Relative Abundance and Distribution of Geese, Swans, and Sandhill Cranes on the Coastal Zone of the Yukon-Kuskokwim Delta

by

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Data and conclusions presented here are preliminary and are not for publication or citation without permission from the authors.
Introduction

In 1985, the Fish and Wildlife Service began development of an aerial breeding pair survey to estimate populations and determine distribution of geese nesting in the coastal zone of the Yukon Delta National Wildlife Refuge. The results of the population aspect of this study have been reported in three progress reports (Butler and Malecki 1986, Butler et al. 1987 and 1988). Preliminary distribution maps were presented in the first progress report (Butler and Malecki 1986). This progress report presents updated relative abundance and distribution maps based on three years of survey data.

Study Area

The study area for this report encompassed 4,900 square miles of coastal zone habitat between the mouths of the Yukon and Kuskokwim Rivers (Figure 1). It is located entirely within the boundaries of the Yukon Delta National Wildlife Refuge, the largest wildlife refuge in the nation. The central portion of the study area has been described as "America's greatest goose-brant nesting area" (Spencer et al. 1951). Currently, 12 Yup'ik Eskimo villages ranging in population from 150 to over 600 people are located within the boundaries of the study area.

Methods

Aerial Survey

In 1985, 65 transects were located at 2-, 4-, or 8-mile intervals from a single random starting point (Figure 2). Transects varied from 8-40 miles in length, totaling 1,408 miles. Ninety transects, totaling 1,672 miles were flown in 1986 (Figure 3). Transects were located at 1-, 2-, 4-, and 8-mile intervals and varied from 8-40 miles in length. One hundred and five transects located at 0.75-, 1-, 2-, 4-, and 8-mile intervals were flown in 1987 (Figure 3). Transects varied from 4-40 miles in length, totaling 1,714 miles.

Transects were conducted following conventions established for breeding ground surveys in North America (U.S. Department of the Interior 1973). A Cessna 206 aircraft was flown at 85-95 mph and at altitudes of 100-150 feet. A Loran C was used for navigation which allowed transects to be flown with precision. Surveys were flown only in good weather conditions with wind 20 mph or less, ceiling greater than 500 feet, and visibility greater than 20 miles. Surveys were conducted from 6 June to 24 June in 1985, from 2 June to 22 June in 1986, and from 3 June to 22 June in 1987.

The pilot and right seat observer recorded all singles, pairs, and flocks of Canada geese (Branta canadensis), emperor geese (Anser canagica), white-fronted geese (Anser albidifrons), and tundra swans (Cygnus columbianus) seen in a one-eighth mile strip on each side of the aircraft. In 1987 sandhill cranes (Grus canadensis) were also recorded. Observations were recorded on continuously running cassette tape recorders. Tapes were replayed
and the data were transferred to Epson HX-20 computers by keystrokes to specific keys for each species and group size. The computer provided summary information for observations for each species by 8 or 4 mile transect segments and calculated the distance in miles of each observation from the start of each segment.

Relative Abundance and Distribution Maps

For geese and sandhill cranes, the number of single plus paired observations sighted on transects were considered to indicate breeding pairs. For tundra swans sighted on transect, the number of paired swans plus the number of singles divided by two were considered indicative of breeding pairs. Flocked observations were considered to represent the nonbreeding component of the population for all species.

Since cackling Canada geese (B.c. minima) cannot always be distinguished from Taverner's Canada geese (B.c. taverneri) from the air, a rational for determining the distribution of each species was developed. The approach was to define an area within which all Canada goose observations were considered cackling Canada geese. Four factors were utilized in this determination: 1) the historic range of cackling Canada geese (Nelson and Hansen 1959, Spencer et al. 1951); 2) personal knowledge of cackling Canada goose distribution from on ground experience and discussions with other biologists and local people; 3) the inland extent of aerial observations identified with certainty as cackling Canada geese; and 4) use of Landsat imagery to identify an inland boundary line between storm tide influenced and more upland tundra habitat.

The study area was divided into 33 physiographic regions based on visual interpretation of 1/250,000 scale Landsat images of the coastal zone (Figure 5). The main criteria used for outlining these regions were observed patterns of physiographic features (i.e., coastal areas of low elevation with small to medium sized lakes verses higher elevation inland areas with larger lakes). Contiguous geographic areas with broadly homogeneous patterns were delineated. The number of indicated breeding pairs within each physiographic area was determined by combining 1985-87 transect data for geese and swans. The number of breeding pairs for sandhill cranes was based only on 1987 transect data. Physiographic areas having a similar number of indicated breeding pairs were combined to produce the relative abundance and distribution maps.

