

Yukon Delta National Wildlife Refuge
Bethel, Alaska

Annual Narrative Report
Calendar Year 1990



U.S. Department of the Interior
Fish and Wildlife Service
National Wildlife Refuge System

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Left to Right - Olrun, Morgart, Hames, R. Perry,
M. Perry, Prince, Jensen, Afean, B. McCaffery,
C. McCaffery, Hunt, Rearden, Strom,

Permanent and Intermittent Staff

1.	Ronald L. Perry	Refuge Manager (EOD 4/84)	GM-14
2.	Dennis W. Strom	Dep. Refuge Manager (EOD 8/83)	GS-12
3.	Michael B. Rearden	Asst. Refuge Mgr./Pilot (EOD 11/80)	GS-12
4.	John R. Morgart	Supv. Wildl. Bio. (EOD 8/87)	GS-12
5.	Michael T. Hinkes	Wildl. Bio./Pilot (Trans. 1/90)	GS-12
6.	George Walters	Pilot (EOD 7/87)	GS-12
7.	David A. Dapkus	Outdoor Rec. Planner (Trans. 11/90)	GS-12
8.	Charles F. Hunt	Interpreter (EOD 1/79)	GS-11
9.	Richard D. Ernst	Wildl. Bio./Pilot (EOD 4/85)	GS-11
10.	Michael L. Wege	Wildl. Bio. (EOD 4/83)	GS-11
11.	Paschal L. Afcan	Asst. Interpreter (EOD 8/85)	GS-09
12.	Mildred F. Prince	Budget Assistant (EOD 8/86)	GS-07
13.	Grace Andrew	Refuge Info. Tech. (EOD 11/88) (Resigned 9/90)	GS-06
14.	David Evan	Refuge Info. Tech. (EOD 11/89) Napaskiak	GS-06
15.	Xenia Jackson	Refuge Info. Tech. (EOD 89) Bethel (Resigned 6/90)	GS-06
16.	Michael Jimmy	Refuge Info. Tech. (EOD 11/84) Emmonak	GS-06
17.	Alice Lee	Refuge Info. Tech. (EOD 12/89) Aniak	GS-06
18.	Billy Lincoln, Jr.	Refuge Info. Tech. (EOD 11/88) Toksook Bay	GS-06
19.	Alex Nick	Refuge Info. Tech. (EOD 11/84) Russian Mission	GS-06
20.	Tony Amos	Bio. Tech., Mekoryuk (EOD 4/83) (Resigned 1/90)	GS-05
21.	Jimmy Slats	Bio. Tech., Chevak (EOD 4/84)	GS-05
22.	Brian McCaffery	Wildlife Biologist (EOD 10/86) (Conv. from Clerk Typist 10/90)	GS-05
23.	Martha Perry	Clerk Typist (EOD 2/87)	GS-04
24.	Nancy Wilson	Clerk Typist (EOD 5/90) (Resigned 6/90)	GS-04
25.	Elena Hames	Clerk Typist (EOD 11/86) (Resigned 6/90, reins. 11/90)	GS-03
26.	Charlotte Wilson	Clerk Typist (EOD 11/90)	GS-03
27.	Michael Jensen	Maintenance Mechanic (EOD 12/88)	WG-09
28.	Palmer Orlun	Maintenanceman (EOD 5/90)	WG-09
29.	Jack Paniyak	Maintenanceman (EOD 9/74)	WG-08

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Brian Colter	Biological Technician (Summer)	GS-05
Gary Henry	Biological Technician (Summer)	GS-05
Steve Kendall	Biological Technician (extended)	GS-05
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Diana May	Biological Technician (Summer)	GS-05
Leo Moses	Biological Technician (extended)	GS-05
Senka Paul	Biological Technician (extended)	GS-05
Thomas M. Nickolie, Jr.	Biological Technician (Summer)	GS-05
Thomas Olson	Biological Technician (Summer)	GS-05
Jackie Crace	Clerk Typist (Summer)	GS-03

Youth Conservation Corps

John Jensen
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Christine McCaffery
Chris Harwood

Reviews and Approvals

Submitted by: Ronald L. Perry Date: 2/12/91

Refuge Supervisor Review: [Signature] Date: _____

Regional Office Review: Paul R. Schmidt Date: _____

Introduction

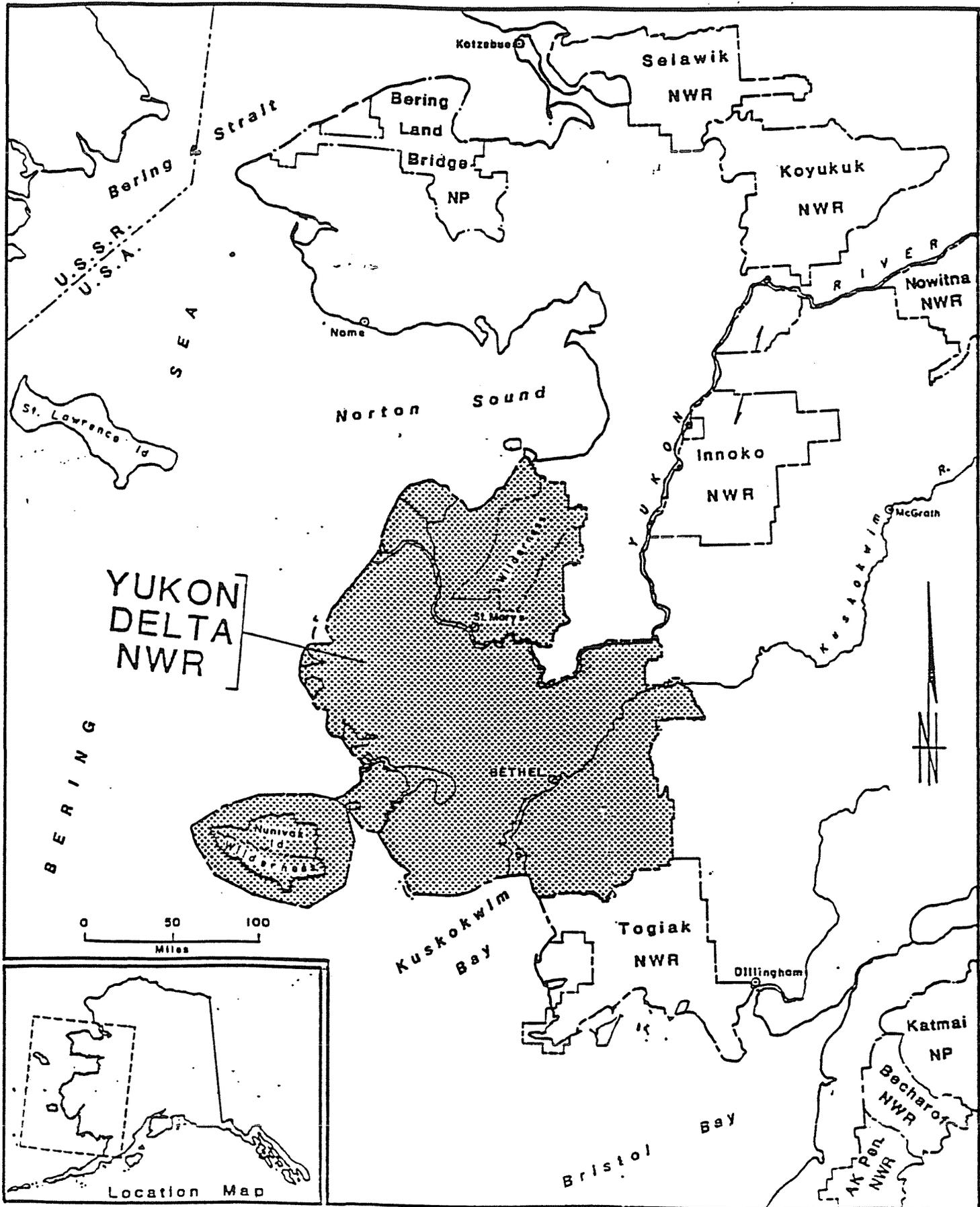
The Yukon Delta National Wildlife Refuge, largest of Alaska's 16 refuges (Figure 1), encompasses over 26 million acres of land and water on the Yukon-Kuskokwim Delta in southwestern Alaska. Approximately 19.6 million acres are federal land. Both the Yukon and Kuskokwim Rivers, major salmon migration rivers, traverse the refuge. Over the course of time, these rivers have created one of the largest river deltas in the world. The Mississippi Delta is the only comparable river delta in North America. The delta, a generally flat marshland containing innumerable lakes and ponds, is the dominant landscape of the refuge. Water was the primary element in the creation of this landscape, and remains a major feature today. Upland areas, the Nulato Hills in the northern part of the refuge, and the Kilbuck Mountains along the refuge's eastern boundary, contain peaks of 2,000 to 4,000 foot elevations.

The abundance of water in lakes, ponds, streams, inlets, bays, and coastal areas provides habitat for waterfowl from all four North American flyways. The refuge supports a varied population of mammals, fish, and birds which are important in maintaining the traditional subsistence way of life of local residents. However, it is the nesting and rearing habitats of four goose species (cackling Canada goose, Pacific white-fronted goose, emperor goose, and black brant) and other waterfowl, shorebirds, and seabirds which are of national significance.

Lands in the Yukon Delta were first set aside as a preserve and breeding ground for native birds by President Theodore Roosevelt in 1909. In 1929, Nunivak Island was set aside as a refuge and breeding ground for wild birds, game, and furbearing animals. In 1930, the small islands and all lands under the waters surrounding Nunivak Island were added to the reservation. Additional lands were reserved by President Franklin D. Roosevelt in 1937 when Hazen Bay Migratory Waterfowl Refuge was established. The Kuskokwim National Wildlife Range, established in 1960, was enlarged in 1961, and its name changed to the Clarence Rhode National Wildlife Range.

On December 2, 1980, President Jimmy Carter signed the Alaska National Interest Lands Conservation Act (the Alaska Lands Act). With the enactment of the Alaska Lands Act, these existing ranges and refuges were combined and enlarged to establish the Yukon Delta National Wildlife Refuge. Two areas within the new refuge were also designated as wilderness by the Alaska Lands Act: the Andreafsky Wilderness Area (1.3 million acres) and the Nunivak Wilderness Area (600,000 acres).

Figure 1. Yukon Delta National Wildlife Refuge



A. HIGHLIGHTS

Land Protection Planning efforts start on the delta. C.3

Goose populations are still on the rise. D.5

The long awaited visitor center and associated displays are completed. H.6

A new VHF radio system is installed on the refuge. I.5

B. CLIMATIC CONDITIONS

The Yukon Delta National Wildlife Refuge is located in western Alaska on the Yukon and Kuskokwim River deltas. The refuge stretches from Nunivak Island in the Bering Sea to Aniak, nearly 200 miles inland. The region is part of the transitional climatic zone, influenced by continental and maritime climates. Summer is cooler than interior Alaska, due to coastal clouds and cold seas. Conversely, this region is warmer than interior Alaska in winter due to the effects of the Bering Sea. Coastal areas freeze last, due to the warming effect of the Bering Sea, and thaw later than the interior due to the cooling effect of Bering Sea ice. Caliginous conditions can occur year-round.

The winds at Bethel average over 13 miles per hour throughout the year. The maximum recorded high and low temperatures are 84 degrees and -48 degrees Fahrenheit. Freeze up normally occurs in mid-October and ice breakup in early to mid-May.

Climatic conditions in 1990 started out with typical January cold weather. Over 30 inches of snow recorded in January, February and March. The winter cold was not as prolonged and severe as 1989. The lowest temperature for the year was -38 degrees in February.

April had less than normal snowfall and warmed up quickly in mid-month. The warm weather continued with the Kuskokwim breaking up at Bethel in early May. The warm, dry weather continued into June with the season's high of 81 degrees Fahrenheit recorded in early July.

The summer rains started in mid-July. The wet trend continued until freezeup. Refuge rivers were high in the fall, due to above normal rain in the interior of Alaska. First snows were recorded the last week of September, with major freezeup occurring by mid-October.

November had over 20 inches of snow. December started with good snow, but the usual warmup occurred the week before Christmas. Several days of rain and temperatures to 41 degrees Fahrenheit

melted snow over large areas of the delta. The aftermath of this warm weather left everything coated with ice. The new year was greeted with a general lack of snow and ice everywhere.

Table 1 gives an overview of climatological data for 1990.

Table 1
1990 Climatological Data for Bethel, Alaska

Month	Temperature (Degrees F.)		Dates with Measurable Precipitation (Inches)	Snowfall (Inches)	Total Precipitation (Inches)
	High	Low			
Jan	35	-29	14	10.4	.92
Feb	33	-38	9	12.8	.96
Mar	41	-26	12	8.7	.79
Apr	49	1	10	2.5	.25
May	73	20	17	0	1.08
Jun	78	38	11	0	.83
Jul	81	40	13	0	2.72
Aug	78	43	15	0	2.84
Sep	59	25	21	2.3	3.21
Oct	47	10	17	1.7	2.05
Nov	36	-24	12	21.7	3.01
Dec	41	-23	8	6.6	2.28
Total			159	66.7	20.94

C. LAND ACQUISITION

3. Other

Land Protection Planning: The U.S. Fish and Wildlife Service is developing a Land Protection Plan for the Yukon Delta National Wildlife Refuge.

A Land Protection Plan is the Service's method of identifying, to land owners and the general public, the interest the Service has in conserving wildlife resources on privately owned land within refuge boundaries.

The Yukon Delta National Wildlife Refuge was reorganized and established by Congress in 1980. The purposes of the refuge listed in the Alaska National Interest Lands Conservation Act are to conserve fish and wildlife populations and habitats in their natural diversity; fulfill international treaty obligations (migratory birds); provide opportunities for continued subsistence uses by local residents; and ensure necessary water quality and quantity within the refuge.

The Yukon Delta Refuge Land Protection Plan will further the goal of conserving wildlife and their habitat by setting priorities

for resource protection or acquisition of refuge inholdings. Some of the most valuable goose, duck and other wildlife habitat is found on private lands within the Yukon Delta NWR.

Some landowners like the concept of maintaining their lands and other natural resources in their present state. Land protection by the Service can be accomplished through different means, such as conservation easements, land bank agreements, and acquisition by exchange and purchase. These means would also include benefits to the landowner.

