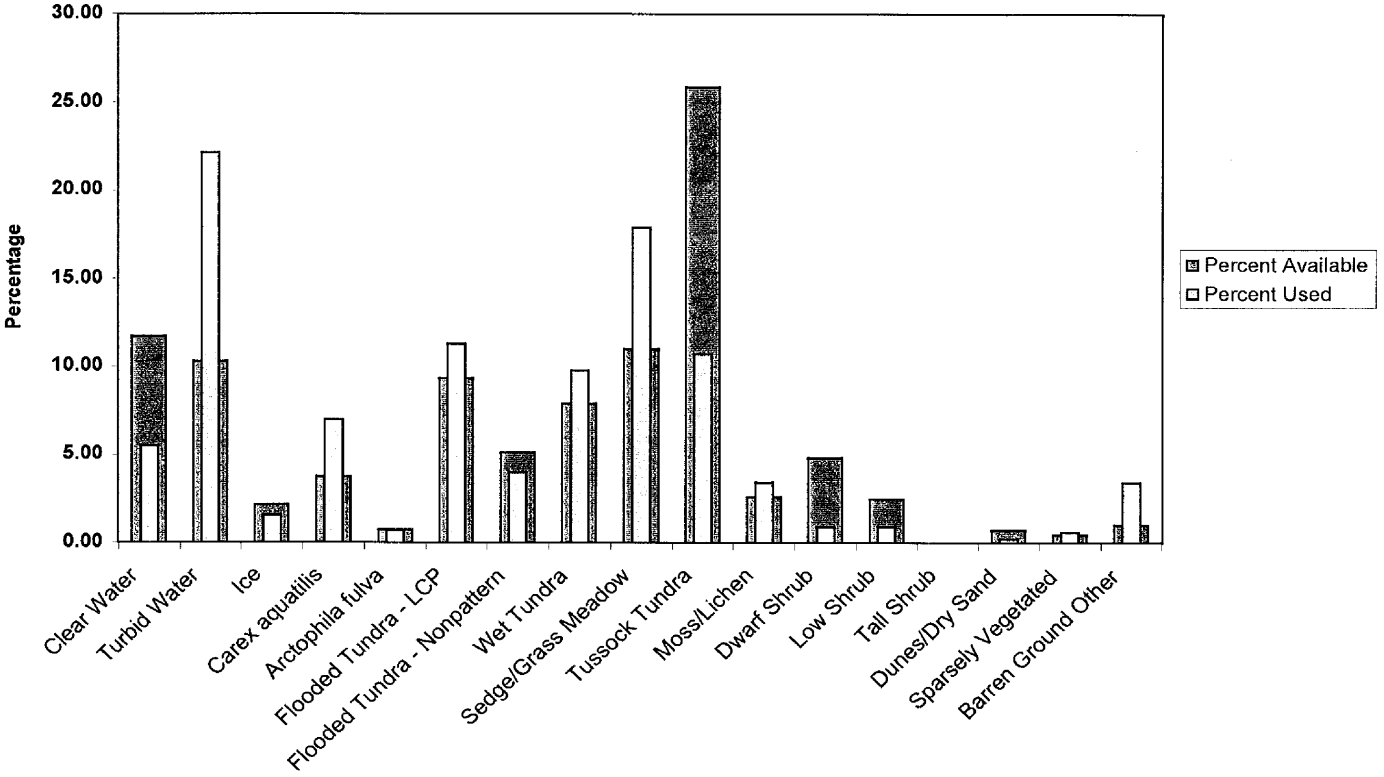

Figure G2. Canada goose earth cover selection ratios (n=313).

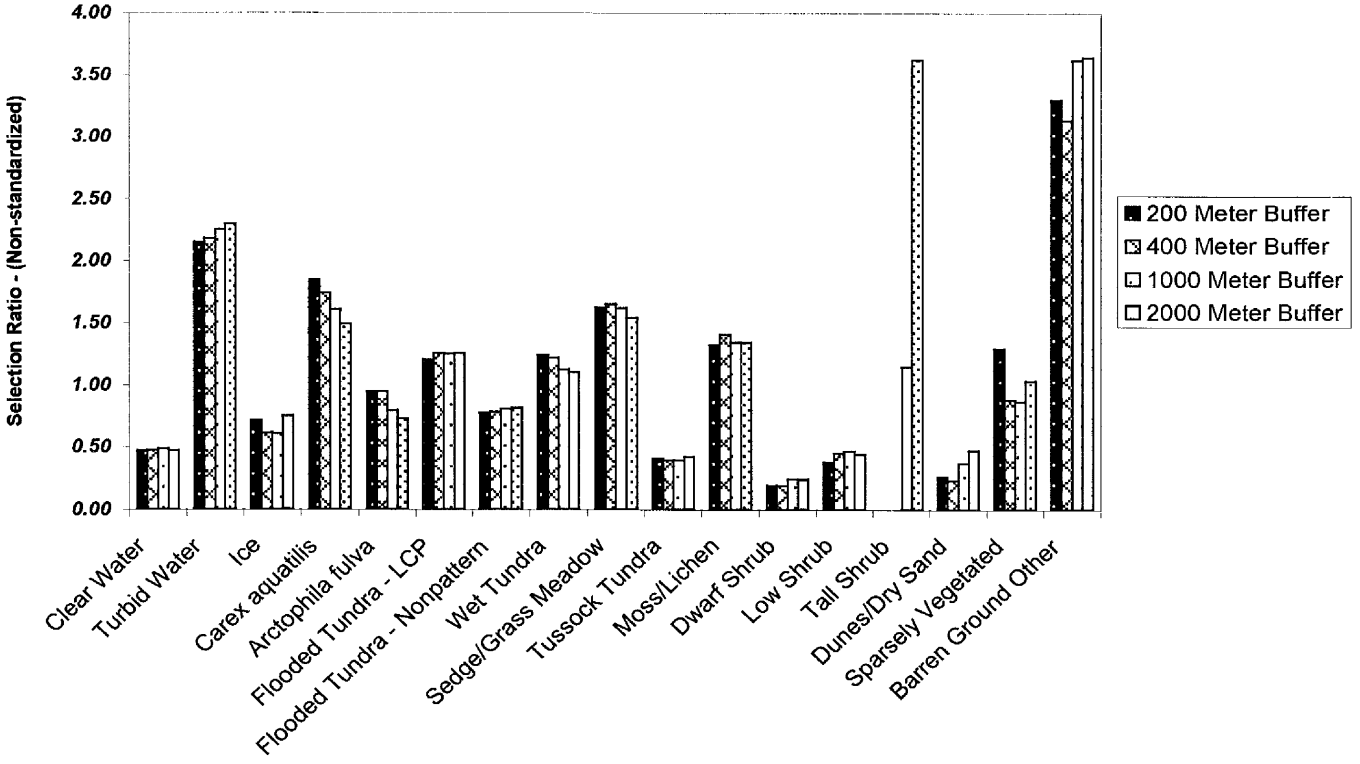

Table G1. Canada goose selection/avoidance of earth cover classes indicated by confidence intervals around 200 m buffer selection ratios.

200 Meter Buffer	Percentage of Acres in Buffer	Percentage of Study Area Acres	Selection Ratio	+/-	Confidence Interval	*
Clear Water	0.06	0.12	0.47	0.159	0.31 ≤ x ≤ 0.63	-
Turbid Water	0.22	0.10	2.15	0.336	1.81 ≤ x ≤ 2.49	+
Ice	0.02	0.02	0.72	0.481	0.23 ≤ x ≤ 1.20	
Carex aquatilis	0.07	0.04	1.85	0.377	1.47 ≤ x ≤ 2.23	+
Arctophila fulva	0.01	0.01	0.95	0.330	0.62 ≤ x ≤ 1.28	
Flooded Tundra - LCP	0.11	0.09	1.21	0.159	1.05 ≤ x ≤ 1.37	+
Flooded Tundra - Nonpattern	0.04	0.05	0.78	0.122	0.66 ≤ x ≤ 0.90	-
Wet Tundra	0.10	0.08	1.24	0.180	1.06 ≤ x ≤ 1.42	+
Sedge/Grass Meadow	0.18	0.11	1.62	0.238	1.39 ≤ x ≤ 1.86	+
Tussock Tundra	0.11	0.26	0.41	0.073	0.34 ≤ x ≤ 0.49	-
Moss/Lichen	0.03	0.03	1.32	0.318	1.01 ≤ x ≤ 1.64	+
Dwarf Shrub	0.01	0.05	0.19	0.069	0.13 ≤ x ≤ 0.26	-
Low Shrub	0.01	0.02	0.38	0.168	0.21 ≤ x ≤ 0.55	-
Tall Shrub	0.00	0.00	0.00		≤ x ≤	
Dunes/Dry Sand	0.00	0.01	0.27	0.228	0.04 ≤ x ≤ 0.50	-
Sparsely Vegetated	0.01	0.00	1.29	0.745	0.55 ≤ x ≤ 2.04	
Barren Ground Other	0.03	0.01	3.30	1.395	1.91 ≤ x ≤ 4.70	+

* + indicates selection for the earth cover class, - indicates avoidance of the earth cover class

Table G2. Canada goose selection/avoidance of earth cover classes indicated by confidence intervals around 400 m buffer selection ratios.

