ENVIRONMENTAL ASSESSMENT
for the
Experimental Control of Fox Populations and its Effect
on Goose Nesting Success on the Yukon Delta National Wildlife Refuge

Proposed By:
Region 7 and the Alaska Fish and Wildlife Office of Research
1011 E Tudor Road
Anchorage, Alaska 99503

March 26, 1986

Legal Mandate: Migratory Bird Treaty Act
Fish and Wildlife Improvement Act

Location: Yukon Delta National Wildlilfe Refuge

Authors: Patrick Gould (AFWOR)
Michael Wege (YDNWR)
Michael Anthony (AFWOR)

Finding of No Significant Impact

Based on a review and evaluation of the information contained in the supporting references listed below, I have determined that the proposed experimental control of fox populations on the Yukon Delta National Wildlife Refuge, Alaska, is not a major Federal action which would significantly affect the quality of the human environment within the meaning of Section 102(2)(c) of the National Environmental Policy Act of 1969. The environmental assessment (Reference 1) supports the conclusion that no impact exceeds a threshold of significance. Accordingly, the preparation of an environmental statement on the proposed action is not required.

Supporting References

1. ENVIRONMENTAL ASSESSMENT for the experimental control of fox populations and its effect on goose nesting success on the Yukon Delta National Wildlife Refuge.

2. RESEARCH PROPOSAL for the experimental control of fox populations and its effect on goose nesting success on the Yukon Delta National Wildlife Refuge.

Robert E. Gilmore

Regional Director

SECTION 810 DETERMINATION

for the

Experimental Control of Fox Populations and its Effect on Goose Nesting Success on the Yukon Delta National Wildlife Refuge

Proposed By:

U.S. Fish and Wildlife Service
Alaska Fish and Wildlife Office of Research
1011 E. Tudor Rd.
Anchorage, Alaska 99503

After a thorough review of the proposed activity, and its effect on subsistence uses and needs, the availability of other lands for the purposes sought to be achieved, and other alternatives which would reduce or eliminate the use, occupancy, or disposition of public lands needed for subsistence purposes, I have determined that the permitted activities will not significantly restrict subsistence uses of refuge lands. My reasons for this decision are as follows:

The two areas on the refuge selected to evaluate the effects of fox removal on the production of geese are: Kigigak Island (ca. 18 mi^2) and a 20 mi^2 area near the mouth of the Tutakoke River. These areas were chosen because of their relatively high density of nesting geese and the availability of previous records of goose productivity and fox predation rates.

It is anticipated that 20-30 arctic fox will be removed from each area. Because of the large fox population inhabiting the coastal fringe of the Yukon Delta NWR and the high mobility of individual animals, repopulation of the study areas during the subsequent fall and winter is assurred and no adverse inpacts on the delta fox population is expected.

The above two factors, immediate repopulation of the study areas and the removal of a small number of animals from a large population, result in no impact on subsistence trapping on refuge lands. In addition, the Tutakoke River study area is distantly located from any delta village and rarely selected for trapping.

Name	Refuge Manager Title	4/10/86 Date

Return to Steve Wilson for filing

U.S. FISH AND WILDLIFE SERVICE

Region 7 - Alaska

ENVIRONMENTAL ACTION MEMORANDUM

Within the spirit and intent of the Council on Environmental Quality's regulations for implementing the National Environmental Policy Act (NEPA) and other statutes, orders, and policies that protect fish and wildlife resources, I have established the following administrative record and have determined that the action by the (office) Alaska Office of Fish & Wildlife Research consisting of: Experimental control of fox populations and its effect on goose nesting success on the Yukon Delta National Wildlife Refuge, Alaska.

______ is a categorical exclusion as provided by 516 DM 6 Appendix 1. No further documentation will be made.

XX is found not to have significant environmental effects as determined by the attached Environmental Assessment and Finding of No significant Impact.

______ is found to have special environmental conditions as described in the attached Environmental Assessment. The attached Finding of No Significant Impact will not be final nor any actions taken pending a 30-day period for public review (40 CFR 1501.4(e)(2)).

______ is found to have significant effects, and, therefore, a "Notice of Intent" will be published in the Federal Register to prepare an Environmental Impact Statement before the project is considered further.

______ is denied because of environmental damage, Service policy, or mandate.

______ is an emergency situation. Only those actions necessary to control the immediate impacts of the emergency will be taken. Other related actions remain subject to NEPA review.

Other supporting documents (list):

		Regional Director	Date
Initiator	Date	Stephen Wilson Regional Environmental Coordinator	3/26/86 Date

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1. DESCRIPTION OF PROPOSED ACTION

To exclude foxes from selected nesting areas of cackling Canada geese and brant on the Yukon Delta National Wildlife Refuge and assess the effect of this on goose productivity. The proposed action and preferred alternative is to use a systematic program of leg-hold trapping, snaring, and shooting.

2. PURPOSE AND NEED FOR ACTION

Populations of four species/subspecies of geese nesting on the Yukon-Kuskokwim Delta have declined precipitously since the 1960's (Raveling, 1984). Current populations of cackling Canada geese (Branta canadensis minima) are about 12 percent of their former numbers. Greater white-fronted geese (Anser albifrons), emperor geese (Anser canagicus) and black brant (Branta bernicla nigricans) are estimated to be about 24, 41, and 71 percent, respectively, of previous population highs. Brant nesting on the Yukon-Kuskokwim Delta, however, are less than 10 percent of their former numbers. Despite restrictions which substantially reduced both recreational and subsistence harvests, populations of black brant, emperor geese and cackling geese continue to decline. Intensive studies by the Fish and Wildlife Service since 1980 indicate that increased predation on nests or broods is the most probable cause for the continuing decline in numbers. Thus nesting success for brant which averaged 80% from 1963-1975 averaged only 40% from 1982-1985 with total failure of nesting on many colonies (Tables 1 and 2). Available data (Stehn, 1986: EXHIBIT A) indicate that the increased predation by arctic foxes results from both increased numbers of foxes and from increased rate of predation as foxes take a constant toll from a declining resource. Because cackling Canada geese and brant do not effectively defend their nests and because nesting is concentrated into relatively small areas, their populations have been most seriously affected. With continued loss of nests at present levels, restoration of populations will be difficult if not impossible. The proposed action would evaluate the feasibility and potential benefits from temporary removal of predators from selected areas with high nesting populations.

It is not likely that fox population size could be controlled by a temporary seasonal food resource of waterfowl and shorebird eggs. Winter food resources such as microtine rodents or marine mammal carcasses are most likely to determine fox survival and population size. Because of the lack of a tight functional relationship between fox population size and waterfowl population size, the actual number of nests taken per unit area or per territorial fox is probably relatively constant. It follows that, as waterfowl nest density decreases, the fraction of the nests taken by predators will actually increase. Although the absolute number of nests taken may be nearly constant, the impact of this predation is increased when expressed on a per goose basis or as percent nesting success. If goose numbers are decreased below a certain threshold density, the population, in the presence of predation, may not be able to maintain adequate production to replace the natural mortality of adults.

In combination with a reduction of hunting mortality, fox population management may be essential in the management of Arctic nesting geese.

Table 1. Nesting success of geese on the Yukon Delta. From unpublished data in files of the U. S. Fish and Wildlife Service.

SPECIES	PERCENT OF NESTS HATCHED 1961-1975	1981-1985
Black Brant	80	40
Cackling Canada Geese	73	47
Emperor Geese	77	69
White-fronted Geese	-	73

Table 2. Nesting suggess of geese at different locations in 1985. From unpublished data in files of the U. S. Fish and Wildlife Service.

Location	PERCENT OF NESTS HATCHED[a] Brant	Cacklers	Emperor	White-front
Kokechick River	34	62	80	-
Kokechick Bay	57	55	72	59
Kashunuk	0	15	39	50
Tutakoke	10	48	83	-
Aphrewn	-	6	47	-
Manokinak-Azun	56	49	64	82
Naskanot Peninsula	59	47	88	83
Kigigak Island	12	51	61	-
Total	37	44	66	50

[a] Includes all nests that were still active at last visit; thus, actual percentage of nests hatched may be significantly smaller than indicated by data in table. A further bias results from the fact that populations in most vulnerable areas (those with lowest hatching success) have become so depleted that they form a relatively small part of samples which thus emphasizes areas of highest success.

There is thus an immediate need to determine the feasibility of controlling fox populations in nesting habitat of cackling Canada geese and brant and to determine the effect of reducing populations of foxes on nesting success.

Because of the high nesting densities of cacklers and brant, it may be possible to protect many of these birds by removing foxes from a relatively limited area. This forms the basis for our proposed actions.

3. ALTERNATIVES INCLUDING THE PROPOSED ACTION

The Alaska Fish and Wildlife Office of Research proposes to investigate the effects of eliminating fox predation on the production of geese nesting on the Yukon-Kuskokwim Delta (EXHIBIT B). The specific areas for these studies are at Kigigak Island in Hazen Bay at the mouth of the Ninglick River, and at the mouth of the Tutakoke River in Angyoyaravak Bay (Figures 1, 2, and 3). Four lethal and four non-lethal alternatives to removing foxes were considered to accomplish this objective.

A. Trapping, snaring, and shooting (Proposed Action and Preferred Alternative). All foxes will be removed from the study areas by a systematic program of leg-hold trapping, snaring, and shooting (refer to EXHIBIT B for details and schedule of proposed fox removal). Padded steel leghold traps and specially designed snares will be used to capture foxes. Tracking from snow machines and calling and shooting would supplement traps and snares where feasible.

B. Removal of young from dens. Denning may be an effective means of reducing predation (Sargeant and Arnold, 1984). Dens would be located within the area to be controlled, and kits would be removed from them.

C. Poisons and or toxicants. Cyanide ejectors (M-44's) are metal tubes which contain spring-loaded cartridges that release NaCN dust into the mouth of an animal that pulls on a baited trigger. Toxic baits such as compound 1080 or strychnine have been used effectively for predator control in other areas of the U. S. Deployment of baits would vary from hand sets to aerial broadcasting of pellets.

D. Aerial gunning. The use of aircraft is an effective method to hunt coyotes and wolves. Helicopters or fixed-wing aircraft would be used to hunt foxes, and the animals would be shot while the plane was in the air.

E. Build exclosures around the study areas. Barriers to fox movement would be erected to exclude animals from nesting areas. A large array of fence types (including electric fences) and artificial moats are considered.

F. Provide alternative food sources. Provide foxes in the area an easily accessible and abundant supply of food away from the study area and thus remove the need for foxes to prey on nesting geese.

G. Live trapping and release. Foxes would be live-trapped and shipped to areas far enough away from the study site that the chances of their return would be nearly nonexistent.

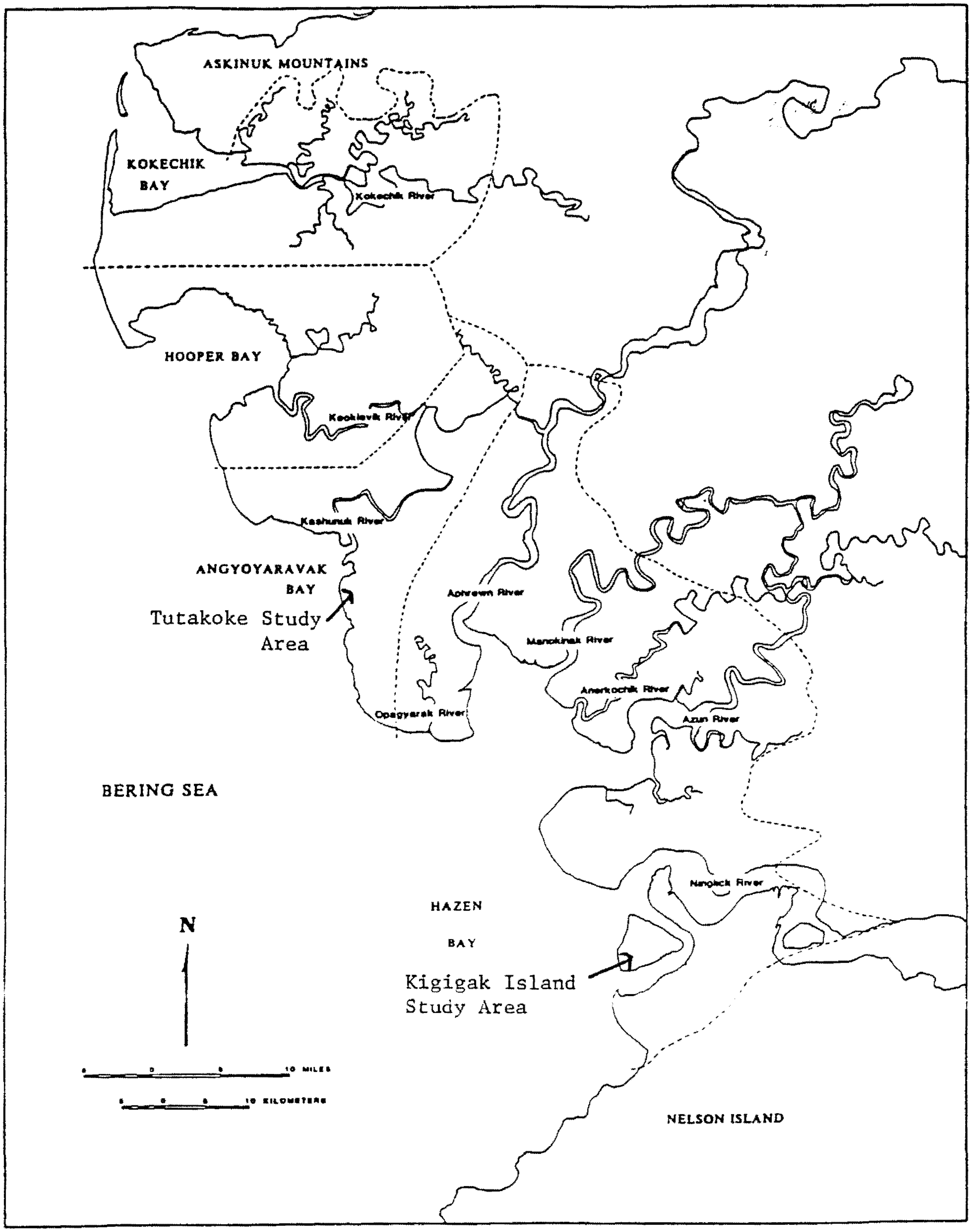

Figure 1. Proposed study areas.

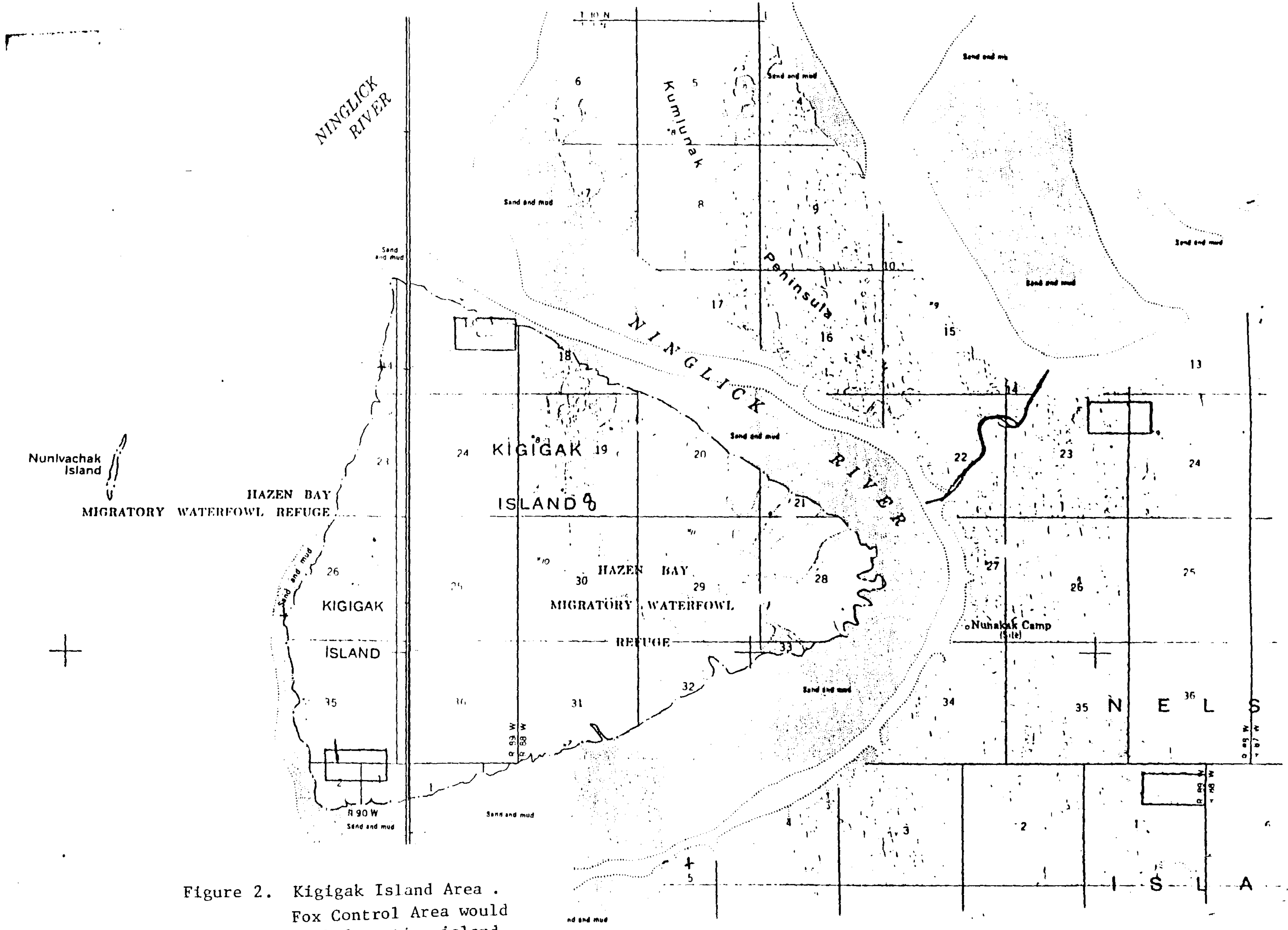

Figure 2. Kigigak Island Area . Fox Control Area would enclude entire island.

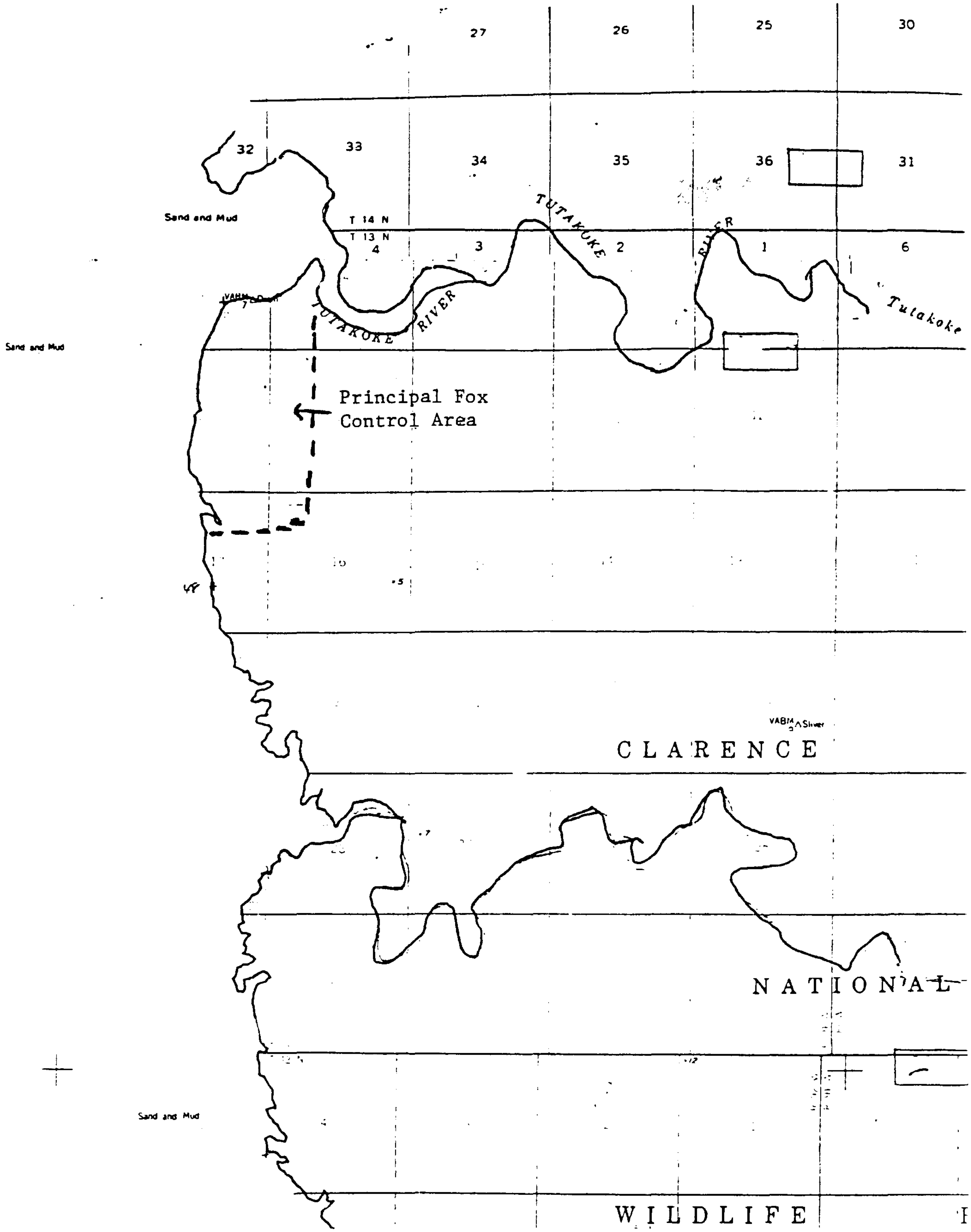

Figure 3. Tutakoke River Area

H. No action. Do not conduct the study. Find areas of comparable goose productivity that are free of foxes and compare productivity between them and areas with foxes.

