EIDER BREEDING POPULATION SURVEY
ARCTIC COASTAL PLAIN, ALASKA
2002

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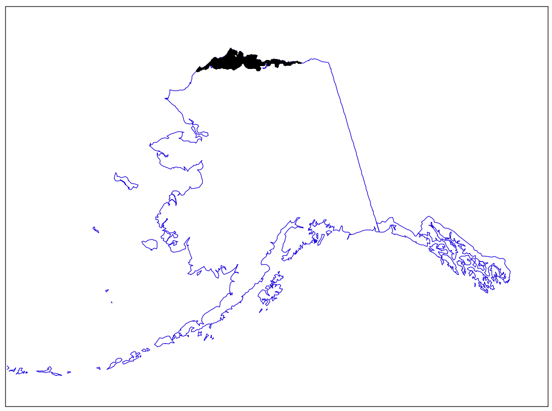

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Abstract. The North Slope Eider Survey has been conducted for 11 consecutive years, 1992 to 2002. Survey techniques have remained constant, except that since1997 observations have been dictated directly into computers that were connected to an onboard GPS, yielding precise coordinates for all observations. The survey pilot was the same person for all years, while the copilot/observer changed in 1997, 2000, and 2002. In 1998 the survey area was split into 11 geographical strata based on habitat features and the boundaries of the National Petroleum Reserve of Alaska, northeast planning area. Data were re-analyzed for all years using the new stratification, which slightly improved precision of the estimates and facilitated area-wise comparisons. The spring thaw and eider phenology were early in the western arctic in 2002, but about average in the Prudhoe Bay area. The 2002 breeding index for spectacled eiders was 6,662. This is close to the long-term average of 6,896, with the population growth rate not significantly different from 1.0. The 2002 King eider index was 14,730, which is14 percent above the 1993-2002 mean. The king eider breeding index indicates an increasing trend (1.031) which is significant at p=0.9, with variance based on sampling error among transects only. Significant long term increases were noted for arctic terns, red-breasted merganser, scaups, long-tailed duck, king eider, and black brant, while the index for red-throated loons has declined. Growth rates for other species have not shown a significant departure from 1.0 since 1992. We conducted replicate surveys of a small reference area in the western portion of the survey area concurrently with operational survey transects from 1999 through 2002, to help evaluate the appropriateness of survey timing. While inconclusive due to the possible presence of transient birds, results suggested that timing was appropriate for spectacled eiders in all years, with the possible exception of 2002, when male departure appeared to begin in that portion of the north slope during the last 2-3 days of the survey. Results of the reference area study for king eiders suggests a less synchronous phenology and higher proportion of transient birds as compared with spectacled eiders, and the resulting highly variable results provided little help for interpreting survey timing for that species.

Key Words: Eider, spectacled, *Somateria fischeri,* Steller's, *Polysticta stelleri*, king, *Somateria spectabilis,* breeding, population, Aerial, survey, waterfowl, arctic, Alaska

INTRODUCTION

A comprehensive aerial waterfowl breeding population survey was initiated in the Arctic Coastal Plain of Alaska in 1986, and has continued annually to the present time. That survey, however, conducted from late June through early July, is phenologically too late for an accurate assessment of eiders, the males of which typically begin to depart the breeding grounds for the post-nuptial molt by about 20 June. Accordingly, in anticipation of the listing of spectacled and Steller's eiders under the Endangered Species Act, a second, earlier survey was initiated in 1992 to obtain an accurate annual population index and distributional data for these two species. The latter survey has consistently provided useful data for spectacled eiders, king eiders, and several other species of waterfowl, but has proven inadequate in sampling intensity for Steller's eiders, which are present on the arctic coastal plain in very low densities. The survey has been conducted annually using essentially the same design since it's inception, though improvements in data collection technology and analysis have been added along the way. This report includes methods and results for the 2002 eider breeding population survey, and summaries for 1992-2002.

OBJECTIVES

Spectacled Eider Recovery Plan (U. S. Fish and Wildlife Service 1996) tasks related to the demographics of the spectacled eider North Slope breeding population are as follows:

B1.1. Determine the breeding range and relative abundance of spectacled eiders on the North Slope.

This task is listed as completed as of 1996 by this and various other surveys conducted by agencies and industry.

B1.4. Monitor trends and generate breeding pair abundance estimates for the [North Slope] breeding population.