400 Meter Buffer	Percentage of Acres in Buffer	Percentage of Study Area Acres	Selection Ratio	+/-	Confidence Interval	*
Clear Water	5.60	11.72	0.48	0.134	0.34 ≤ x ≤ 0.61	-
Turbid Water	22.43	10.29	2.18	0.282	1.90 ≤ x ≤ 2.46	+
Ice	1.32	2.14	0.62	0.394	0.22 ≤ x ≤ 1.01	
Carex aquatilis	6.54	3.77	1.74	0.310	1.43 ≤ x ≤ 2.05	+
Arctophila fulva	0.69	0.72	0.95	0.246	0.70 ≤ x ≤ 1.20	
Flooded Tundra - LCP	11.77	9.35	1.26	0.131	1.13 ≤ x ≤ 1.39	+
Flooded Tundra - Nonpattern	4.03	5.11	0.79	0.094	0.69 ≤ x ≤ 0.88	-
Wet Tundra	9.57	7.87	1.22	0.131	1.09 ≤ x ≤ 1.35	+
Sedge/Grass Meadow	18.16	11.01	1.65	0.198	1.45 ≤ x ≤ 1.85	+
Tussock Tundra	10.31	25.87	0.40	0.060	0.34 ≤ x ≤ 0.46	-
Moss/Lichen	3.64	2.58	1.41	0.273	1.14 ≤ x ≤ 1.68	+
Dwarf Shrub	0.94	4.81	0.19	0.062	0.13 ≤ x ≤ 0.26	-
Low Shrub	1.13	2.49	0.45	0.148	0.30 ≤ x ≤ 0.60	-
Tall Shrub	0.00	0.01	0.00			
Dunes/Dry Sand	0.17	0.75	0.23	0.175	0.06 ≤ x ≤ 0.41	-
Sparsely Vegetated	0.43	0.49	0.89	0.367	0.52 ≤ x ≤ 1.25	
Barren Ground Other	3.27	1.04	3.13	1.154	1.98 ≤ x ≤ 4.28	+

* + indicates selection for the earth cover class, - indicates avoidance of the earth cover class

Table G3. Canada goose selection/avoidance of earth cover classes indicated by confidence intervals around 1000 m buffer selection ratios.

1000 Meter Buffer	Percentage of Acres in Buffer	Percentage of Study Area Acres	Selection Ratio	+/-	Confidence Interval	*
Clear Water	5.69	11.72	0.49	0.100	0.39 ≤ x ≤ 0.59	-
Turbid Water	23.18	10.29	2.25	0.218	2.04 ≤ x ≤ 2.47	+
Ice	1.30	2.14	0.61	0.346	0.26 ≤ x ≤ 0.96	-
Carex aquatilis	6.06	3.77	1.61	0.242	1.37 ≤ x ≤ 1.85	+
Arctophila fulva	0.58	0.72	0.80	0.150	0.65 ≤ x ≤ 0.95	-
Flooded Tundra - LCP	11.69	9.35	1.25	0.099	1.15 ≤ x ≤ 1.35	+
Flooded Tundra - Nonpattern	4.12	5.11	0.81	0.069	0.74 ≤ x ≤ 0.88	-
Wet Tundra	8.82	7.87	1.12	0.082	1.04 ≤ x ≤ 1.20	+
Sedge/Grass Meadow	17.85	11.01	1.62	0.154	1.47 ≤ x ≤ 1.77	+
Tussock Tundra	10.40	25.87	0.40	0.048	0.35 ≤ x ≤ 0.45	-
Moss/Lichen	3.48	2.58	1.35	0.203	1.14 ≤ x ≤ 1.55	+
Dwarf Shrub	1.18	4.81	0.24	0.079	0.17 ≤ x ≤ 0.32	-
Low Shrub	1.16	2.49	0.47	0.119	0.35 ≤ x ≤ 0.59	-
Tall Shrub	0.01	0.01	1.15			
Dunes/Dry Sand	0.28	0.75	0.37	0.220	0.15 ≤ x ≤ 0.59	-
Sparsely Vegetated	0.42	0.49	0.87	0.276	0.60 ≤ x ≤ 1.15	
Barren Ground Other	3.78	1.04	3.62	1.026	2.59 ≤ x ≤ 4.65	+

* + indicates selection for the earth cover class, - indicates avoidance of the earth cover class

Table G4. Canada goose selection/avoidance of earth cover classes indicated by confidence intervals around 2000 m buffer selection ratios.

2000 Meter Buffer	Percentage of Acres in Buffer	Percentage of Study Area Acres	Selection Ratio	+/-	Confidence Interval	*
Clear Water	5.56	11.72	0.47	0.080	0.39 ≤ x ≤ 0.55	-
Turbid Water	23.65	10.29	2.30	0.183	2.12 ≤ x ≤ 2.48	+
Ice	1.61	2.14	0.75	0.268	0.48 ≤ x ≤ 1.02	
Carex aquatilis	5.62	3.77	1.49	0.189	1.30 ≤ x ≤ 1.68	+
Arctophila fulva	0.53	0.72	0.73	0.106	0.62 ≤ x ≤ 0.84	-
Flooded Tundra - LCP	11.79	9.35	1.26	0.083	1.18 ≤ x ≤ 1.34	+
Flooded Tundra - Nonpattern	4.20	5.11	0.82	0.062	0.76 ≤ x ≤ 0.88	-
Wet Tundra	8.65	7.87	1.10	0.067	1.03 ≤ x ≤ 1.17	+
Sedge/Grass Meadow	17.00	11.01	1.54	0.123	1.42 ≤ x ≤ 1.67	+
Tussock Tundra	10.96	25.87	0.42	0.047	0.38 ≤ x ≤ 0.47	-
Moss/Lichen	3.47	2.58	1.34	0.178	1.17 ≤ x ≤ 1.52	+
Dwarf Shrub	1.18	4.81	0.24	0.069	0.18 ≤ x ≤ 0.31	-
Low Shrub	1.11	2.49	0.44	0.096	0.35 ≤ x ≤ 0.54	-
Tall Shrub	0.02	0.01	3.62			
Dunes/Dry Sand	0.36	0.75	0.48	0.194	0.29 ≤ x ≤ 0.67	-
Sparsely Vegetated	0.50	0.49	1.03	0.267	0.77 ≤ x ≤ 1.30	
Barren Ground Other	3.80	1.04	3.64	0.810	2.83 ≤ x ≤ 4.45	+

* + indicates selection for the earth cover class, - indicates avoidance of the earth cover class

Figure H1. White-fronted goose earth cover use vs. availability for 200m buffer.