4. AFFECTED ENVIRONMENT

Two areas on the refuge have been selected to evaluate the effects of fox removal on the production of geese: Kigigak Island (ca. 12 mi^2) and a 20 mi^2 area near the mouth of the Tutakoke River (Figures 1, 2, and 3). These areas lie within the coastal fringe of the central Yukon River Delta and are subject to flooding by melt water in spring and by storm tides from the Bering Sea primarily in fall. Byrd and Ronsee (1983) described the plant associations found in this vegetated intertidal zone (EXHIBIT C). The principal habitat in the study area is graminoid meadow characterized by numerous small- to medium-sized ponds (usually less than 60 cm deep), with vegetation dominated by a mixture of sedges and grasses, primarily *Carex rariflora*, *C. ramenskii*, and *Calamagrostis canadensis*. Prostrate willows (*Salix fuscescens*) are also common. The northernmost part of the Tutakoke area and eastern tip of Kigigak Island have sedge meadows, dominated primarily by *Carex ramenskii*, which are strongly dissected by tidal sloughs and areas of bare mud.

The Tutakoke area was chosen because of its large populations of cackling Canada geese and brant in close proximity, availability of previous records of goose productivity and fox predation rates, and because it is representative of "typical" goose nesting areas on the Yukon-Kuskokwim Delta that are accessible to foxes throughout the entire year. Kigigak Island was chosen because of its relatively large populations of cackling Canada geese and brant, availability of previous records on goose productivity and fox predation, and because it is isolated from foxes by a wide water barrier after "breakup" (Figure 2).

EXHIBIT D lists the birds and mammals which occur along the refuge's coastal fringe. The only threatened or endangered species known to occur on the proposed study sites is the American peregrine falcon (*Falco peregrinus anatum*). No nest sites are known to be present. Peregrines which have been observed annually only during the spring and fall in these areas, are believed to be immatures and migrants (see EXHIBIT E).

The study areas do not contain historical, architectural, or archaeological sites.

5. ENVIRONMENTAL CONSEQUENCES

A. Eliminate foxes by systematic trapping, snaring, and shooting.

It is our carefully considered opinion that within the restricted study areas, systematic trapping, snaring, and shooting would be the most viable of all alternatives. Steel leg-hold traps and snares are effective ways to eliminate foxes on the Delta and types have been developed specifically for foxes which are very effective and relatively humane (Woodstream Softcatch #1.5 padded traps and 6'x3/32" snares). Traps and snares do capture non-target species, but compared to toxicants they are more selective. They require, however, considerably more time and personnel. Firearms along with predator calls are a very effective approach to fox elimination, require fewer personnel, less time, and do not affect non-target species. The permitted use of only traps is particularly time consuming and frustrating in areas having high populations of non-target species. The major disadvantage of these methods is that field operation costs are higher than many of the alternatives. The Alaska Fish and Wildlife Office of Research has a state permit to conduct research on foxes and to control foxes by means of legal take as required (EXHIBIT F).

It is estimated that there are several thousand Arctic foxes inhabiting the coastal fringe between the Askanuk Mountains and Nelson Island and it is anticipated that 20-30 individuals will be removed from each study area. The high mobility of Arctic foxes (Eberhardt et al., 1983) would insure the repopulation of the area after the experiment and no adverse impacts on the fox populations or non-target species are expected. Stomach contents, reproductive tracts, and sectioned canine teeth will be processed to collect biological information on foxes removed from nesting areas.

Our activities are not expected to create negative impacts on peregrine falcons during this study because nesting birds, those most sensitive to disturbance, are not present, and the young birds and migrants which do come into the area can easily avoid any disturbance by immediately moving out.

B. Eliminate foxes by removing young from dens. The effectiveness of denning on reducing egg predation rates is not known (Sargeant, 1984). It is prohibited by state law and by refuge policy. Denning would not insure the removal of breeding adults from the area, and non-breeding individuals would not be affected. Adult foxes may continue to take eggs even though they no longer have young to feed.

C. Eliminate foxes by systematic use of poisons or toxicants. These are very effective, but highly controversial methods. Cyanide ejectors (M-44's) are metal tubes which contain spring-loaded cartridges that release NaCN dust into the mouth of an animal that pulls on a baited trigger. The devices must be reset after each kill and like traps are very labor intensive. They are immediately lethal and thus there is no chance of saving affected non-target species. The most serious drawback to the use of poisons which persist in the environment is that there is little chance for effective control after they have been deployed. Mortality of non-target species can be significant depending upon the compounds used, dosages, and time and types of placement. The most likely non-target species include mink, otter, gulls, jaegers, cranes, and owls. Toxic baits such as compound 1080 or strychnine pellets are not registered for use. M-44's are also illegal. They are restricted by both EPA regulations (i.e., they are not registered for use against Arctic foxes) and by USFWS policy (not allowed to be used on refuges). The use of poisons would thus require extensive coordination, governmental approval processes, certifications, and other steps that would consume time, funding and staff resources. The major advantages of these methods is their reasonable cost and high kill per contact ratio.

D. Eliminate foxes by aerial gunning. Aerial gunning is untried for Arctic fox removal and requires special permission from the Alaska Department of Fish and Game. Aerial gunning is a very expensive highly controversial method of predator control. Furthermore, there is serious concern about disturbance of nesting birds by intensive use of aircraft. Aerial hunting would be most effective only during the relatively short period when the foxes remain partially white after snow melt, and only during the 4-6 hours per day when foxes are most active. At all times foxes represent small, fast, and agile targets.

E. Eliminate foxes by building exclosures around the study sites. This alternative requires a large expenditure of time, money, and materials and would require extensive disturbance to local soils and vegetation. Besides restricting the movement of foxes, the exclosures would also restrict other non-target species. Simple fences are inefficient since they can be easily circumvented by foxes digging under them. Counter sinking the fences would be necessary and this alternative is impractical at remote locations on the Delta and difficult to achieve in the frozen ground as well as causing a great deal of destruction to local vegetation and soils. Electrified fences hold great promise as adequate exclosures, but unfortunately, this method has not been tested in the Arctic and is impractical for use on remote areas of the Delta because of the lack of a suitable source of electricity and excessive costs.

F. Eliminate foxes by providing alternate food sources. May work best with non-territorial individuals, but the technique has not been tried on Arctic fox and its usefullness is unknown. Each territory would need to have a separate food supply placed in it. Foxes are suspected of having an innate egg caching behavior which means that alternate food sources might not have the desired effect. It is possible that well fed foxes would have more time to invest into egg caching activities and thus actually increase egg loss.

G. Eliminate foxes by live trapping and release in other areas. Foxes on the Yukon Delta have had a great deal of contact with man and are extremely difficult to live trap. Live traps also encounter problems with capture of non-target species such as ground squirrels, which frequently spring traps which thus must be rechecked and reset more frequently. Logistics and expenses of moving captured foxes to other areas would be prohibitive for this operation.

H. No action. We have been unable to locate any suitable fox-free goose nesting areas to compare with our experimental sites. The information to be obtained from this study could be a critical element in efforts to reverse the trend in declining populations of Arctic nesting geese. Failure to conduct the study would result in no information being available to assess the practicality of reducing fox predation levels in any efforts to increase productivity and populations of Arctic nesting geese.

6. CONSULTATION AND COORDINATION WITH OTHERS

Proposals of this study have been sent to Lew Pamplin, Director of Game, Alaska Department of Fish and Game (ADF&G), and to Tom Rothe Waterfowl Coordinator for the ADF&G. A letter has been sent to Dr. Bill Burgoyne, Alaska Department of Environmental Conservation - Pesticides regarding the use of non-toxic chemicals to be used as markers in this study (see Exhibit G). Public meetings have been held at the villages of Hooper Bay, Tooksook Bay and Newtok to explain this work and with Chevak, Paimute, and SeaLion Corporations to coordinate with them on our proposals for activities on their lands. We are planning to employ local Natives to assist in this work. Extensive coordination and communication has occurred between the Alaska Fish and Wildlife Office of Research and Region 7 including Refuges, Endangered Species, and Wildlife Resources. This work will be a cooperative effort between the AFWOR and the Yukon Delta National Wildlife Refuge (YDNWR). An Intra-service Consultation Project Evaluation Form is attached to this document as EXHIBIT E.

7. LITERATURE CITED

Byrd, G. V., and D. Ronsee. 1983. A preliminary classification of plant communities in the vegetated intertidal zone of the central Yukon delta, Alaska. Special Report of the Yukon Delta National Wildlife Refuge.

Ebehardt, L. E., R. A. Garret, and W.C. Hanson. 1983. Winter movements of arctic foxes, Alopex lagopus, in a petroleum development area. Canadian Field-Naturalist 97(1): 66-70.

Raveling, Dennis G. 1984. Geese and hunters of Alaska's Yukon Delta: management problems and political dilemmas. Pages 555-128 in Trans. N. Amer. Wildl. and Natur. Resour. Conf. 49.

Sargeant, A. B., and P. M. Arnold. 1984. Predator Management for Ducks on waterfowl production areas in the northern plains. Proceedings Eleventh Vertebrate Pest Conference pgs. 161-167. (D.O. Clark, ed). Univ. Calif., Davis, CA.

Stehn, R. 1986. Nesting success of geese in the coastal tundra region of the Yukon Kuskokwim Delta, 1985. 1985 Field Report, U.S. Fish and Wildlife Service, Alaska Fish and Wildlife Office of Research, Anchorage.

EXHIBIT A

NESTING SUCCESS OF GEESE IN THE COASTAL TUNDRA REGION OF THE YUKON-KUSKOKWIM DELTA, 1985

Robert Stehn

18 February, 1986

Alaska Fish and Wildlife Office of Research
1011 E. Tudor Rd., Anchorage, AK 99503

1985 Final Report

Submitted to
Yukon Delta National Wildlife Refuge
P.O. Box 346, Bethel, AK 99559

Key words: nesting success, nest density, production, geese, Yukon-Kuskokwim Delta, Yukon Delta NWR, Cackling Canada goose, Emperor goose, White-fronted goose, Black brant.

Summary

Progress was made in 1985 towards development of sampling methods to provide an unbiased estimate of annual production by geese nesting on the Yukon-Kuskokwim Delta, Alaska. Scattered plots, less intensive sampling at a single location, and the use of a simple nest card data collection format were the main changes in methods compared to 1984.

Nesting success in all 4 species remained considerably below levels reported in recent years. Cackling Canada geese averaged 44% nest survival and Emperor geese had 66% nest success, both about the same as the low production shown last year. White-fronted geese declined to 60% nest success and Pacific Black Brant increased slightly to 37% success. Although 1985 was a late spring, clutch size, nesting density, and nesting success were close to levels observed in 1984, an average year with respect to environmental conditions.

Both nesting success and density showed extreme differences between various regions of the YK Delta. The high density and 62% success of Cackling geese along the Kokechik River contrasts with the extremely low numbers and 6% success along the Aphrewn River. For the second consecutive year, predation by Arctic fox was thought to be the single most important cause of nest loss. The positive correlation between nesting success and nest density, shown most clearly for Cackling geese, may be an indication that once populations fall below some critical threshold, other factors such as predation may become important in limiting recovery of the population.

Introduction

Field studies on nesting populations of Cackling Canada geese, Emperor geese, Pacific White-fronted geese, and Pacific Black brant have been conducted on the Yukon-Kuskokwim Delta (YK Delta) continuously since 1961. Studies have focused on aspects of breeding biology and ecology of geese at specific study locations (Mickelson 1975, Eisenhauer and Kirkpatrick 1977, Ely and Raveling 1984, Sedinger and Raveling 1984). Efforts to expand the data base on population status and annual productivity of geese were initiated in 1981 by staff of Yukon Delta National Wildlife Refuge (Byrd et al 1982, Garrett et al 1983, Garrett and Wege 1984). These studies were continued in 1985 by USFWS research staff based in Anchorage.

The information gathered has been used to provide an annual index to the size of nesting population and production of young for 4 species of geese. One stated objective of these studies is to provide basic information to the Pacific flyway study committees on annual changes in populations and productivity of geese. The extent to which the data collected corresponds to the actual changes in nesting density or production depends on a series of factors and assumptions relating to sampling errors, bias in sampling design, and correlations among the data and other unmeasured factors. Previous reports of annual production on the YK Delta have not tested the implicit assumption that the areas sampled are representative of the whole delta. This simplifying assumption may be misleading. The data gathered in 1985 show that at least this year various regions of coastal tundra differ widely both in nesting density and success. One implication of this finding is that a valid sampling plan to assess annual production is both needed and complicated, particularly due to the difficulty of arranging for random sampling in field operations on the YK Delta.

Associated with any study of nesting density and success in various regions of the YK Delta is the consideration of habitat features that may explain the patterns observed. What habitat variables are most important to nesting geese? Can measures be made that reflect mortality from hunting or predation, nest site preference, food availability during incubation, or proximity to brood rearing habitat, and can these be correlated with the current geographic pattern of population density? Answers to these questions may provide clues as to the causes of the decline and suggest management actions to speed the recovery of these populations.

This progress report includes some sections from my July field report plus the results from further analyses and careful retabulation of the 1985 nesting data. I have included nesting data from the field camps at Camp Lake, Kokechik West, Tutakoke, and Old Chevak in most of the analyses and tables. Separate progress reports from these locations by Petersen, Kertell, Sedinger, and Ely, respectively, are available that fully explain additional data collected and interpret the information from the perspective of each specific study site.

After explanation of field methods used in 1985, the results are presented in four sections which include analyses of:

1) weather conditions, river break-up, and migration chronology compared to previous years,
2) nesting chronology among species in various regions of the YK Delta,
3) nesting density for each species in various regions,
4) nesting success for each species in various regions, and a comparison with nesting success in years 1981 to 1984.

A general discussion follows which includes some tentative implications of the results obtained so far. Suggestions for further work and mention of ongoing studies are scattered throughout.

Methods

This year several sampling methods were used for obtaining nest success data on geese. Methods used at the Camp Lake study area emphasized careful searching, tower observations, and nest revisits at 5-day or greater intervals (Petersen 1984). Several areas along the Kashunuk River were sampled using methods as described by Ely and Raveling (1984). Eighteen cackler plots were sampled as previously described (Butler 1984). These three data sets are directly comparable to data obtained in the past. The Tutakoke River and Kokechik Bay brant colonies were sampled using randomly located circular plots.

In addition, from a base camp at Kanagayak, as many as 7 teams of 2 people searched a total of 54 plots with an average size of approximately 100 acres. On these plots all habitat areas, not just islands and shorelines, were searched for nests. The geographic location (Figure 1) and selection of these plots were based on a combination of factors. These included:

1) availability of color IR photos at 1:10000 or 1:6000,
2) intent to cover as wide a geographic area as possible,
3) intent to cover various habitats based on color IR photo appearance,
4) logistical constraints of boat or aircraft transportation, and
5) experience of various field crews.

Because these plot selections were made without any random sampling, extrapolation of results to the entire delta is not statistically valid. Post-stratification of plots is possible by geographic region as shown in Figure 1, by areas subjectively defined from a Landsat image map, or by strata based in part on relative goose density observed on aerial surveys (Butler and Malecki 1985). Tentative projections are thus possible, but these results can not be trusted until a sampling plan is used that incorporates random plot selection. The 1985 plots, as well as data from earlier years, provides data to examine sources of variation and explore stratification schemes. These analyses will be incorporated into detailed recommendations for a sampling plan in a later report.

Plot boundaries were based either on natural features such as lakes, sloughs, or grass meadows, or based on straight lines delimiting .125 square mile plots (80 acre rectangles). With the aerial photos available either method was feasible. Plot boundaries were drawn on a mylar overlay cut to fit the 10 inch square color IR photo. Both were taken into the field and nest numbers were written on the mylar, thus allowing exact nest locations to be plotted. The mylar overlays and photos did not work as well as hoped. Mylar obscured some of the photo detail and the photo surface had to be kept completely dry. Even without rain, nest searching and floating eggs are wet procedures. Nevertheless, nest locations are available on all the plots. Distance between neighboring nests or details of nest location in relation to habitat features could potentially be extracted from the maps. YDNWR also has 2 years of data complete with nest locations.

Methods used to record and analyze waterfowl nesting data have probably differed for each investigator working on the YK Delta. Some studies have specific data collection requirements and may demand specific methodologies, nevertheless a set of basic observations can be made at each visit to a nest and these should be recorded in a way that is:

a) relatively easy to remember and not prone to recording errors,
b) standard among observers whether they are inexperienced or expert,
c) standardized between various study plots and years of study,
d) capable of allowing both quick field summary and extensive computer data analysis,
e) flexible enough for various species, conditions, and habitats,
f) changeable in the field to allow for new codes and additional information or comments to be recorded.

In 1985, with these guidelines in mind, we used 4 x 6 inch preprinted note cards to record information for each nest. In my opinion, these nest cards proved quite successful and allowed 17 observers to assemble a coherent data set on 1,548 nests. With some modifications I suggest this system be continued in the future for goose nesting studies, and I urge others to adopt similar methods. The method is based on the decade old Cornell Nest Record Card program which was drawn from earlier British nest record systems.

The key to the method is not the format, the codes, or the card, but rather the approach of recording all unambiguous information or features of a specific nest attempt at the time of visitation in the field. The card prompts the observer to check for certain things and record the information consistently and accurately with short alphabetic or numeric codes. Only observational data, not any interpretation of what is present, is recorded. This allows the data to be objective, independent of observer experience, repeatable, and interpretable by others. For example, if a broken half of an eggshell is found in a nest, it should be recorded and coded as that, a broken eggshell present, not as evidence of avian predation. The interpretation of the observation should be made at a later time. This saves time in the field, ensures data recorded by two different observers is comparable, and allows reanalysis of the data if a future study reveals that arctic fox may leave broken eggshells as well.

I have written a FORTRAN 77 computer program to rewrite the data format used in 1984 and another program to rewrite the data format used by the Epson field computer data input program. Rewriting these alternate formats into nest card codes is workable, but some loss of specific features of the nest card format is unavoidable.

In working with all three data gathering systems I have come to some conclusions that may be of general value in designing other similar field data collection systems.

a) Alphabetic codes are easier to remember, less prone to errors, and more compact since at least 36 (26 letters + 10 digits + symbols) codes can be fit into one column. Confusion of '1' and 'I' or lower case 'L', 'O' and '0', '6' and 'b', '8' and 'B', 'D' and '0', etc. must be carefully avoided.

b) Observer, plot, nest number, and species codes should in combination provide redundant or excess uniqueness. This allows any error in one of the codes to be identified, rather than lost or confused with other data. Leading zeros in numbers, '006' versus ' 6', will effect the order of computer sort routines and therefore should be used carefully, even though extra zeros will not affect the numeric value if these columns are read as a number.

c) Transcribing field notes using the Epson data input program provides a convenient printed back up for organization into a loose leaf data notebook. The data is also recorded onto tape for rapid dumping into the main computer back in Anchorage. The Epson field computer system requires a 12V storage battery, solar panel, paper, notebooks, tapes, etc., thus a permanent, somewhat warm and dry base camp is needed. Adequate time in the field is absolutely necessary to keep up with the data collection effort. The field computer does not have adequate memory to hold all the data at once, therefore, any errors must be noted on paper and the data file edited in Anchorage. Several days of checking and correcting is to be expected even though data dumping for the whole season only takes a few hours.

d) Nest cards completed in the field require no transcribing in the field, although some soggy cards were recopied. I'm not aware of any cards that were destroyed or misplaced this year. About 4 weeks of work was required for one person to type 1600 nest cards into the computer and check the data back in Anchorage. The cost of the person-month in Anchorage should be weighed against the equivalent time that would be removed from field observation and data collection if the data had to be typed into computers in the field.

Table 1 briefly lists the categories of information recorded at each nest and describes the meaning of the codes used. These differ slightly from the cards used in the field in that some codes were split or added based on additional notations made on the field cards.

An effort was made to age almost every nest found containing eggs. A series of criteria were used by the computer program, in the order listed, to provide an estimate of the most likely date of clutch completion and the maximum error associated with that estimate. These are:

a) Laying sequence observed - If the number of eggs present increased between two visits to the nest, the clutch completion date is taken to be the date of the first visit plus the number of additional eggs present in the nest at the subsequent visit. Error of this estimate is taken to be plus or minus one day.

b) Pipping eggs observed - Pipping eggs, including star-pipped and vocal, indicated that hatch was the next day and clutch completion date was taken to be 1 day less than the length of the incubation period before the date pipping was observed. Maximum error is 1 day. If both the laying sequence and the hatch date were determined with a maximum error of 2 days, the incubation period was calculated by subtraction. Incubation period is here defined as the number of days between the last egg and hatch. It does not include the day the last egg was laid (this is day zero, not day 1 as in most literature) although admittedly the female may actually have begun incubation behavior.

c) Goslings observed at the nest site - Indicates day of hatch and clutch completion date is determined by subtracting the length of the incubation period. Maximum error is assumed to be 2 days.

d) Float angle determined for floating eggs - Clutch completion is determined by subtracting the days of incubation averaged from all eggs aged by floating according to the codes described in Table 1. Maximium error is taken as 3 days.

e) Float angle determined for sinking eggs - Days of incubation determined as the average age of all eggs aged by floating according to the codes in Table 1. Error is taken to be 5 days.

f) Membranes present - Hatching has occurred as evidenced by intact membranes, and goslings have left the immediate nest site. Hatching date is calculated to have occurred halfway through the interval between the last two visits to the nest. The maximum error is taken as the entire interval length between these two visits.

Clutch initiation date was calculated by subtracting the maximum clutch size observed from the clutch completion date. No allowance was made for a skip day in clutches larger than 4 eggs. No correction was made in dates that would be caused by egg loss occurring before the first visit to the nest.

The nest card data file is read by a FORTRAN program to calculate all the ages and summarize the initiation, outcome, habitat, and nest status information recorded for each nest. Details of visitation are kept for the first 6 visits. An intermediate data file is produced that can then be analyzed by a SPSSX program which provides a convenient method to further recode, combine , and summarize the data. Computer listings of programs are available on request.

Weather Conditions and Migration Chronology

Winter and spring conditions on the YK Delta were characterized in 1985 by heavier snow accumulation and later break-up than average. The ice went out on the Kuskokwim River at Bethel on 25 May, 9 days later than the long term average. Later break up dates have been documented in only four other years: 1952, 1962, 1964, and 1971. The coastal areas were even more delayed. The Ninglikfak River at Chevak broke about 11 June and considerable ice floes remained in the Manokinak River on 18 June.