This task relates to the decision criteria for future delisting or reclassifying from Threatened to Endangered. These criteria are based on population growth rate and the minimum abundance estimate, which is defined as "the greater of the lower end of the 95% confidence interval from the best available estimates, or the actual number of birds counted". It is generally known that aerial observers detect less than 100 percent of the birds within the sample area, and of course the recovery team wants to evaluate these criteria against estimates that have been adjusted for observer bias, rather than uncorrected indices, so they have requested that detection rate studies be conducted to determine these values (*Task B1.4.1.2*).

In addition, with increasing interest in expanding commercial interests in resource extraction and transportation on the North Slope, there is increasing demand for precise waterfowl distributional data for permitting and other decision making, particularly for listed species such as spectacled and Steller's eiders and other species of concern.

Our specific objectives, then, are:

1. Determine the population trend for spectacled eiders in light of recovery and reclassification criteria, including power analysis.

2. Estimate the abundance of spectacled eiders observable from the air.

3. Develop and implement a detectability study to correct for birds present but not detected in the sample area by observers.

4. Describe the distribution of observed eiders within 500 m. of actual location, covering all known spectacled eider habitat on a rotational basis each 4 years using a systematic grid with less than 2 km between sampled strips. Use data to produce point location and density polygon maps describing location of observed eiders and areas with specified ranges of (multi-year mean) peak eider breeding density.

5. Collect, analyze and report similar data for all other waterfowl, loons, grebes, eagles, owls, ravens, gulls, terns, and jaegers within the spectacled eider survey area.

STUDY AREA AND METHODS

Aerial crew for 2002:
Pilot/port observer: **William Larned**, *Migratory Bird Management, Soldotna*
Starboard observer: **Alan Brackney**, *Arctic National Wildlife Refuge, Fairbanks*

Survey techniques followed those described by Butler et al. (1995). Transects were oriented roughly east-west, and consisted of computer-generated segments of great-circle routes, for compatibility with Global Positioning System (GPS) navigation. The lines, along with end-point coordinates, distance figures and segment end indicators, were machine-plotted on 1:250,000 scale U.S. Geological Survey topographic maps, which were used for navigation. Transects were spaced systematically from a randomly-selected starting point, at intervals of 2.3 km. Every fourth transect was flown on a given year, with the sampling frame shifted incrementally each year, requiring 4 years for coverage of all transects. Thus the transects flown in 1997 were duplicates of those flown in 1993. However, the GIS base map for the survey area boundary was redrawn in 1998, and the survey lines for that year approximated those of 1997. The annual incremental frame shift was then resumed based on the new coverage. In 1998 we split the survey area into 11 geographical strata, based on a habitat classification map developed by Ducks Unlimited, and the boundaries of the NPRA Northeast Planning Area (Fig. 1). All results presented in this report, including those from previous years, were calculated using this stratification, so slight differences may be seen when comparing data herein with corresponding figures from earlier reports. Advantages of this stratification system are that it decreased the variance for estimates of eiders and most other waterbirds, and it facilitates comparisons between different geographic areas within both the Eider Survey area and the area of the Standard ACP Breeding Population Survey (the strata for this survey are a subset of those for the ACP Survey (Fig. 1)). The survey transects flown in 2002 are depicted in Fig. 2. Flight hours required to complete the survey in 2002 totaled 38.1 on transects (table 1), plus 2 hours for reconnaissance. These hours did not include ferry time to and from the survey area.

We used a Cessna 206 amphibian for all years of this survey. Navigation equipment included a GPS, a radar altimeter, and a Horizontal Situation Indicator (HSI) slaved to a remote compass, with integrated GPS course deviation indicator. We flew along the transect center lines at 30 m altitude and 176±19 $km \cdot hr^{-1}$ ground speed, while both the pilot and the right-hand observer recorded all water birds, avian predators and shorebirds observed within 200 m of either side of the aircraft. Observers used tape markers placed on the aircraft lift struts to aid in estimating the outer transect (strip) boundaries. The marker locations of 8.5 degrees below the horizontal at eye level were determined using a clinometer. We recorded bird observations as singles, pairs and flocked birds according to the protocol used for the North American Waterfowl Breeding Population Survey (U. S. Fish and Wildlife Service and Canadian Wildlife Service 1987). We actively minimized observations in the "unknown eider" category by occasionally leaving the transect centerline to confirm identification of eiders. Additional birds seen as a result of these maneuvers were not included in the data set.