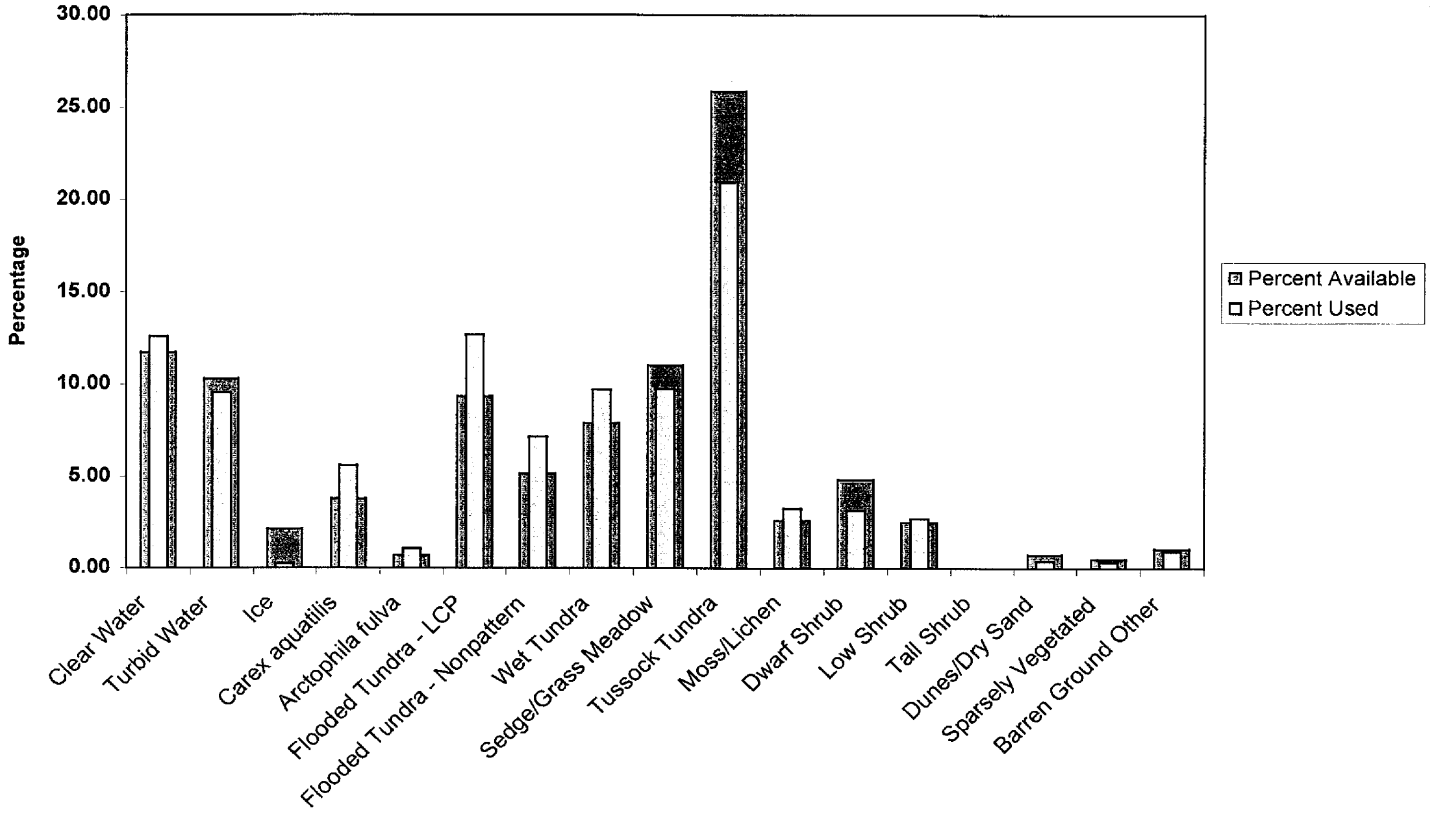

Figure H2. White-fronted goose earth cover selection ratios (n = 4595)

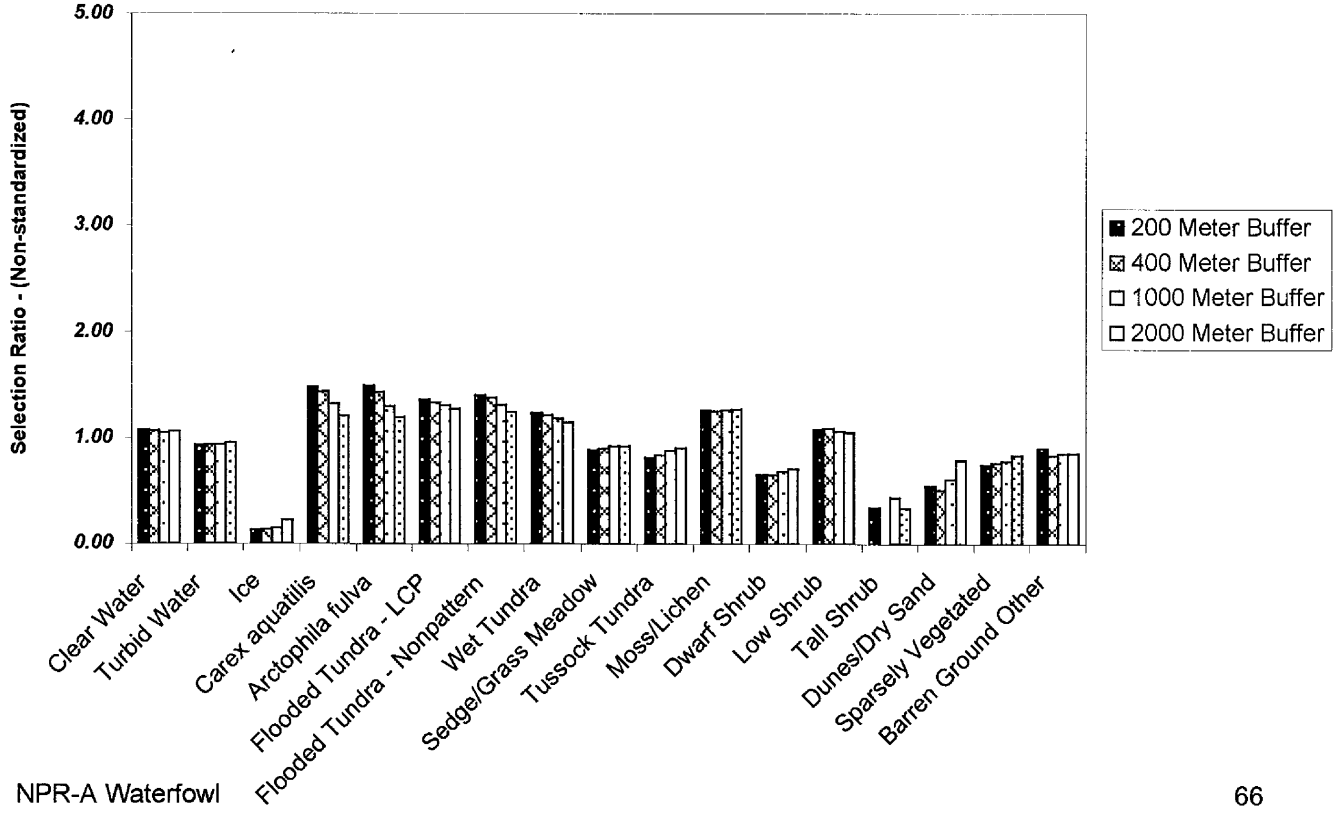

Table H1. White-fronted goose selection/avoidance of earth cover classes indicated by confidence intervals around 200 m buffer selection ratios.

200 Meter Buffer	Percentage of Acres in Buffer	Percentage of Available Acres	Selection Ratio	+/-	Confidence Interval	*
Clear Water	12.561	11.717	1.072	0.0603	1.012 ≤ x ≤ 1.132	+
Turbid Water	9.515	10.286	0.925	0.0458	0.879 ≤ x ≤ 0.971	-
Ice	0.276	2.141	0.129	0.0616	0.068 ≤ x ≤ 0.191	-
Carex aquatilis	5.567	3.766	1.478	0.0621	1.416 ≤ x ≤ 1.540	+
Arctophila fulva	1.077	0.721	1.493	0.1276	1.365 ≤ x ≤ 1.621	+
Flooded Tundra - LCP	12.692	9.347	1.358	0.0456	1.312 ≤ x ≤ 1.403	+
Flooded Tundra - Nonpattern	7.159	5.108	1.401	0.0526	1.349 ≤ x ≤ 1.454	+
Wet Tundra	9.670	7.867	1.229	0.0382	1.191 ≤ x ≤ 1.267	+
Sedge/Grass Meadow	9.747	11.015	0.885	0.0361	0.849 ≤ x ≤ 0.921	-
Tussock Tundra	20.953	25.867	0.810	0.0257	0.784 ≤ x ≤ 0.836	-
Moss/Lichen	3.260	2.583	1.262	0.0811	1.181 ≤ x ≤ 1.343	+
Dwarf Shrub	3.141	4.813	0.653	0.0489	0.604 ≤ x ≤ 0.702	-
Low Shrub	2.677	2.488	1.076	0.0705	1.006 ≤ x ≤ 1.146	+
Tall Shrub	0.002	0.005	0.341	0.6689	0.000 ≤ x ≤ 1.010	
Dunes/Dry Sand	0.405	0.748	0.542	0.1361	0.406 ≤ x ≤ 0.678	-
Sparsely Vegetated	0.361	0.486	0.744	0.1371	0.607 ≤ x ≤ 0.881	-
Barren Ground Other	0.937	1.044	0.898	0.1483	0.749 ≤ x ≤ 1.046	

* + indicates selection for the earth cover class, - indicates avoidance of the earth cover class

Table H2. White-fronted goose selection/avoidance of earth cover classes indicated by confidence intervals around 400 m buffer selection ratios.