Aerial reconnaisance flights were made from Bethel on 20 and 24 May to determine coastal snow conditions and distribution of geese. On 20 May, 90-100% cover of snow and ice persisted from Kokechik Bay to Nelson Island. Geese were few in number and concentrated at the mouth of the Aphrewn and Azun Rivers on Hazen Bay, the Naskonat Peninsula, and the south coast of Nelson Island. By 24 May, 50-70% snow cover and considerable meltwater was noted. The Naskonat Peninsula and southern Nelson Island held concentrations of Brant, Canada geese and Emperors. Along the coast from Chefornak south to the mouth of the Kuskokwim River, snow cover was less than 20% and most smaller lakes were ice free. Brant, Canada geese, Emperors, swans, and cranes were observed in numbers suggesting that this region may have been an important spring staging area in 1985 (Figure 2).

Reports from along the Yukon River also indicated unusually high or long-lasting concentrations of geese. Canada geese, including Cacklers, and Whitefronts were noted around Pike and Reindeer lakes east of Paimiut Slough between the villages of Russian Mission, Aniak, and Holy Cross. Some harvest of birds occurred in this area.

Concentrations of Cacklers in the interior delta may also have been prolonged because the usual spring staging of cacklers west of Anchorage was restricted. Most of the upper Cook Inlet coastal habitats remained 70-95% snow and ice covered and unavailable for feeding until mid-May. Cacklers were observed from 30 April until 10 May with the highest concentrations occurring on the Susitna Flats. Disturbance by low flying aircraft has been further documented and investigation is needed to determine if the energy balance of migrating geese is adversely affected. Completed field reports on spring staging are available (Butler and Gill 1985, Loranger and Eldridge 1986).

Arrival of geese to the YK Delta coast was later than in recent years. At Kokechik Bay, Whitefronts, Cacklers and Emperors arrived on 14, 17, and 17 May, respectively. Brant first arrived on 15 May, 2 days later than in 1984. Peak arrival for all species was 7-10 days later than in 1984.

Predominantly cool and cloudy weather prevailed until 9 July. No storm tide flooding occurred during nesting. Rain and stormy conditions occurred on some days near the time of hatch, however conditions were judged not severe enough to cause significant brood mortality.

Nesting Chronology

The earliest nest initiation recorded was 23 May for a White-fronted goose near Old Chevak. Earliest nest initiation dates documented at Kokechik Bay for Emperors and Cacklers were 27 May and 29 May, respectively. Brant began nesting on 28 May at Tutakoke River and Kokechik Bay. Hatching was essentially complete by 7 July. Chronology of nesting was delayed 7-13 days for each species compared to 1984 and by approximately 6 days from the long-term average dates.

The average nesting chronology combining all regions of the YK Delta is tabulated for each species (Table 2) and compared with the previous two years (Table 3). The average of observed hatch dates excludes nests with greater than 9 days maximum error. The frequency distribution of clutch completion and observed hatch show remarkable synchrony (Figure 3). The bimodal distribution in Brant reflects a 2 day difference this year between the Tutakoke and Kokechik Bay colonies. The hint of a bimodal distribution of clutch completion in Cacklers, Emperors, and Whitefronts may be caused by a small portion of the population being delayed in nesting by 6-9 days. These are perhaps young birds or birds in poor physiological condition. Renesting, continuation nesting, or errors in aging eggs are other possibilities to be considered. Most of these late nests were not successful, which also decreases the chance they will be aged, but a few did hatch. This confirms the existence of delayed nesting efforts in at least a few birds.

One way analysis of variance (SPSSX Breakdown procedure) was used to examine differences in average clutch completion date among 9 regions of the YK Delta (Figure 1). Emperors and Whitefronts showed no significant difference among regions, however some significant differences were found for Cacklers and Brant. Brant at Kokechik Bay completed clutches an average of 2 days prior to Brant at Tutakoke or other colonies. Cacklers at Kokechik Bay were also 2 days ahead of Tutakoke, Kashunuk, and Kokechik River birds. Regions further south (Manokinak, Naskonat, and Kigigak) were similar to Kokechik Bay. South Nelson Island Cacklers and Emperors were 2-3 days advanced over other regions, however small sample size prevented the significance of this difference to be determined.

Nesting Density

Comparison of the number of geese nesting at Kokechik Bay and along the Kashunuk River on Mickelson's and Raveling's study areas shows that approximately the same nesting density remains in 1985 (Table 4). In 1969-72, the Onumtuk study area averaged 51 Cacklers, 5.1 Emperors, 4.8 Whitefronts, and 8.1 Brant per square mile (Mickelson 1975). The average density from 9 plots searched this year in the same general area averaged 50 Cacklers, 10.5 Emperors, 5.9 Whitefronts, and 8.0 Brant per square mile (Table 5). However, conflicting evidence is shown by the declining trends in number of cacklers nesting on 2 plots from within the original Onumtuk study area (Figure 4). One possible explanation for this discrepancy is that visitation to a plot, even if as seldom as one visit in some years, may cause a decline in numbers specific to that plot even though nearby areas remain at original levels. Another explanation is that although Mickelson states that the Onumtuk area had a high density of Cacklers, no data is presented to show that perhaps nearby areas did not have even higher densities. Most likely the explanation is due to how the plots were selected and the averages determined. Mickelson mentions a portion of his study area that had 41 Cacklers in .25 mi^2, or 164 per square mile, but when density is averaged over the entire study area, which includes some river edge habitat and upland tundra less suitable for nesting, the number becomes considerably reduced. The plots selected this year were placed where nesting density was suspected to be high based on the appearance of the habitat on the color IR photos. Thus, by not avergaging in areas less suitable for nesting, 1985 densities are inflated relative to Mickelson's. Nevertheless, even if this is so, the data indicates that the amount of decline of Cacklers in the Onumtuk area is 30 to 40% and definitely not as great as the decline of 80 to 90% in the total population size.

The number of geese nesting on 18 plots studied in both 1984 and 1985 did not significantly differ (paired t-tests) for any of the species (Table 6). Above average snow cover and meltwater in 1985 may have prevented nesting in some local areas, and perhaps concentrated Cacklers and Emperors in other areas. Kokechik Bay near Camp Lake is apparently an example this year of increased density as well as an earlier nest initiation date relative to other nearby areas.

Nesting density differed greatly among regions (Table 5). South Nelson Island and numerous plots along the Aphrewn River had very low nesting densities of Cacklers. Other regions, such as the Kokechik River, Tutakoke River, and Kigigak Island, had a high density of Cacklers (Table 5). Valid statistical comparisons are not possible because no variance estimates are available without random plot selection within each region. Emperors were at their highest density on the Naskonat Peninsula and in the Manokinak-Azun region. Whitefronts were relatively more abundant on the Naskonat Peninsula, on South Nelson Island, and along the Kashunuk River. It should be emphasized that these comparisons do not include study areas at Kokechik Bay and Old Chevak. Although plot selection tended to avoid likely Brant nesting areas, scattered small colonies of Brant were found on 19 of 71 plots, mainly on Kigigak, Naskonat Peninsula, plot 28A, 17A, and Onumtuk 2. It is possible that scattered groups of Brant contribute significantly to the total population on the YK Delta particularly since the large colonies are so reduced.

A data set containing measures of various components of the habitat on each plot will be analyzed for correlations with nesting density. A total of 86 plots were searched in 1985. All of these have 1:10000 color IR photo coverage (taken by YDNWR, Winship and Butler, 1984). The number of islands, peninsulas, isthmuses, and lakes of various size categories have been counted on most of these plots. Total area, percent surface area covered by water, and linear distance of shoreline and sloughs will be measured or estimated on each plot. Plant community data has been collected on about 30 plots. Distance to nearby brood rearing areas, river or coastal mudflats, villages, and upland tundra will be measured. Only the most preliminary analysis has been done at this time showing, as expected, that the density of cacklers correlates with the number of small islands. With data from previous and future years, this approach should help determine the potential value of various habitat types for nesting geese and help to explain the current pattern of distribution of the populations.

Among regions there appear to be differences among the proportions of various nest site locations selected and the physical characteristics of these sites. Petersen (1985) also mentions differences at a single location between those years with high Emperor density (Eisenhauer study) and recent years. Nest site selectivity interacts with population density, availability of various nest sites on a plot, and local conditions of snow and meltwater at the time of nest initiation. Quantification of these and other relationships may lead to a measure of present population as a fraction of previous or potential population. For this report all the regions and plots are combined and the average proportions of various nest site locations (Table 7) and physical dimensions of these sites (Table 8) are listed for each species. Islands are selected as nest sites by 75% of the Cacklers. Shoreline (32%), islands (26%), and peninsulas (19%) are roughly equally divided by Emperors. Whitefronts also selected shorelines most frequently (35%) followed by slough banks, grass flats, and peninsulas. Island size was smaller for Cacklers, 4 x 2 meters, and for Whitefronts, 3 x 2 meters, than for Emperors, 8 x 3 meters. Whitefront nests were further from the nearest water than the other species.

Nesting Success

The average success was 44% for Cacklers and 66% for Emperors, both essentially the same as last year. Success for Whitefronts declined to 60%. Brant nesting success improved to 37%, a fair increase over the 14% recorded last year. Nesting success for all species remains well below levels recorded only a few years ago (Table 9). These averages combine all regions in proportion to the number of nests found. No effort has been made yet to correct the bias caused by greater representation of high density areas, or to derive weighting factors based on area of habitat or number of pairs estimated to be in each region.

Average clutch sizes (Table 3) for Cacklers, Emperors, and Whitefronts were slightly lower in 1985 than the 15-year average (1970-1984), while that of Brant was slightly higher. All fall within the normal range when compared to the 15-year average.

Regional differences in nesting success were significant only for Cacklers. Unweighted averages of percent success (SPSS Breakdown procedure) on 54 plots excluding the permanent camp locations showed that the Aphrewn, South Nelson, and Kashunuk areas were much lower than the Kokechik River, Tutakoke, and Naskonat Peninsula regions. Cackler success was significantly correlated with nesting density when examined both by averages for each plot or by regions (Figure 5). Similar trends, both in regional success estimates and in correlations with density, were shown by Emperors but the results were not significant. Whitefronts and the small scattered colonies of Brant do not show any indication of similar patterns.

Nesting success data is influenced by several potential biases. When a plot is searched, not all nests are found. The percent is thought to be near 100% for Brant, quite high (80-95%) for Cacklers and Emperors, but perhaps lower (60-80%) for Whitefronts in grass flat and slough margin habitats. No data were obtained in 1985 on these detectabilities. Nests predated or abandoned during laying are difficult to find if searches are conducted late in incubation. Inactive nest bowls are harder to spot and, if no down is present, they may mistakenly be classified as a site from the previous year. These biases would cause nesting success to be overestimated. Also, later in incubation, the female will not flush until the observer is closer to the nest, incubation breaks may be less frequent, and the male is more likely to be in the vicinity of the nest site (Figure 6). All these factors increase detectability of active nests and will again cause nest success to be overestimated.

An opposite bias in nest success data relates to the impact of human visitation in decreasing the chance of success. The frequency of visitation to nests was decreased this year (Table 10) but perhaps still not to the extent possible if visitor impact is a serious problem. Visitation early in incubation may cause the nest to be abandoned. At any time during incubation, but particularly early, a human searcher on the plot will scare females off their eggs leaving them exposed to avian predation. Parasitic jaegers are attracted to human nest searchers or the disturbance caused by nest visitation (Strang 1980). The rate of egg loss for undefended nests was measured this year by placing artificial nests containing chicken eggs in empty goose nest bowls. About 70% loss occurred within 2 days and much of that within the first few hours when the rate of loss was calculated to be 8% per hour (Vacca 1985). Covering the eggs with down decreased the rate of loss. The presence of a wire flag nest marker or nest location on an island versus a peninsula made no difference in the percent of egg loss (Vacca 1985). The impact of nest searching is reduced late in incubation because females either stay closer or return faster after displacement from the nest. Further analysis of both the 1984 and 1985 data is required before an accurate estimate of visitor impact is available.

Comparison of nesting success data between plots or years can be confused not only by these two sources of bias, incomplete search and visitor impact, but also by inadequate tabulation of the data. A nest either is successful (hatches 1 or more eggs) or unsuccessful, but the data collected falls into 4, rather than 2 discrete categories. A nest may:

1) have failed before it is found, [a,b]
2) fail before the last visit but after the first visit, [b,c,d,e]
3) remain active at the time of the last visit, or [d,e]
4) have hatched before the last visit. [e]

Estimation of the average nesting success usually combines the first two categories and the last two to calculate the proportion successful. However, biases and other factors can influence the number of nests in each category differently. In addition to the average natural rate of nest loss, the parameter which is to be estimated, the data collected depend on:

a) incomplete search bias,
b) the date of the first visit in relation to days past average nest initiation date,
c) the number and timing of additional nest visits,
d) visitor-induced predation or abandonment, and
e) the date of the last visit in relation to days before or after average hatch.

The number of nests in each category, 1 thru 4, is likely to be influenced by those factors, a thru e, that are contained in the brackets following each group listed above. Comparison of nesting success between plots or years must either control or account for any differences that may be caused by these sources of bias.

Additional work and exploration of the data is needed to attempt quantification of these nesting success covariables. For now, comparisons between years or plots should perhaps examine data only for the proportion of nests failed before the first visit. Incomplete search bias and date of search may be simpler to control or quantify than the unknown impact of visitation. I have tabulated the 1985 nest success data for each species into 4 categories for each region (Tables 11, 12, 13, 14). The Kokechik Bay data differ primarily because the date of first visit is much earlier than in other regions. The Kashunuk and Tutakoke data contain a mixture of early and late nests visits. The 4-part tabulation of nest outcomes, although incomplete without the exact dates and visitation frequency for each plot, will encourage realistic comparisons of 1985 data to other data sets.

Discussion

The quality and quantity of data collected this year on YK Delta geese reflects the increased financial support, greater experience of field personnel involved in the project, and a partial shift in emphasis away from permanent study sites. The field effort went relatively smoothly in that no major mishaps occurred and adequate data were collected. The most troublesome aspect of using Kanagayak as a base for field operations was that the charter aircraft support was located in Bethel. We expected to use air support 3 days per week which did not justify leaving the pilot and the plane in the field full time. Because of differences in weather between the coast and Bethel, other demands on the same aircraft and pilot, inevitable miscommunication, and minor but unanticipated delays, my intricate plans for ferrying personnel to and from plots, as well as resupplying other camps, usually did not work. A Cessna 185 on amphibious floats is too heavy to get into many smaller lakes and often not big enough for bulky and heavy equipment. An effort to use smaller and lighter camp and scientific equipment is necessary. Using Kanagayak as a base for mobile boat crews has a disadvantage in being many hours in travel time away from any area with high nesting density of geese. The Zodiac Mark 2's with 30 hp Mariners were inoperable either because of design, disrepair, or overloading from the weight of 2 people plus temporary camp equipment and safety gear. Sixteen foot aluminum boats were much better. The lunch box radios and the repeater system failed completely because of inadequate instructions for the charging and use of the equipment.

The biologists involved in collecting the 1985 data provided all the extra effort, dedication, and patience needed to make the field effort a success. The collective effort of these individuals (Table 15) and the continuing analysis of the data collected will, with the advantage of a few years for hindsight, provide the best testimony on the efficiency and usefulness of this year's method for data collection on the YK Delta.

In general, goose production on the YK Delta in 1985 remained low compared to 1981 and 1983 data (Garrett and Wege 1985). Environmental conditions of the late spring may be partially responsible, but these do not fully explain decreased production because density, nest success, and clutch size do not differ significantly from 1984 which was an average year in regard to environmental conditions. Several interelated factors, having varying effects in different years, must control goose production on the YK Delta.

The similar nesting density of Cacklers on the Onumtuk study area in 1985 with densities reported in the early 1970's seems to disagree with the large declines observed in overall population size (O'Neil 1979, Raveling 1984). It is possible that the Onumtuk study area is for some reason not a typical area, perhaps because it was known to Chevak residents as a study area. However it is just as possible that the Onumtuk area is typical of high density Cackler habitat and the observed discrepancy in the degree of populations decline is real. This can be explained by hypothesizing a change in the distribution of nesting on the YK Delta. Apparently at least some areas with high densities around 1970, which were originally selected for study in part because of their high density, continue to hold similar densities. In order to account for the decline in total numbers, large areas of the YK Delta, probably those with lower density in 1970, must now have much lower densities. However, it can not be excluded that high density areas in some way different from Onumtuk have shown large decreases. If differential decline in low density populations has occurred this is not consistent with one of the hypothesized causes for the population decline, that being the overharvest of eggs or adults on the nesting areas. Hunters would be expected to seek out areas and concentrate efforts where the geese are at greatest concentration, not the reverse. It is therefore necessary to consider that the important voluntary reduction in harvest called for in the YK Delta Goose Management Plan may not by itself have the hoped for result of allowing populations to recover.

Because both the density of nesting geese and the percentage decline in population size is different in various regions of the YK Delta, this may provide a means to evaluate factors that contribute to the recent population decline. Differences in the degree of decline of nesting density must be caused by either a) factors that effect the survival or physiological condition of those adults and subadults returning to their specific natal area, or b) factors that influence the survival of eggs, recently hatched goslings, or molting adults in the local nesting area itself or immediately prenesting staging and feeding areas associated with a specific nesting population.

This statement and the following argument are based on two assumptions; these are usually accepted but the data is sparse. First, I assume it is improbable that geese are actively moving to or selecting new nesting areas. Some local shifts of nest sites seem to occur in Cacklers perhaps due to social factors or local environmental conditions of ice or meltwater that effect nest site availability. Nevertheless, female geese in general are known to show a high degree of philopatry. Neck-collared Emperors return to within 500 meters of the same nest site in subsequent years, although the same nest bowl is not reused (Petersen 1985). Second, I assume that factors influencing the condition (egg production) and survival of geese when they are not on the YK Delta will affect the entire population evenly. In other words, the migrating and wintering population is completely mixed without a persistent subpopulation structure. Whitefronts from different parts of Alaska winter in different locations, but it is not known if this pattern also holds for regions within the YK Delta.

If these assumptions are correct, it follows that differential survival of eggs, goslings and molting geese from a local nesting population must ultimately cause any difference in nesting density in that region compared to other regions. The pattern of annual survival rates can conveniently be broken into two very different time frames; the long term average over centuries and a short term average pattern over 3 to 20 years that influence a few generations of geese. Long term higher survival (and higher density) is correlated with those variables thought of as favorable habitat characteristics. It is the shorter term survival pattern that must be responsible for the recent abrupt change in population size. If wintering or migration habitat or survival is limiting population size, population decline should occur evenly over all areas of the YK Delta. This is what would be expected, particularly for Cacklers and Whitefronts, following many years of overharvest of these species in wintering areas. However, if any differential changes in distribution are observed this should identify specific areas where some local aspect of excessive mortality is harming goose populations. Reduced numbers over the entire population may interact with a local factor to cause further declines. In order to determine the change in density, both past and present geographic distribution and density of nesting geese must be known. Aerial survey and ground searches provide the present data, but inference, based on understanding the features of the habitat that correlate with nesting density within a region, must be used to reconstruct past distribution between regions. Initial work towards this goal for each of the four species is being conducted.

Much of the observed nest loss in 1985 was caused by predation. Foxes were observed searching for nests, carrying eggs, and swimming in lakes near islands with nests. Fox predation on Brant nests at the Tutakoke River colony continued throughout incubation despite shooting 6 foxes. New animals apparently continued to move into the area. Glaucous gulls and Parasitic jaegers also contributed to nest loss, but it does not seem likely that widespread nest failure in some areas and good success in other areas was due to different rates of avian predation. Gulls and jaegers were observed in all areas.

The late spring and accompanying increased energetic demands on nesting females may cause increased time spent off eggs or the complete abandonment of nesting. The loss will appear to be caused by predators that quickly find undefended nests, but it is in fact caused by nutritional or energetic exhaustion. The presence of food resources close to nest sites might help to reduce this loss and this aspect of habitat quality warrants study as it could influence clutch size and partial nest predation rates.

The predator responsible for nest destruction cannot reliably be identified based on sign observed at the nest site. Clues such as all eggs and shell fragments removed, shells with large holes "pecked" or eaten into the sides, or half consumed eggs, etc. have been observed following both confirmed fox and jaeger depredation.

It is possible that once the density of nesting geese declines below some threshold level, predation is able to prevent adequate production of young and, after several years, eliminate that local nesting population entirely. It is not known why high fox populations have occurred in both 1984 and 1985 in areas such as Tutakoke which rarely had extensive fox predation in previous years. It is not known whether fox populations have actually increased, but there is little doubt that the role of foxes in the last 2 years as a nest prodator has increased or become more readily observed. The impact of fox predation on geese, particularly under conditions of low goose nesting density, and the ecological role of foxes on the YK Delta are questions that should be answered as soon as possible. Additional management actions may be needed to ensure the recovery of goose populations.

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Table 1. Data codes used to record field observations for each nest found on the YK Delta, 1985.