Results

The major nesting habitat of cackling Canada geese encompasses 1,592 square miles (Figure 6). The average density of indicated breeding pairs within this area was 3.4 pairs/mi\(^2\). Densities of indicated breeding pairs varied from less than 1 pair/mi\(^2\) in inland areas and along the coast north of Scammon Bay to greater than 12 pairs/mi\(^2\) in the Kokechik Bay and Kigigak Island regions.
The 142 square mile region along the northern coastal fringe of the Yukon River Delta (Figure 6) is a mixed Taverner Canada goose-cackling Canada goose nesting area. The number of breeding pairs observed in this area was 0.13/mi², and less than 10 percent of these were thought to be cacklers.

The nesting habitat for Taverner's Canada goose encompassed 3,190 square miles, including the mixed Taverner-cackler area (Figure 7). Less than one indicated breeding pair/square mile was recorded over most of the area. Densities were highest in the 251 square mile central portion of the North Yukon Delta, where numbers of indicated breeding pairs reached 3 indicated breeding pairs/mi².

The major nesting habitat of emperor geese encompassed 2,350 square miles (Figure 8). The average density of indicated breeding pairs within the area was 1.5 pairs/mi². Densities ranged from less than 1 pair/mi² on the south side of Nelson Island and on the coastal fringe of the North Yukon Delta to greater than 7 pairs/mi² in Kokechik Bay area.

Greater white-fronted geese were observed over the entire study area (Figure 9). The average number of indicated breeding pairs in the area was 0.72 pair/mi². Densities of indicated breeding pairs ranged from less than 1 pair/mi² over much of the inland areas to 3 pairs/mi² along the coast south of Nelson Island.

Relative abundance zones were also determined for all geese combined (Figure 10). The average number of indicated breeding pairs for combined species over the study area was 3 pairs/mi². Densities of indicated breeding pairs ranged from less than 2 pairs/mi² north of Scammon Bay and south of Nelson Island to greater than 25 pairs/mi² at Kokechik Bay and Kigigak Island.

Tundra swans were observed over the entire study area. The average density of tundra swan pairs over the study area was 1.1 pairs/mi². Densities ranged from less than 1 pair/mi² over the northern and southern portions of the study area to greater than 3 pairs/mi² over the northern interior of Hazen Bay (Figure 11).

Sandhill cranes were observed over the entire survey area. The average density indicated breeding pairs of sandhill cranes over the study area was 1.3 pairs/mi². Densities ranged from less than 1 pair/mi² on inland areas north of Scammon Bay to 3 pairs/mi² over the northern interior of Hazen Bay (Figure 12).

Discussion

Survey Assumptions

Single plus paired observations were determined to be the best indicator of breeding pairs in aerial surveys of the eastern Prairie population of Canada geese (Malecki et al. 1981). For surveys flown during the nesting period single observations are considered to be the attending mate of an unseen
incubating female. Paired observations represent failed nesters or both members of a pair from an active nest. In this study, single and paired observations from the air were shown to correlate very well with numbers of nests present on the ground (Butler et al. 1987 and 1988). This suggests that relative abundance zones shown in figures 6 through 10 reflect real differences in the numbers of nests and/or breeding pairs present.

Tundra swan breeding pairs were determined in a different manner than geese because of differences in visibility and behavior. During nesting, mature breeding swans remain near the nest on the nesting territories and they are observed as singles and pairs with or without nests. Swans rarely flush in response to the plane, and incubating females are visible. Because single incubating swans are not missed, as is the case with geese, all single swan observations (those with nests and without nests) are considered to be half of a pair.