The Service wanted to involve all landowners in the development of the Yukon Delta Land Protection Plan. All people or village corporations who own land within the boundaries of the Yukon Delta National Wildlife Refuge were encouraged to learn more about development of this plan. Public meetings were held in Bethel and other villages in the Yukon-Kuskokwim Delta in November and December.

The Land Protection Planning team from the regional office, Leslie Kerr, Danielle Jerry, and Greg McClellan travelled with Assistant Interpreter Paschal Afcan of the Yukon Delta NWR. A total of 14 villages in the Yukon-Kuskokwim Delta were visited: Akiachak, Bethel, Chevak, Eek, Hooper Bay, Kipnuk, Kotlik, Lower Kalskag, Mekoryuk, Mountain Village, Newtok, Nunapitchuk, Toksook Bay, and Tununak.

The basic comments from the delta villages on the Land Protection Plan were:

People did not want to make any decisions without consulting with all the people in their village and the surrounding villages.

Once the plan is written and established, and the community has decided to take no action, is there any recourse to be included later on?

If there could be a trade or exchange, does it have to be contiguous with village corporation lands?

When buying land are you talking about surface or subsurface?

Will you force us to sell land if we have high priority land you want?

If we trade land would we be able to fish and hunt on it? What would you do if we own the surface but someone else owns the subsurface?

We don't want changes being made in the delta. We want the

lands to be managed as they have been by Natives throughout history.

I don't like the purchase concept because the Service is not stable with its policies; the Service might eventually decide to sell land to someone else, who in turn, may develop it.

When people own land it ruins personal relationships for everyone.

The Natives have a long tradition of protecting their land for wildlife. We are not interested in monetary gain but in subsistence and our traditional way of life.

D. PLANNING

1. Master Plan (Comprehensive Conservation Plan)

The comprehensive conservation plan was completed, accepted, printed, and distributed in January, 1988. Step-down management plans, such as the Kisaralik River Management Plan and Nunivak Island Reindeer/Muskox Management Plan were drafted and expected to be finalized in 1991.

2. Fire Management Plan

This year marked the seventh operating season under the interagency fire management plan by the state, private owners, Bureau of Land Management, and the refuge. This system has allowed the refuge to accomplish land management objectives and saved the government money. The plan incorporates four management options for wildfire, ranging from immediate suppression to no suppression. Approximately 50% of the refuge is contained in the modified category, which dictates suppression during the critical burning dates, but allows less suppression after those dates.

3. Public Participation

Yukon-Kuskokwim Delta Goose Management Plan:

The Yukon-Kuskokwim (Y-K) Goose Management Plan was renewed in April, 1990 at the Yukon Delta National Wildlife Refuge conference room. All parties to the plan participated. The plan remained unchanged from 1989.

Prior to the signing of the Y-K Delta Goose Management Plan for 1990, representatives from the U.S. Fish and Wildlife Service travelled to 37 Y-K Delta villages to ask people what they thought of the plan staying the same. Twenty-eight villages voted to keep the Y-K Delta Goose Management Plan the same and

nine villages could not make a decision. Most of the villages that did not make a decision did so as a delaying tactic and not because they were against the plan. All but one village were glad to meet with the Fish and Wildlife Service to discuss the plan.



Subsistence meeting held in Quinhagak in October to gather public testimony on federal management of subsistence.
(Hunt)

Another section of the plan had to do with the village harvest survey. Twenty-four agreed that the Fish and Wildlife could do a survey, one village said no because the households weren't giving Fish and Wildlife Service accurate data. One village (Atmautluak) refused to meet with us, and nine villages could not make up their minds which was interpreted by us as a "no." There was some progress made from past years. Toksook Bay and Chefornak approved the survey this year after being totally against in the past. (See village harvest survey section D.5.b. for more details).

Additional public involvement was done under the Kisaralik River and Nunivak Reindeer/Muskox Management planning efforts, Teach

About Geese school curriculum, Lower Yukon Moose challenge grant study, Upper Kuskokwim moose/caribou challenge grant study, and the regional office initiated Land Protection plan and Subsistence program.

Nunivak Island Reindeer and Muskox Management Plan:

A draft plan for managing reindeer and muskox on Nunivak Island was completed. This management plan is necessary because introduced ungulates have exceeded (both historically and currently) range carrying capacity and have severely overgrazed portions of the island. The public participation process has involved numerous public meetings over the course of 3 years with the public as well as various state and federal government agencies. The plan will undergo one last public review in 1991 before it is finalized.

Kisaralik River Management Plan:

A final draft of this plan was nearly completed by year's end. The need for this step-down plan for public use recreational management on the Kisaralik River is apparent. Twenty one commercial river guides have applied to operate on the river and have all been tabled until the plan is complete. Private use of the river, primarily for rafting, has increased annually for several years. This draft will receive regional office review, public review and then should be instituted by the 1992 season

5. Research and Investigations

a. Arctic Nesting Goose Studies

The slight downturn in 1989 populations was reversed in 1990 with flyway populations of all four goose species of special concern showing increases: emperors - 67,600 (47%), cacklers - 110,200 (43%), brant - 146,000 (14%), and whitefronts - 240,800 (10%). However, mixed signals occurred again from breeding ground surveys. While indices of total birds within the coastal zone increased for whitefronts, cacklers, and emperors by 33%, 30%, and 5%, respectively; breeding pair indices decreased for emperors (11%) and cacklers (4%) and remained unchanged for whitefronts. Except for cacklers, recent years of good production are not translating into increased refuge breeding populations.

An Overview of 1990: Steady snow melt accompanied the gradual warming which began in late March and continued through break-up. As a result, the moderately deep winter snow pack caused no unusual flooding of nesting areas. Break-up, migration arrival, and nesting chronology were considered "early" when compared with previous years. Subsequent weather conditions during nesting were moderate with the absence of storm or wind tides. An

exception occurred at the Tutakoke River brant colony. A high tide near the end of hatch flooded approximately 10% of the nests. An unknown fraction of impacted nests failed to hatch.

The following data come from the annual assessment of nesting success of geese in the coastal tundra region of the refuge. Sampling for nest density and success utilized single searches of randomly located 1/4 x 1/2 mile rectangular plots. The coastal region of the Yukon-Kuskokwim Delta was divided into 15 strata defined by general physiographic regions and results of 1985 and 1986 aerial surveys of geese. A total of 101 plots were searched by crews from field camps located at Kokechik Bay, Old Chevak, Tutakoke River, and Manokinak River as well as four mobile crews based at Kanagyak field station. Float angles of eggs indicated average predicted hatching dates were June 21, 22, and 24 for cacklers, emperors, and whitefronts. These dates averaged six days earlier than in 1989 and matched the nesting chronology of 1988, also an "early" year. The survey estimated that 24,500 cackler, 18,500 emperor, and 13,800 whitefront nests were initiated on the 1,560 square miles of coastal habitat that contains about 90% of all geese on the Yukon-Kuskokwim Delta.

Despite this relatively early chronology, clutch size was reduced from 1989 for all four species: brant - 3.5 eggs (n = 544), cacklers - 4.4 eggs (n = 553), emperors - 5.3 eggs (n = 340), and whitefronts - 4.6 eggs (n = 215). Nest success was unchanged from 1989 for emperors (80%) and whitefronts (89%), but cacklers (54%) and brant (71%) declined. Increased nest depredation by arctic fox appeared the major cause of the reduced cackler nest success.

The Alaska Fish and Wildlife Research Center, Anchorage, continued several projects on the refuge:

First, development of an aerial videography procedure to census brant on staging and nesting areas was continued. Initial indications are that >90% of nests are readily visible on videos. Plans call for full implementation of the procedure in 1992 with 1991 serving as the final year of testing at each of the refuge's four major colonies.

Second, this was the third and final year of experimental fox removal to improve goose nesting success in the Manokinak River region. As in past years, the Manokinak River served as a boundary between a large area where foxes were trapped and shot before nest initiation and an area across the river where foxes were not removed (check area). Fox activity was observed, goose nesting success documented, and rodent abundance estimated in both the removal and check areas to determine the effectiveness of trapping and shooting to remove foxes and to evaluate the effects of removing foxes on goose productivity.

A total of 20 arctic foxes were removed from April 24 to May 9. One additional fox was shot by an observer in a tower on June 11. Fourteen males and seven females were taken. One female was gravid with seven embryos; no others showed signs of reproducing. A female with young was trapped at a den in the removal area on June 25 and equipped with a radio collar. Also, six foxes (four females and two males) were trapped, fitted with a radio collar, and released in the check area. None of the radio collared foxes were relocated across the river from where they were captured.

Unlike the previous two years, foxes were seen in regions with high goose nesting density in the removal area rather than in upland areas away from nesting habitat. Furthermore, during the total of 65 hours of observation in the check area and 63 hours in the removal area, foxes in the removal area appeared to be preying on goose nests more aggressively (1.75 eggs/hr compared to 0.11 egg/hr in the check area).



Tom Olson and Diana May preparing to trap microtines on the Magak marshes.
(J. Lawler)

Trapping on established lines in the removal and check areas indicated that tundra vole populations were greatly reduced from previous years. Only 2.4 voles were captured per 100 trap nights compared to 10.7/100 in 1989 and 16.6/100 in 1988. Sampling of subnivean vole sign immediately after snow melt also indicated that winter activity was reduced from previous years.

Goose nesting success by species did not differ among eight sample plots each in the removal and check areas and totals included: cacklers - 57% (n = 173), emperors - 89% (n = 125), and whitefronts - 91% (n = 80).



A red fox in midsummer watches a passing boat.
(S. Kendall)

Based on results from 1988-90, it is apparent that trapping and opportunistic shooting is inadequate to accomplish removal of all foxes from large areas of goose nesting habitat. The results of incomplete removal on goose nesting success is highly variable depending on the behavior of surviving foxes, abundance and distribution of foxes, and abundance of alternative prey (voles).

Third, the sixth year of a study of nesting ecology of cacklers, emperors, and whitefronts near the Kashunuk River was completed. Nesting plots in this area were first established in 1974 and the continuing work provides some of the best long-term information available on the nesting ecology of these species. Nearly 1,200

cacklers have been neck collared on the study area since 1986, including 300 in 1990. Approximately 130 different collared cacklers were observed in 1990; 50% of these were of known age (marked as locals). Local females were much more likely to be observed than were males. Females marked as adults were also more likely than males to be observed in subsequent years. Cacklers are not faithful to specific nest sites, but return to nest in the vicinity of previous nest sites.



Emperor geese remain in Alaska throughout the year - most nest on delta and winter in the Aleutian Islands. (J. Lawler)

Fourth, work is continuing on a study of the distribution and migratory behavior of whitefronts from western Alaska. Movements of geese fitted with radio-transmitters have demonstrated significant differences between populations nesting on the Yukon-Kuskokwim Delta and the Bristol Bay lowlands. Work in 1991 will concentrate on documenting the movement of nonbreeders between these two areas and describing breeding areas within the Bristol Bay region. Genetic differences between individuals from these two populations, and from other breeding locations in North America is also being assessed.

Fifth, in conjunction with studies of geese and arctic fox at the Old Chevak and Manokinak River field camps, the breeding biology of lesser sandhill cranes has been documented since 1986. The refuge may host the largest concentration of nesting cranes in

North America and little information has been collected since a study by Cheryl Boise between 1975-80. In 1990, the fate of 27 nests at Old Chevak and 37 nests at Manokinak River was determined. Eighty percent of the nests were initiated during the third week of May, with 56% occurring on May 19 and 20. Eighty-two percent of the nests hatched the third week of June, with 68% of them between June 18 - 20. Nest success was 82% at Old Chevak and 95% at Manokinak River. As was true for geese at Manokinak River in 1990, there were no consistent differences in crane nesting success between the check and removal areas. An incubation period of 30 days (range 27 - 32 days) was calculated for five nests with known dates of egg laying and hatch. Prior to this, the incubation period (28 days) was known from a single nest followed by Boise in the late 1970's.



There was increased emphasis on banding sandhill cranes on the delta in 1990. (S. Kendall)

Float angles for eggs from 25 nests with known hatch dates were recorded to determine if this method is an accurate predictor of incubation stage. There was substantial variation in predicted

hatch dates for eggs with the same float angle. Factors contributing to this variability are: (1) large variation in egg shape which affects the float angle, and (2) variation in the way individuals conducted the egg floating and recorded float angles. Nonetheless, it did provide a rough estimate of incubation stage.

In the vicinity of the Old Chevak study area, three neck collared cranes originally banded by Boise in 1976 (A14 and A28) and 1977 (A98) were observed. Behavioral observations indicated that A28 and A98 were males and A14 was a female. These birds had also been sighted by Boise in the same area subsequent to banding (1977-80). A14 and A98 have held territories within 1-4 km of their banding location since at least 1986. A28 held a territory in 1990 which was within 2 km of where it was banded. It's likely these birds have been summering in the same areas since 1980 and indicates that nesting cranes have high fidelity to their natal areas. In 1990, trial banding and color marking of flightless juveniles was attempted during the course of primary field activities. A total of 16 cranes were captured and banded.

The University of Alaska, Fairbanks continued a study of brant ecology at Tutakoke River. Color marking in 1990 included 2,500 brant at Tutakoke River and 500 at Kokechik Bay. The total of 4,000 sightings of marked birds at Tutakoke River represented about 2,000 individuals, including three banded on Wrangel Island in 1989. Future data analyses include determining the relationship between size of goslings at banding and their subsequent survival and reproductive rates as well as developing estimates of age-specific fecundity.

The 1990 field season initiated a 3-4 year effort to measure exchanges among refuge colonies (Kokechik Bay, Tutakoke River, Kigigak Island, and Baird Inlet Island). All marked birds observed came from the Tutakoke colony because 1990 was the first year of banding at Kokechik Bay. During 1.5 days at the Kokechik Bay colony, 20 (0.9%) of 2,206 breeding birds examined were color marked. Males were nearly six times as likely to be marked. A total of six dispersers, five males and one female, that were color marked as goslings at Tutakoke River were observed. Only two (0.5%) of 419 nonbreeders examined were banded. At Kigigak Island six individuals of 1,710 breeders and 1,906 nonbreeders were color marked. One of the six bands was read. A single nonbreeder was color marked among 504 breeders and 1,565 nonbreeders at Baird Inlet Island. Lastly, two Tutakoke River birds were captured in brood flocks on the Colville River.