Year:	85
Observer:	2 letter initials (first and last name) of each person
Plot:	3 letters and/or numbers; '15A', 'KR3', 'SN9'
Nest Number:	4 numbers
Species:	4 letters; CCGO-cackler, WFGO-whitefront, BLBR-black brant, EMGO-emperor, LALO-lapland longspur, PINT-pintail
Plant Community:	2 letters (UP-upland, IN-intermediate, TI-tidal) or numbers
Nest Site:	I-island, P-peninsula, S-shore, pond edge G-grassflat, meadow L-slough bank N-pingo or upland tundra D-displaced island W-willow brush
Length:	for islands and peninsulas, maximum length (meters)
Width:	for islands and peninsulas, maximum width (meters)
Percent Area:	estimated % of maximum rectangular area that is dry land (rectangle = 99%, circle = 78%, triangle = 50%)
Distance:	distance from nest to nearest water (meters)
Height:	height of nest rim above nearest water (centimeters)
Depth:	depth of water 3m into pond or at pond midpoint (centimeters)

At each visit record:

Month:	6 = June, 7 = July
Day:	day of the month
FFD:	female flushed at this distance from the observer (= 98 if distance is greater than 98 m; = 99 if present near nest but no distance is estimated)
MFN:	male distance from nest when first observed (=98, =99 same as above)
Nest lining:	G - grass or leaves only in nest lining D - down present S - scrape, hollow, or platform only

Nest status:

"blank" - apparently normal, active, with no sign of prior loss
X - destroyed, disturbed, partial or total predation with no further evidence to indicate cause
A - avian predation suspected
J - jaeger observed at nest
L - gull observed at nest
M - mammalian predation
F - fox sign observed
K - mink sign observed
R - otter sign observed
H - human disturbance suspected prior to visit
Y - subsistence egging
B - biologist suspected to have caused loss or abandonment
P - parent bird killed by predator; carcass or feather pile nearby
Z - parent bird found dead on or near nest
I - inactive, nest abandoned, cold eggs, no obvious predation

Table 1. continued

D - deserted, previously active, down present. Even if predation has occurred, if there is some reason to believe that desertion in fact preceeded the predation, it should be recorded as desertion.
Q - questionable or indirect visit, nest contents not inspected

For each egg present record:

Egg status: Eggs should be numbered beginning with the darkest egg to the lightest to detect partial loss, laying, or dump eggs.

E- egg warm, OK, normal
if egg is floated, instead of 'E' record a number

1 - sinking, flat on bottom	age = 2 days
2 - sinking, acute angle from bottom	= 5 "
3 - sinking, obtuse	= 9 "
4 - sinking, perpendicular	= 12 "
5 - equal density with water	= 13 "
6 - floating, perpendicular at surface	= 14 "
7 - floating, breaking surface	= 16 "
8 - floating, acute angle	= 21 "
9 - floating, obtuse angle	= 23 "

C - cold egg
R - dump egg (same or different species) suspected based on odd size, color, sequence, etc.
O - out of nest
X - missing; probably destroyed or taken by predator
"blank" - missing; destroyed or taken by predator
V - visitor accidently broken or removed
K - cracked but not pipping
B - broken shell pieces in or near nest
A - addled, rotten, or dead young in egg
D - dead gosling (nestling) in nest
P - pipping (including vocal and star pipped)
M - membrane (large piece with fecal sac)
H - hatched young in or near nest
N - nestling (altricial young) in nest

A portion of the computer data file is copied below to show the format of the records. Up to 5 visits fit on 1 line and programs allow for 10 more visits to be placed on 2 additional lines. The codes and format make the data file relatively easy to read and check.

Table 2. Average chronology of nesting, standard deviation, and sample size in four species of geese on the Yukon-Kuskokwim Delta, 1985.

	CCGO	EMGO	WFGO	BLBR
Clutch Initiation	3.8 June 4.6 (352)	2.1 June 4.2 (244)	31.6 May 3.6 (74)	31.1 May 2.7 (228)
Clutch Completion	8.2 June 4.1 (352)	7.6 June 3.1 (244)	4.8 June 2.7 (74)	4.3 June 2.5 (228)
Expected Hatch	3.5 July 4.5 (237)	1.8 July 3.5 (117)	30.2 June 2.8 (52)	29.0 June 1.9 (126)
Observed Hatch	2.5 July 3.0 (129)	1.1 July 2.6 (144)	28.8 June 2.3 (25)	28.0 June 2.4 (163)
Incubation Period	25.1 days 1.6 (12)	23.7 days 1.1 (11)	24.5 days 0.7 (2)	24.1 days 1.1 (25)

Table 3. Comparison of nesting chronology and clutch size in 1983, 1984, and 1985 for 4 species of geese on the YK Delta. Data of '83 and '84 are from Garrett and Wege (1985). Tabled values are the central range of dates, or the mean, standard deviation and sample size.

	CCGO		EMGO		WFGO		BLBR	
Peak of clutch completion:								
83	5/25-29		5/21-28		5/21-27		5/24-27	
84	5/27-6/3		5/23-29		5/25-27		5/25-31	
85	6/4-10		6/4-9		6/2-8		6/2-5	
Peak of observed hatch:								
83	6/19-27		6/14-21		6/15-22		6/15-20	
84	6/21-25		6/16-23		6/17-20		6/17-22	
85	7/1-5		6/29-7/3		6/26-7/1		6/26-30	
Maximum clutch size from active nests found during incubation: ("incomplete" combined with "complete" clutches in 1983 and 1984 data)								
83	4.96	(666)	5.39	(287)	4.66	(263)	3.45	(1194)
84	4.51	(466)	5.10	(228)	4.15	(19)	3.04	(986)
85	4.34, 1.62	(417)	5.62, 2.18	(314)	4.27, 1.89	(92)	3.38, 1.49	(798)
Maximum clutch size from nests first found during laying: ("complete" clutches, 1983 and 1984)								
83	4.96	(213)	5.45	(121)	5.39	(26)	3.60	(971)
84	5.12	(65)	5.38	(25)	5.14	(7)	3.38	(95)
85	5.06, 1.09	(17)	6.43, 1.91	(14)	4.00	(2)	4.39, 1.55	(98)
Minimum clutch size of successful nests at hatch:								
85	3.65, 1.61	(146)	4.09, 1.67	(179)	3.33, 1.43	(33)	2,78, 1.04	(335)
Frequency of distribution of clutch sizes, 1985:								
1	24	5.6%	5	1.6%	5	5.4%	100	12.5%
2	44	10.3%	14	4.4%	12	13.0%	120	15.0%
3	64	15.0%	38	11.9%	19	20.7%	196	24.6%
4	67	15.7%	51	16.0%	15	16.3%	220	27.6%
5	114	26.7%	48	15.1%	17	18.5%	118	14.8%
6	90	21.1%	61	19.2%	12	13.0%	28	3.5%
7	21	4.9%	40	12.6%	8	8.7%	7	.9%
8	3	.7%	25	7.9%	3	3.3%	4	.5%
9	0	-	14	4.4%	0	-	3	.4%
10 or more	0	-	22	6.9%	1	1.1%	2	.3%

Table 4. Total number of nests of Cackling Canada geese, Emperor geese, Pacific Black brant and Pacific White-fronted geese on three study areas on the Yukon-Kuskokwim Delta, Alaska, 1969-1985.

	Cacklers			Emperors			Brant			Whitefronts		
Area:	1	2	3	1	2	3	1	2	3	1	2	3
1969	-	84	-	-	-	-	-	-	-	-	-	-
1970	-	83	-	-	-	-	-	-	-	-	-	-
1971	58	69	-	151	-	-	89	-	-	-	-	-
1972	24	52	-	110	-	-	61	-	-	-	-	-
1973	31	57	-	116	-	-	60	-	-	-	-	-
1974	-	-	-	-	-	-	-	-	-	-	-	-
1975	-	41	-	-	-	-	-	-	-	-	-	-
1976	-	67	-	-	-	-	-	-	-	-	-	-
1977	-	69	143	-	-	36	-	-	-	-	-	29
1978	-	74	138	-	-	58	-	-	-	-	-	46
1979	-	66	119	-	-	47	-	-	-	-	-	27
1980	-	68	-	-	-	-	-	-	-	-	-	-
1981	-	57	91	-	-	40	-	-	-	-		20
1982	23	42	-	47	3	-	67	0	-	-	0	-
1983	37	35	90	79	5	44	-	20	-	-	0	32
1984	38	38	-	84	6	-	46	14	-	-	2	
1985	84	51	82	90	5	50	110	17	-	-	1	32

Study Area 1: Eisenhauer study area, Kokechik Bay
Study Area 2: Onumtuk Plots 1 and 2, Kashunuk River
Study Area 3: Raveling study areas, Kashunuk River

Table 5. Area of plots and overall density (average weighted by plot size) of geese in various regions of the Yukon-Kuskokwim Delta as determined by nest searches conducted 15 June - 5 July 1985. Plots associated with permanent camps at Tutakoke, Old Chevak, Camp Lake and Kokechik West are excluded from this table, except Onumtuk 1,2, and 17A are included.

Region	Plots	Area (sq. mi.)	Nest density/sq. mile CCGO	EMGO	WFGO	BLBR
Kokechik River	6	1.33	108	22	2	14
Kashunuk River	9	2.37	50	11	6	8
Tutakoke River	7	1.77	70	10	3	40
Aphrewn River	18	2.64	6	4	2	0
Manokinak-Azun	13	2.33	49	25	4	11
Naskonat Peninsula	6	.85	36	35	9	40
Kigigak Island	7	1.42	65	8	1	92
South Nelson	5	1.01	5	4	6	0
Combined	71	13.72 (8781 acres)	47.0	13.5	4.0	21.7

Table 6. Total number of nests and percent success for 3 species of geese on 18 plots searched in both 1984 and 1985 on the YK Delta.

	CCGO				EMGO				WFGO			
	nests		%success		nests		%success		nests		%success	
	84	85	84	85	84	85	84	85	84	85	84	85
6A	47	22	58	55	11	8	91	63	1	2	100	100
12A	15	20	33	65	0	1		100	3	3	100	100
12B	5	2	0	0	4	4	50	0	0	0	-	-
Onum1	12	19	17	5	2	1	100	0	0	0	-	-
Onum2	27	32	37	9	4	4	100	75	2	1	100	100
HS1	3	2	67	50	3	1	100	100	0	0	-	-
15A	27	38	67	55	7	3	29	100	1	0	100	-
15B	12	11	83	82	12	5	92	80	1	0	100	-
16A	17	16	82	69	12	0	100	-	0	0	-	-
17A	11	19	82	32	4	5	100	80	1	0	100	-
AP2	6	0	17	-	4	1	0	100	0	0	-	-
19B	3	2	33	0	1	2	0	0	0	1		0
22B	21	31	43	26	1	5	100	40	0	1	-	100
23A	15	8	60	25	9	5	89	40	4	0	100	-
25B	5	4	0	50	10	10	60	100	0	1	-	0
MK9	13	17	85	76	10	9	60	89	2	0	100	-
27A	12	11	8	0	5	8	80	13	4	6	75	83
32B	9	1	33	0	3	0	33	-	3	4	67	100
Totals	260	255			91	72			22	19		
T-test	t=-.14 n.s.				t=-1.86 n.s.				t=-.51 n.s.			
Wtd Avg % Success			49%	40%			71%	62%			91%	84%

Equivalent plot designations:
HSI = Hock Slough   AP2 = Aphrewn Production   19B = AB5 + AB6
22B = MC5 + MC8   25B = MK1   MK9 = Manok.C3(84)

Table 7. Proportion and number of nests located at various sites by each of four species of geese nesting on the YK Delta, 1985.

Nest Location	CCGO	EMGO	WFGO	BLBR
Island	.75 (663)	.26 (111)	.09 (11)	.43 (508)
Peninsula	.12 (110)	.19 (79)	.14 (18)	.12 (145)
Shoreline	.08 (72)	.32 (134)	.35 (45)	.24 (289)
Slough bank	.005 (4)	.02 (7)	.19 (24)	.003 (3)
Grass flat	.02 (15)	.12 (51)	.15 (19)	.20 (244)
Pingo	.006 (5)	.08 (33)	.07 (9)	.001 (1)
Displaced Island	.02 (17)	.01 (5)	.02 (3)	.003 (3)
combined:	(886)	(420)	(129)	(1193)

Table 8. Average dimensions and physical features of nest site locations used by four species of geese nesting on the Yukon-Kuskokwim Delta, 1985.

	CCGO	EMGO	WFGO	BLBR
Islands:				
length (m)	4.2	8.5	3.1	15.3
width (m)	2.0	3.2	1.6	5.9
area (m^2)	12.1	32.5	5.3	92.6
distance to water (m)	.48	.50	.35	.91
height above water (cm)	25	23	22	23
Depth of water (cm)	36	38	28	39
Peninsulas:				
length	10.6	9.6	11.6	16.4
width	3.1	4.7	6.6	2.4
area	32.2	76.8	81.4	30.7
distance to water	.90	.60	1.49	1.05
height above water	24	26	38	29
depth of water	37	38	53	33
Shoreline:				
distance	1.03	1.26	2.12	1.29
height	20	23	31	24
depth	32	39	43	35
Slough bank:				
distance	1.30	.30	2.49	--
height	21	--	64	--
Grass flat or meadow:				
distance	7.04	6.50	15.24	--
height	23	14	--	--
depth	30	30	22	--

Table 9. Nesting success estimates and number of nests examined for geese on the Yukon Delta NWR combined over all sampling areas. 1981 to 1984 data is taken from Garrett and Wege (1985).

Year	Brant	Cacklers	Emperors	Whitefronts
1981	58% (1016)	61% (196)	78% (90)	
1982	36% (4080)	25% (586)	70% (178)	
1983	53% (3914)	64% (724)	73% (397)	88% (282)
1984	14% (1321)	42% (556)	60% (371)	70% (82)
1985	37% (1242)	44% (900)	66% (425)	60% (132)

Table 10. Proportion and number of nests receiving different frequency of revisits for each of four species of geese nesting on the YK Delta, 1985.

Number of Visits	CCGO	EMGO	WFGO	BLBR
1	.65 (582)	.41 (174)	.60 (79)	.37 (459)
2	.21 (187)	.27 (116)	.23 (31)	.15 (189)
3	.07 (60)	.11 (46)	.09 (12)	.14 (175)
4	.03 (24)	.02 (10)	.02 (3)	.25 (309)
5	.01 (11)	.03 (14)	.03 (4)	.06 (72)
6	.02 (17)	.04 (18)	.01 (1)	.02 (23)
7	.02 (14)	.06 (25)	.01 (1)	.01 (13)
8	.002 (2)	.03 (13)	.01 (1)	.002 (2)
9	.003 (3)	.01 (5)		
10		.007 (3)		
11		.002 (1)		
Total nests	(900)	(425)	(132)	(1242)
Total visits	1342	1127	230	3203
Avg. visits/nest	1.49	2.65	1.74	2.58

Table 11. Percent of Cackling Canada Goose nests with various outcomes in various regions of the Yukon-Kuskokwim Delta, 1985.

	%Failed prior to first visit	%Failed before last visit	%Active at last visit	%Hatched by last visit	Number of nests
Kokechik River	25	13	22	40	(156)
Kokechik Bay	14	31	1	54	(112)
Kashunuk	72	13	11	4	(199)
Tutakoke	42	10	37	11	(156)
Aphrewn	89	6	6	0	(18)
Manokinak-Azun	50	0	40	9	(117)
Naskonat Peninsula	53	0	47	0	(32)
Kigigak Island	46	4	7	44	(105)
South Nelson	60	0	40	0	(5)
Combined	45	11	21	23	(900)

Table 12. Percent of Emperor Goose nests with various outcomes in various regions of the Yukon-Kuskokwim Delta, 1985.

	%Failed prior to first visit	%Failed before last visit	%Active at last visit	%Hatched by last visit	Number of nests
Kokechik River	17	3	26	54	(35)
Kokechik Bay	8	19	3	69	(160)
Kashunuk	40	21	12	27	(75)
Tutakoke	18	0	29	54	(28)
Aphrewn	46	8	39	8	(13)
Manokinak-Azun	34	2	36	28	(58)
Naskonat Peninsula	12	0	88	0	(34)
Kigigak Island	33	6	11	50	(18)
South Nelson	50	0	50	0	(4)
Combined	22	12	21	45	(425)

Table 13. Percent of White-fronted Goose nests with various outcomes in various regions of the Yukon-Kuskokwim Delta, 1985.

	%Failed prior to first visit	%Failed before last visit	%Active at last visit	%Hatched by last visit	Number of nests
Kokechik River	11	33	44	11	(9)
Kokechik Bay	41	0	0	59	(17)
Kashunuk	41	10	14	36	(59)
Tutakoke	33	0	67	0	(6)
Aphrewn	63	0	37	0	(8)
Manokinak-Azun	18	0	64	18	(11)
Naskonat Peninsula	17	0	83	0	(12)
Kigigak Island	0	0	0	100	(2)
South Nelson	0	0	100	0	(8)
Combined	33	7	33	27	(132)

Table 14. Percent of Black Brant nests with various outcomes in various regions of the Yukon-Kuskokwim Delta, 1985.

	%Failed prior to first visit	%Failed before last visit	%Active at last visit	%Hatched by last visit	Number of nests
Kokechik River	67	0	6	28	(18)
Kokechik Bay	12	30	8	49	(635)
Kashunuk	100	0	0	0	(20)
Tutakoke	44	46	5	5	(371)
Aphrewn	—	—	—	—	(0)
Manokinak-Azun	40	4	40	16	(25)
Naskonat Peninsula	41	0	59	0	(34)
Kigigak Island	81	7	1	11	(139)
South Nelson	—	—	—	—	(0)
Combined	33	30	8	29	(1242)

Table 15. Biologists, person days, and plots that were recorded on initial visit to nests of any species on 1985 plots on the YK Delta. Plots without nests are not included, and switching of observer codes for convenience in mapping nests locations, introduce slight inaccuracy to these tabulations. Camp Lake was staffed by Margaret Petersen, Karen Laing, and Paul Flint. Old Chevak nests were found by Craig Ely, Lori Hawkins, Una Swain, and Dave Budeau. Tutakoke was manned by Jim Sedinger, Dave Ward, and Dan Welsh.

Observer	Total nests found	Days with nests found	Number of plots searched	Plots:
Pam Seiser	264	16	13	27A,KG1,KG2,KG3,KG4,KG7,KG8,KG9,KR2,KR3, KR4,KS1,KS3
Karen Kincheloe	192	16	14	27A,AW5,KG3,KG4,KG6,KG7,KG8,KG9,KS1,KS3, NP10,NP7,NS4,NS5
Don Youkey	190	18	20	13,AB3,AB5,AP4,AP7,AW2,AW3,AW5,AW6,KR1,KR3, KR4,KS3,NP10,NP7,NS1,NS2,NS3,NS4,NS5
Greg DesLaurier	146	13	15	06B,12A,14A,14B,15A,15B,16A,28A,AB3,AB7, AW6,AW8,HS1,ON6,OS1
Andy Loranger	127	15	17	23A,28A,32B,AB5,AB6,AP2,MC5,MC8,MK9,MR2, MR5,MR6,MT2,SN8,SN9,SN11
Shelli Vacca	121	8	9	12A,14A,15B,16A,28A,KG3,KG4,KG6,OS3
Greg Miller	115	10	11	06A,13,AP1,AP4,AP7,KR1,KR3,KR4,KS3,NRY,SN7
Steve Fleischman	110	13	12	12B,14A,AB5,AB6,MC5,MC8,MK1,MK7,MK9,MR5 ON6,OP3
Barbara Hicks	52	5	5	06A,27A,KR2,KR3,KR4
Jim Gilbert	55	6	5	14B,15A,28A,OS1,KR2
Jerry Tande	20	3	3	12B,14A,OS3
Cal Lensink	23	4	5	23A,AP2,MC3,MR2,MT2
Bob Stehn	82	8	4	06A,21A,AW1,KR2
Bill Eldridge	3	1	1	AW1
Dawn Conway	15	1	1	28A
Jim Sedinger	19	1	1	15A
Dave Ward	14	1	1	15A
Ken Kertell	417	12	20	W01 - W22
Camp Lake (3)	510	26	5	K01,K02,K03,K04,K3S
Old Chevak (4)	257	16	9	12A,C01,C02,C03,C04,C10,C11,C20,C21
Tutakoke (3)	451	30	-	16A,17A, circular plots
unkn. observer	31			
total nests =	3214			

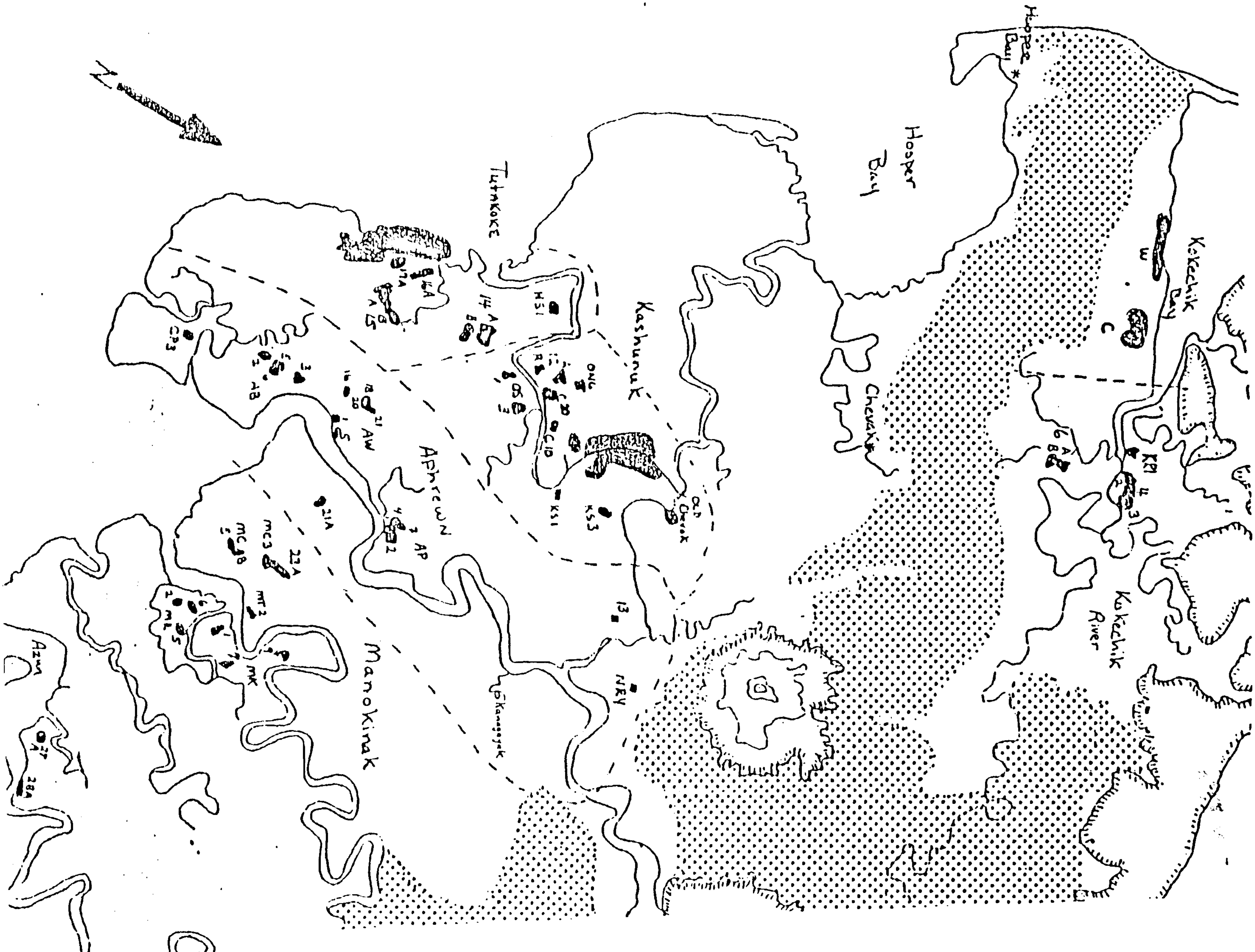

Figure 1. Map showing the location of plots searched for goose nests and the regional grouping of plots on the Yukon-Kuskokwim Delta, 1985.

