

ANDREW
FWLB
0813



Development of an Aerial Breeding Pair Survey for
Geese Nesting in the Coastal Zone of the Yukon Delta

by

William I Butler Jr.

Migratory Bird Management Project
U.S. Fish and Wildlife Service
1011 E. Tudor Road
Anchorage, Alaska 99503

and

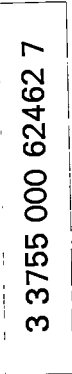
Richard A. Malecki

New York Cooperative Wildlife Research Unit
Cornell University, Fernow Hall
Ithaca, New York 14853

Progress Report
1 February 1986

Key words: Cackling Canada geese, Taverner's Canada geese,
Canada geese, emperor geese, greater white-geese, tundra
swan, nesting habitat, nesting distribution, breeding pair
survey, aerial survey, waterfowl, Yukon-Kuskokwim Delta,
Yukon Delta, Alaska.

Data and conclusions presented here are preliminary and are not
for publication or citation without permission from the authors.



Library
U.S. Fish & Wildlife Service
1011 E. Tudor Road
Anchorage, Alaska 99503

Merged With
ARLIS
Anchorage, Alaska

Abstract

Aerial surveys of nesting cackling Canada geese (Branta canadensis minima), emperor geese (Anser canagicus), greater white-fronted geese (Anser albifrons), and tundra swans (Cygnus columbianus) were conducted in the coastal zone of the Yukon Delta in 1985. The results presented are from the first year of a 3-4 year study to develop management surveys. Breeding pair estimates and 95 percent confidence intervals for each species were: cackling Canada geese (CCG) 5267 \pm 1998, emperor geese (EG) 4954 \pm 1376, greater white-fronted geese (WFG) 5820 \pm 1258, and tundra swans 8197 \pm 1238. The distribution of nesting CCG encompassed 1283 square miles. Relative abundance of CCG breeding pairs varied from less than 1 pair/square mile to greater than 10 pairs/square mile. Emperor geese breeding pair distribution encompassed 1859 square miles. Relative abundance of EG ranged from less than 1 pair/square mile to over 6 pairs/square mile. Tundra swans and WFG were observed over the entire survey area (5180 square miles). Relative abundance of breeding pairs for both ranged from less than 1 pair/square mile to over 3 pairs/square mile.

Introduction

Background

The recent declines in numbers of geese nesting on the Yukon Delta (O'Neill 1979, Raveling 1984, Timm and Dau 1979), particularly the cackling Canada goose (Branta canadensis minima), has focused attention on the need for information to manage arctic nesting geese. In 1985, the Fish and Wildlife Service (FWS) responded by expanding research and management programs gathering data on geese in Alaska. A Migratory Bird Project, staffed with a pilot/biologist was established in Anchorage. The primary responsibility of this project was to develop and conduct aerial surveys to provide population information on geese from Alaska's breeding and staging areas.

Currently there are no measures of annual breeding populations for cackling Canada geese, emperor geese (Anser canagicus), or greater white-fronted geese (Anser albifrons) from the coastal zone of the Yukon Delta. A reliable annual index to breeding pairs is needed if the FWS and Yukon Delta National Wildlife Refuge (YDNWR) are to meet their management responsibilities. This report presents the first years data on the development of an aerial survey to provide population information for management of arctic geese nesting in the coastal zone of the YDNWR.

Objectives

The objectives of this study were:

- a. Develop aerial survey procedures that provide an index to the annual number of breeding pairs of cackling Canada geese (CCG), emperor geese (EG), and greater white-fronted geese (WFG) in the coastal zone of the YDNWR. The survey will estimate annual breeding populations within + 15 percent at 95 percent confidence levels.
- b. Determine the minimum level of effort (number of transects) needed to accomplish objective a. above.
- c. Develop a visibility index for each of the above goose species through cooperation with Research Division, Anchorage. Application of a visibility index to estimates from a. above will provide annual nesting population estimates.
- d. Obtain a better understanding of the distribution and abundance of CCG, WFG, and EG in the coastal zone of the YDNWR.

The development of a suitable management survey for the coastal zone of the Yukon Delta is expected to take 3-4 years. Results expected at the end first year include: first cut estimates of the number of pairs of CCG, EG, and WFG in the coastal zone, an estimate of the variability of goose observation data in the coastal zone, development of meaningful stratification criteria, survey design for 1986 that will yield more precise population estimates, a map of the coastal zone outlining the distribution and relative abundance of geese, and an evaluation of utilizing ground census procedures to develop a visibility index.

Study Area

The study area encompasses 5180 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 YDNWR, the largest wildlife refuge in the Nation. The central portion of the study area was described as "Americas greatest goose-brant nesting area" in 1951 (Spencer et al.). 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

The aerial survey design follows recommendations from Caughley (1977). Sixty-five transects were systematically placed from a random starting point at 8, 4, and 2 mile intervals from the mouth of the Yukon to River the mouth of the Kuskokwim River (Figure 2). Greater survey effort was allocated to areas known to support more geese. Transects varied from 8 to 40 miles in length (total 1408 miles) and extended from the coast inland to upland tundra.

Transects were flown 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 e.g., wind 20 mph or less, ceiling greater than 500 feet, and visibility greater than 20 miles. The survey was conducted from peak of initiation (6 June 1985) to just before peak of hatch (24 June 1985).