Unlike the other three species of subarctic nesting geese, Pacific black brant populations did not decline dramatically.

(D. May)

The refuge again maintained a field camp at Kokechik Bay. Field personnel monitored goose production and assessed the number and impact of resident fox on nesting success. With generally favorable weather conditions, nest success was above average for brant (64%, n = 206), cacklers (72%, n = 92), emperors (73%, n = 59), and whitefronts (91%, n = 11). As was the case in 1989, it appeared only two of the approximately four resident pairs of arctic fox produced kits and their impact on goose production was minimal.



Thomas Olson, a local hire employee from Hooper Bay worked at Camp Lake on Kokechik flats. (J. Lawler)

b. Subsistence Waterfowl Harvest Survey - Research and Development Effort

For the second year in a row, a household survey of subsistence waterfowl take was conducted directly by the refuge staff and the Migratory Bird Management division of the Service. This survey has been conducted on the refuge since 1980; previously it was conducted by Dr. John Copp through a contract with Oregon State University.

Yukon-Kuskokwim Delta residents harvested approximately 93,000 birds for subsistence in 1990 (Table 2). Half of these were ducks; primarily pintails and mallards. About one out of every four birds taken was a goose: pacific whitefronts were the most common goose taken in 1990. Other birds taken most often were ptarmigan, swans, and cranes. Ptarmigan were taken in greater numbers in 1990 than any other single bird species.

TABLE 2. YUKON DELTA NATIONAL WILDLIFE REFUGE, 1985-90.

MIGRATORY BIRD SUBSISTENCE HARVEST ESTIMATES
YUKON KUSKOKWIM DELTA
1985 - 1990

	1985	1986	1987	1989	1990	5 YR AVG
GEESE						
Whitefronted Geese	3803	2806	3722	5324	7896	4710
Cackling Canada Geese	1485	2067	3218	3584	5603	3191
Emperor Geese	4031	3091	1352	1616	3232	2664
Black Brant	2168	1483	1030	2372	2994	2009
<hr/>						
Total GMP Species	11487	9447	9322	12896	19725	12575
Taverner's Canada Geese	4060	3649	4497	5455	4026	4337
Lesser Snow Geese	1206	2102	5201	889	1233	2126
<hr/>						
TOTAL GEESE	16753	15198	19020	19240	24984	19039
<hr/>						
TUNDRA SWANS	3531	5363	6721	6034	5348	5399
SANDHILL CRANES	3289	3477	2191	3193	2096	2849
<hr/>						
DUCKS						
Pintails	8090	9934	17540	6893	8230	10137
Mallards	4818	8907	9073	6908	11934	8328
Unidentified ducks	1827	2514	2627	2171	1608	2149
Wigeons	1356	1199	2799	824	2867	1809
Shovelers	560	1381	2395	806	809	1190
Green wing teals	2195	2353	4264	1605	2512	2586
Buffleheads	153	298	281	514	231	295
Harlequins	11	179	242	393	141	193
Greater Scaup	1783	4554	6256	2237	1395	3245
Goldeneyes	310	774	2332	1129	1796	1268
Oldsquaws	2680	2783	2691	4638	1481	2855
White wing scoters	767	1136	2143	630	4027	1741
Black scoters	3163	5079	5987	4629	4394	4650
Surf Scoters	256	342	956	462	1848	773
Common Eiders	571	971	322	634	404	580
King Eiders	4258	1816	3360	3107	2123	2933
Spectacled Eiders	297	321	296	493	273	336
Common Mergansers	32	304	304	118	74	166
Red breasted merganser	61	203	299	187	230	196
<hr/>						
TOTAL DUCKS	33188	45048	64167	38378	46377	45432
<hr/>						
PTARMIGAN	*	8926	15092	13371	12507	12474
<hr/>						
OTHER BIRDS						
Yellow billed loons	132	381	143	88	89	167
Red throated loons	50	133	44	463	90	156
Common loons	362	662	1179	689	353	649
Arctic loons	127	91	42	96	32	78
Common murre	51	242	354	228	21	179
Small shorebirds	1975	604	225	101	48	591
Large shorebirds		75	124	19	141	90
Mew gulls	5	21	14	0	11	10
Sabines gulls	30	7	35	0	0	14
Glaucous gulls	412	217	287	21	576	303

Arctic terns	21	193	42	0	12	54
<hr/>						
TOTAL OTHER BIRDS	3165	2626	2489	1705	1373	2272
TOTAL BIRDS NOT INCLUDING PTARMIGAN	59926	71712	94588	68550	80178	74991
TOTAL BIRDS INCLUDING PTARMIGAN	*	80638	109680	81921	92685	87465

*Not surveyed

**This figure is the sum of the 4 year average for ptarmigan (12,474) and the 5 year average for all other birds (74,991).

Goose harvests were up significantly in 1990 compared with the mid and late 1980's. About 25,000 geese were taken in 1990 compared with 19,000 in 1987 and 1989. To put this figure in a longer term perspective, in the 1960's total goose harvest was estimated at 83,000, or over three times as many geese.

Harvests of all four Goose Management Plan species increased in 1990. Pacific whitefront harvest was almost 8,000 in 1990, compared with the previous late 1980's high of 5,300 in 1989. Cackler harvest was up in 1990 to 5,600 birds compared with the previous high of 3,600 birds in 1989 (Fig. 2). The increasing whitefront and cackler harvests reflect the corresponding steady increases in the populations of these two species since 1985.

The black brant harvest in 1990 was almost 3,000 birds, about 600 birds higher than in 1989. Black brant subsistence harvest experienced a low of about 1,000 birds in 1987, which was when the black brant population was also at an all-time low.

Reported harvest of emperors doubled in 1990 compared with 1989. The 3,200 emperors taken in 1990 was close to the numbers taken in 1985 and 1986 (Fig. 2).

Duck harvest were also up in 1990 compared with 1989. However, the 1990 harvest of 46,000 ducks was very close to the 1985-1990 average of 45,000 ducks. Duck harvest peaked in 1987 when pintail harvest was so high (Fig. 3).

The big increase in duck harvest in 1990 was the harvest of mallards, contrary to previous years, when pintails were the primary duck species taken. The 1990 mallard take of 12,000 birds was about 5,000 birds higher than the 1989 take of 7,000.

Other duck species whose harvests increased noticeably in 1990 were wigeons, white-winged scoters, and surf scoters. The 1990 wigeon harvest of 3,000 birds was similar to 1987, when harvests of several duck species were unusually high. The white-winged and surf scoter harvests were twice as high as the previous high in 1987: 4,000 and 1,800 were reported taken in 1990, respectively.

Swan and crane harvests were both below recent averages. The 1990 swan harvest, at 5,348 birds, was down a little from the 1987 and 1989 harvests which were over 6,000. People took approximately 1,000 fewer cranes in 1990 than in 1989, but the 1990 harvest was similar to the 1987 harvest (Fig. 3).



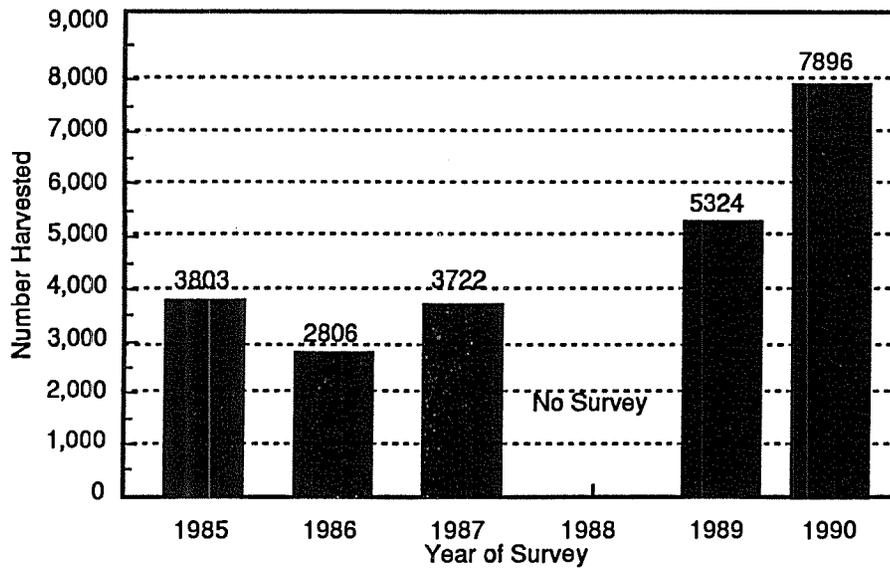
An alert brood of tundra swan cygnets.
(D. May)

In 1990, 871 households in 23 delta villages (Fig. 4) participated in the harvest survey. This was a record level of participation: one out of every four households on the delta was sampled. The following villages participated in the survey: Akiachak, Alakanuk, Aniak, Bethel, Chefornek, Chevak, Eek, Emmonak, Hooper Bay, Lower Kalskag, Upper Kalskag, Kotlik, Kwethluk, Marshall, Napakiak, Napaskiak, Nunapitchuk, Pilot Station, Russian Mission, Scammon Bay, St. Mary's, Tuluksak, and Toksook Bay.

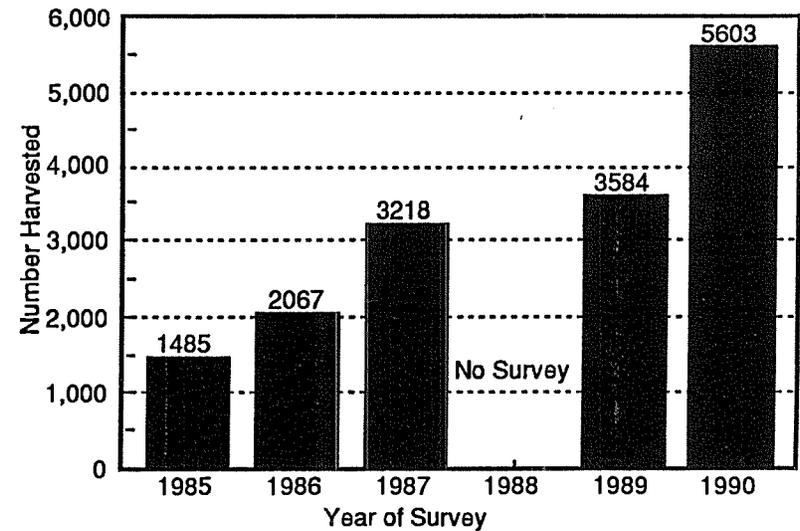
The refuge also employed a record number of local village survey workers to pass out and collect survey forms: 34 workers were hired as contract employees. Only four of these left the job without finding and training their own replacement. Most survey workers completed their assignments successfully: 14 received bonuses for getting all forms in on time. A total of about \$39,000 went directly into local village economies, in the form of payments to these survey workers. Each survey worker earned an average of about \$1,150.

Survey results for 1990 showed, as they have every year, that spring is the most important time for waterfowl hunting. In 1990, as in other years, half of the total bird harvest occurred

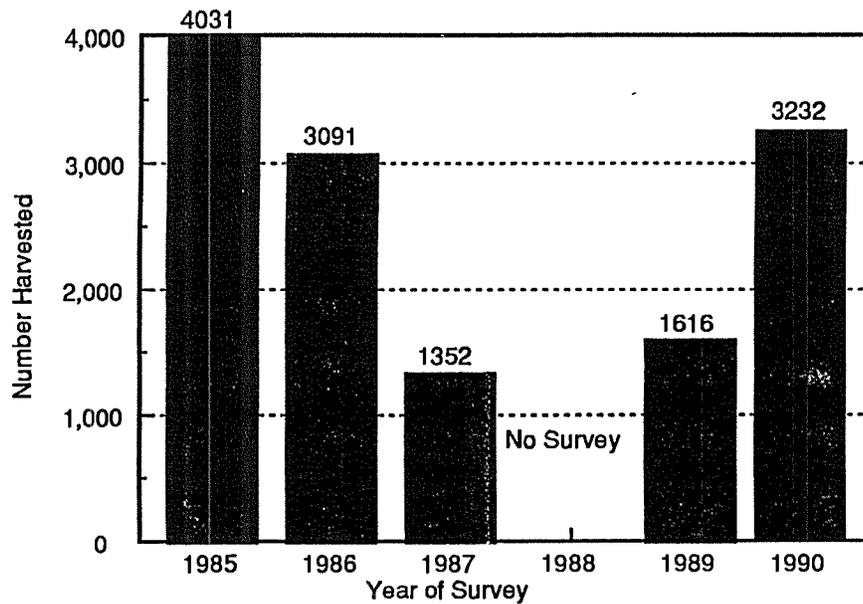
Goose Management Plan Species White-Front - Leqleq Harvest