400 Meter Buffer	Percentage of Acres in Buffer	Percentage of Available Acres	Selection Ratio	+/-	Confidence Interval	*
Clear Water	12.449	11.717	1.062	0.0482	1.014 ≤ x ≤ 1.111	+
Turbid Water	9.628	10.286	0.936	0.0375	0.898 ≤ x ≤ 0.974	-
Ice	0.290	2.141	0.135	0.0563	0.079 ≤ x ≤ 0.192	-
Carex aquatilis	5.408	3.766	1.436	0.0485	1.388 ≤ x ≤ 1.485	+
Arctophila fulva	1.029	0.721	1.428	0.0893	1.338 ≤ x ≤ 1.517	+
Flooded Tundra - LCP	12.443	9.347	1.331	0.0383	1.293 ≤ x ≤ 1.370	+
Flooded Tundra - Nonpattern	7.038	5.108	1.378	0.0425	1.335 ≤ x ≤ 1.420	+
Wet Tundra	9.528	7.867	1.211	0.0298	1.181 ≤ x ≤ 1.241	+
Sedge/Grass Meadow	9.892	11.015	0.898	0.0310	0.867 ≤ x ≤ 0.929	-
Tussock Tundra	21.627	25.867	0.836	0.0221	0.814 ≤ x ≤ 0.858	-
Moss/Lichen	3.239	2.583	1.254	0.0699	1.184 ≤ x ≤ 1.324	+
Dwarf Shrub	3.127	4.813	0.650	0.0423	0.608 ≤ x ≤ 0.692	-
Low Shrub	2.688	2.488	1.081	0.0574	1.023 ≤ x ≤ 1.138	+
Tall Shrub	0.002	0.005	0.456	0.8951	0.000 ≤ x ≤ 1.351	
Dunes/Dry Sand	0.377	0.748	0.505	0.1006	0.404 ≤ x ≤ 0.605	-
Sparsely Vegetated	0.371	0.486	0.764	0.1129	0.651 ≤ x ≤ 0.877	-
Barren Ground Other	0.864	1.044	0.827	0.1145	0.712 ≤ x ≤ 0.941	-

* + indicates selection for the earth cover class, - indicates avoidance of the earth cover class

Table H3. White-fronted goose selection/avoidance of earth cover classes indicated by confidence intervals around 1000 m buffer selection ratios.

1000 Meter Buffer	Percentage of Acres in Buffer	Percentage of Available Acres	Selection Ratio	+/-	Confidence Interval	*
Clear Water	12.277	11.717	1.048	0.0327	1.015 ≤ x ≤ 1.081	+
Turbid Water	9.611	10.286	0.934	0.0299	0.905 ≤ x ≤ 0.964	-
Ice	0.318	2.141	0.149	0.0461	0.102 ≤ x ≤ 0.195	-
Carex aquatilis	4.964	3.766	1.318	0.0345	1.283 ≤ x ≤ 1.352	+
Arctophila fulva	0.936	0.721	1.298	0.0552	1.243 ≤ x ≤ 1.353	+
Flooded Tundra - LCP	12.165	9.347	1.301	0.0322	1.269 ≤ x ≤ 1.334	+
Flooded Tundra - Nonpattern	6.688	5.108	1.309	0.0324	1.277 ≤ x ≤ 1.342	+
Wet Tundra	9.301	7.867	1.182	0.0221	1.160 ≤ x ≤ 1.204	+
Sedge/Grass Meadow	10.122	11.015	0.919	0.0263	0.893 ≤ x ≤ 0.945	-
Tussock Tundra	22.725	25.867	0.879	0.0188	0.860 ≤ x ≤ 0.897	-
Moss/Lichen	3.264	2.583	1.264	0.0596	1.204 ≤ x ≤ 1.323	+
Dwarf Shrub	3.279	4.813	0.681	0.0388	0.642 ≤ x ≤ 0.720	-
Low Shrub	2.635	2.488	1.059	0.0441	1.015 ≤ x ≤ 1.103	+
Tall Shrub	0.002	0.005	0.440	0.8647	-0.425 ≤ x ≤ 1.304	
Dunes/Dry Sand	0.452	0.748	0.605	0.0765	0.528 ≤ x ≤ 0.681	-
Sparsely Vegetated	0.380	0.486	0.783	0.0773	0.705 ≤ x ≤ 0.860	-
Barren Ground Other	0.883	1.044	0.845	0.0923	0.753 ≤ x ≤ 0.938	-

* + indicates selection for the earth cover class, - indicates avoidance of the earth cover class

Table H4. White-fronted goose selection/avoidance of earth cover classes indicated by confidence intervals around 2000 m buffer selection ratios.

2000 Meter Buffer	Percentage of Acres in Buffer	Percentage of Available Acres	Selection Ratio	+/-	Confidence Interval	*
Clear Water	12.433	11.717	1.061	0.0252	1.036 ≤ x ≤ 1.086	+
Turbid Water	9.791	10.286	0.952	0.0262	0.926 ≤ x ≤ 0.978	-
Ice	0.478	2.141	0.223	0.0418	0.182 ≤ x ≤ 0.265	-
Carex aquatilis	4.549	3.766	1.208	0.0237	1.184 ≤ x ≤ 1.232	+
Arctophila fulva	0.859	0.721	1.191	0.0432	1.148 ≤ x ≤ 1.234	+
Flooded Tundra - LCP	11.865	9.347	1.269	0.0294	1.240 ≤ x ≤ 1.299	+
Flooded Tundra - Nonpattern	6.354	5.108	1.244	0.0261	1.218 ≤ x ≤ 1.270	+
Wet Tundra	8.984	7.867	1.142	0.0178	1.124 ≤ x ≤ 1.160	+
Sedge/Grass Meadow	10.144	11.015	0.921	0.0239	0.897 ≤ x ≤ 0.945	-
Tussock Tundra	23.383	25.867	0.904	0.0174	0.887 ≤ x ≤ 0.921	-
Moss/Lichen	3.267	2.583	1.265	0.0555	1.209 ≤ x ≤ 1.320	+
Dwarf Shrub	3.408	4.813	0.708	0.0383	0.670 ≤ x ≤ 0.746	-
Low Shrub	2.597	2.488	1.044	0.0379	1.006 ≤ x ≤ 1.082	+
Tall Shrub	0.002	0.005	0.336	0.6640	-0.328 ≤ x ≤ 1.000	
Dunes/Dry Sand	0.588	0.748	0.786	0.0754	0.711 ≤ x ≤ 0.862	-
Sparsely Vegetated	0.406	0.486	0.836	0.0603	0.776 ≤ x ≤ 0.897	-
Barren Ground Other	0.893	1.044	0.855	0.0723	0.783 ≤ x ≤ 0.928	-

* + indicates selection for the earth cover class, - indicates avoidance of the earth cover class

Appendix I

Population Density Polygons Summarized by NPRA Earth Cover Types for Spectacled Eider, King Eider, Steller's Eider, Oldsquaw, Brant, Canada Goose, and White-fronted Goose

Table I2. King eider population density polygons summarized by NPR-A earth cover types.

Resource Selection Index

	Low Density Polygons			Medium Density Polygons			High Density Polygons			
Class Name	**Percentage**	**Selection Index**	**Standardized Selection Index**	**Percentage**	**Selection Index**	**Standardized Selection Index**	**Percentage**	**Selection Index**	**Standardized Selection Index**	**Total Earth Cover Percentage**
Clear Water	12.28	0.94	5.67	13.54	1.03	6.64	15.63	1.19	8.11	**13.11**
Turbid Water	8.42	0.89	5.39	9.00	0.95	6.12	9.25	0.98	6.66	**9.46**
Ice	1.08	0.26	1.58	0.75	0.18	1.16	0.00	0.00	0.00	4.14
Carex aquatilis	4.07	1.26	7.64	4.99	1.54	**9.93**	6.40	1.98	**13.50**	3.23
Arctophila fulva	0.79	1.26	7.65	0.86	1.37	**8.82**	0.83	1.32	**9.00**	0.63
Flooded Tundra - LCP	9.60	1.24	7.48	7.48	0.96	6.19	6.19	0.80	5.43	7.77
Flooded Tundra - Nonpattern	5.79	1.33	**8.05**	5.11	1.17	7.55	4.35	1.00	6.80	4.35
Wet Tundra	8.59	1.26	7.62	9.11	1.34	**8.59**	9.29	1.36	**9.27**	6.82
Sedge/Grass Meadow	10.04	1.07	6.47	13.58	1.45	**9.30**	18.09	1.93	**13.12**	9.39
Tussock Tundra	27.87	1.05	6.38	27.39	1.04	6.66	24.31	0.92	6.26	**26.44**
Moss/Lichen	2.33	1.15	6.96	1.34	0.67	4.28	1.02	0.50	3.43	2.02
Dwarf Shrub	4.01	0.50	3.01	2.58	0.32	2.06	1.98	0.25	1.67	8.07
Low Shrub	3.03	1.31	**7.95**	2.50	1.09	6.98	1.12	0.49	3.32	2.31
Tall Shrub	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
Dunes/Dry Sand	0.89	1.30	**7.85**	0.69	1.01	6.52	0.39	0.57	3.89	0.68
Sparsely Vegetated	0.45	1.02	6.15	0.35	0.79	5.07	0.27	0.61	4.13	0.44
Barren Ground Other	0.76	0.68	4.14	0.72	0.64	4.13	0.89	0.80	5.41	1.12
Totals	100	16.52	100.00	100	15.55	100.00	100	14.69	100.00	100.00