The pilot and right seat observer recorded all singles, pairs, and flocks of CCG, EG, WFG, and tundra swans (Cygnus columbianus) observed in a 1/8 mile strip on each side of the aircraft. Observations were recorded on continuously running tape players. The data were transferred to Epson HX-20 computers in the field. The computer provided summary information for observations for each species by 8 mile transect segments and calculated point locations of each observation in miles from the start of each segment.

A rear seat observer recorded all glaucous gulls (Larus hyperboreus), mew

gulls (Larus canus), long-tailed jaegers (Stercorarius longicaudus), parasitic jaegers (Stercorarius parasiticus), and sandhill cranes (Grus canadensis) in a 1/4 mile strip on one side of the airplane.

Breeding population estimates

Breeding population estimates were made using ratio estimate procedures described by Caughley (1977). The number of single and paired geese sighted on transect were considered indicative of breeding pairs. Singles and paired geese 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). Observations of flocked geese were considered to be predominately subadults and nonbreeding birds.

For tundra swans sighted on transect the number of paired swans plus the number of single swans divided by 2 were considered indicative of breeding pairs. Because of the visibility of swans on nests an estimate of pairs with nests was also made.

Since CCG cannot be distinguished from Taverner's Canada geese (B. c. taverneri) from the air a rationale for determining the survey area for CCG was developed. The approach was to define an area within which all Canada goose observations were considered CCG. Three factors were utilized in this determination: 1) the historic range of CCG (Nelsen and Hansen 1959, Spencer et al. 1951), 2) personal knowledge of CCG distribution from on ground experience and discussions with other biologists and local people, and 3) use of Land Sat imagery to identify the inland boundary between tidal and upland tundra habitat.

The survey area for EG was determined by connecting the last emperor goose observation inland on transects and by identifying tidal habitat from Land Sat imagery.

Since WFG and tundra swans occur refuge wide the survey area for these species was determined by connecting the ends of all transects.

Relative abundance and distribution

Relative abundance and distribution maps of breeding pairs were made for CCG, EG, WFG, and Tundra Swans (figures 3-6). Areas within the study area having similar physiographic features were determined from 1/250,000 scale Land Sat images of the coastal zone. The number of breeding pairs within each physiographic area were determined from transect data. Physiographic areas having a similar number of breeding pairs were combined to produce the relative abundance and distribution maps. Landownership within relative abundance zones was determined for each species.

Results

Breeding pair estimates

Breeding pair estimates and 95% confidence intervals for each species were: CCG 5267 \pm 1998, EG 4954 \pm 1376, WFG 5820 \pm 1258, tundra swan 8197 \pm 1238 (Table 1).

Relative abundance and distribution

The distribution of nesting CCG encompassed 1283 square miles (Figure 3). The average number of CCG pairs observed on transects within this area was 4.1 pairs/square mile (pairs + singles/area sampled). Relative abundance zones varied from less than 1 pair/square mile in the inland areas on the south side of Nelson Island to greater than 10 pairs/square mile in the Kokechik Bay area.

The distribution of EG encompassed 1859 square miles (Figure 4). The average number of EG pairs observed on transects (pairs + singles/area sampled) within this area was 2.6 pairs/square mile. Relative abundance zones for EG ranged from less than 1 pair/square mile north of the Askinuk Mountains and in the inland areas on the south side of Nelson Island to greater than 6 pairs/square mile in Kokechik Bay and in coastal areas north of Hazen Bay.

Greater white-fronted geese were observed over the entire 5180 square mile study area (Figure 5). The average number of WFG pairs observed on transect was 1.1/square mile (pairs + singles/area sampled). Relative abundance zones ranged from less than 1 pair/square mile over much of the inland areas to greater than 3 pairs/square mile in coastal areas of Hazen Bay.

Tundra swans were also observed over the entire study area. The average number of tundra swan pairs observed on all transects was 1.5 pairs/square mile (pairs + (singles/2)/area sampled). Relative abundance zones ranged from less than 1 pair/square mile over the northern and southern portions of the study area to greater than 3 pairs/square mile over the northern interior of the Hazen Bay area.

Land ownership

Determination of land ownership within relative abundance zones shown in Figures 3-6 indicates a significant proportion of land classified as high and medium is under Native ownership. Native lands include 42.5 percent of land classified high and 42.0 percent of land classified as medium for CCG (Table 2). Seventy-five percent of land classified as high for EG are Native owned (Table 3). For greater white-fronted geese Native lands include 34.9 percent of the land classified as high and 67.8 percent of the land classified as medium (Table 4). No Native owned land occurs within tundra swan areas classified as high and only 12.7 percent of the lands classified as medium are Native owned (Table 5). The tundra swan is the only species with almost all high and medium land under Refuge jurisdiction. Ownership of land classified as low for all species is divided approximately 40.0 percent Native and 60.0 percent Refuge.

Total observations

The total number of geese and swans seen as singles, pairs, and flocks are displayed in Table 6. The total number of geese seen on transects flown early and late in incubation are displayed in Table 7.

Discussion

Breeding pair estimates

With the exception of tundra swans all breeding pair estimates exceeded the design goal of estimating the breeding populations within $\pm 15\%$ at the 95% confidence levels. This was not unexpected in the first year of the survey. The variability in breeding pair data for CCG was highest of all the species as indicated by the 95% confidence interval of 37.9% (Table 1). An increase in the number of transects in the high and medium relative abundance zones (Figure 3) and analysis of survey data by stratified sampling procedures (Cochran 1953) in 1986 should increase the precision of the breeding pair estimates to near design objectives for geese.