Beginning in 1997 a new data acquisition system was used, in which observations were entered vocally into a microphone connected to a laptop computer. The computer also received GPS position data concurrently via a serial connection from the panel-mounted GPS receiver. These two inputs resulted in a sound file (.wav format) with a linked .pos file containing location, date and time. To create a final data file, the observer played back the sound file on the computer and entered the species name and group size for each observation, using a custom transcribing program. The transcription program produced an ASCII text file, each line containing a single observation including species code, group size, and latitude-longitude coordinates, as well as date, time, stratum and transect identifiers. Additionally, the system output a track file which is a list of position coordinates for the aircraft recorded every five seconds during flight. A separate computer was used by each observer, and each computer was connected to the GPS and supplied with power via a 28-volt DC to 110-volt AC inverter connected to the aircraft's electrical system. The software used for this system was developed by John I. Hodges, U.S. Fish and Wildlife Service, Migratory Bird Management, 3000 Vintage Blvd., Suite 240, Juneau, AK 99801-7100. The resultant files may be used to produce map, tabular and other products describing population trends and distribution of the various taxa surveyed.

Waterfowl observation data were treated according to protocol described for the standard North American Waterfowl Breeding Population Surveys (U.S. Fish and Wildlife Service and Canadian Wildlife Service 1987). That is, for all ducks except greater scaup, the indicated total population index is calculated as twice the number of males observed as singles, in pairs, and in groups of males up to four, plus birds in flocks of 5 or more males or mixed sex. In 2002 we also doubled single dark geese (white-fronted geese, Canada geese and black brant), to account for assumed undetected mates on nests, which is a departure from that protocol. Historical data were changed accordingly for multi-year analysis. For scaup (which are known to have sex ratios strongly skewed toward males) and all other species, singles were not doubled and the population indices are based on total birds observed.

This survey attempts to index the number of birds of various species of waterfowl and other selected bird groups that are present within the study area. The term index as used here is defined as a number (count) that represents an unknown proportion of the population of birds occupying the survey area during the nesting season, based on adult males for eiders and other sexually dimorphic species. While unknown, the proportion is assumed to be constant among years, and the index may therefore be used to track population changes through time. Bias in this survey comes primarily from three sources: sampling error due to the nonrandom distribution of birds within the sample, timing of the survey relative to bird breeding phenology, and variations in detection of birds in the sample. Sampling error is addressed using ratio estimate procedures described by Cochran (1977), and the calculated variance is used to produce 95% confidence intervals for the population estimates. Survey timing is designed to coincide with the presence of spectacled and king eider males, which are normally present on the breeding grounds only from arrival until shortly after nest initiation. Variations in timing of arrival and departure between individual spectacled eider males on a study area in the Prudhoe Bay vicinity suggest that there may be few, if any, days when all breeding males are present in the survey area at the same time, especially in years of early spring melt (Troy 1997). Median nest initiation dates for Spectacled eiders at Prudhoe Bay from 1993 to 1996 varied from 7 to 16 June (average 1982-96 = 15 June), and telemetry data suggest that male departure begins within about 3 days of that date, and is more synchronized in the years when it commences later (Troy 1997). Most males have departed the area by 20 to 25 June. It is unknown how phenology in the Prudhoe Bay area compares with other parts of the Arctic Slope. King eider phenology is similar, but the period of male presence is normally more protracted and possibly less synchronous, perhaps because king eiders utilize a greater diversity of wetland types which thaw at different times. In general in the high arctic, king eiders begin to nest in the last half of June, about 2-3 weeks after arrival (Bellrose 1976). Daily counts of male king eiders on a Study area immediately southeast of Teshekpuk Lake in 2002 indicated a stable presence from June 8 to 16, with rapid departure of most males on 18 June (Powell pers. comm.). On 18 June a brief spike in the number of males present suggested a transient group of departing males moving through the study area. An earlier study in Canada found males departing from Bathurst Island, N.W.T., rather abruptly and synchronously from one week to 10 days after clutch initiation (Lamothe 1973). For our survey we assumed that proper timing for spectacled eiders is adequate for king eiders as well.

Our procedure for determining proper survey timing consisted of the following: 1. We monitored weather, and ice and snow cover data, planning to arrive in the survey area when ponds and tundra vegetation are available to nesting eiders over most of the arctic slope. 2. We contacted biologists in Prudhoe Bay and Barrow for their observations on eider phenology. 3. We flew reconnaissance surveys to determine the distribution of spectacled eider pairs. When the most eider pairs appeared to be occupying breeding territories rather than in mixed-sex flocks, we began the survey. Since the survey is timed for eiders, its appropriateness for other species varies and is likely questionable for some. It has been assumed that the standard breeding population survey conducted in Late June and early July is timed better for some of the other ducks, geese, swans and other waterbirds, as some may be still arriving and dispersing to breeding territories during the eider survey.