Cackler - Tuutangayak Harvest



Emperor - Nacaullek Harvest



Brant - Neqlernaq Harvest

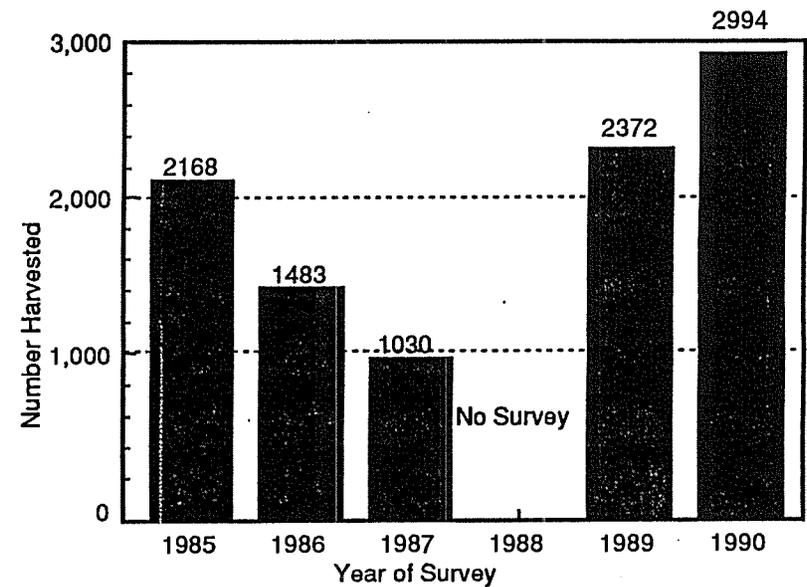
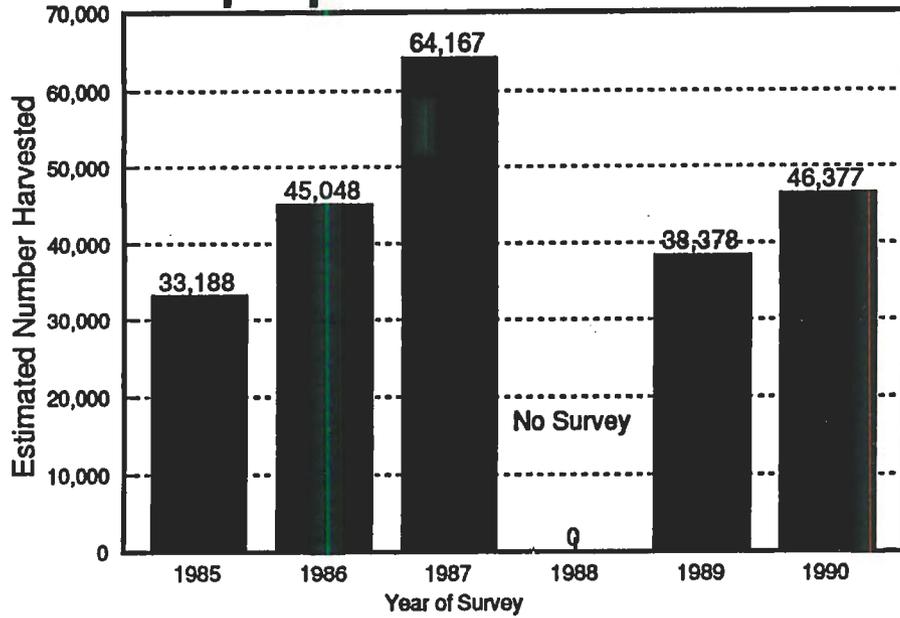


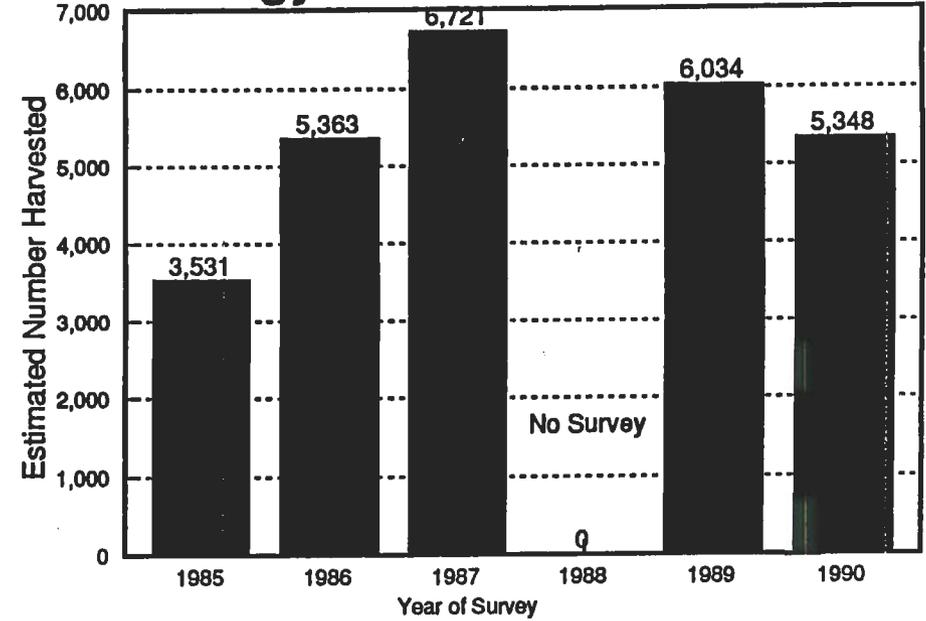
FIGURE 2. YUKON DELTA NATIONAL WILDLIFE REFUGE, 1985-90.

FIGURE 3. YUKON DELTA NATIONAL WILDLIFE REFUGE, 1985-90.

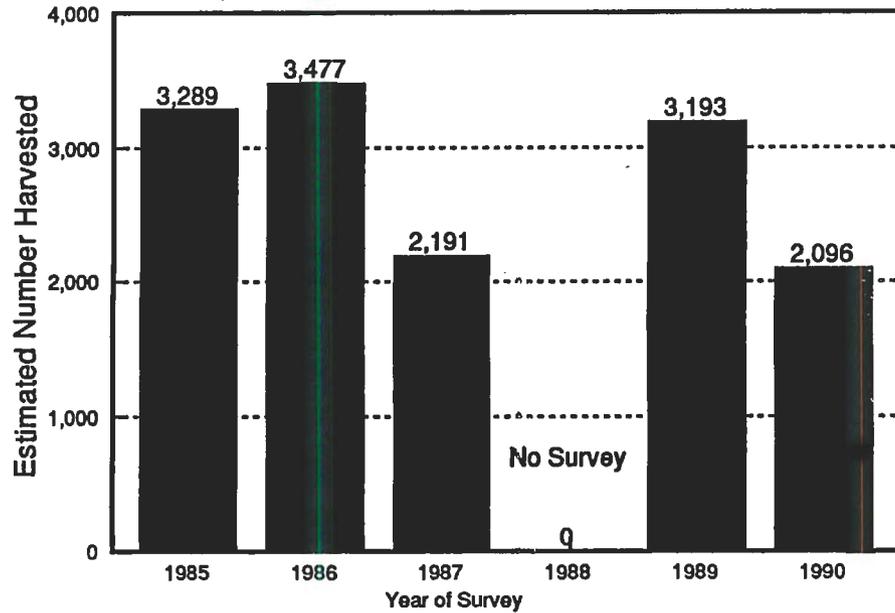
Duck - Uqsuqat Harvest



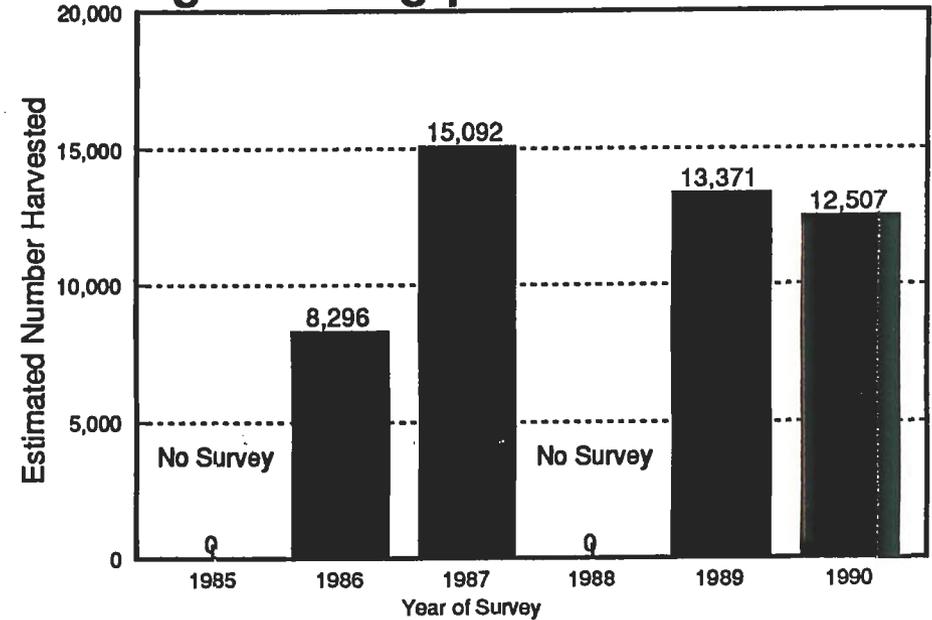
Swan - Qugyuut Harvest



Crane - Qut'raat Harvest



Ptarmigan - Qangqiiret Harvest



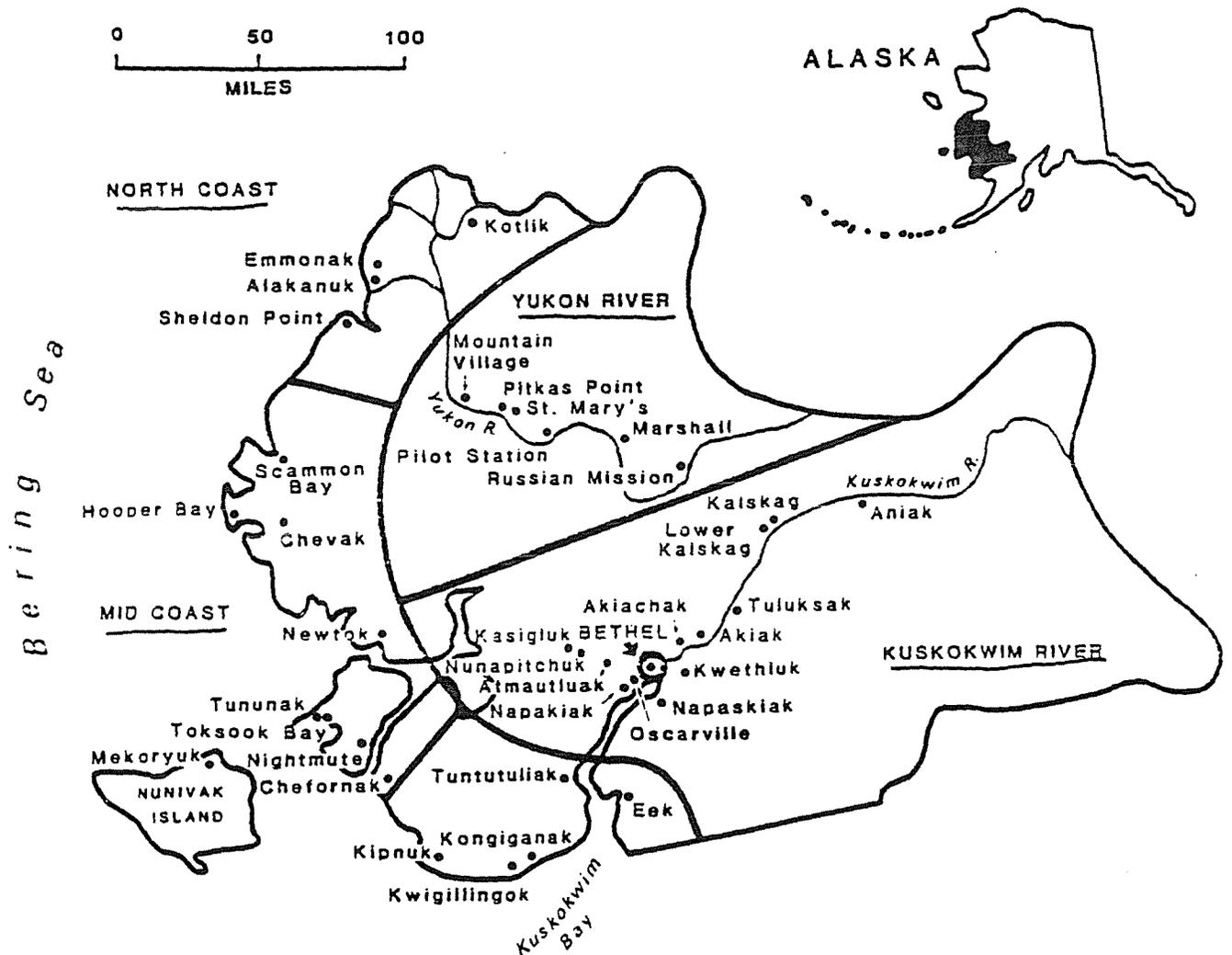


FIG. 4. COMMUNITIES AND REGIONS ON
ON THE YUKON DELTA NATIONAL WILDLIFE REFUGE, ALASKA.

in the spring. However, compared with previous years, relatively fewer birds were taken in the early summer and more were taken in the late summer and fall.

The major weakness of the 1990 survey was, as in 1989, the lack of participation of key villages in the south coast region: namely, Kipnuk, Kongiganak, and Kwigillingok. These villages are located in areas of prime emperor habitat and it is known that many geese are taken. Therefore, we are least confident with our emperor data. However, the participation of the mid-coast villages of Chefornek and Toksook Bay in 1990 improved the reliability of our emperor harvest data compared with 1989.

c. Kilbuck Mountain Caribou Study

Caribou were once abundant over much of the Yukon-Kuskokwim Delta. The species had seriously declined in the area by the 1900's, however, as a result of overharvesting, competition with introduced reindeer, wildfire, and a possible shift in caribou migration patterns. By the mid-1900's caribou all but disappeared from the area with the exception of a small, remnant herd in the Kilbuck Mountains. This herd was thought to contain as few as 200 animals in 1984 which led to an emergency closure of the hunting season in 1985. A management study entitled "Populations, Movements and Potential Range of Caribou in the Kilbuck Mountains" was initiated in 1985. The objectives of the study plan included determining caribou population size and density, population dynamics, movement patterns, seasonal habitat requirements, and mortality factors. Other objectives included determining the extent of suitable, unoccupied habitat in the Kilbuck Mountains, compatibility of reindeer herding with caribou management objectives, and if caribou from adjacent herds were migrating into the area. To assist in this process, a total of eight male and ten female caribou were captured and radio-collared prior to 1990. An additional 15 animals were captured and collared in 1990. These animals are located monthly (weekly during calving) to determine individual home ranges, movement patterns, and range fidelity. Caribou have more than tripled their area of use since monitoring was initiated. Furthermore, the herd has grown to more than 1,200.

d. Bristle-thighed Curlew Studies

In 1990, the refuge's bristle-thighed curlew program continued at Curlew Lake for the third consecutive year. Wildlife Biologist McCaffery, Volunteer McCaffery, Volunteer Harwood, Wildlife Biologist Greg McClellan (Region 7 - Realty), and James Ferguson (a high school student from Kasigluk) all contributed to the field effort. Six of the eight curlews banded in 1988 returned to breed on the study site in 1990, including one which did not breed locally in 1989. Among the returning birds was #007, a female first banded in June 1988. She has nested on the study

area in all three years (1988-1990), and each subsequent fall, she has been detected on Laysan Island, Hawaii, by curlew researchers from the University of Montana.