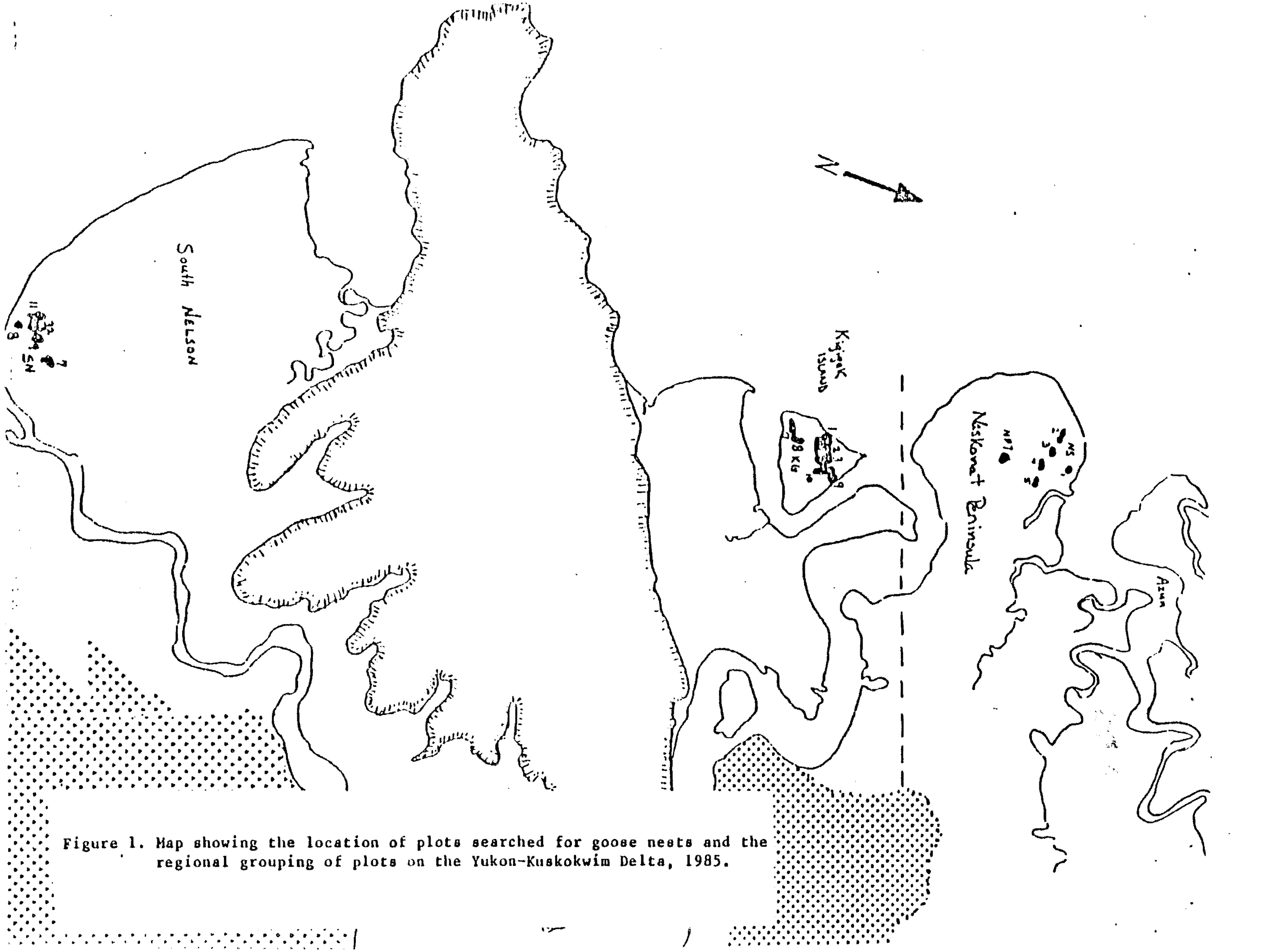

Figure 1. Map showing the location of plots searched for goose nests and the regional grouping of plots on the Yukon-Kuskokwim Delta, 1985.

Figure 2. Map showing areas where concentrations of geese were seen on 20 May or 24 May 1985 before breakup in a late year on the YK Delta. Also noted is the location of a suspected spring concentration area near the Yukon River.

Figure 3. Frequency distribution of clutch completion dates and observed hatch dates in 4 species of geese on the Yukon-Kuskokwim Delta, 1985.

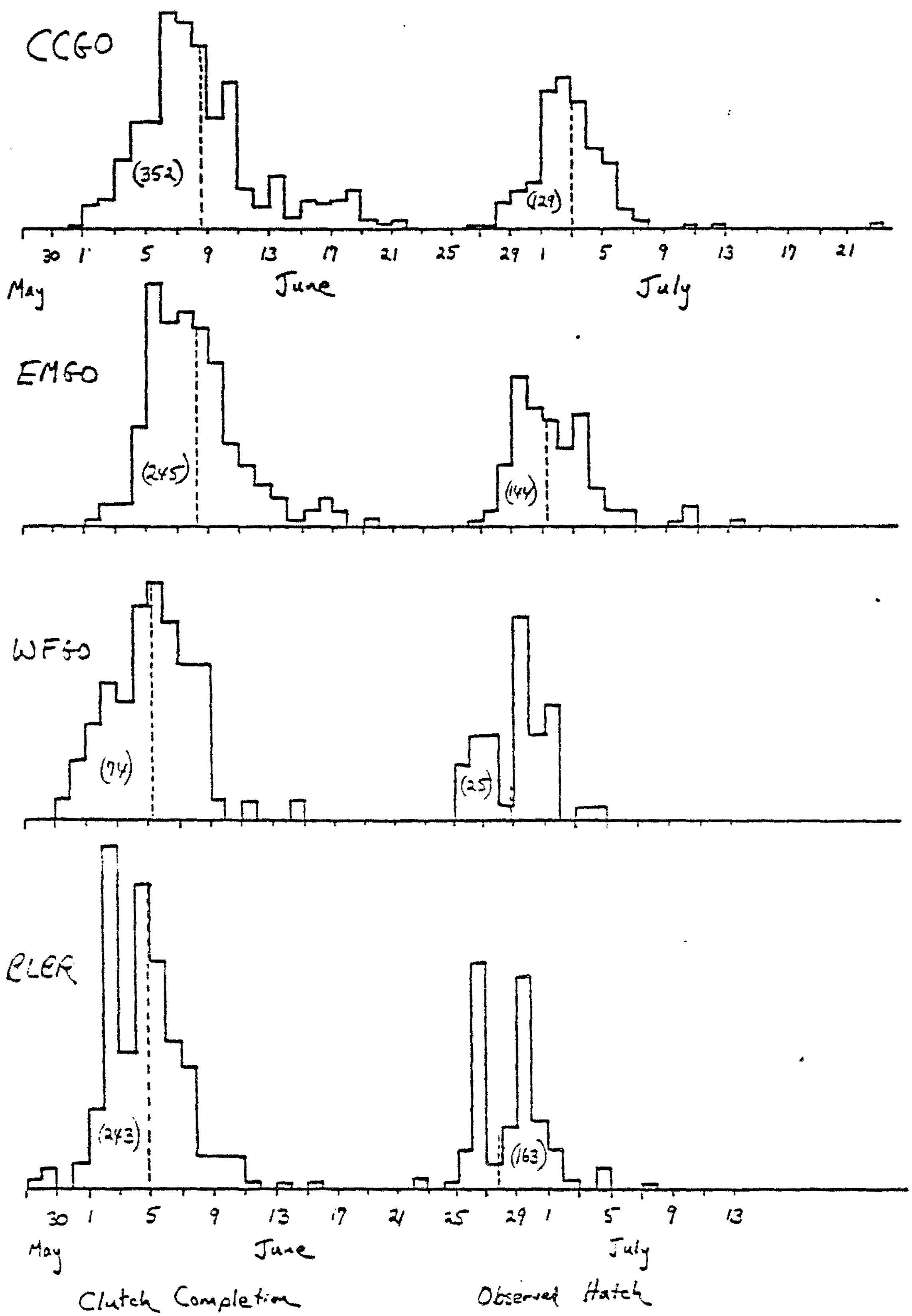

Figure 4. Trend in number of cackler nests found each year on Onumtuk 1 and Onumtuk 2 plots contained within Mickelson's study area along the Kashunuk River, YK Delta.

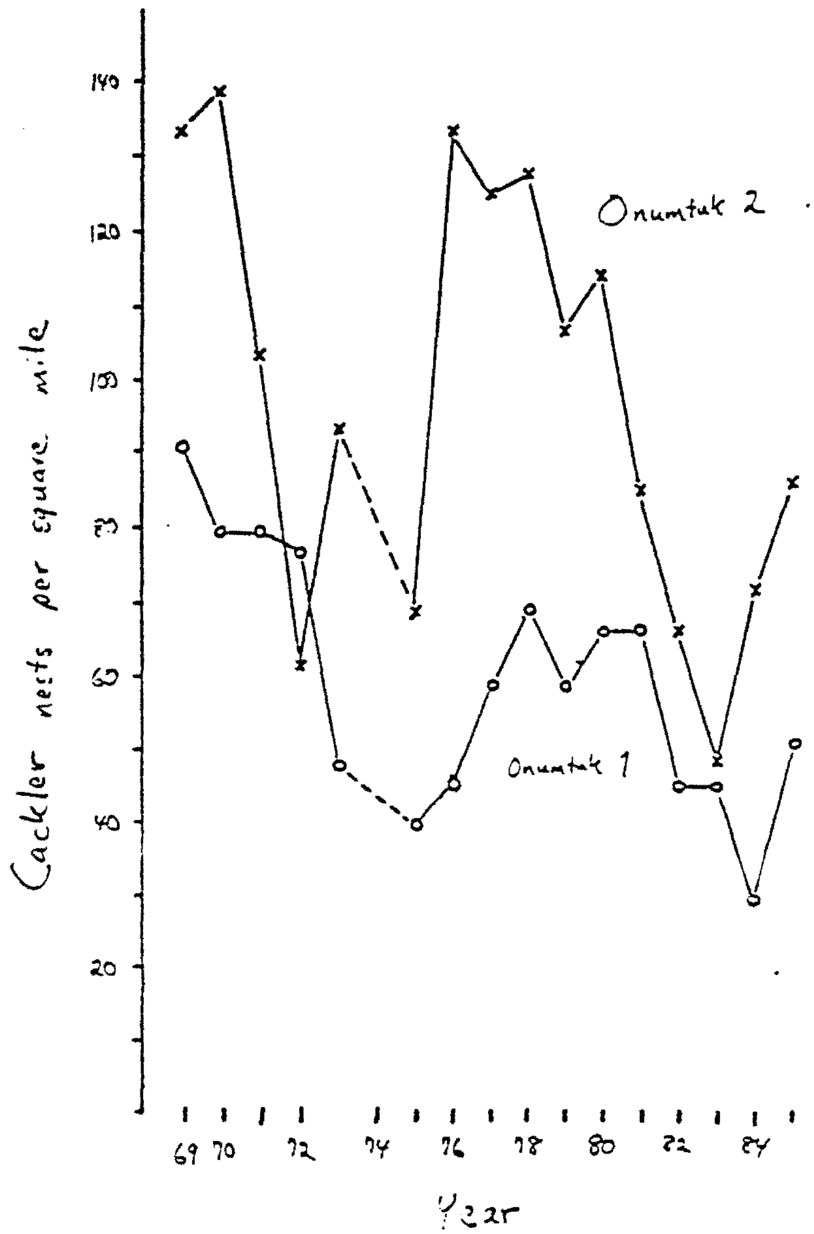

Figure 5. Relationship between average regional density and average nest success in Cackling Canada and Emperor geese on the Yukon-Kuskokwim Delta, 1985.

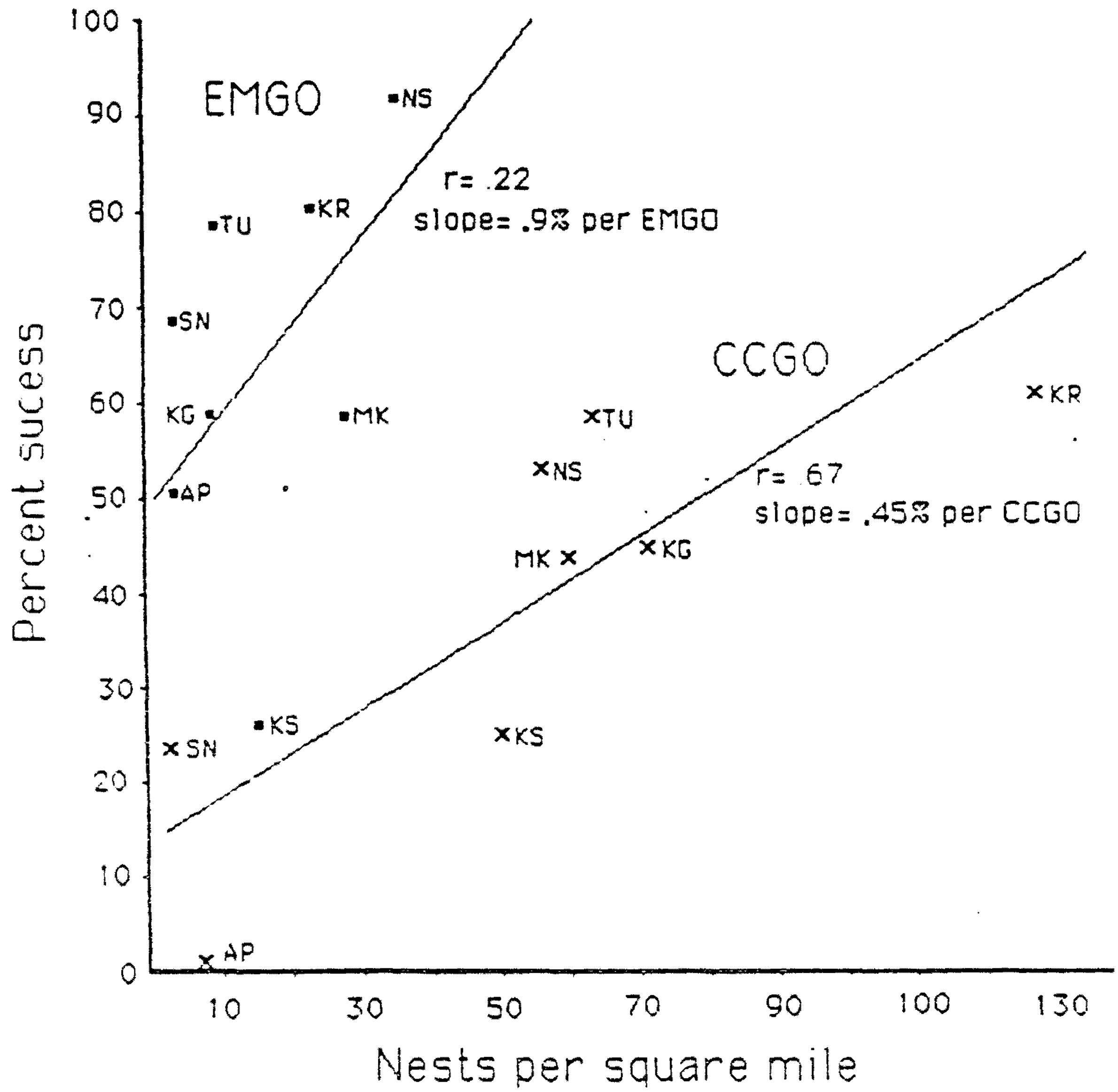

Figure 6. Nest attendance of females and males in different stages of incubation in 4 species of geese on the YK Delta, 1985. The average distance from the observer when the female flushes, and the distance of the male from the nest during different stages of incubation is also shown.

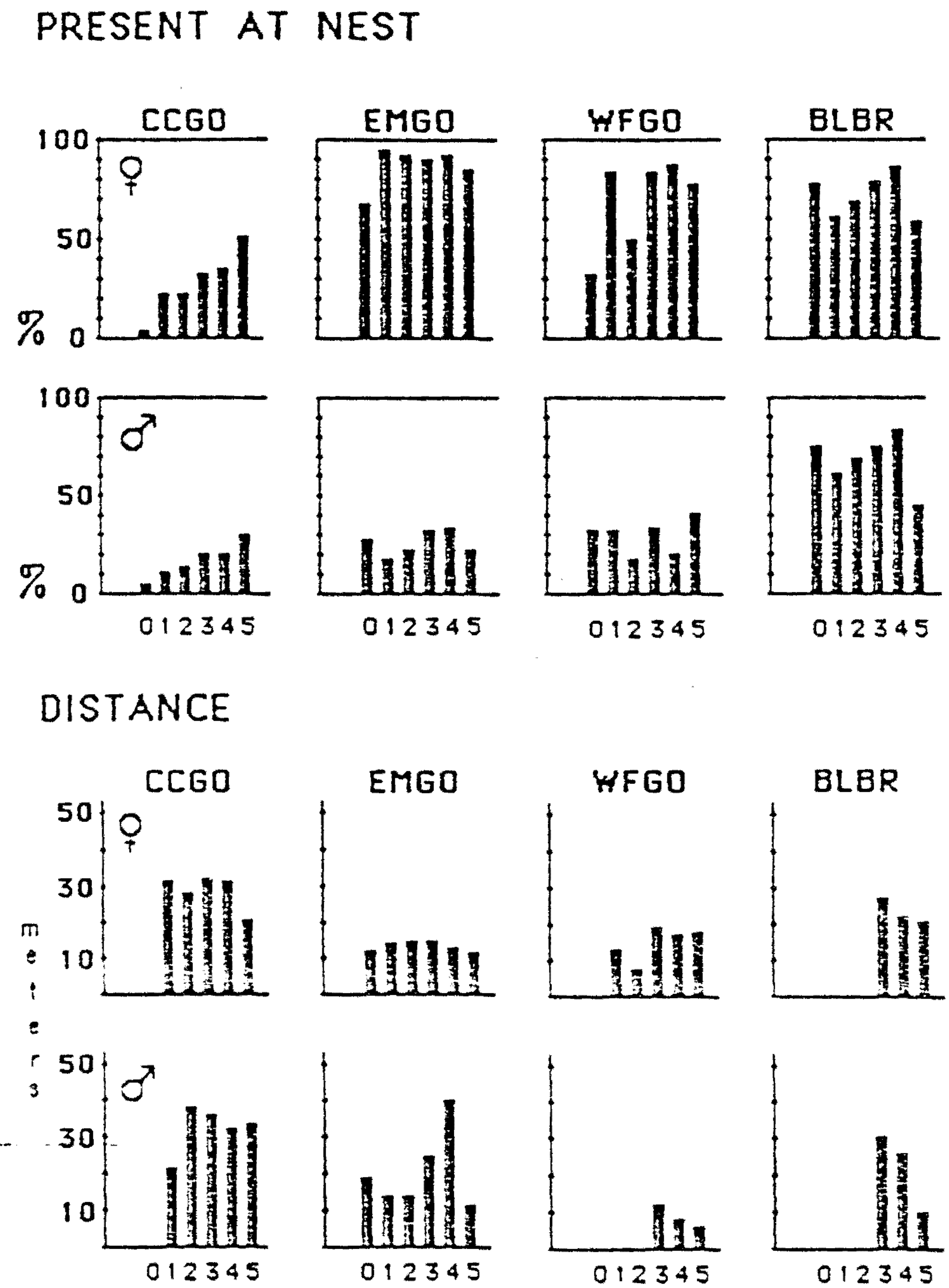

EXHIBIT B

RESEARCH PROPOSAL

Alaska Fish and Wildlife Office of Research

Anchorage, Alaska

Experimental Control of Fox Predation on Nesting Geese on Yukon Delta National Wildlife Refuge

BACKGROUND

Populations of all four species of geese nesting on the Yukon-Kuskokwim (YK) delta have declined precipitously since the 1960's (Raveling 1984). Current populations of cackling Canada geese (*Branta canadensis minima*) are about 12 percent of their former numbers. White-fronted geese (*Anser albifrons*), emperor geese (*Anser canagicus*), and black brant (*Branta bernicla nigricans*) are estimated to be about 24, 41, and 71 percent, respectively, of previous population highs. In 1984 the U. S. Fish and Wildlife Service through its Alaska Fish and Wildlife Office of Research (AFWOR) increased studies of populations of geese nesting on the YK delta. The research effort includes intensive study of the ecology of nesting geese at several locations on Yukon Delta National Wildlife Refuge (YDNWR). In addition, methods of estimating productivity and factors influencing productivity are be studied at many diverse locations on YK delta.

In 1985 a study was begun at Kokechik Bay on arctic foxes, which were identified as an important predator of goose eggs at all study sites in 1984 and 1985 (Stehn et al. 1986). Because cackling Canada geese (cacklers) and brant rarely defend their nests and have high nesting densities, they have been most severely affected. The apparent increase in fox populations (manifested by increased fox sitings and documented increases in predation of eggs) plus limited numbers of nesting geese may preclude recovery of goose populations (Stehn et al. 1986). Therefore, there is an immediate need to determine the feasibility of controlling fox populations in nesting habitat of cacklers and brant and to determine the effect of reducing populations of foxes on nesting success. Because of the high nesting densities of cacklers and brant, it may be possible to protect many of these birds by removing foxes from a relatively limited area.