Table I3. Steller's eider population density polygons summarized by NPR-A earth cover types

Resource Selection Index

	Low Density Polygons			Medium Density Polygons			High Density Polygons			
Class Name	**Percentage**	**Selection Index**	**Standardized Selection Index**	**Percentage**	**Selection Index**	**Standardized Selection Index**	**Percentage**	**Selection Index**	**Standardized Selection Index**	**Total Earth Cover Percentage**
Clear Water	9.05	0.69	4.22	3.63	0.28	2.15	0.09	0.01	0.09	**13.11**
Turbid Water	11.34	1.20	7.34	10.24	1.08	8.41	0.05	0.00	0.06	**9.46**
Ice	2.12	0.51	3.12	0.26	0.06	0.48	0.00	0.00	0.00	4.14
Carex aquatilis	2.93	0.91	5.54	2.15	0.66	5.16	0.18	0.06	0.69	3.23
Arctophila fulva	1.33	2.13	**13.04**	0.90	1.43	**11.11**	0.22	0.35	4.36	0.63
Flooded Tundra - LCP	10.39	1.34	8.18	8.37	1.08	8.37	1.81	0.23	2.88	7.77
Flooded Tundra - Nonpattern	4.91	1.13	6.90	3.51	0.81	6.25	0.35	0.08	0.99	4.35
Wet Tundra	6.99	1.02	6.27	3.61	0.53	4.10	0.82	0.12	1.49	6.82
Sedge/Grass Meadow	17.21	1.83	**11.21**	22.33	2.38	**18.47**	14.01	1.49	**18.47**	9.39
Tussock Tundra	21.25	0.80	4.92	29.47	1.11	8.65	58.17	2.20	**27.23**	**26.44**
Moss/Lichen	3.83	1.89	**11.59**	2.21	1.10	8.50	0.17	0.08	1.02	2.02
Dwarf Shrub	4.33	0.54	3.28	11.66	1.45	**11.23**	22.65	2.81	**34.76**	8.07
Low Shrub	3.79	1.64	10.05	1.37	0.60	4.62	1.48	0.64	7.96	2.31
Tall Shrub	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
Dunes/Dry Sand	0.01	0.01	0.07	0.00	0.00	0.01	0.00	0.00	0.00	0.68
Sparsely Vegetated	0.16	0.36	2.18	0.04	0.10	0.76	0.00	0.00	0.00	0.44
Barren Ground Other	0.38	0.34	2.08	0.25	0.22	1.71	0.00	0.00	0.00	1.12
Totals	100	16.35	100.00	100	12.88	100.00	100	8.08	100.00	100.00

Table I4. Oldsquaw population density polygons summarized by NPR-A earth cover types.

Resource Selection Index

	Low Density Polygons			Medium Density Polygons			High Density Polygons			
Class Name	**Percentage**	**Selection Index**	**Standardized Selection Index**	**Percentage**	**Selection Index**	**Standardized Selection Index**	**Percentage**	**Selection Index**	**Standardized Selection Index**	**Total Earth Cover Percentage**
Clear Water	10.96	0.84	4.88	11.27	0.86	5.50	11.71	0.89	6.61	**13.11**
Turbid Water	9.38	0.99	5.78	8.18	0.86	5.54	5.63	0.60	4.41	**9.46**
Ice	1.05	0.25	1.48	0.7	0.17	1.08	0.07	0.02	0.13	4.14
Carex aquatilis	3.84	1.19	6.94	3.8	1.18	7.53	3.67	1.14	8.41	3.23
Arctophila fulva	0.66	1.05	6.15	0.89	1.42	**9.10**	0.73	1.17	8.63	0.63
Flooded Tundra - LCP	9.63	1.24	**7.23**	8.73	1.12	7.19	7.55	0.97	7.19	7.77
Flooded Tundra - Nonpattern	4.42	1.02	5.92	5.67	1.30	**8.34**	9.11	2.09	**15.49**	4.35
Wet Tundra	7.79	1.14	6.66	8.32	1.22	7.81	6.88	1.01	7.46	6.82
Sedge/Grass Meadow	10.81	1.15	6.72	9.94	1.06	6.78	12.32	1.31	**9.71**	9.39
Tussock Tundra	27.1	1.02	5.98	30.06	1.14	7.28	30.2	1.14	8.45	**26.44**
Moss/Lichen	2.8	1.38	**8.08**	2.01	0.99	6.36	0.65	0.32	2.38	2.02
Dwarf Shrub	6.71	0.83	4.85	5.59	0.69	4.44	8.12	1.01	7.45	8.07
Low Shrub	2.46	1.07	6.22	3.32	1.44	**9.22**	2.86	1.24	**9.18**	2.31
Tall Shrub	0.02	0.67	3.88	0	0.00	0.00	0.00	0.00	0.00	0.03
Dunes/Dry Sand	0.9	1.32	**7.67**	0.58	0.85	5.43	0.11	0.16	1.19	0.68
Sparsely Vegetated	0.5	1.14	6.66	0.34	0.78	4.97	0.07	0.16	1.18	0.44
Barren Ground Other	0.94	0.84	4.91	0.6	0.54	3.44	0.32	0.29	2.12	1.12
Totals	100	17.15	100.00	100	15.62	100.00	100	13.51	100.00	100.00

Table I5. Brant population density polygons summarized by NPR-A earth cover types.

Resource Selection Index

	Low Density Polygon			Medium Density Polygon			High Density Polygon			
Class Name	**Percentage**	**Selection Index**	**Standardized Selection Index**	**Percentage**	**Selection Index**	**Standardized Selection Index**	**Percentage**	**Selection Index**	**Standardized Selection Index**	**Total Earth Cover Percentage**
Clear Water	9.91	0.76	4.23	6.22	0.47	2.41	5.02	0.38	1.63	**13.11**
Turbid Water	15.61	1.65	**9.24**	18.35	1.94	**9.87**	6.84	0.72	3.08	**9.46**
Ice	4.74	1.14	6.40	4.36	1.05	5.36	0.04	0.01	0.04	4.14
Carex aquatilis	4.59	1.42	7.96	6.02	1.86	9.48	16.31	5.05	**21.56**	3.23
Arctophila fulva	0.93	1.48	**8.29**	0.87	1.39	7.06	2.59	4.13	**17.61**	0.63
Flooded Tundra - LCP	13.73	1.77	**9.89**	14.64	1.89	**9.59**	27.20	3.50	**14.94**	7.77
Flooded Tundra - Nonpattern	5.26	1.21	6.76	4.38	1.01	5.12	6.15	1.41	6.02	4.35
Wet Tundra	8.22	1.20	6.74	7.20	1.06	5.37	6.02	0.88	3.77	6.82
Sedge/Grass Meadow	11.78	1.26	7.02	17.43	1.86	9.45	13.72	1.46	6.24	9.39
Tussock Tundra	15.83	0.60	3.35	10.97	0.42	2.11	5.20	0.20	0.84	**26.44**
Moss/Lichen	4.01	1.98	**11.09**	5.10	2.52	**12.84**	10.16	5.03	**21.44**	2.02
Dwarf Shrub	1.98	0.25	1.37	0.60	0.07	0.38	0.07	0.01	0.04	8.06
Low Shrub	1.41	0.61	3.42	0.67	0.29	1.49	0.41	0.18	0.76	2.31
Tall Shrub	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.03
Dunes/Dry Sand	0.53	0.78	4.34	0.55	0.80	4.06	0.00	0.00	0.00	0.68
Sparsely Vegetated	0.32	0.73	4.07	0.47	1.08	5.52	0.17	0.38	1.63	0.44
Barren Ground Other	1.16	1.04	5.82	2.17	1.94	**9.89**	0.10	0.09	0.40	1.12
Totals	100	17.87	100.00	100	19.65	100.00	100	23.44	100.00	99.98

Table I6. Canada goose population density polygons summarized by NPR-A earth cover types.