Relative abundance and Distribution

Information on present distribution and abundance of geese in the coastal zone of the YKD is needed for on going management decisions e.g., permitting activities, land exchanges, recommendations for goose management areas, etc. It is important to recognize, however, that the information presented here is based on one year of data at a time when populations of geese are depressed. The inherent capacity of the habitat to support nesting geese may not be reflected by the current distribution and relative abundance of geese. For CCG and EG in particular, all the nesting habitat identified in Figures 3 and 4 should be considered critical to the recovery and restoration of populations.

Total observations

The Missouri Department of Conservation has used data from breeding ground aerial surveys to manage the Eastern Prairie population of Canada geese for 14 years (pers. comm. Dale Humburg). The percent of total birds seen in flocks is used as an indicator of production. The relatively low proportion (29.7 percent, Table 6) of CCG seen in flocks from this survey may reflect poor recruitment over the last 2-3 years rather than indicating good production this year. The proportion of CCG seen in flocks increased later in incubation compared to EG and WFG (Table 7). This could indicate a higher proportion of failed nesters for CCG.

This kind of information is collected as natural part of the breeding pair survey and becomes more useful for management with successive years of comparable surveys.

Summary

The results expected from the first year of the survey were achieved. Additional information and data analysis to be completed this year include: comparison of ground plot data with aerial observations; estimates of gull and jaeger numbers in coastal zone; estimates of sandhill crane numbers in the coastal zone; completion of transfer of survey data to regional computer; development of computer capability to summarize observations, calculate breeding pair estimates, and plot observations on 1/250,000 scale United States Geologic Survey maps.

Results expected at the end of 1986 include: more precise breeding pair estimates comparable to 1985 estimates, refinement of relative abundance and distribution maps, a better understanding of the nesting distribution of CCG and EG, an indication of the variability in survey data between years, first cut design of management survey, an indication of the precision we can expect from the management survey, and estimates of the level of effort and costs of the management survey.

Literature cited

- Cochran, W.G. 1953. Sampling techniques. John Wiley and Sons, Inc., New York. 330pp.
- Caughley, G. 1977. Sampling in aerial survey. *J. Wildl. Mgmt.* 41:605-615.
- Malecki, R.A., F.D. Caswell, R.A. Bishop, K.M. Babcock, and M.M. Gillespie. 1981. A breeding-ground survey of epp Canada geese in northern Manitoba. *J. Wildl. Mgmt.* 45:46-53.
- Nelson, U.C. and Hansen H.A. 1959. The cackling Canada goose--its migration and management. *Trans. N. Amer. Wildl. Conf.* 24:174-186.
- O'Neill, E.J. 1979. Fourteen years of goose populations and trends at Klamath Basin Refuges. Pages 316-321 in R.L. Jarvis and J. C. Bartonek, Eds. Management and biology of Pacific Flyway geese. Oregon State University Book Stores, Inc., Corvallis, Oregon.
- Spencer, D.L., U.C. Nelson, and W.A. Elkins. 1951. America's greatest goose-brant nesting area. *Trans. N. Amer. Wildl. Conf.* 16:290-295.
- Raveling, D.G. 1984. Geese and hunters of Alaska's Yukon Delta: management problems and political dilemmas. *Trans. N. Amer. Wildl. and Natur. Resour. Conf.* 49:555-575.
- Timm, D.E. and C.P. Dau. 1979. Productivity, mortality, distribution and population status of Pacific Flyway white-fronted geese. Pages 280-289 in R.L. Jarvis and J. C. Bartonek, Eds. Management and biology of Pacific Flyway geese. Oregon State University Book Store, Inc., Corvallis, Oregon.
- U.S. Department of the Interior. 1973. Standard operating procedures for aerial waterfowl breeding ground population and habitat surveys. Canadian Wildlife Serv. and U.S. Fish and Wildlife Serv. U.S. Fish and Wildlife Serv. Anchorage, Alaska. (mimeo) 80pp.

Table 1. Breeding pair estimates from 1985 aerial survey of the Yukon Delta coastal zone.

	Breeding Pairs	Standard Error	95 percent Confidence Interval
Cackling Canada geese	5267	1020	\pm 37.9%
Emperor geese	4954	702	\pm 27.8%
Greater white-fronted geese	5820	642	\pm 21.6%
Tundra swan pairs	8197	631	\pm 15.1%
Tundra swan pairs with nests	2571	312	\pm 23.7%

Table 2. Ownership and land area in square miles within three relative abundance categories for cackling Canada geese in the coastal zone of the Yukon Delta NWR.

Ownership	High ¹ (%)	Medium (%)	Low (%)	(%)
Native	140 (42.5)	117 (42.0)	263 (39.0)	^{total} 520 (40.5)
Refuge	<u>189</u> (57.5)	<u>162</u> (58.0)	<u>412</u> (61.0)	<u>763</u> (59.5)
total	329	279	675	1283

1. Relative abundance categories based on estimated number of breeding pairs from 1985 coastal zone aerial survey of the Yukon Delta-high 6-7 pairs/square mile, medium 4-5 pairs/square mile, and low 0-2 pairs/square mile.

Table 3. Ownership and land area in square miles within three relative abundance categories for emperor geese in the coastal zone of the Yukon Delta NWR.