We used two methods to determine retrospectively the appropriateness of the timing of our survey. First, beginning in 1997 we used a ratio of lone drakes (singles) to total indicated pairs (singles plus pairs) averaged over the entire survey sample as an index for spectacled and king eiders, to help compare survey timing between years for these primary target species (Larned and Balogh 1997). The assumption inherent in this index is that the proportion of lone or grouped males in the surveyed population will increase as the season progresses because males remain visible as lone males on breeding ponds as females spend more time with nesting activities. While we feel this is valid with species such as pintails that often linger and molt in wetlands within the survey area, with eiders there is a greater tendency for males to leave the breeding grounds immediately after nest initiation than with most other ducks, making many lone males unavailable for observation. Therefore, while this index is helpful in concert with other indicators of phenology, it could be misleading when considered independently.

For the second method, beginning in 1999 we added a phenology reference area. This study area consists of a 97.4 km^2 irregular polygon located about 10 km northwest of our fuel cache at Atqasuk Village (Fig. 3). In 1999 and 2000 we flew this polygon as often during the survey as practicable, collecting bird data as in the operational survey. We flew a set of transects in a roughly parallel north-south but adaptive fashion, maneuvering the aircraft to most efficiently cover all water bodies, given current conditions of wind and sun angle etc. The coverage was designed as a comparable 100 percent coverage. Data consisting of daily counts of total birds and relative numbers of singles, pairs and flocked birds enabled us to attempt to evaluate our survey timing in relation to apparent breeding phenology. We did not use these data to adjust our survey data in any way to compensate for errors resulting from inappropriate survey timing.

In 2001 we determined that we had not been obtaining a complete coverage, and the adaptive transects, and therefore likely our coverage, varied from survey to survey. Therefore, we attempted to further standardize coverage by flying a set of 14 pre-drawn (electronic) north-south transects using our standard survey technique, which produced a standardized 50 percent coverage (Fig. 4).

We have made little progress in addressing the detection rate objective. The survey is assumed to track the population of birds that visits the survey area during the breeding season. Of this total, some birds will not be represented in the sample because: 1. They have not yet arrived in the survey area; 2. They have left the survey area; 3. They have departed the sample transect before detection, due to disturbance by the aircraft; 4. They are not visible from the aircraft (hidden by vegetation, terrain, aircraft fuselage etc.); 5. They are misidentified; 6. The observers fail to see them due to any of several variables of detection bias, such as fatigue, experience level, visual acuity differences, distractions, sunlight conditions, presence or absence of snow and ice, bird behavior, and work load (density of other birds or objects competing for the observer's attention). As previously mentioned, we have attempted to minimize the effects of numbers 1 and 2 by proper survey timing. Aerial survey crews working in other areas have attempted to compensate for the net effect of these variables by ground-truthing a sub-sample using ground or helicopter crews (US Fish and Wildlife Service and Canadian Wildlife Service 1987), using those data to calculate visibility ratios to adjust operational survey data. During the 2001 survey we conducted a fixed-wing/helicopter detectability study covering a 270 km^2 subset of our operational transects. The results of this study were not satisfactory; therefore we are still left with an unadjusted annual index to abundance, for which we strive diligently to minimize the effects of the variables of phenology and observer bias.

RESULTS AND CONCLUSIONS

Habitat conditions and survey timing

There was an unusually early thaw for most of the Slope in 2002. Barrow reported most snow gone from the tundra by 22 May, and mild temperatures. Then the last few days of May and early June the temperature dropped and small ponds that had begun to thaw re-froze. Our reconnaissance flights on 8 June and first survey flights found most tundra nesting cover open, even very close to the coast, but nearly all large thaw lakes and many small ponds were still frozen. According to reports from Barrow and Kuparuk, and our observations, timing of waterfowl arrival was about normal. We initiated the survey on 9 June, and spectacled eiders seemed to be occupying territories in pairs, though we saw some king eiders still in large flocks. Temperatures by 9 June were staying above +5° C in the Deadhorse area, which hastened the thaw process. The ratio of lone males to total males during the survey, a rough measure of survey timing in relation to nest initiation, was average for king eiders (.34) and slightly above average for spectacled eiders (.53), suggesting a slightly late survey timing for spectacled eiders (Table 2). This measure should be used cautiously, as male eiders usually depart from the tundra habitats soon after nest initiation.