We propose to evaluate the effects of fox removal on production of geese nesting at Kigigak Island and at the Tutakoke River area. Special attention will be given to cacklers at both areas and to the brant colony under study near the mouth of Tutakoke River. The Tutakoke area was chosen because of its high populations of cacklers and brant in close proximity, its previous records of goose productivity and fox predation rates, and because it is representative of "typical" goose nesting areas on YK delta that are accessible to foxes throughout the entire year. Kigigak Island was chosen because of previous records of goose productivity and fox predation, and because it is isolated from foxes by a wide water barrier after "breakup".

The study is designed to obtain indices of activity of foxes and avian predators in controlled and uncontrolled areas, to measure movements of foxes into areas where control activities are being conducted, to determine the relative significance of fox predation compared to total nest predation, and to determine the nesting success of geese in areas where foxes have been controlled. Before control efforts begin, foxes within the designated control areas at both study sites will be marked using nontoxic baits containing tetracycline hydrochloride. Foxes on the periphery of the controlled area will be presented nontoxic baits containing rhodamine B. Use of these systemic markers will allow us to determine the effectiveness of control measures and movements of foxes. Observations from towers will be used to index activity of foxes and avian predators during control activities. Nesting success of geese will be estimated on historical plots in controlled and uncontrolled areas just before hatch occurs. Foxes trapped and killed in the study areas from April through June will be examined to collect information on age, sex, reproductive status, parasites, foods, and physical characteristics.

STUDY PLAN

Objectives

1) Determine the feasibility of short term, site specific control of foxes for improving nesting success of geese.

2) Determine the extent that nesting success of geese is enhanced by control of foxes.

3) Determine the significance of fox predation compared to total nest predation (i.e., gulls, jaegers, and mink).

4) Protect nesting geese under study at Tutakoke River.

5) Collect information on physical characteristics, age, sex, reproductive status, foods, and parasites of foxes inhabiting nesting areas of geese.

Procedures

Tutakoke Study Area - Beginning in March 1986 the area within an approximate 6-mile radius of the mouth of the Tutakoke River (see map) will be searched biweekly for signs of fox activity. A systematic search along transects will be conducted initially from aircraft. Areas with dens, areas known to have had dens in previous years, and heavily tracked areas will be mapped. Ground searches for activity will be conducted from snow machines if warranted by results of aerial observations.

In early April 4-g nontoxic baits, containing 125 mg tetracycline (Allen 1982), will be distributed within an 88 km^2 area at sites with sign of fox activity (see map). A 180 km^2 area bordering the core area (see map) will be baited with nontoxic drop baits containing 120 mg rhodamine B each (Johns and Pan 1982). Baits will be buried under snow whenever possible to reduce feeding by scavenging birds. A subsample of 50 baits of each type will be examined after placement to determine use of baits. Sampling will continue until 75 percent of the sampled baits have been taken.

Fox control will begin when baits have been consumed, but no later than the middle of April. Areas with fox sign will be intensively trapped (no less than 4 traps per discrete area of fox activity) using leghold traps and snares. Traps will be checked daily. Snares will be checked every other day at a minimum. Tracking from snow machines, calling and shooting will also be used to remove foxes if feasible.

Removal of foxes over the entire designated area will continue biweekly until breakup. From breakup until egg hatch, trapping will be conducted weekly from two camps within a reduced portion of the core trapping area--near the brant colony and around an area inland from the brant colony with high nesting density of cacklers (see map). Reproductive and gastrointestinal tracts of all trapped foxes will be preserved by freezing or with chemical preservatives. The following biological information will be collected from the carcasses of captured foxes: (1) aging by tooth sectioning, (2) reproductive status, (3) parasites, (4) contents of gastrointestinal tract, (5) condition of pelage, and (6) body size and weight.

Activity of foxes, jaegers, and gulls around the brant colony and in habitat associated with cackling Canada goose nesting will be monitored every other day after initiation of nesting by observations from towers. Counts of foxes observed will be used to determine reoccupation of the area by foxes and to facilitate removal of foxes foraging in the nesting area. Counts of predatory birds will be used to estimate the potential for losses of eggs to avian predators. Observation periods for foxes will be from 2200-2400 hours. Observations of bird activity will occur during times of optimum activity, which will be coordinated with tidal fluctuations and related feeding activity by birds. Observations of fox activity at Kokechik Bay--where an uncontrolled population of marked foxes exists--will follow the same schedule.

Kigigak Island Study Area - Tetracycline-treated drop baits will be distributed on the island at breakup. Fifty bait locations will be examined after placement to determine use of bait and continue until 75 percent are removed. Fox control activities on Kigigak Island will begin at breakup. Fox control will begin 3 days after bait placement. Trapping, snaring, and shooting will be used to take foxes. Fox control and observations of fox and bird activity will follow the same schedule as for the Tutakoke area.

Success of the damage control effort will be judged by comparison of brant productivity between the Tutakoke colony and another large colony near Kokechik Bay. Predation rates in previous years at these sites will be used to measure relative severity of predation between years and between areas. Nesting success of cacklers within the control area will be compared with nesting success from similar areas outside the fox control area at Tutakoke (see map) and from plots at Old Chevak. At Tutakoke River and Kigigak Island plots will be located on areas where nesting surveys have been conducted in previous years to allow historical comparisons. Comparison plots will be located on the mainland adjacent to Kigigak Island (see map). A single sample of nesting success will be made about one week before hatch occurs.

Analysis

Proportion of successful nests will be compared among 1984, 1985 and 1986 on areas with data for all years. Nesting success in 1986 also will be compared between areas with fox control and uncontrolled areas. Nesting success on plots inside the fox control area at Tutakoke will be compared with plots on the periphery of the control area and with plots outside the control area to detect area effects of fox control. Chi-square goodness-of fit with appropriate correction for continuity will be used to make these comparisons (Snedecor and Cochran 1980).

Indices of fox and bird activity from observations will be compared between controlled and uncontrolled areas with Chi-square tests. Observation data from Kokechik Bay, which involves radio-collared foxes, will be used to determine observability of foxes.

Teeth, claws, and hair will be examined under ultraviolet light for fluorescence from tetracycline and rhodamine B to determine the origin of trapped foxes and rate of reoccupation of controlled areas.

Stomach contents, reproductive tracts, and sectioned canine teeth will be processed to collect biological information on foxes removed from nesting areas.

Personnel

The proposed work will require the participation of U. S. Fish and Wildlife Service personnel from the Alaska Fish and Wildlife Office of Research (AFWOR), Wildlife Assistance (WA), and Yukon Delta National Wildlife Refuge (YDNWR). Responsible individuals are as follows:

Michael Anthony, Zoologist (AFWOR)- Planning and coordinating control work, locating and trapping of foxes, processing fox carcasses, collecting data on fox activity and goose productivity at Kokechik Bay, and assessing control success.

Wells Stephensen, Animal Damage Control Supervisor (WA)- Prescribing methods for removal of foxes, supervising actual control work, and assessing control success.

Mike Wege, Biological Technician (YDNWR)- Trapping foxes, observing activities of foxes and birds, and measuring goose production at Kigigak Island.

Kurt Becker, Pilot/Biologist (YDNWR)- Operating aircraft for locating fox sign and lactating female foxes radio-collared in the Tutakoke area.

Jack Paniyak, Biological Technician (YDNWR)- Supervising location of foxes, trapping foxes, and collecting fox carcasses (as available).

Four temporary biological technicians (yet to be named)- Trapping foxes, observing foxes, and surveying goose nesting success after breakup.

Schedule

Scheduled activities are contingent on suitable weather for safe working conditions. Scheduled participation in searching/trapping for foxes by Anthony and Stephensen are dependent on need of additional manpower.

March (second week)- Anthony, Stephenson, and Becker conduct aerial survey for fox activity.

March (fourth week)- Anthony, Paniyak and technicians conduct ground survey for fox activity.

April (first week)- Anthony and biological technicians place baits in Tutakoke study area.

April (second week)- Anthony and biological technicians trap for foxes.

May (first week)- Biological technicians begin trapping and observations for fox activity at two Tutakoke camp sites. Biological technicians place baits at Kigigak study area and begin trapping when baits are removed.

May through June- Trapping of foxes by biological technicians at Tutakoke and Kigigak study areas as described in Procedures. Observation of fox activity at all camps. Goose nesting surveys by personnel at Tutakoke and Kigigak camps. Assistance provided by Anthony and Stephensen as needed.

FUNDING

Salaries and associated personnel costs will be borne by the offices from which participating employees are supervised. Maintenance and operation of camps at the Tutakoke study area will be the responsibility of Alaska Fish and Wildlife Office of Research (AFWOR). Establishment and maintenance of the Kigigak Island camp will be the responsibility of Yukon Delta National Wildlife Refuge (YDNWR).

Snow machine procurement and operating costs will be shared by AFWOR and YDNWR.

Aircraft services will be provided by YDNWR

Salaries and benefits

Personnel	Work days	Cost
	- Tutakoke -	
Anthony	40	6233
Stephensen	10	1749
Paniyak	5	383
Becker	5	875
Bio. Techs.(3)	150	11963
	- Kigigak -	
Wege	40	3922
Bio. Tech.	40	3190
Total		28315

Supplies and Services

Establishment of camps	1000
Camp supplies (food and equip.)	2500
Fuel	500
Field supplies	500
Aircraft	5500
Transportation	4000
Bait	800
Total	14800
Grand total	43115

FUNDING RESPONSIBILITIES

	RESEARCH		REFUGE			REGION	
Personnel	Brant	Cacklers	Brant	Cacklers	Kigigak	Brant	
Anthony	6233						
Stephensen						1749	
Paniyak			383				
Becker			875				
Wege					3922		
Bio. Techs.(3)	3988	7975*					
Bio. Tech.					3190		
TOTALS	10221	7975 7975*	1258		7112	1749	= 28315 7975*
Support							
Camp setup				500*	500		
Camp supplies			500	1200*	800		
Fuel			500*				
Field supplies	500*						
Aircraft			5500*				
Transportation	500	2800*			700		
Bait		800*					
TOTALS	1000 500*	3600 3600*	6500 6000*	1700 1700*	2000		= 14800 = 11800*
GRAND TOTALS	11221 500*	11575 11575*	7758 6000*	1700 1700*	9112 --	1749 --	= 43115 = 19775*

*Items not covered in FY-86 budget allocations

REPORTS AND PUBLICATIONS

A report on the effects of controlling fox predation and on biological information collected on foxes will delivered to cooperators by AFWOR by December 15, 1986.

Submitted by R. Michael Anthony

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EXHIBIT C

A PRELIMINARY CLASSIFICATION OF PLANT COMMUNITIES IN THE VEGETATED INTERTIDAL ZONE OF THE CENTRAL YUKON DELTA, ALASKA

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A PRELIMINARY CLASSIFICATION OF PLANT COMMUNITIES IN THE VEGETATED INTERTIDAL ZONE OF THE CENTRAL YUKON DELTA, ALASKA

By: G. Vernon Byrd and Dennis Ronsse

The coastal fringe of the Yukon Delta between the Askanuk Mountains and Nelson Island (Figure 1) is a low, nearly flat plain of alluvium deposited by tributaries of the Yukon River(Dupre 1977). The region is subject to flooding by melt water in spring and by storm tides from the Bering Sea primarily in fall. This area which is periodically inundated has been called the "vegetated intertidal zone" (reference).

Most of the vegetation studies on the Yukon Delta have been accomplished in conjunction with bird studies (Holmes and Black 1973, Mickleson 1975, Eisenhauer and Kirkpatrick 1977). Two studies primarily directed at plant identification and associations have been done at Scammon Bay (Hultén 1962) and (Jackson 1976). No effort has been made heretofore to define plant communities over a broad area of the Yukon Delta, although two major vegetative/physiographic associations have been recognized (Byrd and Smith 1981): 1) upland tundra and 2) tidal meadow. The associations have an intermediate zone where the major types overlap.

In the preliminary classification of vegetation in Alaska (Viereck and Dyrness 1980) terrestrial plants in our study area fall into the "level 1" formations: tundra shrubland and herbaceous vegetation. Since little work has been done on the plants of the outer Yukon Delta, the established classification is progressively less appropriate at it becomes more specific, ~~levels (Table 1).~~ (see Table 1).

The purpose of our study was to subjectively and quantitatively evaluate the distinct plant associations we could consistently recognize. This was a preliminary effort which should eventually lead to habitat mapping for the whole region.

METHODS

From June to August 1973 we observed plants in a number of locations within the region and subjectively developed working descriptions of communities. To test our hypotheses about plant associations we established 10 random transects(ranging from 100m to 800 m long) in two areas near the Manokinak River mouth (figure 2). Transects were 1 m wide and they were oriented generally perpendicular to the coast. A two-stage sampling design was used; secondary 1 m^2 sampling units were chosen and replicated in each sampling interval (5 or 50 m depending on transect length) along a transect. Each 1 m^2 plot was assigned to the appropiate community based on subjective definitions. A m^2 string was placed over the vegetation at each plot location and the percent cover of each species in each plot was visually estimated to the nearest 5 percent. Species represented by only one or two individuals were given a 1 percent cover value. All plots in each plant community were then averaged to get a mean percent cover value. This was multiplied by the frequency of occurrence (% of total plots in a given community in which the species was present) to derive a relative importance value.

RESULTS AND DISCUSSION

Vegetation in the area could be represented meaningfully on two continuums. 1)soil moisture and 2) salt tolerance. These factors may act independently or together to shape plant communities. For example, a gradual increase in elevation may improve drainage (decreasing soil moisture) and simultaneously reduce the chances of tidal flooding (thus reducing salinity). In contrast, relatively low wet areas which are far enough from the coast to have reduced salinity may have quite different species than areas with similar soil moisture near the coast (where salinity is higher).

In the area east of Hazen Bay, where we ran transects, there was a gradual increase in elevation as we proceeded inland. A generalized cross-section of the area with plant communities is shown in figure 3. In reality there was an interdigitation of plant communities.

Since the composition of plants changed gradually along the continuum (Table 2) defining plant communities is really just setting arbitrary points along the continuum which may generally be recognized by observing indicator species.

Annotated List of Plant Communities

Coastal Mudflat - Much of this community is inundated by salt water during daily high tides. Although we surveyed just seven plots (Table 3), it was apparent from subjective ovservation that the major plants found here were indeed *Carex subspathacea* and *Puccinellia phryganodes*. These two species grew in low dense clumps sometimes forming extensive mats, and the relative dominance of each species varied considerably among areas. The community was not restricted to the immediate sea coast (although it was most common there), but was found also at the edge of tidal ponds and shallow sloughs near the coast.

The identification of the *Carex* to species was based on previous reports (e.g., Reference) because we never found flowers, the plants being grazed so heavily by geese that only very short vegetative parts were ever observed.

Sedge Meadow - This community occurs slightly above the mean high tide line. It may be inundated by saline water during nearly every monthly high tide cycle. The dominant plants were *Carex ramenskii* and *Potentilla egedii* (Table 4). Also frequently present but less important were *Poa eminens*, *Calamagrostis* spp. (probably *C. deschamsoides*) and *Stellaria* spp..

In the wettest sites this community contained nearly pure stands of *C. ramenskii*, but in the better drained sites where this community occurred, *Carex glareosa*, and several grasses occurred. To be assigned to this community a plant association contained less than 20 percent grass (all forms combined).

Sedge Grass - Next up the ~~elevated~~ elevation gradient from the Sedge Meadow, this community contains a higher percentage of grass than the Sedge Meadow (Tables 2
Although *Carex ramenskii* and *Potentilla egedii* remain dominant (as they were in the Sedge Meadow community) the importance of *C. ramenskii* is somewhat diminished. In the Sedge-Grass Meadow community grasses comprise approximately

20 to 35 percent cover. *Calamogrostis* spp. (probably *C. deschampsoides*) and *Carex glareosa* become important in this community and *Carex rariflora* appears.

Silverweed Sedge Grass - Found primarily along coastal sloughs, this community was dominated by *Potentilla egedii* (silverweed), and *Carex ramenskii* (Table ~~8~~ 6). The widespread *Elymus arenarius* which occupied most communities reached its peak importance in this community. *Poa eminens* and *Calamagrostis* spp. are also common. It was slightly better drained than previously discussed communities but was still influenced strongly by saline water during even mild storm tides.

Grass Sedge - The main difference between this community and the Sedge Grass community is the increase in importance of grass here (> 35% cover) coinciding with a decrease in *Carex ramenskii* and *Potentilla egedii* (Tables 2 and ~~6~~ 7). The change apparently results from improved drainage.

Pond Edge - Ponds in the vegetated intertidal zone are generally shallow (average < 70 cm) and brackish. They often have gently sloping borders which are covered by several centimeters of water in spring, but become very shallow or moist soil as summer progresses. In very shallow water and moist soil nearly pure stands of *Carex mackenziei* occur (Table ~~7~~ 8). Also important, especially in shallow water is *Hippurus tetraphylla*.

Willow Gramanoid - With a decrease in salinity due to increased elevation (which reduces the frequency of inundation by saline water) comes an increase in *Salix* (probably *S. ovalifolia*, and *S. fuscescens*). *Carex rariflora*, and *Festuca rubra* reached their peaks of importance in this community (Table ~~8~~ 9). *Calamagrostis* spp. and other grasses remain important as they were in the Grass Sedge community. *Carex ramenskii* was reduced greatly from lower areas.

Crowberry-Willow - *Empetrum nigrum* replaces *Salix* spp. (although this taxa remians very important) as the dominant plant. *Carex rariflora*, *Calamagrost* spp., and *Festuca rubra* remain~~ed~~ important, as they were in the Willow Gramanoid community (Tables 2 and ~~9~~ 10).

Coastal Crowberry - Frequently this community occurred on raised ridges or hummocks surrounded by one or more of the former communities. *Empeterum nigrum* was by far the most important species, followed by moss, *Lathyrum maritimus*, and *Carex rariflora* (Table ~~10~~ 11).

Inland Crowberry - This community differs from the coastal crowberry by having a big increase in moss and *Betula nana* (Table 12). Also the gramanoids deminish drastically. This community is generally above the storm tide zone and is therefore not heavily influenced by saline water.

Table 1. Preliminary classification system for vegetation of Alaska (Viereck and Dyrness 1980) as it applies to the coastal fringe of the central Yukon Delta.

Level I	Level II	Level III	Level IV	Level V[a]
TUNDRA	Sedge Grass Tundra	Wet Sedge Grass	Wet Sedge Meadow	Sedge Meadow
				Pond Edge
			Wet Sedge Grass Meadow	Sedge Grass
				Grass Sedge
			Wet Sedge Herb Meadow	Silverweed Sedge Grass
	Shrub Tundra	Willow	Willow Sedge	Willow Gramanoid
			Willow Grass	Willow Gramanoid
		Birch and Ericaceous shrubs	Birch and Ericacous Sphagnum	Inland Crowberry
			Crowberry	Coastal Crowberry
	Mat and Cushion Tundra	Closed Mat and Cushion	Matted Cushion-Grass	Crowberry Willow
SHRUBLAND	Low Shrub	Open Low Shrub	Mixed Shrub Sphagnum	Inland Crowberry
HERBACEOUS VEGETATION	Sedge Grass	Wet Sedge Grass	Sedge Marsh	Pond Edge
		Saline Sedge Grass (tidal marsh)	Halophytic Sedge	Coastal Mudflat
				Sedge Marsh

[a]Listed here are the communities we defined, not those listed in Viereck and Dyrness 1980).

TABLE 2. Relative Importance Values of major plants in communities on the coastal fringe of the Yukon Delta.

Species	Coastal Mudflat	Sedge Meadow	Sedge Grass	Silverweed Sedge Grass	Grass Sedge	Pond Edge	Willow Graminoid	Crowberry Willow	Coastal Crowberry	Inlan Crow
Carex ramenskii		73.4	34.0	37.3	20.3	1.5	0.6	0.1	0.1	
Carex glareosa		0.2	10.3	1.1	10.2		2.2	<0.1		
Carex rariflora			2.0		2.9	0.1	28.8	28.7	9.5	0.
Potentilla egedii	0.1	17.0	21.5	48.5	15.9	0.9				
Calamagrostis spp.		1.1	11.5	5.4	15.9	3.1	9.3	13.2		
Elymus arenarius		0.1	0.8	15.0	7.6		0.8	1.5	0.1	
Poa eminens		1.3	3.5	7.0	6.4		2.7	0.1		
Festuca rubra		<0.1	0.4	<0.1	4.2		12.7	7.1	3.3	0.
Chrysanthemum arcticum		<0.1	3.4	0.1	4.6	0.1	2.3	0.7	0.1	
Salix spp.		<0.1	<0.1		0.7		29.3	21.8	3.6	1.
Empetrum nigrum			<0.1		<0.1		3.9	38.1	42.5	50.
Lathyrus maritimus								2.6	10.5	
Moss			<0.1		<0.1		0.5	0.1	14.8	58.
Betula nana								0.1	3.9	18.
Puccinellia phryganodes	50.0			<0.1						
Carex subspathacea	33.5									
Carex mackenziei			<0.1			48.9				

TABLE 3. Composition of the coastal mudflat plant community on the coastal fringe of the Yukon Delta, Alaska (n=7).

Species	$\bar{x}$	s.e.	Frequency of Occurrence	Relative Importance Value[a]
Puccinellia phryganodes	50.0	5.8	1.00	50.0
Bare mud	33.5	5.2	1.00	33.5
Carex subspathacea	13.1	4.4	1.00	13.1
Stellaria spp.	1.6	0.9	.43	0.7
Hippuris tetraphylla	3.6	3.6	.14	0.5
Potentilla egedii	1.0	0.7	.13	0.1

[a]product of $\bar{x}$ and frequency of occurrence.

TABLE - . Composition of the *sedge meadow* plant community on the coastal fringe of the Yukon Delta, Alaska (n=16).