Ownership	High ¹ (%)	Medium (%)	Low (%)	(%)
Native	102 (75.0)	38 (14.5)	546 (37.3)	total 686 (37.0)
Refuge	<u>34</u> (25.0)	<u>224</u> (85.5)	<u>915</u> (62.7)	<u>1773</u> (63.0)
total	136	262	1461	1859

1. Relative abundance categories based on estimated number of breeding pairs from 1985 coastal zone aerial surveys of the Yukon Delta-high 3-4 pairs/square mile, medium 2-3 pairs/square mile, and low 0-2 pairs/square mile.

Table 4. Ownership and land area in square miles within three relative abundance categories for greater white-fronted geese in the coastal zone of the Yukon Delta NWR.

Ownership	High ¹ (%)	Medium (%)	Low (%)	(%)	(%)
Native	129 (34.9)	145 (67.8)	1705 (37.1)	total 1979	(38.2)
Refuge	<u>241</u> (65.1)	<u>69</u> (32.2)	<u>2891</u> (62.9)	<u>3201</u>	(61.8)
total	370	214	4596	5180	

1. Relative abundance categories based on estimated number of breeding pairs from 1985 coastal zone aerial survey of the Yukon Delta-high 7-11 pairs/square mile, medium 3-6 pairs/square mile, and low 0-2 pairs/square mile.

Table 5. Ownership and land area in square miles within three relative abundance categories for tundra swans in the coastal zone of the Yukon Delta NWR.

Ownership	High ¹ (%)	Medium (%)	Low (%)	(%)
				total
Native	-- (0.0)	23 (12.5)	1956 (41.3)	1979 (38.2)
Refuge	<u>255</u> (100.0)	<u>161</u> (87.5)	<u>2785</u> (58.7)	<u>3201</u> (61.8)
total	255	184	4741	5180

1. Relative abundance categories based on estimated number of breeding pairs from 1985 coastal zone aerial surveys of the Yukon Delta-high 3-4 pairs/square mile, medium 2-3 pairs/square mile, and low 0-2 pairs/square mile.

Table 6. Total number of Geese and Swans seen as singles, pairs and flocks from the 1985 coastal zone survey Yukon Delta, Alaska. (Percent of total birds seen as single, pairs or flocks)

	Singles	(%)	Pairs	(%)	Flocks	(%)	Total Birds
Cackling Canada	207	17.0	648	53.3	362	29.7	1217
Other Canada	41	13.8	182	61.5	73	24.7	296
Emperor Geese	177	10.4	556	32.6	970	57.0	1703
White-fronted Geese	115	8.2	550	39.5	709	52.3	1394
Tundra Swans ¹	492	22.6	484	22.2	1205	55.2	2181

¹A total of 176 tundra swan nest are included-138 nests with single swans in attendance and 38 nests with paired swans in attendance.

Table 7. Total number of Geese seen as singles, pairs and flocks from transects flown early and late in the incubation period. (Percent of total birds seen as single, pairs or flocks)

	Singles	(%)	Pairs	(%)	Flocks	(%)	Total Birds
Cackling Canada Geese							
early	131	20.5	424	66.4	84	13.1	639
late	76	13.1	224	38.8	278	48.1	578
Emperor Geese							
early	108	8.0	480	35.7	757	56.3	1345
late	69	19.3	76	21.2	213	59.5	358
White-fronted Geese							
early	80	7.5	454	42.8	526	49.6	1065
late	35	10.5	96	28.7	203	60.8	334