Phenology reference area surveys

Surveys have been flown over a 97.4 km2 study area in a high-density spectacled eider breeding area near Atqasuk periodically during the survey each year since 1999 to help us evaluate the appropriateness of the timing of our survey. This year we surveyed the reference area on 6/10, 6/13, 6/16, and 6/22. Spectacled eider numbers in the reference area seemed to drop off precipitously immediately after the survey period, suggesting that male departure was earlier than normal this year, and perhaps we were slightly late in survey initiation (Fig. 5). Our observations on a flight from Barrow to Atqasuk on 6/16 also suggested a dramatic departure at this time, as we saw few eiders in even the best habitats. An increasing ratio of lone males to pairs suggests nest initiation was occurring during the survey (Fig. 5). As usual, the picture for king eiders was confusing, with fairly level numbers observed through 16 June but a decreasing proportion of lone males vs. pairs. A drop-off in king eiders occurred between 16 and 22 June, but pairs were still seen on the 22nd. Long-tailed duck numbers were relatively constant through 22 June, but the proportion of pairs vs. lone males dropped off after 16 June (Fig. 5).

Population estimates and breeding distribution for selected species

Table 4 presents tallies for sample data (single, pair and flocked bird totals in the sample), as well as estimates calculated from these data, for 2002. Table 5 presents long-term population trend slopes, growth rates, and the power of the survey to detect trends expressed as estimates of the number of years required to detect a 50 percent growth or decline in 10 years. Figures 8-36 include stacked bar graphs depicting annual sample composition (singles, pairs, flocked birds), annual population indices with 95 percent confidence limits based on within-year sampling error among transects as stratified by 11 physiographic regions, and average annual growth rate as determined by log-linear regression. Annual indices and other values are calculated for singles and pairs only and for total indicated birds.

In 2002 the spectacled eider index of 6,662 was slightly below the 1993-2002, and the trend showed a non-significant downward trend of 0.987 (Fig. 22). The king eider index (14,730) was 14 percent above the average, and the trend shows a significant positive growth rate of 1.031 (Fig. 24). No Steller's eiders were recorded this year, and none were seen off-transect.

The long-tailed duck index (40,846) was the highest yet, and 21 percent above the 1992-2002 mean (Fig. 21). The upward growth rate of 1.021 is significant at p = 0.90. The red-breasted merganser index of 585 was the second highest since the survey began and the growth rate of 1.118 for this index was barely significant (Fig. 15). The scaup index (Fig. 20) was approximately double the mean value, with flocked birds contributing an unusually high proportion of the total. This high value was largely responsible for the significantly high growth rate of 1.073. American wigeon (Fig.17), northern shoveler (Fig. 18), northern pintail (Fig. 19), and white-winged scoter (Fig. 26) all showed non-significant positive growth rates, while the mallard was slightly downward (Fig. 16).

Snow geese (Fig. 27), white-fronted geese (Fig. 28), Black Brant (Fig. 30), Tundra swans (Fig. 31), and sandhill cranes (Fig. 32) all show positive growth rates, but only the brant rate was significant.

Among loons, the yellow-billed loon index of 1551 was the highest on record, but the growth rate of 1.006 was not significantly different from 1.0 (Fig. 8). The pacific loon also had a non-significant upward trend (Fig. 9), while red-throated loons had a slightly below-average year and a significant negatively-sloping growth rate of 0.930 (Fig. 10).

Jaegers (Fig. 11), Glaucous gulls (Fig. 12), and Sabine's gulls showed no significant departure from a level trend, but arctic terns continued a persistent and significant upward trend, with a growth rate of 1.075 (Fig. 14). Despite widespread concern about increasing common raven populations on the Slope, we see no evidence as yet in our data (Fig. 34). This may be because ravens tend to be clustered around villages and commercial facilities, which our survey does not specifically sample. Snowy owls had another year of low density in 2002 (Fig. 36). Nineteen ninety-five was the only year since the survey's inception that had a large number of snowy owls present on the Slope.

Distribution of observations of spectacled and king eiders for 2002 (Figs. 6 and 7, respectively) were grossly similar to those of past years (Larned et. al 2001, density polygon maps, 1992-2000).

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