Bristle-thighed curlew recordings made by Volunteer Christine McCaffery will be included on the new Peterson Field Guide to Western Bird Songs.

(B. McCaffery)

Two other birds banded at Curlew Lake in previous years were sighted in Hawaii later in the summer. #020 was banded near Curlew Lake on July 15, 1989, and was seen on the study site only once thereafter, on June 27, 1990. This male was next resighted on Midway Island (August 9-10, 1990), and then again on Laysan Island (28 August 1990). #024, one of only two curlew chicks to fledge from the Curlew Lake study area in 1989, was resighted this year on Lisianski Island, where it was noted off and on throughout the summer.



This female bristle-thighed curlew was nicknamed Charity after she mated with a male who courted 3 other females without success. (C. Harwood)

At Curlew Lake in 1990, five pairs and one territorial bachelor were monitored regularly throughout the breeding season. Nine of 10 paired birds were color-banded. The unpaired male and the bachelor male were consistently identifiable on the basis of plumage and vocalization characteristics, respectively. An additional 2 pairs also nested on, or immediately adjacent to the study area. Six of the 7 nests initiated hatched young, the highest nest success yet recorded for this species on the refuge. It is probably not a coincidence that, for the first time, ravens were not nesting near our curlew study areas. At least 3 broods, and possibly as many as 5, survived through the first week of July. Our crew's last field day at Curlew Lake was July 8, before any young were old enough to fledge.

In 1990, we expanded our investigation of curlew foraging behavior at Curlew Lake. Eighty-six foraging samples (6:00 minutes each) were obtained from a total of 27 different individuals between May 8 - July 1. The mean number of berries consumed per sample was 10.1 (1.68/min.). As first suggested in 1989, the appearance of blueberry flowers (Vaccinium uliginosum) in mid-June dramatically affects the curlews' behavior. Foraging samples collected prior to the onset of flowering yielded a mean

of 15.3 berries (2.55/min.), whereas samples collected during blueberry flowering yielded a mean of 4.1 berries (0.68/min). Meanwhile, the mean number of blueberry blossoms consumed per 6 minute sample during the 3-week flowering period was 68.2 (11.34/min.). In fact, during the first half of the flowering period, curlews foraging on flowers consumed an average of 98.5 blossoms/sample (16.42/min.). One male curlew ingested 219 blossoms during a single 6 minute sample, more than 1 blossom every 2 seconds! We also collected 83 fecal samples from bristle-thighed curlews on our study area. Preliminary analyses have been completed on 37; 36 contained the seeds of crowberry (Empetrum nigrum).



Curlew Lake Camp - home to the researchers working with bristle-thighed curlews.
(B. McCaffery)

In order to better understand the importance of overwintered berries in the spring diet of curlews, we attempted to determine the proportion of the fall berry crop which actually survives the winter. In August 1989, 36 small plots were established at Curlew Lake to assess overwinter survivorship of berries. At our study site, crowberries, mountain cranberries (V. vitis-idaea), bog cranberries (Oxycoccus microcarpus), and bearberries (Arctostaphylos alpina) regularly overwinter, and were considered in this study. At 18 stations, a control and an experimental plot were staked, and all berries were counted. The 18

experimental plots were then covered with exclosure cages of chickenwire or hardware cloth to exclude frugivores. The control plots were expected to yield an estimate of overall overwinter survivorship. The difference between the control and experimental plots was expected to provide an estimate of the fraction of overwinter "mortality" attributable to harvesting by both avian and mammalian frugivores.

In May 1990, we re-censused all 36 plots upon our arrival at Curlew Lake or, for those plots still covered by snow, as soon as plots were snow-free. On the 18 control plots, 37% of the early August 1989 berry crop survived until May 1990. Thus exposure and harvesting combined produced an estimated winter mortality of 63%. However, on the experimental plots where frugivores were excluded, 67% of the August 1989 crop survived. On these plots, mortality due to weather factors alone was approximately 33%. Thus, our findings suggest that overwinter mortality may eliminate 2/3 of the late summer berry crop by the next spring, and that this mortality is divided more or less evenly between exposure and harvesting. From the plants' perspective, the latter form of "mortality" is much more advantageous.

Wildlife Biologist McCaffery authored a paper entitled, "Comparative nesting ecology of sympatric Numenius curlews in western Alaska." The paper was delivered in June by Bob Gill (Region 8 - Anchorage) at the American Ornithologists' Union annual meeting in Los Angeles.

e. Lower Yukon Moose Study

The seasonal movements of moose along the lower Yukon River is the subject of a project initiated by the refuge, Alaska Department of Fish and Game, and Pilot Station and Marshall Schools, Lower Yukon School District. This cooperative project was funded by all participants through the Challenge Grant Program and allowed high school students to participate in an actual field research project. The objectives of the study include determining population size, age and sex composition, movements and seasonal distributions, and mortality factors of this small, but growing population of animals. Another major objective of the project is to increase local understanding of wildlife management objectives.

Two cows and 1 bull were captured and collared with satellite transmitters in March 1989. Three cows were also collared with conventional VHF beacons. In 1990, 4 more bulls and 1 cow were captured and outfitted with conventional radio collars. The 3 moose with satellite collars were recaptured and their collars replaced as well. All conventional collars are aerially tracked on a monthly basis. Students from Marshall and Pilot Station accompany refuge biologists on a rotating basis during these aerial surveys.

The school and refuge receive monthly location data on each moose with a satellite collar. Approximately 3-5 locations per moose are received every 2 days. The students are plotting the locations of the moose using a computer mapping system and will follow the movements of each animal for the next couple of years, depending on battery life of the transmitters.

Students will learn about the home range, seasonal migration patterns, and habitats used by each moose. In addition, they are gaining experience in the use of computers, and have created public service announcements for the local newspaper and radio.

f. Lower Kuskokwim Moose and Caribou Study

The lower Kuskokwim moose and caribou study was developed and approved during 1989, and funded for implementation during 1990. The purpose of the study is to estimate numbers, age and sex composition, recruitment, movements, and seasonal distribution of moose, and movements and seasonal distribution of caribou in the lower Kuskokwim River drainage. Another primary objective is to improve local residents' understanding of the principles of wildlife management through active participation in an ongoing field study that has practical applications for them and their subsistence lifestyle. This project was funded through the Challenge Grant Program by the Service, Alaska Department of Fish and Game, Bureau of Land Management, Association of Village Council Presidents, Kuskokwim College, and Yupiit and Kuspuk School Districts.

Fifteen moose (14 cows, 1 bull) were captured and outfitted with radio-collars in March 1990. Seven caribou (5 cows, 2 bulls) were captured and radio-collared at the same time. In addition to conventional radio transmitters, 5 of the caribou collars were fitted with satellite transmitters as well.

The moose are radio-tracked aurally on a monthly basis by refuge biologists and students from the 2 cooperating school districts. In addition, the refuge and schools receive tracking locations on a monthly basis for the satellite collared caribou. Approximately 3-5 locations per caribou are received every 2 days. The students plot the daily movements of these animals using a computer mapping program. Data generated by this study are used by the students in their science, math, computer, and journalism curricula.

g. Contaminants

A report of findings for a study investigating placer mining impacts to the Tuluksak River (1987-89) was completed. Limnological information and analytical data collected during non-mining periods indicate that the Tuluksak River's water quality meets state water quality standards. No sediment levels

exceeded criteria associated with environmental concern; however, sediment collected in, and downstream of, mined sites contained significantly greater concentrations of trace elements and heavy metals than unmined sites. Total metals in fish were generally below draft tissue criteria developed by Ecological Services, Anchorage, and therefore do not pose an environmental threat. No conclusive evidence was found that mining activities have adversely impacted Tuluksak River's water quality or fish population. However, river sediment in, and below, mining operations appears to be accumulating heavy metals and trace elements. It is hypothesized that substantial alterations in the Tuluksak River's water quality (e.g., pH, alkalinity), could release the accumulated heavy metals and trace elements into the water column, making them bioavailable and causing adverse impacts to the River's aquatic resources. The refuge plans to continue an extensive monitoring program of this site on a regular schedule (every 2-3 years; during and not during mining activity) to determine if contaminant problems associated with placer mining are affecting refuge resources.

A report of findings for a study investigating contaminants of the environment surrounding the Cape Romanzof long range radar site was completed. Cape Romanzof was constructed in 1952 and began operation as a military aircraft control and warning site in 1953. The 2 year study conducted by the refuge and Ecological Services, Anchorage, centered on determining which contaminants (e.g., organochlorines, polynuclear aromatic hydrocarbons, inorganics) from installation activities may have entered the surrounding refuge environment. The investigation revealed evidence that the Cape Romanzof long range radar site has substantially contaminated the area's environment. Findings indicate that a small stream that runs through the area is contaminated with petroleum hydrocarbons, and resident fish and wildlife (dolly varden, red fox, voles) are contaminated with petroleum hydrocarbons, PCBs and DDT-related compounds. The report details contaminated sites requiring remediation and recommends additional study and cleanup. The refuge plans to conduct additional and more extensive monitoring (every 2-3 years) to determine if contaminant problems associated with the Cape Romanzof facility are continuing to impact refuge resources.

A general study plan was developed in 1989 to conduct an environmental contaminants investigation and cleanup of 2 abandoned mine sites on the Yukon Delta National Wildlife Refuge (Canyon Creek and Columbia Creek). Both sites are considered dangerous because of the amount of waste petroleum products, unmarked and rusty barrels with unknown contents, explosives, and dilapidated buildings. An environmental consulting firm was contracted to sample the contents of all drums and containers. Samples were separated into drums whose contents could be burned as "used oil fuel" according to federal energy recovery regulations and those requiring additional handling/sampling to

properly dispose of. Requests for bids to clean up the 2 sites were solicited but cancelled because bids were far in excess of funds allocated to accomplish the project.

E. ADMINISTRATION

1. Personnel

We experienced our normal high turnover of Refuge Information Technicians and Clerks.

Tony Amos	Bio. Tech.	Hired	4/83
		Resigned	1/90
Grace Andrew	Refuge Info. Tech.	Hired	11/88
		Resigned	9/90
Caroline Angaiak	Student Trainee	Hired	3/90
		Resigned	5/90
Pavilla Bayayok	Bio. Tech.	Hired	5/90
		Resigned	8/90
Jacquelyn Crace	Clerk Typist	Hired	7/90
		Resigned	8/90
Brian Colter	Bio. Tech.	Hired	5/90
		Resigned	8/90
David A. Dapkus	Outdoor Rec. Planner	Hired	5/88
		Transf.	11/90
Gary Henry	Bio. Tech.	Hired	4/90
		Resigned	8/90
Michael T. Hinkes	Wildl. Bio./Pilot	Hired	12/86
		Transf.	1/90
Xenia Jackson	Refuge Info. Tech.	Hired	11/89
		Resigned	6/90
James P. Lawler	Bio. Tech.	Hired	5/90
		Resigned	8/90
Diana May	Bio. Tech.	Hired	5/90
		Resigned	8/90
Leo Moses	Bio. Tech.	Hired	6/90
		Resigned	12/90
Thomas M. Nickolie, Jr.	Bio. Tech.	Hired	7/90
		Resigned	8/90
Thomas Olson	Bio. Tech.	Hired	5/90
		Resigned	8/90
Nancy Wilson	Clerk Typist	Hired	5/90
		Resigned	7/90

2. Youth Programs

Two Youth Conservation Corp employees were hired this summer, John Jensen and Amedee "Buzz" Chaney. They contributed significantly to the labor intensive activities around the headquarters. They also helped the maintenance staff do rehabilitation work and painting at the Kanagyak Field station.



YCC employees "Buzz" Chaney and John Jensen.
(Jensen)

4. Volunteer Programs

Three volunteers worked on the refuge this summer. Tommy Cooper helped extensively on the goose plot work during the spring and later on the ground work associated with the duck brood survey. Christine McCaffery and Chris Harwood both worked with bristle-thighed curlews. Christine also worked in the visitor center helping the Outdoor Recreation Planner and Chris aided in the seabird survey on Nunivak Island. Altogether their hard work contributed very significantly to many important refuge projects.

5. Funding

In the last four years, the FY-88 budget was the best for both amount and timeliness. The FY-91 budget is finally complete but has vacillated widely in the planning period, which made our planning nearly impossible.

Table 2
Funding for Yukon Delta National Wildlife Refuge

Activity Code	FY88	FY89	FY90	FY91
1111 (Endangered)	--	32K	--	17K
1230	20K	--	--	--
1241 (Fire)	--	--	16K	--
1260	1,168K	1,538K	1,566K	1,709K
1411	--	--	35K	87K
Cong. Add-on	552K	--	--	--
TOTAL	1,704K	1,570K	1,617K	1,813K

6. Safety

On February 11, 1990, Assistant Interpreter Paschal Afcan and Refuge Information Technician (RIT) David K. Evan drove a refuge Chevy S-10 light truck to Napaskiak for a meeting. They were using the Kuskokwim River ice-road and both were wearing seatbelts.

At approximately 2:30 p.m., refuge headquarters was contacted by the local Bethel City Police that a vehicle accident had occurred on the river ice-road involving refuge personnel. RIT Evan was examined at the local Alaska Native Hospital for minor cuts and bruises on his head and face. He was released upon completion of the examination. The driver, Paschal Afcan, was not injured.



The mangled remains of the Chevy S-10 pickup after a high speed accident on the ice road. Two occupants were uninjured because they were wearing seatbelts and shoulder harnesses.
(C. Hunt)

Deputy Refuge Manager Dennis Strom and RIT supervisor Chuck Hunt drove to the scene of the ice-road vehicle accident. Alaska State Troopers were examining the scene and measuring the tracks and the distance where the vehicle went off the ice-road, tumbled, and rested overturned. The Chevy S-10 was wrecked beyond repair.

Upon questioning the investigating Alaska State Troopers, they said that the vehicle was moving in excess of 60 miles per hour. The vehicle skidded off the ice-road, hit the snowbank, flipped over twice and rested upside down some 300 feet from where it went off the ice-road. As a result of this ice-road vehicle accident, the driver's government license was revoked.

When the monthly safety meetings were not held, the safety officer wrote a monthly safety reminder which was distributed to all staff including field personnel in the villages.