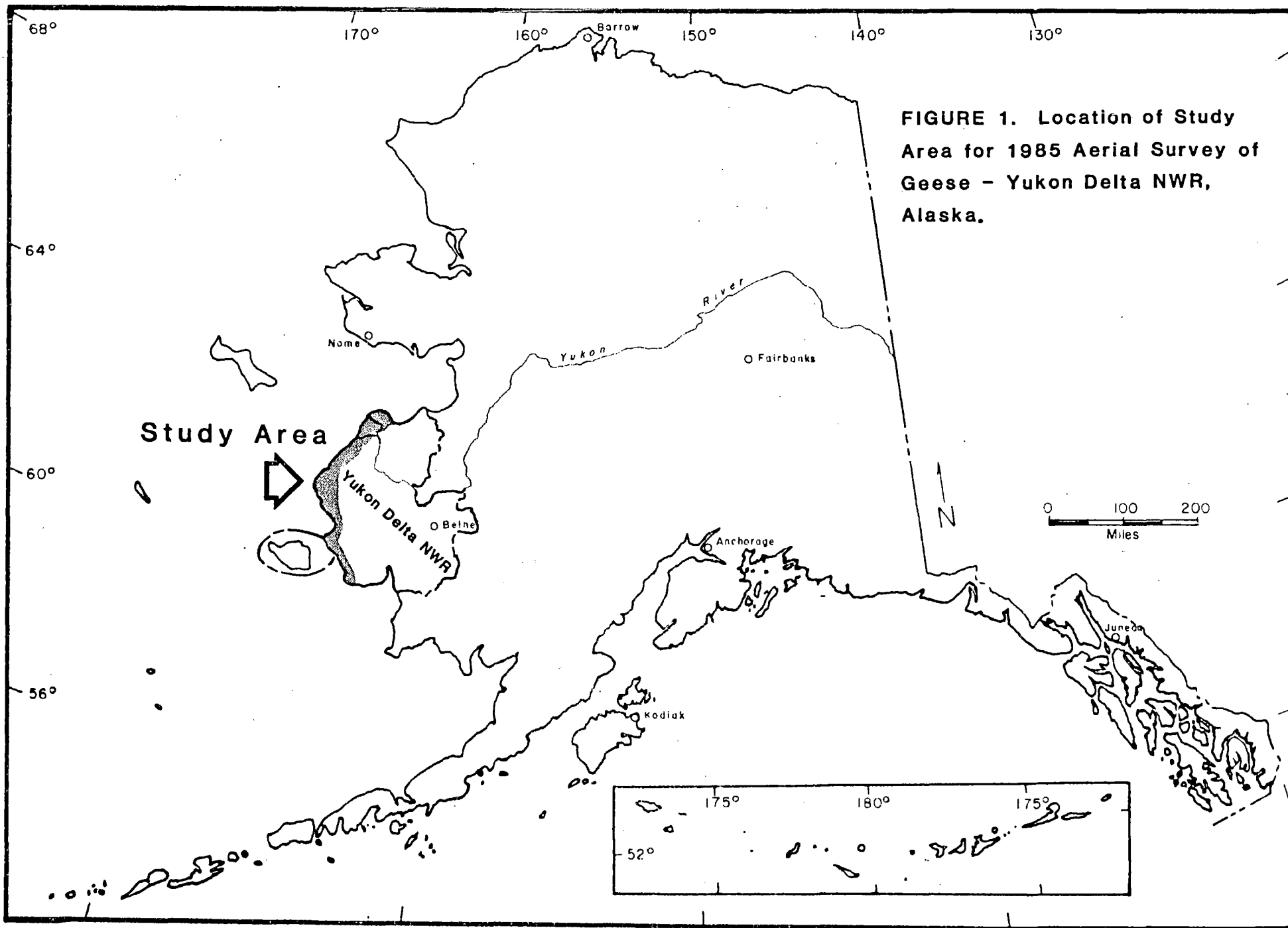
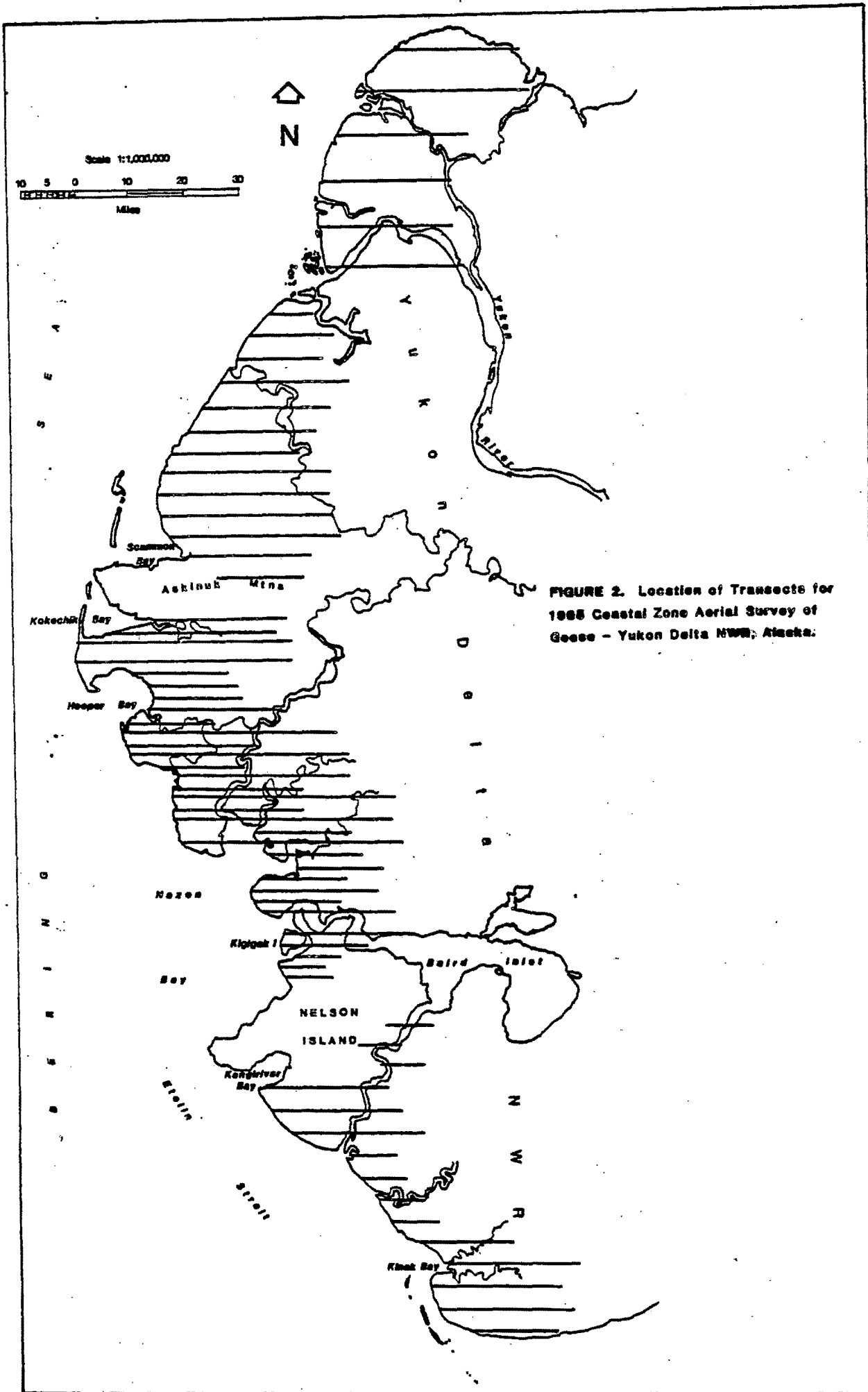