Resource Selection Index

	Low Density Polygons			Medium Density Polygons			High Density Polygons			
Class Name	**Percentage**	**Selection Index**	**Standardized Selection Index**	**Percentage**	**Selection Index**	**Standardized Selection Index**	**Percentage**	**Selection Index**	**Standardized Selection Index**	**Total Earth Cover Percentage**
Clear Water	11.23	0.86	3.83	2.74	0.21	1.22	2.14	0.16	0.76	**13.11**
Turbid Water	11.44	1.21	5.41	30.96	3.27	**19.16**	24.69	2.61	**12.15**	**9.46**
Ice	1.49	0.36	1.61	2.40	0.58	3.39	5.82	1.40	6.54	4.14
Carex aquatilis	4.69	1.45	6.49	5.48	1.70	9.93	6.40	1.98	9.22	3.23
Arctophila fulva	0.76	1.22	5.45	0.54	0.87	5.07	0.25	0.39	1.84	0.63
Flooded Tundra - LCP	13.84	1.78	7.97	10.43	1.34	7.86	8.11	1.04	4.86	7.77
Flooded Tundra - Nonpattern	5.12	1.18	5.26	4.47	1.03	6.01	2.47	0.57	2.64	4.35
Wet Tundra	8.77	1.29	5.75	7.54	1.11	6.47	5.98	0.88	4.08	6.82
Sedge/Grass Meadow	7.91	0.84	3.77	19.74	2.10	**12.31**	26.37	2.81	**13.07**	9.39
Tussock Tundra	21.42	0.81	3.62	8.70	0.33	1.93	5.12	0.19	0.90	**26.44**
Moss/Lichen	3.56	1.76	7.87	3.01	1.49	8.71	3.82	1.89	8.80	2.02
Dwarf Shrub	3.91	0.48	2.17	0.81	0.10	0.59	0.19	0.02	0.11	8.07
Low Shrub	2.37	1.03	4.59	0.54	0.23	1.37	0.90	0.39	1.81	2.31
Tall Shrub	0.10	3.22	**14.42**	0.00	0.00	0.00	0.00	0.00	0.00	0.03
Dunes/Dry Sand	1.28	1.86	**8.34**	0.08	0.11	0.65	0.09	0.14	0.63	0.68
Sparsely Vegetated	0.80	1.82	**8.13**	0.24	0.54	3.17	0.10	0.22	1.03	0.44
Barren Ground Other	1.33	1.19	5.33	2.32	2.08	**12.18**	7.57	6.78	**31.56**	1.12
Totals	100	22.36	100.00	100	17.09	100.00	100	21.49	100.00	100.00

Table I7. White-fronted goose population density polygons summarized by NPR-A earth cover types.

Resource Selection Index

	Low Density Polygons			Medium Density Polygons			High Density Polygons			
Class Name	**Percentage**	**Selection Index**	**Standardized Selection Index**	**Percentage**	**Selection Index**	**Standardized Selection Index**	**Percentage**	**Selection Index**	**Standardized Selection Index**	**Total Earth Cover Percentage**
Clear Water	10.02	0.76	4.73	12.28	0.94	5.78	14.59	1.11	6.08	**13.11**
Turbid Water	9.04	0.96	5.91	8.23	0.87	5.37	9.20	0.97	5.31	**9.46**
Ice	1.21	0.29	1.81	0.38	0.09	0.57	0.03	0.01	0.04	4.14
Carex aquatilis	3.52	1.09	**6.74**	4.17	1.29	**7.98**	4.92	1.52	**8.32**	3.23
Arctophila fulva	0.61	0.98	6.06	0.97	1.55	**9.60**	0.93	1.49	**8.14**	0.63
Flooded Tundra - LCP	7.68	0.99	6.12	9.81	1.26	**7.79**	16.98	2.19	**11.93**	7.77
Flooded Tundra - Nonpattern	4.28	0.98	6.08	6.66	1.53	**9.44**	7.46	1.71	**9.36**	4.35
Wet Tundra	7.11	1.04	6.45	8.97	1.31	**8.12**	10.16	1.49	**8.13**	6.82
Sedge/Grass Meadow	11.81	1.26	**7.78**	9.68	1.03	6.37	6.45	0.69	3.75	9.39
Tussock Tundra	29.82	1.13	**6.98**	27.80	1.05	6.49	18.05	0.68	3.73	**26.44**
Moss/Lichen	1.99	0.98	6.07	2.29	1.13	6.98	4.99	2.47	**13.49**	2.02
Dwarf Shrub	8.22	1.02	6.30	3.75	0.47	2.87	1.95	0.24	1.32	8.07
Low Shrub	2.53	1.10	**6.79**	3.52	1.53	**9.43**	2.47	1.07	5.86	2.31
Tall Shrub	0.02	0.59	3.66	0.00	0.00	0.00	0.00	0.00	0.00	0.03
Dunes/Dry Sand	0.78	1.13	**7.01**	0.64	0.94	5.80	0.75	1.10	5.99	0.68
Sparsely Vegetated	0.46	1.04	6.44	0.31	0.71	4.40	0.45	1.03	5.62	0.44
Barren Ground Other	0.92	0.82	5.08	0.54	0.49	3.00	0.60	0.54	2.93	1.12
Totals	100.00	16.17	100.00	100	16.19	100.00	100	18.31	100.00	100.00

Appendix J

J1-J4: Spectacled eider selection/avoidance of unsupervised classes from TM scene path 79 row 11, using 200, 400, 1000, and 2000 meter buffers.

J-5: Table showing three classes from an unsupervised classification for which spectacled eider show relative preference, matrixed with the NPR-A earth cover classification.

200 Meter Buffer						
	Acres within Buffer	Percentage of Acres in Buffer	Total Area Acres	Percentage of Study Area Acres	Selection Ratio	Standarized Selection Ratio
Class 1	1,445.34	8.19	1,492,005.80	19.36	0.42	0.64
Class 2	1,794.06	10.17	731,721.14	9.50	1.07	1.62
Class 3	457.91	2.59	388,256.97	5.04	0.51	0.78
Class 4	42.26	0.24	66,631.99	0.86	0.28	0.42
Class 5	459.02	2.60	194,923.21	2.53	1.03	1.56
Class 6	186.59	1.06	64,677.14	0.84	1.26	1.91
Class 7	288.89	1.64	67,736.85	0.88	1.86	2.82
Class 8	141.67	0.80	33,118.17	0.43	1.87	2.83
Class 9	64.72	0.37	24,957.39	0.32	1.13	1.71
Class 10	228.62	1.30	45,572.52	0.59	2.19	3.32
Class 11	181.70	1.03	44,050.67	0.57	1.80	2.73
Class 12	103.64	0.59	47,825.16	0.62	0.95	1.43
Class 13	57.82	0.33	20,491.25	0.27	1.23	1.86
Class 14	203.27	1.15	26,675.84	0.35	3.33	5.04
Class 15	105.64	0.60	33,955.94	0.44	1.36	2.06
Class 16	246.19	1.39	55,673.47	0.72	1.93	2.92
Class 17	241.30	1.37	44,026.87	0.57	2.39	3.62
Class 18	249.30	1.41	33,393.72	0.43	3.26	4.93
Class 19	219.28	1.24	45,501.35	0.59	2.10	3.18
Class 20	116.76	0.66	34,187.00	0.44	1.49	2.26
Class 21	368.95	2.09	74,139.60	0.96	2.17	3.29
Class 22	114.31	0.65	32,646.03	0.42	1.53	2.31
Class 23	25.58	0.14	23,578.10	0.31	0.47	0.72
Class 24	409.21	2.32	87,761.51	1.14	2.04	3.08
Class 25	240.19	1.36	56,830.82	0.74	1.85	2.79
Class 26	374.29	2.12	58,832.15	0.76	2.78	4.20
Class 27	369.62	2.09	101,753.27	1.32	1.59	2.40
Class 28	331.81	1.88	84,599.28	1.10	1.71	2.59
Class 29	109.86	0.62	79,865.38	1.04	0.60	0.91
Class 30	586.46	3.32	125,785.72	1.63	2.04	3.08
Class 31	324.03	1.82	155,558.19	2.02	0.91	1.38
Class 32	386.97	2.19	102,078.19	1.32	1.66	2.51
Class 33	634.49	3.60	187,075.78	2.43	1.48	2.24
Class 34	634.94	3.60	179,194.33	2.33	1.55	2.34
Class 35	175.25	0.99	97,628.51	1.27	0.78	1.19
Class 36	934.95	5.30	259,472.47	3.38	1.57	2.37
Class 37	473.92	2.69	261,134.43	3.39	0.79	1.20
Class 38	280.44	1.59	285,554.29	3.71	0.43	0.65
Class 39	809.96	4.59	360,498.07	4.68	0.98	1.48
Class 40	1,076.17	6.10	256,290.00	3.33	1.83	2.77
Class 41	769.71	4.36	279,855.64	3.63	1.20	1.82
Class 42	276.87	1.57	244,593.80	3.17	0.49	0.75
Class 43	66.27	0.38	130,569.44	1.69	0.22	0.34
Class 44	2.00	0.01	118,163.58	1.53	0.01	0.01
Class 45	29.13	0.17	192,735.51	2.50	0.07	0.10
Class 46	92.74	0.53	77,262.91	1.00	0.52	0.79
Class 47	570.89	3.23	134,914.37	1.75	1.85	2.80
Class 48	330.70	1.87	112,147.35	1.46	1.29	1.95
Class 49	15.12	0.09	33,216.69	0.43	0.20	0.30
Class 50	0.00	0.00	16,521.28	0.21	0.00	0.00
Totals	**17,648.81**	**100.00**	**7,705,639.14**	**100.00**	**66.07**	**100.00**