**Physiographic Regions and Relative Abundance**

Comparison of the current relative abundance and distribution of geese with the characteristics of the underlying physiographic regions provides general insights into the ecological factors associated with high density goose nesting habitat. The areas that support the highest densities of geese today are the coastal areas of Kokechik and Hazen Bay (Figure 5; regions 25, 26, 18, and 10), Kigigak Island (Figure 5; region 7), and the coastal fringe south of the Tutakoke River (Figure 5; regions 13 and 14). These areas are all on the coastal fringe of old deltas from previous river courses of the Yukon River that were abandoned 1,250-2,500 years ago when the Yukon took its present northern course (Dupre 1978). The underlying geologic strata are estuarine deposits with surface features that have been shaped by underlying permafrost, the freezing and thawing cycle at the surface, and the interaction of tides, waves, and wind on lakes and river born sediments. The high density goose nesting areas are characterized by large sparsely vegetated mud flats in close association with expansive sedge-grass meadow areas dissected by numerous narrow sloughs and covered with many small to medium sized lakes. The daily tide cycle fills and empties the sloughs, and flood tides occasionally inundate these areas.

The resulting habitats are very dynamic, complex mixtures of plant communities (Tande and Jennings 1986, Jackson 1978) and highly productive when compared to the stable, more inland areas of higher elevation.

The high density areas provide geese an abundance of nest sites (lake shores, peninsulas, islands, and slough banks) that provide varying degrees of protection from predators and are generally above spring meltwater and/or runoff. The nesting areas are closely associated with slightly lower, tidally-influenced vegetated areas and mudflats that are used for brood rearing. On the Yukon Delta the ecological factors discussed above combine to form extensive (100's of square miles) tidally-influenced regions with abundant nest sites intermixed with highly productive brood rearing areas capable of supporting high densities of nesting geese.
The age of these habitats may be an important factor in development of high density goose areas. The coastal fringe of the north delta of the Yukon River (Figure 5; regions 31 and 33) is influenced by similar physical factors (the combination of tidal action and river-born sediments), yet supports very low densities of nesting geese. These regions have very few lakes of any size and appear from the air as monotypic sedge flats. Because this is the young aggrading portion of the Yukon Delta and geologically younger than the regions to the south (Dupre 1979), sufficient time for the development of lakes suitable for nesting has not occurred.

Other river deltas in western Alaska do not currently support the high densities of nesting geese found in the coastal zone on Yukon Delta (King and Derksen 1986; King and Butler 1986). The largest area of vegetated intertidal habitat north of the Yukon Delta is the barrier island and estuary-river delta complex on the north side of the Seward Peninsula. It encompasses only 100 square miles. The extent of cackler nesting habitat on the Yukon Delta is 1,592 square miles by comparison. There are several differences between the Yukon delta and those deltas farther north that may determine the amount and quality of goose nesting habitat: 1) the northern rivers are much smaller and don't produce large, low elevation deltas, 2) lower sedimentation rates result in reduced mudflat areas, 3) the tidal fluctuation is much lower (1-2 feet verses 4-10 feet), 4) lower tidal flux allows the freshwater influence to extend more coastally, 5) the lack of expansive low elevation delta and low tidal flux combine to reduce the amount intertidal habitats.

Management Implications

An understanding of the these factors can help when evaluating historic distribution information and in evaluating potential reintroduction areas. Such an understanding is equally useful in interpreting the current information on distribution and abundance of geese from this study. For example, the coastal areas north of Scammon Bay (Figure 5; region 27) and the coast south of Nelson Island (Figure 5; region 3) are physiographically similar to the coastal areas south of the Tutakoke River, yet support lower densities of nesting geese. Because populations are low, it is important to recognize that present low densities of geese in some areas may not reflect the inherent capacity of the habitat to support nesting geese. For this reason all cackling Canada and emperor goose nesting habitat identified in this study should be considered critical to the recovery and restoration of these populations.
Literature Cited


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Figure 1. Location of Study Area, Yukon Delta NWR, Alaska.
FIGURE 2. Location of Transects for 1985 Coastal Zone Aerial Survey of Geese - Yukon Delta NWR, Alaska.
FIGURE 5. Physiographic Regions Used in Developing Relative Abundance and Distribution Maps in the Coastal Zone of the Yukon Delta.
FIGURE 7. Relative Abundance and Distribution of Nesting Taverner's Canada Geese in the Coastal Zone of the Yukon Delta from Aerial Surveys, Summer 1985-1987.

- Singles + pairs per square mile:
  - 0-1
  - 1-2
  - 2-3

Singles + pairs per square mile

- 0-1
- 1-2
- 2-3

MAP LEGEND:

- singles + pairs per square mile

- 0-2
- 3-6
- 6-8
- 10-14
- 16-18
- 28-30