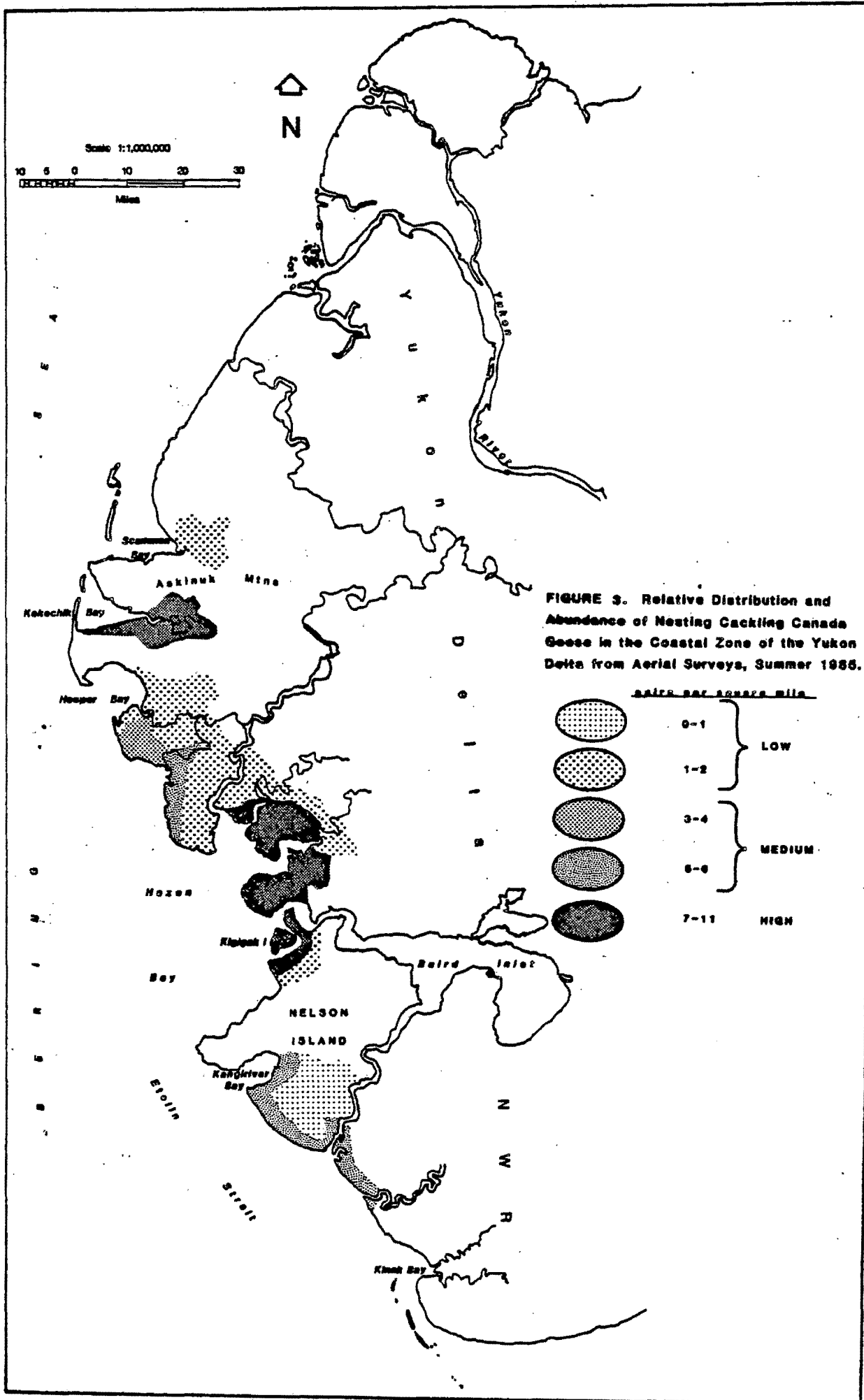