Species	$\bar{x}$	s.e.	Frenquency of Occurrence	Relative Importance Value[a]
Carex ramenskii	73.4	3.4	1.00	73.4
Potentilla egedii	19.4	4.8	.88	17.0
Poa eminens	3.3	1.3	.38	1.3
Calamagrostis spp.	2.6	1.1	.44	1.1
Stelleria spp.	1.8	1.3	.38	.7
Bare soil	2.5	1.4	.19	.5
Triglochin palustris	1.9	1.1	.13	.2
Carex glareosa	1.0	0.9	.19	.2
Elymus arenarius	0.4	0.3	.13	.1
Salix spp.	0.6	0.6	.06	<.1
Rumex arcticus	0.6	0.6	.06	<.1
Ligusticum scoticum	0.6	0.6	.06	<.1
Festuca rubra	0.3	0.3	.06	<.1
Chrysanthemum arcticum	0.1	0.1	.06	<.1

[a]product of $\bar{x}$ and frequency of occurrence.

TABLE 5. Composition of the *sedge-grass meadow* plant community on the coastal fringe of the Yukon Delta, Alaska (n=34).

Species	$\bar{x}$	s.e.	Frequency of Occurrence	Relative Importance Value[a]
Carex ramenskii	38.6	4.0	.88	34.0
Potentilla egedii	27.2	3.4	.79	21.5
Calamagrostis spp.	12.2	1.3	.94	11.5
Carex glareosa	13.9	2.3	.74	10.3
Poa eminens	6.0	1.1	.59	3.5
Chrysanthemum arcticum	5.2	1.1	.65	3.4
Carex rariflora	8.4	3.1	.24	2.0
Elymus arenarius	2.2	0.7	.35	0.8
Festuca rubra	1.9	0.8	.21	0.4
Triglochin palustris	0.6	0.4	.09	0.1
Empetrum nigrum	0.6	0.6	.03	<0.1
Salix spp.	0.3	0.3	.09	<0.1
Poa lanata	0.4	0.4	.03	<0.1
Carex mckenzii	0.2	0.2	.06	<0.1
Moss	0.2	0.2	.06	<0.1
Sedum roseum	0.2	0.2	.03	<0.1
Saussurea nuda	<0.1	<0.1	.03	<0.1
Pedicularis spp.	<0.1	<0.1	.03	<0.1
Stellaria spp.	<0.1	<0.1	.03	<0.1

[a]product of $\bar{x}$ and frequency of occurrence.

TABLE 6. Composition of the silverweed-sedge-grass slough bank plant community on the coastal fringe of the Yukon Delta, Alaska (n=13).

Species	$\bar{x}$	s.e.	Frequency of Occurrence	Relative Importance Value[a]
Potentilla egedii	48.5	5.2	1.00	48.5
Carex ramenskii	37.3	5.5	1.00	37.3
Elymus arenarius	15.0	1.6	1.00	15.0
Poa eminens	8.5	1.4	.82	7.0
Calamagrostis spp.	6.3	1.7	.85	5.4
Carex glareosa	2.4	0.9	.46	1.1
Triglochin palustris	1.2	0.6	.23	0.3
Stellaria spp.	0.8	0.5	.15	0.1
Chrysanthemum arcticum	0.5	0.4	.23	0.1
Festuca rubra	0.4	0.7	.08	<0.1
Ligusticum scoticum	0.4	0.4	.08	<0.1
Puccinellia phryganodes	0.4	0.4	.08	<0.1

[a] product of $\bar{x}$ and frequency of occurrence.

TABLE 7. Composition of the grass-sedge meadow plant community on the coastal fringe of the Yukon Delta, Alaska (n=43).

Species	$\bar{x}$	s.e.	Frequency of Occurrence	Relative Importance Value[a]
Carex ramenskii	27.4	3.4	.74	20.3
Calamagrostis spp.	16.7	1.4	.95	15.9
Potentilla egedii	21.5	3.2	.74	15.9
Carex glareosa	12.6	1.8	.81	10.2
Elymus arenarius	12.0	4.6	.63	7.6
Poa eminens	9.1	1.3	.70	6.4
Chrysanthemum arcticum	7.0	1.1	.65	4.6
Festuca rubra	7.3	1.3	.58	4.2
Carex rariflora	8.8	2.2	.33	2.9
Rumex arcticus	9.3	1.6	.14	1.3
Salix spp.	5.7	1.3	.12	0.7
Ligusticum scoticum	0.7	0.4	.09	0.1
Moss	0.6	0.5	.05	<0.1
Triglochin palustris	0.4	0.3	.09	<0.1
Stellaria spp.	0.3	0.2	.09	<0.1
Saussurea nuda	0.3	0.3	.05	<0.1
Empetrum nigrum	0.1	0.1	.07	<0.1
Sedum roseum	0.1	0.1	.02	<0.1
Polemonium acutiflorum	0.1	0.1	.02	<0.1
Primula spp.	<0.1	<0.1	.02	<0.1

[a]product of $\bar{x}$ and frequency of occurrence.

TABLE 7. Composition of the pond edge plant community on the coastal fringe of the Yukon Delta, Alaska (n=9).

Species	$\bar{x}$	s.e.	Frequency of Occurrence	Relative Importance Value[a]
Carex mckenzii	48.9	10.9	1.00	48.9
Hippuris tetraphylla	34.4	11.3	.78	26.9
Calamagrostis spp.	9.4	5.2	.33	3.1
Carex ramenskii	6.7	4.7	.22	1.5
Potentilla egedii	3.9	2.6	.22	0.9
Carex rariflora	0.6	0.6	.11	0.1
Chrysanthemum arcticum	0.6	0.6	.11	0.1
Triglochin palustris	0.1	0.1	.11	<0.1

[a]product of $\bar{x}$ and frequency of occurrence.

TABLE 9. Composition of the *willow-gramanoid* plant community on the coastal fringe of the Yukon Delta, Alaska (n=14).

Species	$\bar{x}$	s.e.	Frequency of Occurrence	Relative Importance Value[a]
Salix spp.	29.3	2.3	1.00	29.3
Carex rariflora	31.0	4.6	.93	28.8
Festuca rubra	13.6	1.5	.93	12.7
Calamagrostis spp.	11.8	2.4	.79	9.3
Empetrum nigrum	6.9	2.2	.57	3.9
Poa eminens	5.4	2.3	.50	2.7
Chrysanthemum arcticum	2.9	1.0	.79	2.3
Carex glareosa	5.1	2.4	.43	2.2
Elymus arenarius	2.6	1.5	.29	0.8
Carex ramenskii *rariflora*	2.9	1.7	.21	0.6
Moss	2.2	1.8	.21	0.5
Poa lanata	1.8	1.8	.07	0.1
Petasites frigidus	1.1	1.1	.07	0.1
Eriophorum spp.	0.7	0.6	.14	0.1
Primula spp.	0.4	0.4	.14	0.1
Ligusticum scoticum	0.4	0.4	.14	0.1
Polemonium acutiflorum	0.1	0.1	.07	<0.1
Stellaria spp.	0.1	0.12	.07	<0.1

[a] product of $\bar{x}$ and frequency of occurrence.

TABLE 10. Composition of the crowberry-willow plant community on the coastal fringe of the Yukon Delta, Alaska (n=11).

Species	$\bar{x}$	s.e.	Frequency of Occurrence	Relative Importance Value[a]
Empetrum nigrum	38.1	5.1	1.00	38.1
Carex rariflora	31.5	9.0	.91	28.7
Salix spp.	21.8	3.3	1.00	21.8
Calamagrostis spp.	13.2	2.1	1.00	13.2
Festuca rubra	8.7	3.5	.82	7.1
Lathyrus maritimus	7.3	3.9	.36	2.6
Petasites frigidus	3.2	1.0	.55	1.6
Elymus arenarius	4.1	2.1	.36	1.5
Chrysanthemum arcticum	2.0	0.6	.36	0.7
Ligusticum scoticum	1.9	1.4	.27	0.5
Valariana capitata	3.2	3.2	.09	0.3
Moss	1.4	1.4	.09	0.1
Bare soil	1.4	1.4	.09	0.1
Betula nana	0.6	0.5	.18	0.1
Carex ramenskii	0.5	0.5	.09	0.1
Poa eminens	0.5	0.5	.09	0.1
Carex glareosa	0.2	0.1	.18	<0.1
Poa lanata	0.2	0.1	.18	<0.1
Saussurea nuda	0.1	0.1	.09	<0.1
Triglochin palustris	0.1	0.1	.09	<0.1

[a]product of $\bar{x}$ and frequency of occurrence.

TABLE 11. Composition of the *coastal crowberry* plant community on the coastal fringe of the Yukon Delta, Alaska (n=10).

Species	$\bar{x}$	s.e.	Frequency of Occurrence	Relative Importance Value[a]
Empetrum nigrum	42.5	5.3	1.00	42.5
Moss	24.6	10.0	.60	14.8
Lathyrus maritimus	17.5	5.5	.60	10.5
Carex rariflora	13.6	4.1	.70	9.5
Betula nana	7.8	1.8	.50	3.9
Salix spp.	6.0	1.8	.60	3.6
Festuca rubra	6.5	2.5	.50	3.3
Petasites frigidus	6.0	2.2	.50	3.0
Poa lanata	5.0	1.7	.60	3.0
Sedum roseum	1.1	1.0	.20	0.2
Elymus arenarius	0.6	0.5	.20	0.1
Carex ramenskii	0.5	0.5	.10	0.1
Chrysanthemum arcticum	0.5	0.5	.10	0.1
Saussurea nuda	0.5	0.5	.10	0.1
Ligusticum scoticum	0.5	0.5	.10	0.1
Rubus chamaemorus	0.5	0.5	.10	0.1
Valeriana capitata	0.2	0.1	.20	<0.1
Primula spp.	0.1	0.1	.10	<0.1
Pedicularis spp.	0.1	0.1	.01	<0.1

[a]product of $\bar{x}$ and frequency of occurrence.

TABLE 12. Composition of the *inland crowberry* plant community on the coastal fringe of the Yukon Delta, Alaska (n=5).

Species	$\bar{x}$	s.e.	Frequency of Occurrence	Relative Importance Value[a]
Moss	58.0	6.7	1.00	58.0
Empetrum nigrum	50.0	6.4	1.00	50.0
Betula nana	18.0	3.5	1.00	18.0
Petasites frigidus	8.0	2.6	.80	6.4
Rubus chamaemorus	9.2	6.0	.60	5.5
Salix spp.	3.0	2.0	.40	1.2
Festuca rubra	2.0	2.0	.20	0.4
Potentilla palustris	1.0	1.0	.20	0.2
Carex rariflora	0.4	0.2	.40	0.2

[a] product of $\bar{x}$ and frequency of occurrence.

FIGURE 1. Map of the coastal fringe of the central Yukon Delta. Area toward the Bering Sea coast from the dashed line is the vegetated intertidal zone.

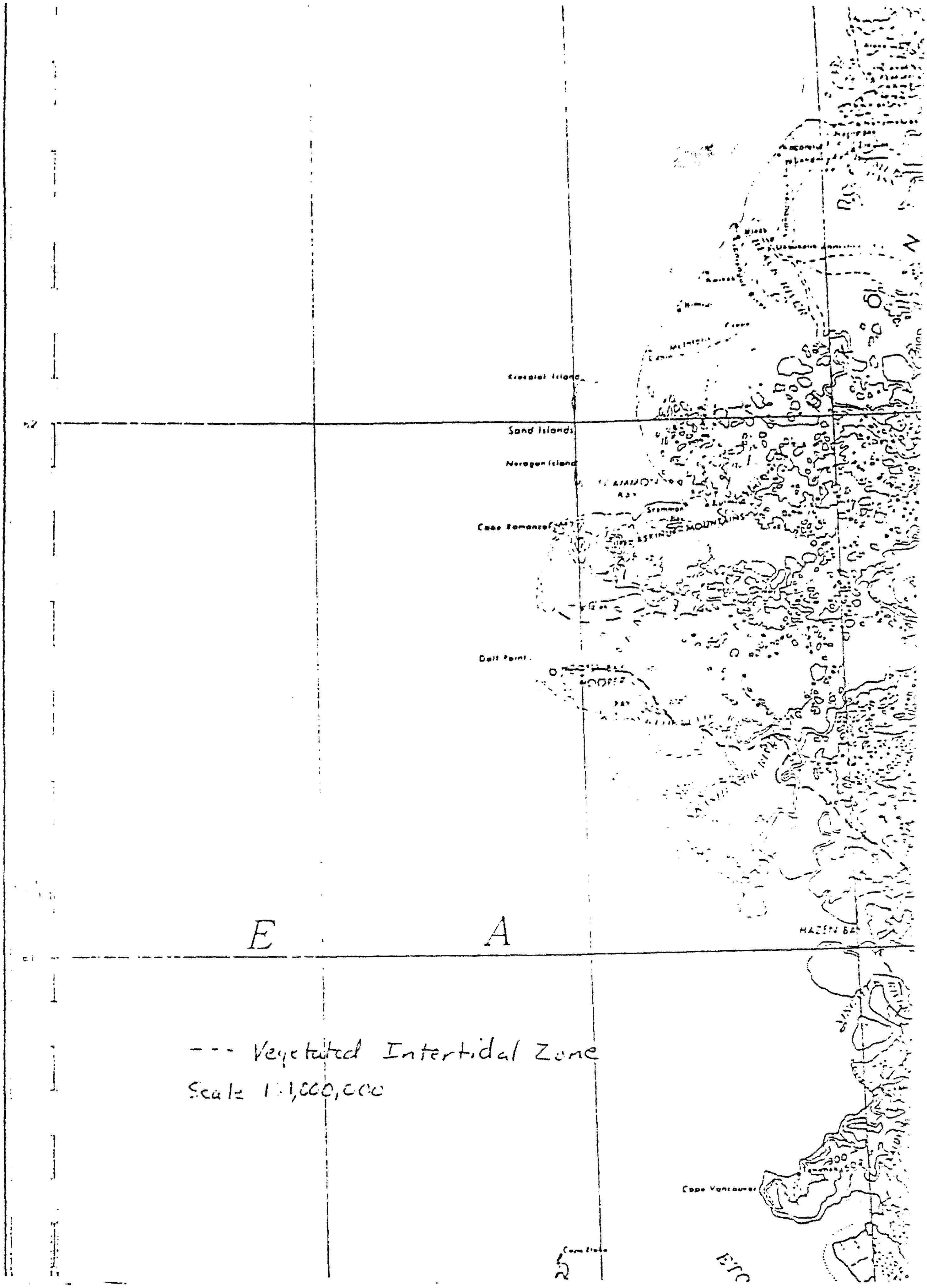
Sand Islands
Neragon Island
Cape Romanzof
Dall Point
HAZEN BAY
Cape Vancouver
E
A
--- Vegetated Intertidal Zone
Scale 1:1,000,000

FIGURE 2. Approximate location of the vegetation transects used to describe plant communities near the Manokinak River mouth, Yukon Delta.

FIGURE 3. Cross-sectional diagram of topography and plant communities found in the vegetated intertidal zone of the central Yukon Delta.

EXHIBIT D

Birds of the Yukon Delta NWR (Including Nunivak Island)

Order	Species	Status
Gaviiformes	Red-throated Loon	C*
	Pacific Loon	C*
	Yellow-billed Loon	R
	Common Loon	C*
	Arctic Loon	C*
Podicipediformes	Horned Grebe	U*
	Red-necked Grebe	U*
Procellariformes	Northern Fulmar	U
	Mottled Petrel	R
	Sooty Shearwater[1]	+
	Short-tailed Shearwater	C
	Fork-tailed Storm Petrel	U
Pelecaniformes	Double-crested Cormorant[2]	+
	Pelagic Cormorant	C*
	Red-faced Cormorant[3]	+
Anseriformes	Tundra Swan	C*
	Greater White-fronted Goose	C*
	Snow Goose	C
	Emperor Goose	C*
	Brant	C*
	Canada Goose	C*
	Green-winged Teal	C*
	Mallard	U*
	Nothern Pintail	C*
	Northern Shoveler	U*
	Gadwall[4]	+
	Eurasian Wigeon	R
	American Wigeon	C*
	Canvasback	R*
	Redhead	R
	Ring-necked Duck[5]	+
	Greater Scaup	C*
	Lesser Scaup	R
	Common Eider	C*
	King Eider	C
	Spectacled Eider	C*
	Steller's Eider	U*

	Harlequin Duck	R*
	Oldsquaw	C*
	Black Scoter	C*
	Surf Scoter	U
	White-winged Scoter	U
	Commonn Goldeneye	U
	Barrow's Goldeneye	U
	Bufflehead	R
	Common Merganser	R
	Red-breasted Merganser	U*
falconiformes	Osprey	R*
	Bald Eagle	R*
	Nortern Harrier	U*
	Sharp-shinned Hawk	R*
	Northern Goshawk	R*
	Red-tailed Hawk[6]	+
	Rough-legged Hawk	C*
	Golden Eagle	R*
	American Kestrel	R
	Merlin	C*
	Peregirne Falcon	R*
	Gyrfalcon	U*
Galliformes	Spruce Grouse	R*
	Willow Ptarmigan	C*
	Rock Ptarmigan	C*
	White-tailed Ptarmigan	R*
	Ruffed Grouse	R*
Gruiformes	Sandhill Crane	C*
Charadriiformes	Black-bellied Plover	C*
	Lesser Golden Plover	C*
	Mongolian Plover	R
	Common Ringed Plover	R
	Semipalmated Plover	C*
	Killdeer[7]	R
	Eurasian Dottrel	R
	Greater Yellowlegs	R*
	Lesser Yellowlegs	U*
	Solitary Sandpiper	R*
	Wandering Tattler	U*
	Spotted Sandpiper	U*

Charadriiformes	Hudsonian Godwit	U
	Bar-tailed Godwit	C*
	Ruddy Turnstone	C*
	Black Turnstone	C*
	Wilson's Phalarope[8]	+
	Surfbird	R*
	Great Knot[9]	+
	Red Knot	C
	Sanderling	U
	Semipalmated Sandpiper	U*
	Western Sandpiper	C*
	Rufous-necked Stint	U
	Least Sandpiper	U*
	Baird's Sandpiper	U
	Pectoral Sandpiper	U
	Sharp-tailed Sandpiper	C
	Rock Sandpiper	C*
	Dunlin	C*
	Buff-breasted Sandpiper[10]	+
	Curlew Sandpiper[11]	+
	Short-tailed Dowitcher[12]	+
	Long-billed Dowitcher	C*
	Common Snipe	C*
	Red-necked Phalarope	C*
	Red Phalarope	C*
	Pomarine Jaeger	C
	Parasitic Jaeger	C*
	Long-tailed Jaeger	C*
	Mew Gull	C*
	Bonaparte's Gull	C*
	Herring gull	R
	Slaty-backed Gull	R
	Glaucous-winged Gull[13]	C*
	Glaucous Gull	C*
	Black-legged Kittiwake	C*
	Sabine's Gull	C*
	Ivory Gull[14]	+
	Common Tern[15]	+
	Arctic Tern	C*
	Forster's Tern[16]	+
	Aleutian Tern	U*

Charadriiformes	Dovekie	R
	Common Murre	C*
	Thick-billed Murre	C*
	Black Guillemot	U
	Pigeon Guillemot	C*
	Kittlitz's Murrelet	U
	Parakeet Auklet	C*
	Least Auklet	C*
	Crested Auklet	C*
	Tufted Puffin	C*
	Horned Puffin	C*
Cuculiformes	Common Cuckoo[17]	+
Strigiformes	Great Horned Owl	U*
	Snowy Owl	U*
	Northern Hawk-owl	U*
	Great Gray Owl	R
	Short-eared Owl	C*
	Boreal Owl	R*
Coraciiformes	Hoopoe[18]	+
	Belted Kingfisher	U*
Piciformes	Downy Woodpecker	R*
	Hairy Woodpecker	U
	Three-toed Woodpecker	U*
	Northern Flicker[19]	+
Passeriformes	Olive-sided Flycatcher	R*
	Western Wood-pewee	U*
	Alder Flycatcher	U*
	Say's Phoebe	U*
	Horned Lark	U*
	Tree Swallow	C*
	Violet-green Swallow	U*
	Bank Swallow	C*
	Cliff Swallow	U*
	Barn Swallow	R*
	Gray Jay	U*
	Black-billed Magpie	R*
	Common Raven	C*
	Black-capped Chickadee	U*
	Boreal Chickadee	U*
	American Dipper	U*
	Middendorff's Grasshopper Warbler[20]	+

Passeriformes	Arctic Warbler	C*
	Rudy-crowned Kinglet	U*
	Bluethroat	R
	Northern Wheatear	R
	Mountain Bluebird[21]	+
	Gray-cheeked Thrush	C*
	Swainson's Thrush	R*
	Hermit Thrush	R*
	American Robin	C*
	Varied Thrush	C*
	Siberian Accentor[22]	+
	Yellow Wagtail	C*
	White Wagtail	R
	Water Pipit	C*
	Bohemian Waxwing	R*
	Northern Shrike	U*
	European Starling[23]	+
	Orange-crowned Warbler	U*
	Yellow Warbler	C*
	Yellow-rumped Warbler	C*
	Blackpoll Warbler	C*
	Northern Waterthrush	C*
	Wilson's Warbler	C*
	American Tree Sparrow	U*
	Savannah Sparrow	C*
	Fox Sparrow	C*
	Lincoln's Sparrow	U*
	Golden-crowned Sparrow	C*
	White-crowned Sparrow	C*
	Dark-eyed Junco	U*
	Lapland Longspur	C*
	Snow Bunting	C*
	McKay's Bunting	R
	Rusty Blackbird	U*
	Brown-headed Cowbird[24]	+
	Brambling[25]	+
	Rosy Finch	U*
	Pine Grosbeak	U*
	Common Rosefinch[26]	+
	White-winged Crossbill	U*
	Common Redpoll	C*
	Hoary Redpoll	C*
	Eurasian Bullfinch[27]	+

Possibles on the Yukon Delta NWR

Black-footed Albatross
Laysan Albatross
Common Sandpiper
Gray-tailed Tattler
Ruff
Common Black-headed Gull
Siberian Tit
Song Sparrow

C = species occurs in almost all proper habitats.
U = not observed regularly, but present.
R = rare, occurs in small numbers.
+ = sightings considered Casual or accidental.
* = species nests within Refuge boundries.