8. Other Items

Special Use Permits were issued to the following individuals and organizations in 1990:

Bureau of Land Management	Native Allotment Surveys
National Aeronautics and Space Admin.	Vegetation and Peat Study
Bering Sea Reindeer Products	Grazing Reindeer
Bering Sea Reindeer Products	Helicopter Herding
AMOCO Production	Subsurface Assessment
AK Fish & Wildlife Research Center	Sandhill Crane Banding
AK Air National Guard	Training
Federal Aviation Administration	Gravel Removal
State of Alaska	Gravel Removal
Charlie Spud	Transporting
Ed Shavings, Sr.	Guiding
Daniel Orlun, Sr.	Transporting
Abraham David	Transporting
Larsen King	Outfitting
AK Fish & Wildlife Research Center	Collect N. Pintails
AK Fish & Wildlife Research Center	Research Fox Predation
D. A. Bell Museum	Collect Sabine Gull
AK Fish & Wildlife Research Center	Collect Red Knots
Larry Float, Sr.	Transporting
Fred Don	Guiding

F. Habitat Management

1. General

The Yukon Delta National Wildlife Refuge encompasses approximately 26.3 million acres within the northern boreal subzone of southwestern Alaska. About 70% of the refuge is below 100 feet in elevation and consists of a broad, flat delta created by the Yukon and Kuskokwim Rivers and their tributaries. The refuge is primarily subarctic tundra, underlain by permafrost, and includes a variety of scrub, peatland, heath meadow, marsh, and bog habitats. Tall scrub and forest habitats are found inland, in the eastern interior areas of the refuge. Alpine tundra occurs in the mountainous areas at higher elevations. Most of these habitats remain essentially untouched by humans. No habitat management as practiced in the lower 48 states occurs. Habitat related activities involve mapping and inventory efforts associated with specific wildlife studies.

2. Wetlands

Most of the refuge is a vast, flat wetland/tundra complex dotted by countless ponds, lakes, and meandering rivers. Some of the most critical wetland habitat on the refuge is the coastal region

bordering the Bering Sea. This narrow strip of land is unquestionably the most productive goose nesting habitat in Alaska. As a result of the Alaska Submerged Lands Act, additional acres on and adjacent to this coastal strip may be selected from refuge lands by Native corporations in the years ahead.



Kokechik flats, lying south of the Askinuk Mountains, is one of the most productive nesting areas for waterfowl on the delta.
(J. Lawler)

3. Forests

Less than 5% of the refuge is considered to be forested. Narrow bands of riparian, black spruce-hardwood, mixed black spruce-balsam poplar, and balsam poplar woodlands extend on to the delta along the Yukon and Kuskokwim Rivers and their tributaries. In addition, pockets of black spruce and white spruce are interspersed throughout the Kilbuck and Andraefsky Mountains. None of the wooded areas on the refuge contains commercially harvestable timber.

6. Other Habitats

The refuge is primarily composed of subarctic wetland/tundra, scrub, forest, and alpine tundra habitats. Another habitat is the intertidal mudflats which are extremely important feeding,

resting, and staging areas for numerous species of shorebirds and waterfowl. Coastal cliffs provide important nesting habitat for seabirds on Nunivak and Nelson Islands, and at Cape Romanzof.

7. Grazing

Reindeer were introduced onto the Yukon-Kuskokwim Delta in 1901 when 176 animals were released near Bethel (Rearden 1974). The mainland reindeer population peaked at 176,000 animals in the late 1930's. A sharp population decline in the early 1940's, however, resulted in a complete breakdown of reindeer herding and the gradual loss of all herd animals on the mainland.

The only active reindeer operation remaining on the refuge is on Nunivak Island. Reindeer were introduced to Nunivak Island in 1920. Nunivak was considered to be ideal habitat because it had lush forage conditions, lacked major competitors and predators, and restricted reindeer movements to a controllable area. The island was set aside as a Department of Agriculture reservation in 1929 partly to conduct experiments in the crossing and propagation of reindeer and caribou. This herd grew to approximately 30,000 by 1944, declined precipitously the following year, and has fluctuated widely ever since. The April 1990 population estimate was 6,600. Reindeer on Nunivak Island are owned and managed by Bering Sea Reindeer Products, a Native-owned corporation based at Mekoryuk. This herd is extremely important as a red meat source and to the cash economy of Native residents of Nunivak Island.

A study conducted by the Soil Conservation Service in the mid-1980's determined that reindeer had severely overgrazed lichen ranges on Nunivak Island. A series of permanent range-monitoring plots were established in 1989-90 and indicated that range condition and trend continued to decline as a result of continued overgrazing. Positive steps were taken in 1990 to reverse this trend through the construction of a slaughter house. Once completed the facility will be able to handle up to 54 carcasses a day, or approximately 2,000 animals per year. Proper handling in a State-inspected slaughter facility will allow access to an unlimited exotic meat market. At the projected rate, it will take approximately 5 years to reduce the herd to a level for range recovery to begin yet still allow for a commercial harvest of reindeer. A draft management plan was written in 1990 to provide formal direction for the proper management of reindeer range on Nunivak.

9. Fire Management

All wildland fire suppression responsibilities on Alaskan refuges have been delegated to the Alaskan Fire Service, Bureau of Land Management. Fire activity on the refuge was light in 1990, with only 5 fires reported (Table 3).

Table 3
Reported Wild Fires on the
Yukon Delta National Wildlife Refuge, 1990

<u>Fire Number</u>	<u>Acreage</u>	<u>Fire Date</u>	<u>Protection Category</u>
7099 Lightning	3.0	06-02-90	Modified
7032 Man-caused	100.0	06-05-90	Modified
7039 Lightning	250.0	06-30-90	Modified
7040 Lightning	4.0	07-01-90	Full
7096 Lightning	218.0	08-10-90	Modified

A total of 575 acres were burned. Fire number 7096 was allowed to burn itself out. The remaining fires were actively suppressed.

12. Wilderness and Special Areas

Two wilderness areas occur on the refuge, the Andraefsky and Nunivak Wildernesses. The Andraefsky Wilderness is quite remote and receives little public use. Nunivak Wilderness is also remote and receives a very small amount of public use. Sport hunters seeking to fill their muskox permits and local Nunivak Island residents pursuing subsistence activities constitute virtually all the public use.

In 1989, the handout on the Andraefsky River was updated to help in responding to written requests for information on floating the river. There are presently no commercial fishing, wilderness, or float-boating guides operating on the river. The upper half of both forks receive almost no float boat use. The major reason for the low public use is limited aircraft access, due to a lack of suitable ridgetops or sand bars for landing aircraft on either fork.

The Andraefsky River and all its headwaters, and the East Fork, within the boundary of the Yukon Delta National Wildlife Refuge was designated as a Wild River under the Alaska National Interest Lands Conservation Act. This designation covers approximately 265 river miles, of which approximately 198 are within the Andraefsky Wilderness, 54 miles cross private lands, and 13 miles cross non-wilderness refuge lands. No other rivers on the refuge

have been so designated.

The land within the former boundaries of the old Clarence Rhode National Wildlife Range and the Hazen Bay Migratory Waterfowl Refuge has been named the Clarence Rhode National Natural Landmark. This is the only such "Special Area" presently designated within the Yukon Delta National Wildlife Refuge. In 1987, the official plaque recognizing this status was mounted in the entrance to the refuge headquarters building in Bethel.

G. WILDLIFE

1. Wildlife Diversity

Migratory birds that utilize the Yukon-Kuskokwim Delta as a nesting place or molting area, or even as a spring or fall staging area migrate through all flyways of North America. Of the 68 species of shorebirds recorded in Alaska, 52 occur in this region. Some 15 of these are Asiatic in origin and straggle to Alaska in small numbers. Migratory shorebirds stage over littoral and supralittoral habitats of coastal areas on the



Rock ptarmigan males retain their white winter plumage well into June.

(C. McCaffery)



Female rock ptarmigan may be distinguished from willow ptarmigan by their proportionately smaller bills. (C. McCaffery)

refuge where total numbers may swell into the millions. Because of the great diversity and abundance of shorebirds using the refuge, much of the coastal strip, the Andraefsky Wilderness, and the coast of the Nunivak Wilderness were nominated by the refuge for inclusion in the Western Hemisphere Shorebird Reserve Network. In addition to the shorebirds which use the delta for breeding and foraging, large numbers of seabirds and other water birds, including gulls, jaegers, cranes, and waterfowl use the area.



Yellow wagtails are among the few Alaskan passerines which winter in Asia. (B. McCaffery)

In past years, the refuge hosted over half of the continental population of black brant, ranging between 50 and 75%. Today, however, fewer than 20,000 brant nest on the refuge. Additionally, at one time the number of cackling Canada geese numbered in the hundreds of thousands. Today there are approximately 110,000. The 1990 estimates for Pacific white-fronted geese and emperor geese are 241,000 and 67,600, respectively. Undoubtedly, these species have been a significant factor in the shaping of the coastal ecosystem.



McKay's buntings nest almost exclusively on St. Matthew Island in the Bering Sea. After breeding, they migrate 250 miles east over water to winter on the delta.
(B. McCaffery)

Despite the sharp reduction in geese from historical levels, the refuge still supports large numbers of ducks. The 1990 breeding pair survey estimated over 1.5 million ducks on the refuge in early June. The principal species were northern pintail, greater scaup, and oldsquaw. Mallards, wigeon, green-winged teal, northern shovelers, and black scoters are also regularly reported in good numbers during the breeding pair survey. Common eiders are fairly common in the vicinity of brant colonies, but the population of the formerly abundant Spectacled Eider has declined precipitously over the last 20 years. From an average breeding population of about 100,000 birds in the early 1970's, the population has fallen to the 1990 estimate of 2,100 breeding pairs.



A mingling of muskox on Nunivak Island.
The population is near 625. (J. Morgart)

With the exception of approximately 20,000 humans, large mammals are not abundant on the refuge. Muskox are found on Nunivak and Nelson Islands. Over the past few years, muskox sightings on the mainland have increased, with sightings ranging from the coast, north to Mountain Village, and east to the refuge boundary. Caribou exist in the Nulato Hills and the Kilbuck Mountains. While the number of caribou in the Nulato Hills is small (probably less than 200), the population in the Kilbuck areas has increased dramatically since hunting was closed in 1985. Current estimates suggest the herd may exceed 1,200 animals.

Moose, grizzly bear, black bear, wolves, wolverine, marten, beaver, and many small mammals occur on the refuge. One curious observation over the past few years has been the range extensions of beaver. Fifteen years ago, beaver were not known in the coastal areas. Today their numbers have increased substantially and are found in the coastal zone well beyond the tree line. Fox (red and arctic) populations remain high on the delta.

The delta sustains a large fishery resource, and 1990 saw the completion of the refuge's fishery management plan. Five species

of salmon (chinook, chum, pink, sockeye, and coho) migrate through the refuge and also utilize many refuge streams for spawning. Other common species are smelt, northern pike, blackfish, stickleback, sheefish, burbot, 5 species of whitefish, rainbow trout, arctic char, and grayling. The Nunivak Island waters include many marine species such as halibut, truecod, and herring.

2. Endangered and/or Threatened Species

Four listed forms occur or could occur on the refuge. The arctic peregrine falcon occurs on the refuge and is listed as threatened. The American peregrine falcon is endangered and also occurs on the refuge. In previous years, peregrine falcons (subspecies unknown) have been reported in the Kilbuck Mountains, Askinuk Mountains, Nulato Hills, and near the village of Chevak. In 1990, the Alaska Department of Fish and Game located several active eyries just off the refuge on St. Michael and Stuart Islands.

The Eskimo curlew and the short-tailed albatross may once have occurred on the refuge, but it is unlikely they still remain. However, recent sightings of Eskimo curlews during spring migration and on the tundra of Canada's Northwest Territories has raised hopes that the species may still occur in Alaska as well. As a result, funding from the Endangered Species program allowed a 3-person refuge crew to spend nearly 3 weeks in late August and early September searching the wetlands and uplands near St. Michael in search of Eskimo curlews. Historically, this was the only site in Alaska where Eskimo curlews were seen in good numbers on an annual basis. A systematic array of transects was established and censused by Wildlife Biologist McCaffery, Refuge Information Technician Jimmy, and Volunteer Harwood. Waterfowl (especially dabbling ducks), cranes, and shorebirds were abundant in this rich coastal habitat. Unfortunately, no Eskimo curlews were detected.

3. Waterfowl

The refuge is responsible for inventorying and monitoring perhaps the largest waterfowl production area in the system. The Yukon-Kuskokwim Delta is the exclusive nesting area for cackling Canada geese, and primary nesting area for emperor geese, black brant, and Pacific flyway greater white-fronted geese. While the populations of two other Canada goose subspecies (lesser and Taverner's) are apparently healthy, the above four species declined dramatically from the mid-60's to the mid-80's. The factors responsible for these declines are many, complex, and not completely understood; but certainly include such things as sport and subsistence hunting, loss and degradation of winter habitat, and predation. The current status of these four populations is presented in Section D.5.

The refuge's duck brood survey was again modified in 1990. The main impetus for this change was initiation of a statewide survey. While this survey and a cooperative study with Kanuti National Wildlife Refuge to compare observations from a helicopter to those of a ground crew were the center of focus in 1990, boat crews also surveyed two rivers. The Izaviknek River was surveyed for the fourth consecutive year and the Aphrewn River was chosen to provide data from the coastal region, which hadn't been surveyed in previous years. This year's survey was designed to be conducted throughout the brood rearing period. For the Izaviknek River, an expected increase in the number of broods and an advancing of the age structure occurred between the first two surveys. Unfortunately, logistic constraints prevented a comparable third survey and eliminated additional surveys in 1990. Nevertheless, it appeared total broods and broody hens (n = 45) and average brood size (3.6 ducklings, n = 27) remained below totals for 1987 (n = 124; 4.4 ducklings, n = 102, respectively) and 1988 (n = 112; 4.4 ducklings, n = 88, respectively). The Aphrewn River survey produced fewer observations of broods and broody hens (n = 14) than expected given its coastal location and number of kilometers surveyed (313 km).