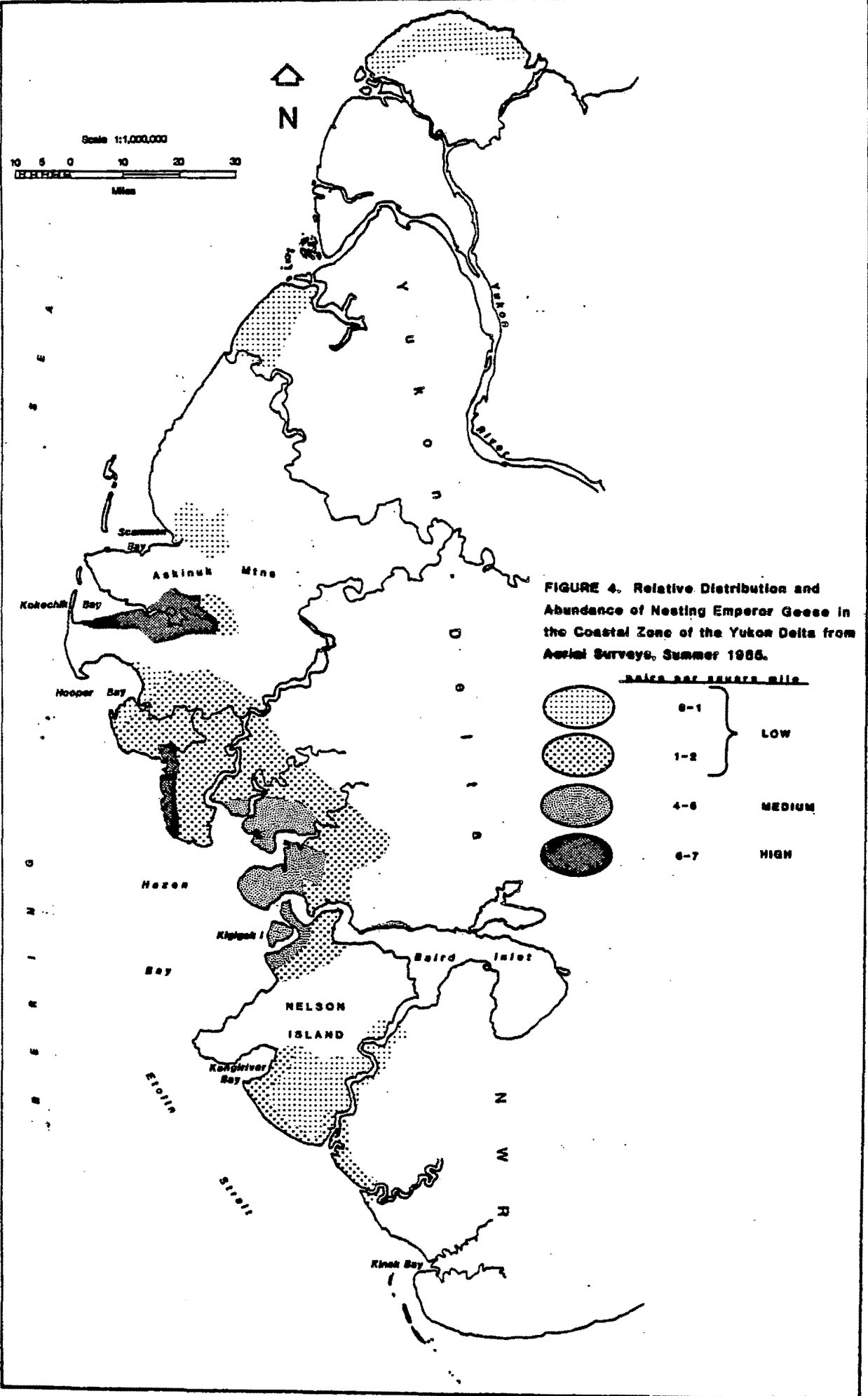
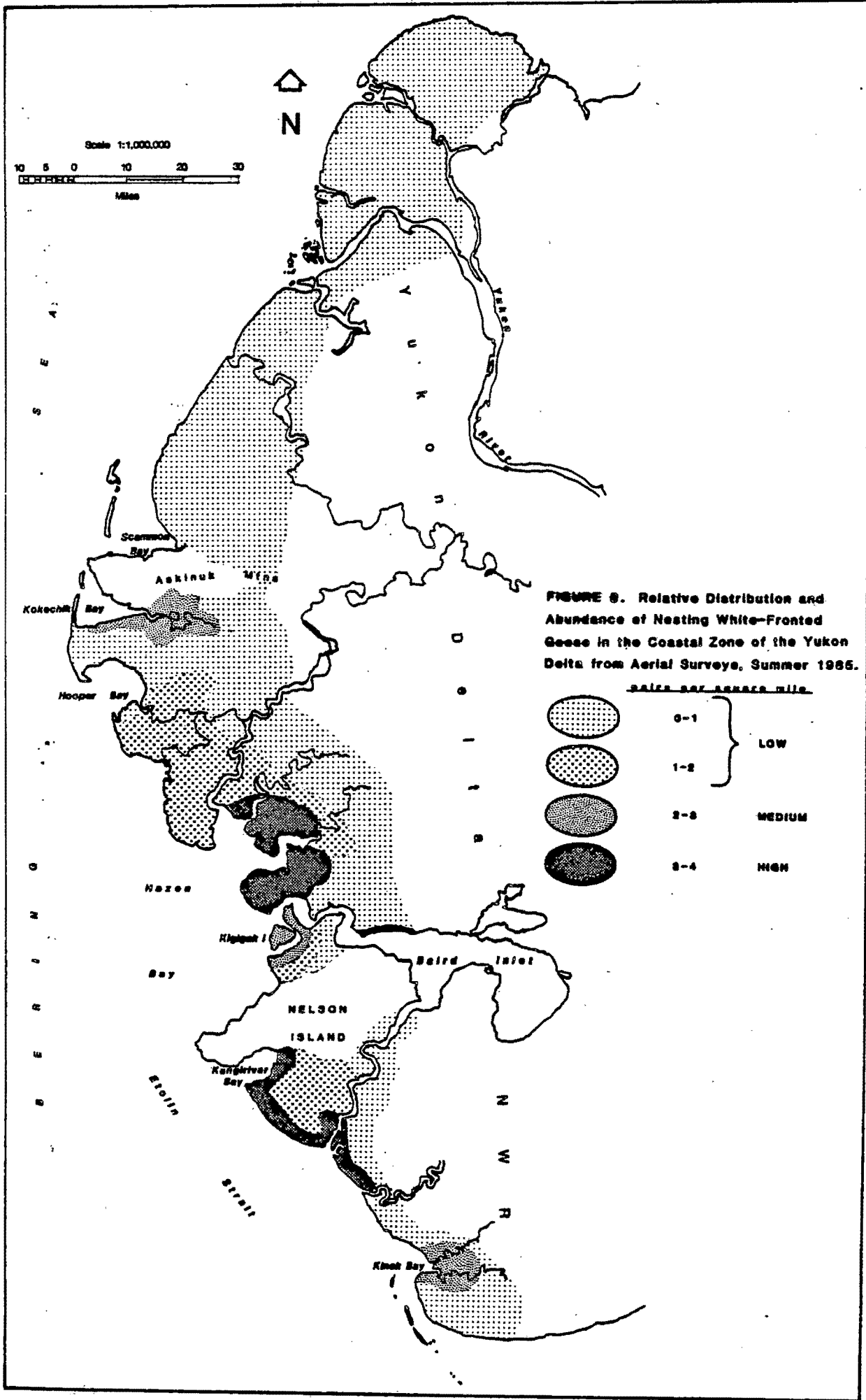