Footnotes

[1] Vern Byrd, Nunivak Island,1983.
[2] C.P.Dau, Nunivak Island, 1979.
[3] Swarth, Nunival Island, 1934.
[4] Observation made by the '85 Research survey crew.
[5] Margaret Petersen, personal comment, no date recorded.
[6] Matt Yurdana, on the Kuskokwim River south-west of L. Kalskag, 1985.
[7] Note: abundant in the summer at the Tutakoke fieldstation.
[8] Gill & Handel, 1982
[9] Springer, Hooper Bay, 1965.
[10] Observation made by the 1985 Yukon Delta NWR Survey Crew
[11] Lensink & Petersen, 1974.
[12] Springer, Hooper Bay, 1965.
[13] Note: there is a high probibility of high frequency hybridization with the Glaucous Gull.
[14] Mike Rearden, Nunivak Island, December 1984
[15] Marshall, Nunivak Island, 1984
[16] Observation on file with the U.S. Fish and Wildlife Service, June 1887.
[17] Gill & Handel, Tutakoke Fieldstation, 1979.
[18] Paniyak & Petersen, Old Chevak, 1975.
[19] C.P. Dau, along the Kashunuk River, 9mi. south of Old Chevak, 1976.
[20] Swarth, Nunivak Island, 1934.
[21] Swarth, Ninivak Island, 1934.
[22] Swarth, Nunivak Island, 1934.
[23] C.P. Dau, Onumuntuk Cabin (near Chevak),1973
[24] Springer, Hooper Bay, 1965; sighted every summer at the Tutakoke Fieldstation from 1978 to 1983.
[25] Springer, Hooper Bay, 1965.
[26] C.P. Dau, 1975.
[27] Marshall, Aniak, 1983.

TABLE . MAMMALS OF THE KUSKOKWIM RIVER DRAINAGE, ALASKA.

Sorex araneus (arcticus, tundrensis)	Arctic Shrew
Sorex caecutiens (cinereus, forsteri)	Masked Shrew
Sorex palustris	Northern Water Shrew
Sorex vagrans (obscurus)	Dusky Shrew
Microsorex hovi	Pigmy Shrew
Myotis lucifugus	Little Brown Bat
Ochotona collaris	Pika
Lepus americanus	Snowshoe Hare
Lepus othus (or timidus)	Tundra Hare
Marmota marmota (caligata)	Marmot
Spermophilus undulatus (Citellus parryi)	Arctic Ground Squirrel
Tamiasciurus hudsonicus	Red Squirrel
Glaucomys sabrinus	Northern Flying Squirrel
Castor fiber (canadensis)	Beaver
Dicrostonyx torquatus (groenlandicus)	Collared Lemming
Synaptomys borealis	Northern Bog Lemming
Lemmus sibericus (lemmus, trimucronatus)	Brown Lemming
Clethrionomys rutilus	Red-backed Vole
Microtus gregalis (miurus)	Singing Vole
Microtus oeconomus	Tundra Vole
Microtus pennsylvanicus. May = M. oeconomus	Meadow Vole
Microtus xanthognathus	Yellow-cheeked Vole
Ondatra zibethicus	Muskrat
Zapus hudsonius	Meadow Jumping Mouse
Erethizon dorsatum	Porcupine
Canis latrans	Coyote
Canis vulpes (lupus)	Wolf
Alopex logopus	Arctic Fox
Vulpes vulpes (fulva)	Red Fox
Ursus americanus	Black Bear
Ursus arctos (horribilis)	Grizzly Bear
Martes americana	Marten
Mustela erminea	Ermine
Mustela nivalis (rixosa)	Least Weasel
Mustela vison	Mink
Gulo gulo (luscus)	Wolverine
Lutra canadensis	Land Otter
Felis lynx (Lynx canadensis)	Lynx
Phoca vitulina	Spotted Seal
Pusa hispida	Ringed Seal
Erignathus barbatus	Bearded Seal
Odobenus rosmarus	Pacific Walrus
Alces alces	Moose
Rangifer arcticus	Caribou
Bison bison	Bison
Ovibos moschatus	Musk Ox
Ovis dalli May = O. nivicoal	Dall Sheep
Delphinapterus levcas	Beluga

EXHIBIT E

INTRA-SERVICE CONSULTATION PROJECT EVALUATION FORM FORMAT

1. Region: Yukon Delta, Alaska

2. Designation: Region 7, Yukon Delta National Wildlife Refuge, FY-86

3. Program(s): Research (Wildlife Resources)

4. Listed species or their Critical Habitats considered:

   a. Within the action area---Falco peregrinus anatum
   b. Adjacent to the action area--Falco peregrinus anatum

5. Name and description of Project:

   Experimental Control of Fox Populations and its Effect on Goose Nesting Success on the Yukon Delta National Wildlife Refuge

   To determine the feasibility of controlling fox populations in nesting habitat of cackling Canada geese and brant and to determine the effect of reducing populations of foxes on nesting success.

6. Location (map attached): Kigigak Island and Tutakoke River areas of the Yukon Delta National Wildlife Refuge, Alaska.

7. Identification of actions/activities that may cumulatively impact species:

   The proposed action will result in the presence of people within the areas creating noise and movement disturbances. In these areas there are no nesting falcons--the principal time when falcons are stressed by these sorts of impacts. Those falcons that are present as wanderers or migrants can move freely and thus avoid these types of impacts. We conclude that there will be no adverse effects of our activities on peregrine falcons in these areas as a result of our activities.

8. Objective of the action: Scientific Research--to exclude foxes from nesting areas of geese

9. Explanation of impacts of action on listed species or their Critical Habitats:

   No impacts are anticipated--see Item 7 above.

10. Previous consultations on this or relative actions/activities: This action was not subject to Section VII action in the past

11. Conclusion: b. Will not affect

12. Recommendation: Conduct study

13. Biological assessment: Not Applicable

Patrick J Gould
Assistant to Chief, AFWAR

APR 1 1986

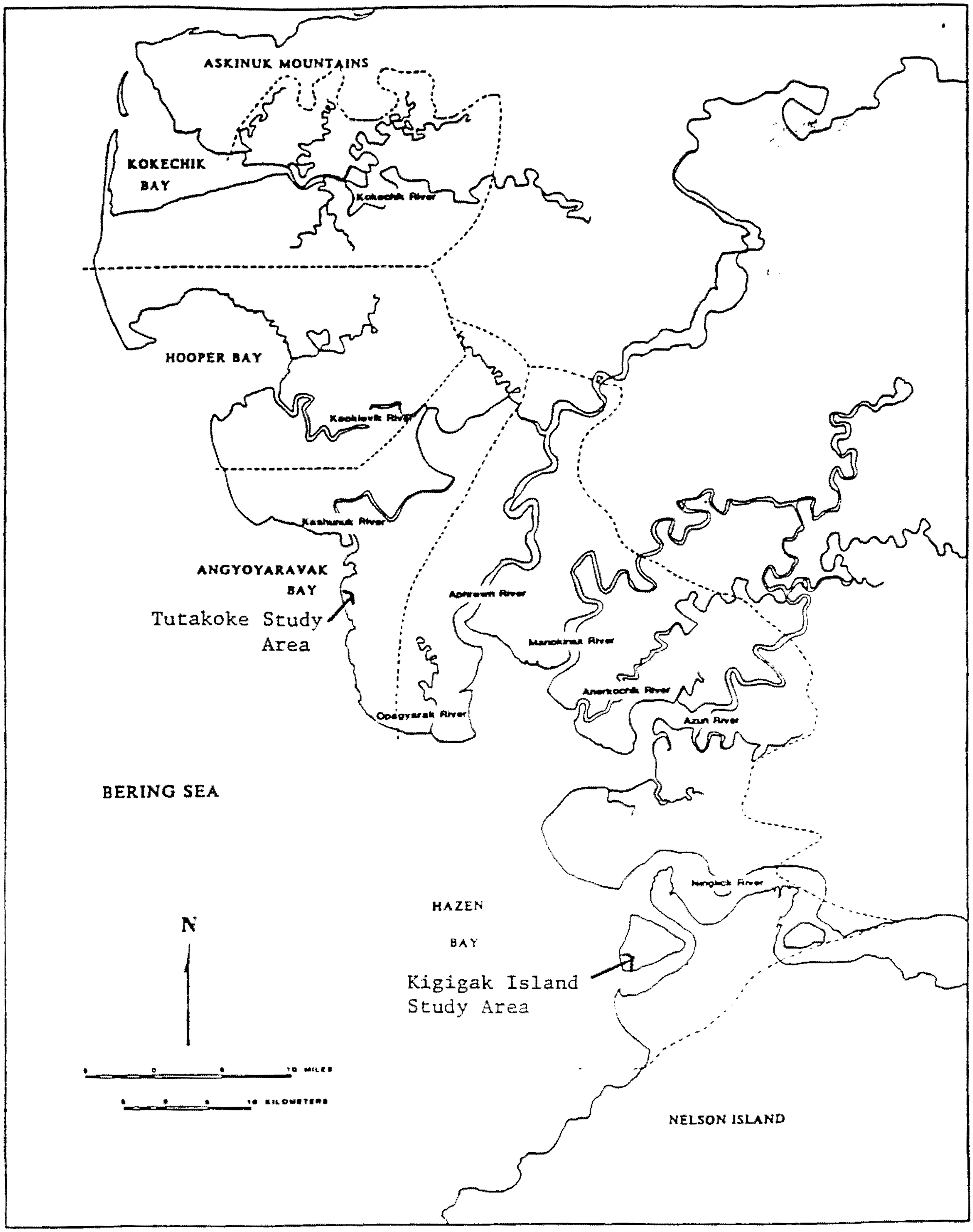

Figure 1. Proposed study areas.

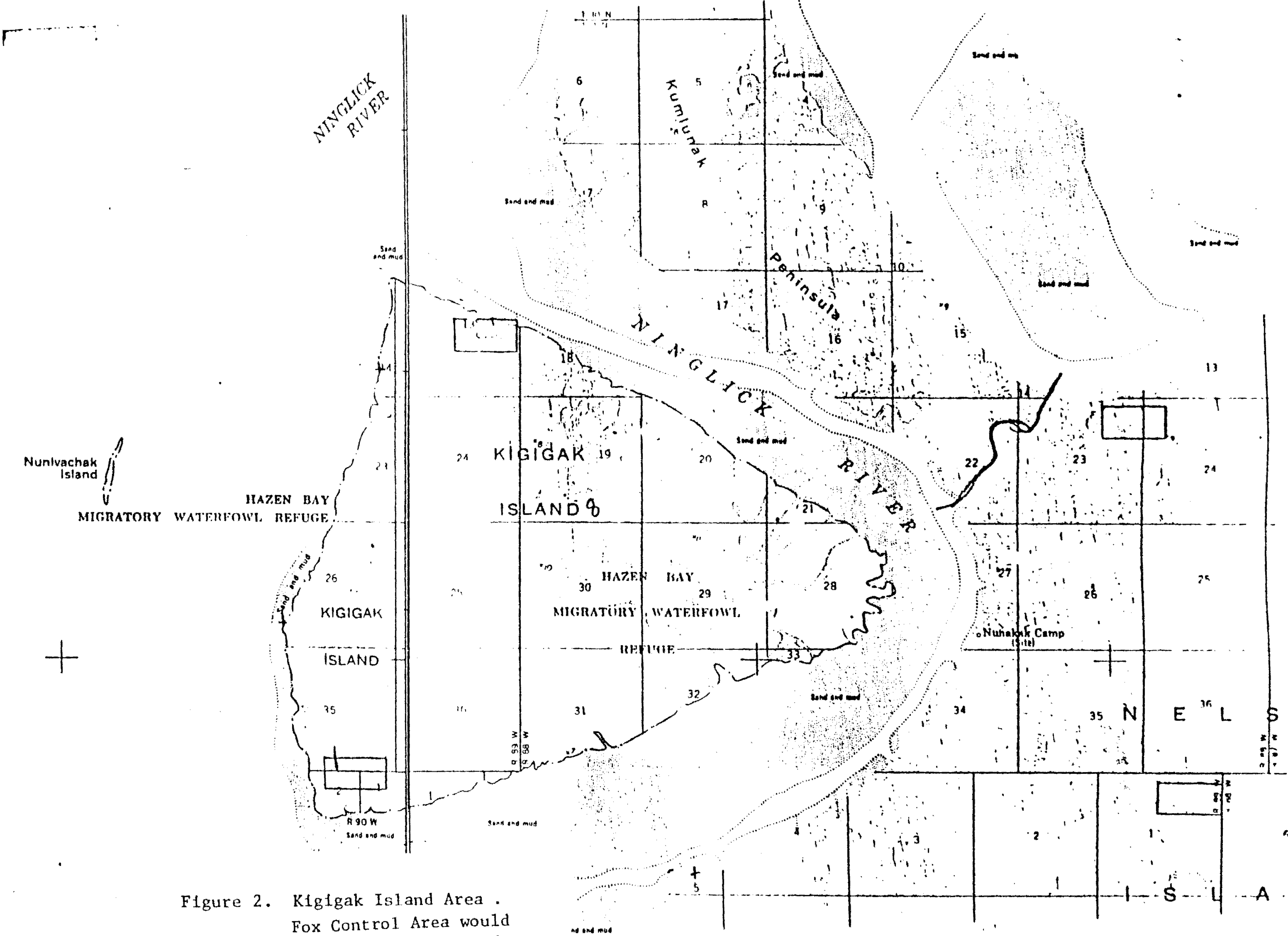

Figure 2. Kigigak Island Area . Fox Control Area would enclude entire island.

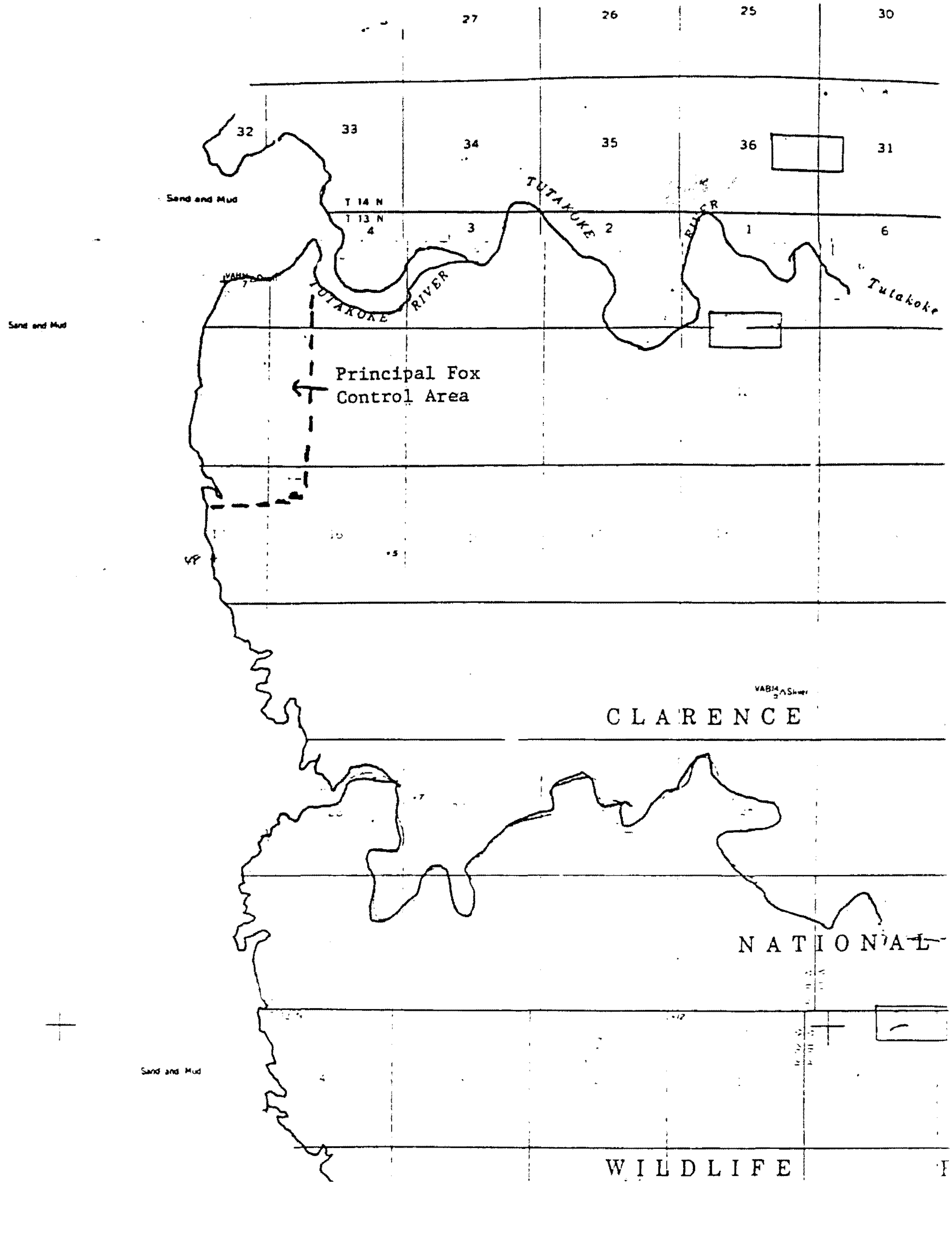

Figure 3. Tutakoke River Area

EXHIBIT F

United States Department of the Interior
ALASKA OFFICE OF FISH AND WILDLIFE RESEARCH
FISH AND WILDLIFE SERVICE
1011 E. TUDOR RD.
ANCHORAGE, ALASKA 99503

IN REPLY REFER TO:
AFWOR

January 31, 1986

Memorandum

To: Assistant Regional Director, AWR

From: Chief, Alaska Fish and Wildlife Office of Research

Subject: Experimental Control of Foxes on the Yukon Delta NWR

This office is preparing a research proposal for an experimental arctic/red fox control program at one or more sites on the Yukon Delta NWR in light of our findings during the past two field seasons. We have reexamined the 1985 objectives of our fox research based on input from the Wildlife Assistance Office and several recent internal review sessions. The proposal will be completed on or before February 7, at which time it will be available for review by you, your staff and the regional panel.

Although we expect to employ only shooting and trapping to harvest foxes beginning in March 1986, it may be necessary to follow National Environmental Policy Act (NEPA) regulations for this research project. I request that you examine our project proposal for NEPA compliance and advise us of the proper procedures we must follow to proceed with the field work.

A. W. Palmisano

Derksen:dlw:2650Z:1/30/86

STATE OF ALASKA
DEPARTMENT OF FISH AND GAME
JUNEAU, ALASKA

Permit No. [illegible]

Expires 12-31-86

SCIENTIFIC OR EDUCATIONAL

PERMIT
to

TAKE ~~OR POSSESS~~
~~HOLD ALIVE~~
BAND OR TAG
~~IMPORT BIRDS OR MAMMALS~~
~~EXPORT BIRDS OR MAMMALS~~

~~BIRDS OR THEIR EGGS~~
MAMMALS ~~OR THEIR FURS~~
~~FISH OR THEIR EGGS~~

This permit authorizes Mike Anthony, U.S. Fish and Wildlife Service (person, agency or organization) of 1011 E. Tudor Road, Anchorage, Alaska 99503 (address) to conduct the following activities during January 30, 1986 to December 31, 1986 in accordance with AS 16.05.930 to:

Authority is granted to the permittee and any person working under his direct supervision to take Arctic fox and Red fox in Unit 18 in areas adjacent to goose nesting areas, in numbers sufficient to conduct research and/or in numbers necessary to reduce predation of waterfowl. Foxes may be tagged, marked, or radio-collared and released, or may be killed to accomplish program objectives. The taking of small mammals as necessary for research projects is also authorized.

This permit must be carried by a person specified on this permit during approved activities who shall show it on request to persons authorized to enforce Alaska's fish and game laws. This permit is nontransferable, and will be revoked, or renewal denied by the Commissioner of Fish and Game if the permittee violates any of its conditions, exceptions or restrictions. No redelegation of authority may be allowed under this permit.

Division

ALASKA DEPARTMENT OF FISH AND GAME

STATE OF ALASKA
DEPARTMENT OF FISH AND GAME
JUNEAU, ALASKA

Permit No 85-44

Expires 12-31-85

SCIENTIFIC OR EDUCATIONAL

PERMIT

to

TAKE ~~OR POSSESS~~
HOLD ALIVE
BAND OR TAG
~~IMPORT BIRDS OR MAMMALS~~
~~EXPORT BIRDS OR MAMMALS~~

~~BIRDS OR THEIR EGGS~~
MAMMALS ~~OR THEIR PARTS~~
~~FISH OR THEIR PARTS~~

This permit authorizes Mike Anthony
person, agency or organization

of USF&WS, 1011 E. Tudor Road, Anchorage, Alaska 99503 to conduct the
address

following activities during March 4, 1985 to December 31, 1985 in accordance with AS 16.05.930 :

Authority is granted to the permittee and any person working under his direct supervision to take Arctic fox and Red fox in Unit 18 in areas adjacent to goose nesting areas, in numbers sufficient to conduct research and/or in numbers necessary to reduce predation of waterfowl. Foxes may be tagged, marked or radio-collared and released, or may be killed to accomplish program objectives. The taking of small mammals as necessary for research project is also authorized.

This permit must be carried by a person specified on this permit during approved activities who shall show it on request to persons authorized to enforce Alaska's fish and game laws. This permit is nontransferable, and will be revoked, or renewal denied by the Commissioner of Fish and Game if the permittee violates any of its conditions, exceptions or restrictions. ~~[illegible]~~

By Delegation of the Commissioner

[signature]
Division of Game

ALASKA DEPARTMENT OF FISH AND GAME

EXHIBIT G

United States Department of the Interior
ALASKA OFFICE OF FISH AND WILDLIFE RESEARCH
FISH AND WILDLIFE SERVICE
1011 E. TUDOR RD.
ANCHORAGE, ALASKA 99503

IN REPLY REFER TO:
AFWOR

March 4, 1986

Dr. Bill Burgoyne
Alaska Department of Environmental
Conservation - Pesticides
Box 2309
Palmer, Alaska 99645

Dear Dr. Burgoyne:

As we discussed in our telephone conservation on 3 March, I will be using two non-toxic chemicals, tetracycline hydrochloride and rhodamine B, in baits to mark arctic foxes on the Yukon Delta National Wildlife Refuge. Although the use of these non-toxic chemicals do not require a permit, I have enclosed for your information our study proposal, which describes how, when, and where these baits will be used. Thank you for your advice in this matter.

Sincerely,

R. Michael Anthony

R. Michael Anthony
Zoologist

Enclosure