In recent years, duck production surveys in Alaska have generally been conducted on sample plots by ground crews or from the air with helicopters. Discussions addressing the merits and limitations of each procedure were the impetus for the current effort to standardize the methodology. While limited evidence indicates that ground and air surveys of breeding pairs of waterfowl produce similar results, no published studies have compared the techniques for brood surveys. A 3-year study will examine the relative effectiveness of helicopter versus ground counts for production surveys in interior (Kanuti National Wildlife Refuge) and tundra (Yukon Delta National Wildlife Refuge) habitats. A total of 19, 2.6 square kilometer plots were surveyed by both techniques. Both surveys of a plot were conducted within 48 hours of each other. Ground surveys were conducted first for 13 plots. Ground observations were larger than aerial observations for broody hens (12 vs. 6) and overall average brood size (5.2 ducklings, n = 29 vs. 3.9 ducklings, n = 83). Ground observations were 79% of the aerial observations of nonbreeding adults (576), 37% of total broods (83), and 50% of total ducklings (315). Despite a larger overall average brood size provided by ground data, it appears that smaller broods were missed by this survey since ground crews observed 70% of those broods with ≥ 5 ducklings observed from the air but only 22% of broods with ≤ 4 ducklings. Mallard broods were less visible to ground crews while pintails were more visible. Shovelers approached significance, but wigeon, green-winged teal, greater scaup, and black scoters were not significantly different.

While it appears that air and ground surveys produce similar results when a plot contains ≤ 5 broods, the species composition of these observations are nevertheless dissimilar. Combining data from all plots resulted in an expected similar composition for total species, nonbreeding adults, broods, and broody hens. However, large differences appeared when individual plots were examined. A brood or broody hen of any species was observed by one survey with no broods observed by the other survey on seven of 19 plots. In addition, a brood or broody hen of the same species was observed by both surveys on nine plots. This never occurred for wigeon, shovelers, pintails, and oldsquaw and less than 46% of the time for mallards, teal, and scaup. Only scoters approached a desirable percentage (67%).

The aerial survey was conducted prior to the ground survey on six plots. For these plots, an average of five broods/plot were observed from the air and 0.5 broods/plot from the ground. Also, two of the four largest differences in the number of broods/plot occurred on these plots. This 10-fold difference is in sharp contrast to the 13 plots where the ground survey occurred first (4.1 broods/plot observed from the air, 2.2 broods/plot from the ground). In addition, the ground crew observed an equal or greater number of broods for seven of the plots they surveyed first. There were no statistically significant differences between these two groups of plots in terms of number of water bodies, degree of difficulty in conducting the aerial survey, and time required to conduct the aerial survey. Additional data are required to assess the possibility that the aerial survey is causing broods to leave the plot. Even if this is the case, data accuracy would not be affected if the survey was conducted exclusively by helicopter. The importance of such an impact lies in determining whether brood survival is decreased by such movement.

First year's results provided tantalizing indications of the efficacy of an aerial helicopter survey: geographically broad sampling, ability to survey a large number of plots, minimal personnel requirement, and moderate cost. Several factors may be involved in the dissimilarity between aerial and ground observations, including impact of brood behavior on visibility from the ground, species identification ability of ground crews, magnitude of brood movement, and impact of disturbance caused by survey procedure. While field work in the immediate future will not address these aspects, it is anticipated that enough information will be provided by the current study design to clearly decide the appropriateness of each survey procedure.

In conjunction with the state-wide duck brood survey in Region 7, the refuge surveyed 94, 2.6 square kilometer plots by helicopter. This total includes the 19 that were surveyed as part of the helicopter/ground survey comparison. Wildlife Biologist McCaffery was the observer, and on coastal plots with numerous

and complex wetlands, Wildlife Biologist Wege served as navigator. The mean number of water bodies/plot was 17 (range: 0-91), and the mean number of minutes required to complete each plot was 31 (range: 1-90). The number of broods/plot average 6.3 (range: 0-32). A computer program developed by Migratory Bird Management (Juneau) yielded a refuge-wide estimate of 186,486 total duck broods. Species with total brood estimates exceeding 10,000 included green-winged teal (69,818), greater scaup (35,769), northern pintail (24,598), American wigeon (16,108), northern shoveler (15,002), and black scoter (11,215). Since most adult ducks were flightless during the brood survey period, we were also able to derive refuge-wide estimates for this subset of the population. Northern pintails were by far the most abundant duck, comprising >50% of the total duck population (813,879 of 1,596,024). This figure represents nearly 1/3 of the continent-wide spring population estimate for 1990. Clearly, the refuge is an important, and perhaps critical, summering area for a major fraction of North America's pintails.

In light of declining pintail numbers in North America, Alaska's relatively stable population has represented a steadily increasing proportion of the continental total. During the 1990 breeding pair survey, Yukon Delta National Wildlife Refuge contained more pintails than any other Alaskan stratum; approximately 16% of the continental and 30% of the Alaskan population. Little is known regarding pintail distribution, age structure, and productivity on the refuge or subsequent winter distribution and mortality in the Lower 48. Banding and color marking are important tools which provide baseline data and allow formation of a sound waterfowl management program.

Banding was conducted in 1990 as part of a five year cooperative program within the Pacific Flyway. Three trapping methods were used: (1) driving flightless adults, (2) rocket-netting, and (3) swim-in traps. Drive-trapping, utilizing two aircraft, a motorized Zodiac raft, and six to nine individuals, captured 92 pintail during four drives on three different lakes within the Kokechik Bay waterfowl study area. Most of the birds were captured on one drive and females comprised 13% of the total.

Rocket-netting and swim-in trapping occurred within marshy areas of Kgun Lake, which is located in the north-central part of the refuge. Rockets were fired six times with three successful firings capturing a total of 39 pintails and 43 green-winged teal.

A total of 207 pintails and 84 teal were captured during 90 trap-days in swim-in traps baited with cracked corn. Six traps were used in pairs or a group of four at five sites. Nearly equal age and sex ratios were achieved with this method for both species.

Simplified logistics and the acceptable age and sex composition achieved with bait trapping make it the method of choice for future efforts. Several thousand molting pintails were present on Kgun Lake prior to initiating trapping and plans call for starting earlier in the season to take advantage of their presence.

4. Marsh and Water Birds

Sandhill cranes, loons, and grebes are widely distributed on the wetland areas of the refuge. Sandhill cranes are particularly abundant and constitute an important component of the delta ecosystem, including the subsistence harvest. Population estimates obtained during the 1990 helicopter duck brood survey included 3,733 common loons, 8,089 red-throated loons, 85,246 Pacific loons, 35,156 red-necked grebes, and 34,845 sandhill cranes. Horned grebes also summer on the refuge, but none were detected during the helicopter brood survey.

5. Shorebirds, Gulls, Terns, and Allied Species

Shore and water birds visiting the refuge each year number in the millions. Many come to breed on the tundra, shorelines, and mountaintops of the refuge. By August, shorebirds flock to coastal and riparian mudflats to build lipid reserves for long migrations, while terns have already departed south. Highest densities of shorebirds occur along the coast at Tern Mountain and Angyoyaravak Bay. Gulls are common along the entire refuge coastline from spring through autumn.

In 1990, surfbirds were again found on the alpine summits just east of Curlew Lake. Breeding displays and paired birds were frequently observed in late May and early June, and a single nest with newly-hatched young was discovered in mid-June.



Still wet after hatching, in just two months these golden plover chicks will migrate 4,000 km over the Pacific Ocean enroute to Hawaiian Islands. (C. Harwood)

The whimbrel population at Curlew Lake experienced a major reproductive failure in 1990. The first indication that the birds were having trouble was the delay between spring arrival and the initiation of nesting. In 1988-1989, the time between first appearance of pairs and the mean nest initiation date averaged 12 days. In 1990, the first nests were initiated 14 days after the first pairs were detected, and the mean initiation date was 20 days after the first pairs were detected. Not only did whimbrels begin nesting later in 1990, but fewer nested as well. In past years, all whimbrel pairs nesting in the study area have initiated nesting in the tussocky dwarf shrub meadows of the lower valley slopes. In 1988 and 1989, 7 and 6 nests, respectively, were found in the valley. In 1990, only 2 pairs nested in the valley. An additional 2 pairs nested in the moist meadows between alpine summits of the site's main ridge system. Whether this habitat shift was a reflection of poor conditions in the valley could not be ascertained.



Whimbrels experienced abysmal reproductive success in 1990. (C. Harwood)

There were other signs of reproductive difficulty as well. In 1988 and 1989, 12 complete clutches all contained 4 eggs. In 1990, 3 complete clutches included 4 eggs, but 2 included only 3 (one nest was found outside the main study area). Two of the 5 nests (both with 4-egg clutches) were depredated, not an unusually high incidence of nest loss. Of the remaining 3 nests, both 3-egg clutches hatched successfully, but only a single egg hatched from the remaining 4-egg clutch. This nest was discovered while an adult was apparently attempting to remove a broken, unpigmented egg from the nest early in incubation. The shell seemed very soft and pliable. It was collected for future analysis. Subsequently, two additional eggs disappeared from the nest.



This whimbrel nest was discovered as the adult tried to remove the broken, unpigmented egg from the nest cut.
(B. McCaffery)

As briefly detailed above, several different parameters of reproductive effort were affected in 1990. Perhaps the most revealing way to highlight the reproductive failure is to compare the number of eggs produced and the number successfully hatched during the three field seasons at Curlew Lake. In 1988, 1989, and 1990, the local whimbrel population produced ≥ 26 , ≥ 22 and 14 eggs, respectively. Of these, 19, 14, and 7 hatched in the 3 years, respectively. We currently are unable to determine the cause of the 1990 reproductive failure. Circumstantial evidence implicates factors on the breeding grounds, but we have not yet tested the broken egg for possible contaminant residues accumulated en route to the delta.



Parakeet auklets (cyclorrhynchus psittacula) are by far the most abundant auklet on Nunivak Island.

(C. Harwood)

Cliffs on the southwest side of Nunivak Island provide nesting sites for an estimated 500,000 seabirds, primarily common murres and black-legged kittiwake, but also including pelagic and red-faced cormorants, glaucous-winged and glaucous-winged X glaucous hybrid gulls, horned and tufted puffins, parakeet and crested auklets, and pigeon guillemots. In 1990, a 4-man refuge crew conducted repeated censuses of murres and kittiwakes on our 18 permanent plots, and also obtained productivity data for murres, kittiwakes, and pelagic cormorants.



Unlike many other cliff-nesting seabirds, murre incubate their pyriform eggs without the protection of a nest, crevice, or burrow.
(C. Harwood)

The mean number of murre counted across the entire plot system was 4,712 (N=8 censuses), virtually identical to the 1989 average of 4,728. Murre productivity was apparently higher in 1990. Approximately 51% of all murre on our productivity subplots were tending either eggs or young, whereas in 1989, the comparable figure was 34%.



A horned puffin perched precariously,
pondering the perils of precipitous
perambulation.

(C. Harwood)



A tufted puffin poses pensively. (C. Harwood)

Black-legged kittiwakes rallied dramatically in 1990, after their abysmal reproductive performance in 1989. The mean number of kittiwakes detected on the 18 plots in 1990 was 1,153, compared to 955 in 1989. More significantly, reproductive activity was much greater in 1990. At the time of our survey, 65% of all kittiwake nests initiated in 1990 were still active (i.e., containing either eggs or chicks). In 1989, only 6% of nests were still active. For the first time since our annual survey began in 1987, we even detected broods including 2 large chicks (usually only a single chick survives).



Ungainly in flight, murrens also use their wings for "flying" underwater in pursuit of piscine prey.
(C. Harwood)

Populations of pelagic cormorants can be difficult to monitor since breeding birds are not necessarily site-faithful to specific nesting areas. At some sites in Alaska, entire cormorant "colonies" have shifted nesting locations between years. Thus repeated counts at the same site from year to year may or may not reflect actual changes in population size. As a

result, we believe that mean brood size may be the most readily determined indicator of the relative health of the Nunivak cormorant population. Each year, we record the brood size at all cormorant nests visible from the cliff-top on and adjacent to our plot system. In 1990, the mean brood size was 2.59 (N=73). This is within the range of brood sizes determined in 1987 (2.51), 1988 (2.87) and 1989 (2.34).

6. Raptors

Seventeen species of raptors have been recorded on the refuge, including 3 natural resource species: golden eagles, bald eagles and peregrine falcon. In 1990, little field work on the refuge focused on raptors. The one exception was a survey of nesting raptors and raptor nest sites in the Askinuk Mountains conducted by Fritz Gerhardt (Migratory Bird Management - Anchorage). Most active raptor nests were in uplands immediately adjacent to extensive wetlands, particularly along the Lithkealik and Kolomak Rivers. Golden eagles, rough-legged hawks, gyrfalcons, peregrines, and merlins have all been recorded as nesting species in the Askinuks.

8. Game Mammals

Muskox

Muskox are probably the refuge's most important game mammal in terms of public use. Muskox were introduced to Nunivak Island from Greenland in 1935. In 1967-68, muskox were transplanted to Nelson Island where the herd reached a high of 287 animals by 1986. Nelson Island muskox have radiated onto the delta mainland for the past 15 years, crossing frozen channels between the island and the mainland. However, the heaviest snowfall since 1976 led to a large emigration of muskox from Nelson Island in the spring of 1988. The Alaska Department of Fish and Game and the Service are attempting to promote the growth and expansion of the mainland muskox population on the refuge and is working with local villages to obtain their support.



A rueful Henry Ivanoff while conducting the muskox census stands atop his snowmachine awaiting help. Overflow can be a danger any time in the winter. (Morgart)

The annual Nunivak Island muskox census was conducted in March and included participants from the Service, Alaska Department of Fish and Game, and Bering Sea Reindeer Products. In addition to the traditional ground survey conducted from snow machines, an aerial census was conducted in April to verify ground counts and to estimate reindeer numbers. The 1990 ground count was conducted under ideal conditions which resulted in a total of 568 muskox being observed. There were 242 bulls, 219 cows, 71 yearlings, and 36 unclassified. Census results show a decrease in muskox numbers compared to the 1989 count. This may be in response to an increased harvest initiated by the Alaska Department of Fish and Game in 1989/90. The target population level for muskox on Nunivak Island is 500 animals, pre-calving. A proposed transplant to the Soviet Union will facilitate muskox reduction on Nunivak Island.