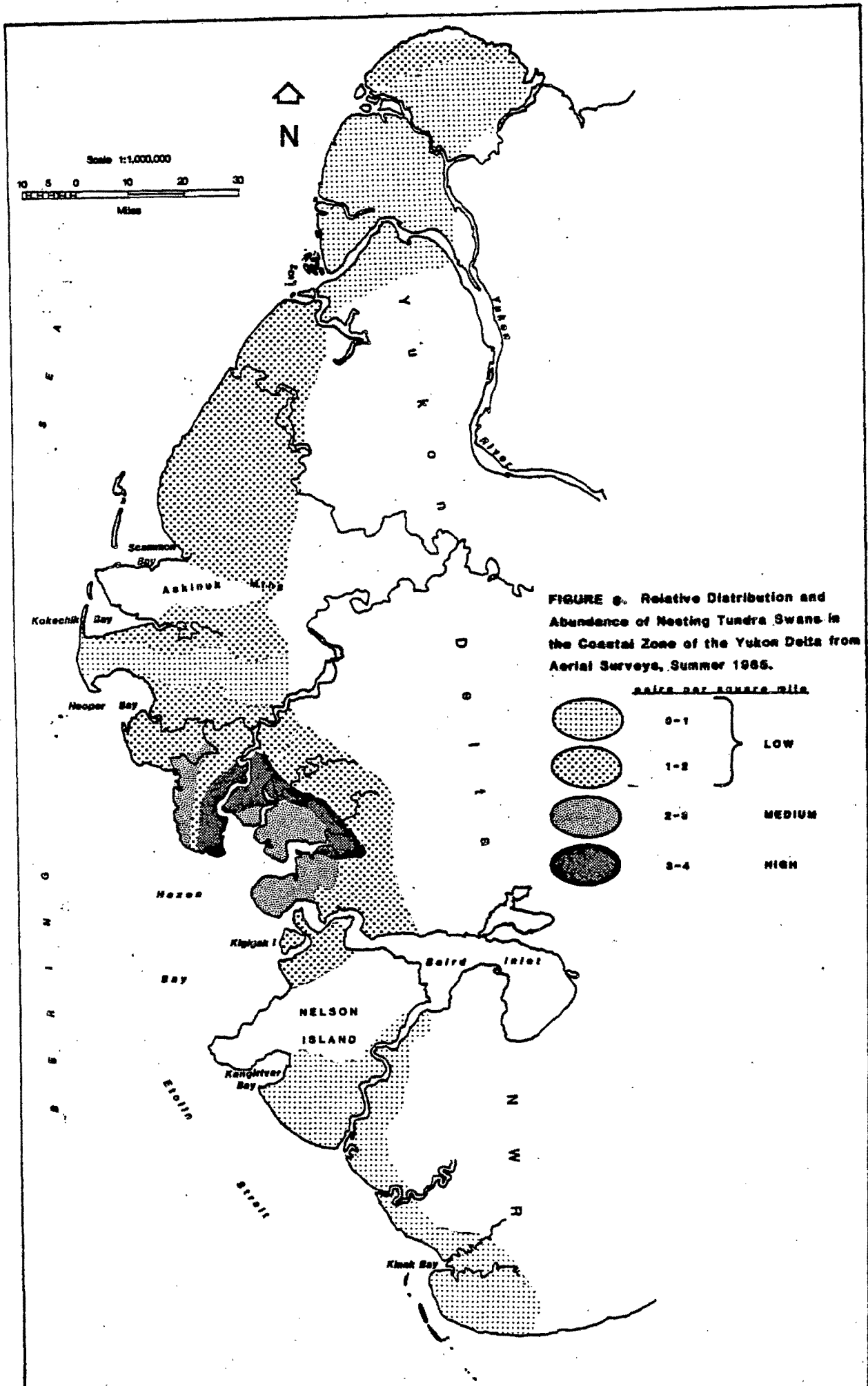
FIGURE 1. Location of Study Area for 1985 Aerial Survey of Geese - Yukon Delta NWR, Alaska.











Cackler

High

Medium

Low

~~10.1~~

~~10.1~~

~~10.1~~

2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

2171A

42

4

~~18~~

52

6

~~8~~

8

39

Newtonk

70
16.0

#

20

2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017
2018
2019
2020
2021
2022

65

Thomsonk

~~10.1~~ 15.0

22

~~21~~ 35

Toksook

~~10.1~~ 25

49
8

Nightmante

17

Chokomaak

26

UMKUMIATE

20

6

140

117

263

Wetad

329

~~279~~

675

Rokuyi

189

162

413

Nuiba Notoh
Wllokanito

13

24