400 Meter Buffer						
	Acres within Buffer	Percentage of Acres in Buffer	Total Area Acres	Percentage of Study Area Acres	Selection Ratio	Standarized Selection Ratio
Class 1	5,930.60	8.18	1,492,005.80	19.36	0.42	0.66
Class 2	7,802.95	10.77	731,721.14	9.50	1.13	1.76
Class 3	1,966.42	2.71	388,256.97	5.04	0.54	0.84
Class 4	197.93	0.27	66,631.99	0.86	0.32	0.49
Class 5	1,945.73	2.69	194,923.21	2.53	1.06	1.65
Class 6	767.71	1.06	64,677.14	0.84	1.26	1.96
Class 7	1,220.50	1.68	67,736.85	0.88	1.92	2.98
Class 8	565.77	0.78	33,118.17	0.43	1.82	2.83
Class 9	258.65	0.36	24,957.39	0.32	1.10	1.72
Class 10	905.15	1.25	45,572.52	0.59	2.11	3.29
Class 11	685.42	0.95	44,050.67	0.57	1.65	2.58
Class 12	391.41	0.54	47,825.16	0.62	0.87	1.35
Class 13	239.74	0.33	20,491.25	0.27	1.24	1.94
Class 14	667.18	0.92	26,675.84	0.35	2.66	4.14
Class 15	435.89	0.60	33,955.94	0.44	1.36	2.12
Class 16	959.19	1.32	55,673.47	0.72	1.83	2.85
Class 17	872.01	1.20	44,026.87	0.57	2.11	3.28
Class 18	967.64	1.34	33,393.72	0.43	3.08	4.80
Class 19	796.40	1.10	45,501.35	0.59	1.86	2.90
Class 20	539.97	0.75	34,187.00	0.44	1.68	2.61
Class 21	1,339.48	1.85	74,139.60	0.96	1.92	2.99
Class 22	496.16	0.68	32,646.03	0.42	1.62	2.52
Class 23	102.75	0.14	23,578.10	0.31	0.46	0.72
Class 24	1,586.79	2.19	87,761.51	1.14	1.92	2.99
Class 25	904.92	1.25	56,830.82	0.74	1.69	2.64
Class 26	1,349.49	1.86	58,832.15	0.76	2.44	3.80
Class 27	1,437.34	1.98	101,753.27	1.33	1.50	2.34
Class 28	1,330.81	1.84	84,599.28	1.10	1.67	2.60
Class 29	438.12	0.60	79,865.38	1.04	0.58	0.91
Class 30	2,366.50	3.27	125,785.72	1.63	2.00	3.11
Class 31	1,295.23	1.79	155,558.19	2.02	0.89	1.38
Class 32	1,611.47	2.22	102,078.19	1.32	1.68	2.61
Class 33	2,548.87	3.52	187,075.78	2.43	1.45	2.26
Class 34	2,983.20	4.12	179,194.33	2.33	1.77	2.76
Class 35	738.35	1.02	97,628.51	1.27	0.80	1.25
Class 36	3,674.85	5.07	259,472.47	3.37	1.51	2.34
Class 37	2,022.24	2.79	261,134.43	3.39	0.82	1.28
Class 38	1,144.44	1.58	285,554.29	3.71	0.43	0.66
Class 39	3,333.03	4.60	360,498.07	4.68	0.98	1.53
Class 40	4,376.73	6.04	256,290.00	3.33	1.82	2.83
Class 41	3,295.89	4.55	279,855.64	3.63	1.25	1.95
Class 42	1,023.24	1.41	244,593.80	3.17	0.44	0.69
Class 43	209.05	0.29	130,569.44	1.69	0.17	0.26
Class 44	10.90	0.02	118,163.58	1.53	0.01	0.02
Class 45	206.38	0.28	192,735.51	2.50	0.11	0.18
Class 46	440.12	0.61	77,262.71	1.00	0.61	0.94
Class 47	2,416.10	3.33	134,914.37	1.75	1.90	2.96
Class 48	1,594.35	2.20	112,147.35	1.46	1.51	2.35
Class 49	76.06	0.10	33,216.69	0.43	0.24	0.38
Class 50	0.00	0.00	16,524.28	0.21	0.00	0.00
Totals	72,469.12	100.00	7,705,641.94	100.00	64.21	100.00

1000 Meter Buffer	Acres within Buffer	Percentage of Acres in Buffer	Total Area Acres	Percentage of Study Area Acres	Selection Ratio	Standarized Selection Ratio
Class 1	35,104.14	8.22	1,492,005.80	19.36	0.42	0.68
Class 2	46,973.35	11.00	731,721.14	9.50	1.16	1.86
Class 3	14,166.11	3.32	388,256.97	5.04	0.66	1.06
Class 4	2,010.45	0.47	66,631.99	0.86	0.54	0.87
Class 5	10,935.82	2.56	194,923.21	2.53	1.01	1.62
Class 6	4,115.64	0.96	64,677.14	0.84	1.15	1.84
Class 7	6,743.68	1.58	67,736.85	0.88	1.80	2.88
Class 8	3,392.19	0.79	33,118.17	0.43	1.85	2.97
Class 9	1,436.23	0.34	24,957.39	0.32	1.04	1.67
Class 10	4,864.00	1.14	45,572.52	0.59	1.93	3.09
Class 11	3,718.44	0.87	44,050.67	0.57	1.52	2.44
Class 12	2,214.39	0.52	47,825.16	0.62	0.84	1.34
Class 13	1,294.56	0.30	20,491.25	0.27	1.14	1.83
Class 14	3,466.47	0.81	26,675.84	0.35	2.35	3.76
Class 15	2,402.53	0.56	33,955.94	0.44	1.28	2.05
Class 16	5,302.34	1.24	55,673.47	0.72	1.72	2.76
Class 17	4,594.90	1.08	44,026.87	0.57	1.88	3.02
Class 18	4,816.85	1.13	33,393.72	0.43	2.60	4.18
Class 19	4,337.81	1.02	45,501.35	0.59	1.72	2.76
Class 20	2,800.17	0.66	34,187.00	0.44	1.48	2.37
Class 21	7,395.74	1.73	74,139.60	0.96	1.80	2.89
Class 22	2,736.35	0.64	32,646.03	0.42	1.51	2.43
Class 23	768.15	0.18	23,578.10	0.31	0.59	0.94
Class 24	8,938.72	2.09	87,761.51	1.14	1.84	2.95
Class 25	4,904.25	1.15	56,830.82	0.74	1.56	2.50
Class 26	7,393.07	1.73	58,832.15	0.76	2.27	3.64
Class 27	8,112.52	1.90	101,753.27	1.32	1.44	2.31
Class 28	7,590.11	1.78	84,599.28	1.10	1.62	2.60
Class 29	2,953.85	0.69	79,865.38	1.04	0.67	1.07
Class 30	13,655.93	3.20	125,785.72	1.63	1.96	3.14
Class 31	7,764.92	1.82	155,558.19	2.02	0.90	1.45
Class 32	9,755.80	2.29	102,078.19	1.33	1.73	2.77
Class 33	14,511.93	3.40	187,075.78	2.43	1.40	2.25
Class 34	18,026.88	4.22	179,194.33	2.33	1.82	2.91
Class 35	4,481.03	1.05	97,628.51	1.27	0.83	1.31
Class 36	21,630.57	5.07	259,472.47	3.37	1.50	2.41
Class 37	12,236.17	2.87	261,134.43	3.39	0.85	1.36
Class 38	6,861.10	1.61	285,554.29	3.71	0.43	0.70
Class 39	19,678.16	4.61	360,498.07	4.68	0.99	1.58
Class 40	26,309.98	6.61	256,290.00	3.33	1.85	2.97
Class 41	18,762.79	4.40	279,855.64	3.63	1.21	1.97
Class 42	5,711.99	1.34	244,593.80	3.17	0.42	0.68
Class 43	1,513.62	0.35	130,569.44	1.69	0.21	0.34
Class 44	200.16	0.05	118,163.58	1.53	0.03	0.05
Class 45	1,952.18	0.46	192,735.51	2.50	0.18	0.29
Class 46	2,727.01	0.64	77,262.91	1.00	0.64	1.02
Class 47	13,401.29	3.14	134,914.37	1.75	1.79	2.88
Class 48	11,540.07	2.70	112,147.35	1.46	1.86	2.98
Class 49	644.95	0.15	33,216.69	0.43	0.35	0.56
Class 50	0.00	0.00	16,521.28	0.21	0.00	0.00
Totals	426,849.36	100.44	7,705,639.14	100.00	62.34	100.00

2000 Meter Buffer						
	Acres within Buffer	Percentage of Acres in Buffer	Total Area Acres	Percentage of Study Area Acres	Selection Ratio	Standarized Selection Ratio
Class 1	136,421.24	8.25	1,492,005.80	19.36	0.43	0.71
Class 2	188,349.55	11.38	731,721.14	9.50	1.20	2.00
Class 3	68,766.72	4.16	388,256.97	5.04	0.82	1.37
Class 4	14,368.70	0.88	66,631.99	0.86	1.02	1.70
Class 5	41,037.64	2.48	194,923.21	2.53	0.98	1.63
Class 6	16,102.28	0.97	64,677.14	0.84	1.16	1.93
Class 7	23,407.95	1.41	67,736.85	0.88	1.61	2.68
Class 8	11,248.95	0.68	33,118.17	0.43	1.58	2.63
Class 9	4,612.02	0.28	24,957.39	0.32	0.86	1.43
Class 10	16,539.73	1.00	45,572.52	0.59	1.69	2.81
Class 11	13,476.68	0.81	44,050.67	0.57	1.42	2.37
Class 12	9,043.69	0.55	47,825.16	0.62	0.88	1.47
Class 13	4,001.77	0.24	20,491.25	0.27	0.91	1.51
Class 14	11,922.37	0.72	26,675.84	0.35	2.08	3.47
Class 15	9,255.41	0.56	33,955.94	0.44	1.27	2.11
Class 16	17,295.03	1.08	55,673.47	0.72	1.50	2.50
Class 17	15,839.85	0.96	44,026.87	0.57	1.68	2.79
Class 18	15,878.55	0.96	33,393.72	0.43	2.21	3.69
Class 19	14,902.68	0.90	45,501.35	0.59	1.53	2.54
Class 20	8,561.54	0.52	34,187.00	0.44	1.17	1.94
Class 21	25,476.00	1.54	74,139.60	0.96	1.60	2.67
Class 22	9,892.79	0.60	32,646.03	0.42	1.41	2.35
Class 23	2,801.29	0.17	23,587.10	0.31	0.55	0.92
Class 24	31,447.08	1.90	87,761.51	1.14	1.67	2.78
Class 25	16,497.25	1.00	56,830.82	0.74	1.35	2.25
Class 26	24,704.29	1.49	58,832.15	0.76	1.96	3.26
Class 27	29,132.39	1.76	101,753.27	1.32	1.33	2.22
Class 28	28,228.58	1.71	84,599.28	1.10	1.55	2.59
Class 29	11,566.53	0.70	79,865.38	1.04	0.67	1.12
Class 30	50,456.28	3.05	125,785.72	1.63	1.87	3.13
Class 31	29,291.01	1.81	155,558.19	2.02	0.90	1.49
Class 32	35,511.57	2.15	102,078.19	1.32	1.62	2.70
Class 33	55,439.70	3.35	187,075.78	2.43	1.38	2.30
Class 34	67,633.84	4.09	179,194.33	2.33	1.76	2.93
Class 35	19,141.53	1.16	97,628.51	1.27	0.91	1.52
Class 36	86,054.36	5.20	259,472.47	3.38	1.54	2.59
Class 37	49,501.09	2.99	261,134.43	3.39	0.88	1.47
Class 38	27,611.66	1.67	285,554.29	3.71	0.45	0.75
Class 39	77,848.21	4.71	360,489.07	4.68	1.01	1.67
Class 40	103,631.12	6.26	256,209.00	3.33	1.88	3.14
Class 41	74,806.52	4.52	279,855.64	3.63	1.24	2.07
Class 42	22,316.21	1.35	244,593.80	3.17	0.42	0.71
Class 43	6,117.64	0.37	130,569.44	1.69	0.22	0.36
Class 44	1,117.31	0.07	118,163.58	1.53	0.04	0.07
Class 45	10,196.08	0.62	192,735.51	2.50	0.25	0.41
Class 46	11,803.61	0.71	77,262.91	1.00	0.71	1.18
Class 47	52,616.18	3.18	134,914.37	1.75	1.82	3.02
Class 48	45,618.75	2.76	112,147.35	1.46	1.89	3.15
Class 49	2,698.54	0.16	33,216.69	0.43	0.38	0.63
Class 50	2,698.54	0.16	16,521.28	0.21	0.76	1.27
Totals	1,652,888.30	100.00	7,705,558.14	100.00	60.02	100.00

Table J5. Three of fifty classes from an unsupervised classification for which spectacled eider show relative preference, matrixed with the NPR-A earth cover.

Unsupervised Classification	NPR-A Earth Cover #	NPR-A Earth Cover Classes	Acres	Percentage
14	1	Clear Water	262.65	0.98%
14	2	Turbid Water	3,399.97	12.75%
14	4	Carex aquatilis	6,674.96	25.02%
14	5	Arctophila fulva	918.27	3.44%
14	6	Flooded Tundra - LCP	8,945.17	33.53%
14	7	Flooded Tundra - Nonpattern	237.30	0.89%
14	8	Wet Tundra	5,690.64	21.33%
14	9	Sedge/Grass Meadow	129.66	0.49%
14	10	Tussock Tundra	86.07	0.32%
14	11	Moss/Lichen	21.35	0.08%
14	12	Dwarf Shrub	60.05	0.23%
14	13	Low Shrub	25.13	0.09%
14	15	Dunes/Dry Sand	31.14	0.12%
14	16	Sparsely Vegetated	8.67	0.03%
14	17	Barren Ground Other	184.59	0.69%
14	18	Clouds/Bad Pixels	0.22	0.00%
Totals			26,413.17	100.00%
Unsupervised Classification	**NPR-A Earth Cover #**	**NPR-A Earth Cover Classes**	**Acres**	**Percentage**
18	1	Clear Water	194.37	0.58%
18	2	Turbid Water	707.44	2.12%
18	4	Carex aquatilis	443.23	1.33%
18	5	Arctophila fulva	700.77	2.10%
18	6	Flooded Tundra - LCP	14,874.88	44.54%
18	7	Flooded Tundra - Nonpattern	14,398.29	43.12%
18	8	Wet Tundra	782.16	2.34%
18	9	Sedge/Grass Meadow	238.63	0.71%
18	10	Tussock Tundra	338.26	1.01%
18	11	Moss/Lichen	41.59	0.12%
18	12	Dwarf Shrub	252.86	0.76%
18	13	Low Shrub	36.47	0.11%
18	15	Dunes/Dry Sand	32.69	0.10%
18	16	Sparsely Vegetated	18.46	0.06%
18	17	Barren Ground Other	333.59	1.00%
Totals			33,393.70	100.00%
Unsupervised Classification	**NPR-A Earth Cover #**	**NPR-A Earth Cover Classes**	**Acres**	**Percentage**
26	1	Clear Water	215.28	0.37%
26	2	Turbid Water	361.17	0.61%
26	4	Carex aquatilis	292.23	0.50%
26	5	Arctophila fulva	21.57	0.04%
26	6	Flooded Tundra - LCP	45,984.59	78.16%
26	7	Flooded Tundra - Nonpattern	4,265.31	7.25%
26	8	Wet Tundra	1,706.88	2.90%
26	9	Sedge/Grass Meadow	493.49	0.84%
26	10	Tussock Tundra	513.73	0.87%
26	11	Moss/Lichen	3,360.39	5.71%
26	12	Dwarf Shrub	315.80	0.54%
26	13	Low Shrub	70.50	0.12%
26	15	Dunes/Dry Sand	171.24	0.29%
26	16	Sparsely Vegetated	86.29	0.15%
26	17	Barren Ground Other	973.64	1.65%
Totals			58,832.12	100.00%

Appendix K

Contact Information

The following additional data is available:

ARC/INFO coverages
Final map classification in ERDAS Imagine format
Final map compositions in Imagine 8.2 format
Raw Landsat TM and DEM imagery
Field database files and FoxPro data entry program
ArcInfo coverage of aerial photogragh flight lines

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