Moose

Prior to 1950, moose were rarely seen on the Yukon-Kuskokwim Delta. During the following years, their numbers increased and moose presently inhabit the eastern boundary of the refuge and

the riparian forests of the Yukon and Kuskokwim Rivers. Moose are undoubtedly more common now than 40 years ago, but their densities are still very low in relation to available habitat. The greatest number occur along the Yukon River between Ohogamiut and Holy Cross, particularly during winter. During the summer, moose are more widespread and are occasionally found as far west as the coast. Some moose along the lower Yukon River appear to be highly migratory, as recently evidenced by the 150 mile movement of a radio-collared animal.

Overharvest (legal and illegal) of moose appears to be the primary factor limiting herd growth and range expansion. The lower Yukon River was recently closed to moose hunting for five years. This action appears to be allowing this population to increase. Upriver hunting continues to be heavy, however, and will undoubtedly slow growth.

Caribou

Historically, caribou occurred on the Yukon-Kuskokwim Delta in large numbers and were the most abundant ungulate in the area. Numbers peaked in the 1860's and during this period, caribou ranged over much of the refuge, even crossing the ice pack to Nunivak Island. Caribou subsequently disappeared from the region with the exception of small, remnant herds in the Kilbuck and Andraefsky Mountains. Members of the western Arctic herd occasionally migrate south as far as the upper Andraefsky River, but remain only a short time. Some caribou from the Mulchatna herd have been appearing around the Aniak Lake area in late winter since 1988. Similar to visitors from the western Arctic herd, these animals only remain for a relatively short period of time.

The population status and distribution of the Kilbuck herd is poorly understood. There has been some discussion on whether these animals comprise a distinct resident herd deserving of special management consideration or are merely a western extension of the expanding Mulchatna herd. Although they are currently managed as a distinct herd, cooperative studies were initiated in 1985 to better understand their biology.

The Kilbuck caribou herd has increased in size over the last 4 years; concurrent with closing the hunting season. Although our studies indicate this is a distinct, resident herd, significant increases in numbers indicates some migration from the Mulchatna herd may be occurring. An incomplete aerial census in November 1990 located >1,200 animals. During early winter (October-December), Kilbuck caribou concentrate along the lower flats and foothills of the Kilbuck and western and central Kuskokwim Mountains. In late winter (January-March), they move to high, wind-blown slopes of the western Kuskokwim Mountains. Peak calving occurs mid-May in the high, rugged mountain tops and

ridges of the western Kuskokwim Mountains. The majority of caribou spend the summer (June-August) in the western Kuskokwim Mountains; overlapping little with their winter range. As rut approaches, Kilbuck caribou return to their winter range.

The status and distribution of the Andraefsky caribou herd is poorly understood. Like the Kilbuck caribou herd, we believe this is a distinct, resident population and that excess hunting pressure has kept this herd at very low levels. Due to the remoteness of their range, little work on this herd has been initiated. Available information comes from an occasional overflight across the area or personal communication with local guides and residents. A few cursory surveys have provided some information on distribution and calving, but it has been far from adequate. Because of heavy subsistence use by local villages, and increasing interest in reestablishing reindeer grazing, study efforts similar to those for the Kilbuck caribou herd will be initiated.

9. Marine Mammals

Marine mammals of the Bering Sea comprise an interesting subset of refuge wildlife and a vital subsistence resource for coastal villages. Walrus, spotted seals, ringed seals, and bearded seals are hunted on the ice in spring, and some seal hunting continues during summer in bays and estuaries. Other marine mammals include beluga, gray, killer, and minke whales.

Polar bears rarely range as far south as the refuge, but were reported in the spring of 1984 near the Tutakoke field camp and Hooper Bay. State and Federal regulations permit the taking of polar bears by Alaska Natives. Ecological Services (Anchorage) manages the marine mammal program. The refuge has no on-going or future mammal studies planned.

10. Other Resident Wildlife

Wolves have been sighted more frequently in the Kilbuck Mountains, probably in response to increasing caribou numbers. Although wolf and ungulate numbers are growing, densities remain low. Fur sealing certificates document an increase in wolf harvest over the last three years.

Beaver distribution continues to expand on the delta. There is concern by Natives that beaver dams are hindering fish and boat travel up streams. Red fox numbers continue to be high around communities, with some incidence of rabies being reported.

Our only attempt to monitor resident birds occurs on the annual Bethel Christmas Bird Count. Wildlife Biologist McCaffery coordinated the count which was held on December 27. Nine observers, including 7 refuge staff members, and 1 feeder-watcher

participated. Strong winds and freezing rain limited mobility and inhibited observations, but 325 individuals of 12 species were detected nonetheless. Two new species were added to the count, gyrfalcon and rock ptarmigan. Regrettably, no McKay's buntings were detected. For each of the previous two years, the Bethel count led the continent in numbers of this Beringian endemic. By early December, it seemed as if we had the opportunity to do so again. Up to a dozen were regularly visiting the feeders of Wildlife Biologist Wege and Supervisory Wildlife Biologist Morgart. Unfortunately, this species only congregates about the feeders in Bethel when snowcover on the surrounding tundra is deep and nearly complete. In mid-December, a thaw produced extensive areas of open tundra, and the McKay's buntings promptly vanished. None were detected on count day; in fact, 1991 was well under way before they were again noticed at local feeders.

11. Fisheries Resources

All five species of Pacific salmon (chinook, chum, silver, sockeye, and pink) spawn on the refuge. The harvest of these salmon from the Yukon and Kuskokwim Rivers through the commercial and subsistence fisheries is of economic and nutritional importance to local residents on the delta. Other important species include herring, Pacific cod, whitefish, blackfish, burbot, northern pike, and halibut.

Sport fishing pressure is light on the refuge, but the tributaries feeding the Kuskokwim and Yukon Rivers provide anglers with an excellent variety of trophy fish. Salmon, rainbow trout, dolly varden, grayling, and northern pike make up the menu of fish accessible to anglers on many of the refuge tributaries. The favorite rivers for sport fishermen include the Aniak, Eek, Kwethluk, Kasigluk, Kisaralik, and Andreafsky.

14. Scientific Collections

R. Michael Anthony (Alaska Fish and Wildlife Research Center) received a permit to trap arctic fox in the vicinity of the Manokinak and Tutakoke field camps. This work was conducted in conjunction with a research study focusing on the effect of fox density (manipulated by trapping) on goose nest predation, and identifying co-variables that affect predation rates (e.g., avian predators, nesting density, microtine abundance, denning and nesting habitat). A total of twenty-six animals were collected under this permit. Twenty fox were removed from the study area and 6 were radio-collared and released.

15. Animal Control

Arctic fox were trapped and/or shot for the fifth consecutive year in areas of high goose nesting density along the coastal

fringe of the refuge. The objectives of the trapping program are: to evaluate the impacts fox depredation has on nesting success of geese (in particular black brant and cackling Canada geese); to determine nest predation rates in the absence of foxes; and to collect baseline information on foxes inhabiting goose nesting areas.

16. Marking and Banding

The annual goose banding/collaring project was conducted out of the Kanagyak field station from July 17-18 and July 31 to August 4, 1990. Refuge personnel involved included Michael Rearden, Jack Paniyak, Jimmy Slats, Mike Wege, and John Morgart. Other participants were pilots Bill Butler and Rod King from Migratory Bird Management and Joel Schmutz from the Alaska Fish and Wildlife Research Center. During the first banding period, 285 molting adult cackling Canada geese were banded and neck-collared in an area 8-15 km northwest of the village of Chevak. During the second period, brood flocks of emperor geese were driven into shoreline traps using aircraft. A total of 1,284 emperors were captured along the coastal fringe of the Yukon-Kuskokwim Delta in an arc from 23.6 km northwest of Chevak to 37.8 km northwest of Newtok. In addition, solar-powered radio-transmitters were placed on 3 emperors.



The delta banding crew processing a large group of Pacific black brant. (USFWS)

Craig Ely (Alaska Fish and Wildlife Research Center) and his crew banded and collared 290 cackling Canada geese near Old Chevak from June 19 to August 4, 1990. Marked cackling Canada geese and emperor geese from both operations will be studied to determine migration patterns, annual and seasonal mortality, and use of staging areas. In addition, marked birds in the cackling Canada goose population are used to derive the wintering ground population count.

Ely's group also banded 10 greater white-fronted geese and 5 tundra swans. Six of the geese were outfitted with solar-powered neck collar transmitters. The radio-marked birds are used in a study on migration timing and wintering ground use.

Jim Sedinger (University of Alaska, Fairbanks) banded 2,554 and 498 black brant at the Tutakohe and Kokechik colonies, respectively. All brant were secondarily marked with colored tarsi bands. In addition, 10 brant were fitted with backpack radio-transmitters. These birds are for a study to determine the relationship between colonial nesting and reproductive success,

to investigate dispersal from colonies, and to estimate age-specific survival and fecundity.

The refuge embarked on a pintail banding program in response to a request by the Service's Pacific Flyway representative. It was decided that 1990 would be an experimental year to evaluate traps and techniques. It was determined that molting flocks of failed and non-breeders were readily driven using a combination of float planes, boats, and people. Unfortunately, this method was not effective towards meeting a banding goal divided equally among sex and age classes. Waterfowl concentration areas were baited with cracked corn immediately pre- and post-fledging. Both bait traps and rocket nets proved efficient in capturing the desired ratio of age and sex groups. A total of 338 northern pintails were banded by the refuge staff in 1990. In addition, 129 non-target green-winged teal were captured and banded as well.



Gary Henry holding one of the pintails banded in August, illustrates the hazards of the profession.
(S. Kendall)

A summary of all waterfowl banded in 1990 on the Yukon Delta National Wildlife Refuge is included in Table 4.

Table 4

Total numbers, age and sex of all waterfowl banded on the Yukon Delta National Wildlife Refuge in 1990

	AHY-M*	AHY-F	HY-M	HY-F	Unk.	Total
Cackling Canada geese	179	189	113	92	2	575
Emperor geese	278	291	365	349	1	1,284
Greater white-fronted geese	1	9	0	0	0	10
Black brant	705	679	803	855	11	3,053
Tundra swan	2	3	0	0	0	5
Northern pintail	133	99	61	45	0	338
Green-winged teal	22	63	26	18	0	129

*AHY = after hatch year; HY = hatch year; M = male; F = female.

Six moose (4 bulls, 2 cows) on the lower Yukon River were darted from a helicopter in March 1990 and radio-collared. One of the animals (a cow) was originally captured in March 1989 and outfitted with a dual function radio-collar that can be monitored with conventional telemetry equipment or by satellite. The satellite transmitter malfunctioned soon after being deployed, however. Two additional moose, originally captured in March 1989 and outfitted with satellite collars, were recaptured in November 1990. Both of their collars were replaced with new satellite collars that should provide another 18 months of service. Funding to capture, mark, and monitor these animals came from the Challenge Grant Program with Marshall and Pilot Station Schools, Lower Yukon School District, and the Alaska Department of Fish and Game.

Fifteen moose (1 bull, 14 cows) and 7 caribou (2 bulls, 5 cows) were captured on the lower Kuskokwim River and Aniak River, respectively, in March 1990. The moose were darted from a

helicopter and outfitted with conventional radio-collars. The caribou were captured from a helicopter using a skid-mounted net gun. Five caribou were outfitted with dual function radio-collars capable of being monitored via conventional telemetry equipment or satellite. The remaining 2 caribou were marked with conventional radio collars. Funding to capture, mark, and monitor these animals came from the Challenge Grant Program with the Yupiit and Kuspuk School Districts, Alaska Department of Fish and Game, Bureau of Land Management, Association of Village Council Presidents, and Kuskokwim College.

Fifteen caribou in the Kilbuck Mountains were captured in November 1990 using a skid-mounted net gun on a helicopter. These animals were part of an on-going study to determine individual home ranges, movement patterns, range fidelity, and herd size of this small, but expanding population in western Alaska.

H. PUBLIC USE

1. General

More than 90% of refuge public use involves subsistence activities (hunting, fishing, trapping, and the collection of greens and berries). Other public use activities include sport hunting and fishing, river floating, and wildlife/wildlands observation.

The refuge is isolated from the common tourist travel routes in Alaska. Once people arrive in Bethel, they still must travel great distances to get to the mountains, coast, or river systems other than the Kuskokwim. Travel to the more scenic areas of the refuge is expensive and keeps the number of non-local visits small.



An old village site near the west end of Kgun Lake. The cross is the type used by the Russian Orthodox Faith. (S. Kendall)

The major public relations activity in 1990 continued to be the information and education effort associated with the four arctic nesting goose species. In December, special calendars, designed to increase awareness of the need to protect the geese, were distributed to virtually every household within refuge boundaries. The calendars utilized posters made by school children during a poster contest held in 1989.

Much effort was devoted this year to publicizing the Goose Management Plan. Meetings were held in nearly all Yukon-Kuskokwim Delta villages by members of the Information and Education Task Force or by Refuge Information Technicians. Nearly all refuge villages have signed resolutions in support of the Goose Management Plan.

2. Outdoor Classrooms - Students

We participated in career day activities at delta schools. These usually include junior and senior high students in two-day sessions. This year, we made presentations on U.S. Fish and Wildlife Service careers to the students of the lower Yukon and lower Kuskokwim school districts.

3. Outdoor Classrooms -Teachers

Our major environmental education curriculum, entitled "Teach About Geese," has been extensively taught in three school districts this year. Through the use of dedicated volunteer teachers and refuge personnel, it has been taught to teachers at workshops in this refuge and also several other Alaska refuges. The curriculum includes a wide variety of lesson plans covering kindergarten through 12th grade and is specially geared for teachers and students in western Alaska. It is an interdisciplinary curriculum supported with numerous teaching aids, video tapes, bird call tapes, posters, and game boards.

6. Interpretive Exhibits/Demonstrations

In last year's narrative we reported that a contract had been let to Good Displays, Inc. of Toledo, Ohio. After several years of anticipation, frustration, planning and collecting, the refuge visitor center became a reality. The Good Displays, Inc. staff arrived on schedule July 9th along with a 20' container van of display material. The crew went immediately to work layering, flooring, putting display cases together, installing and programming audio and fiberoptics equipment, painting, lettering and putting up outdoor signs and a mural. After the dust settled and the paint dried, the final product was accepted on July 18th. The new items, indoors and outdoors, do a fine job of depicting people and resources of the delta area.



Freeze-dried specimens are used extensively in the new visitor center display. (Rearden)



This display compares the old and the new. (Rearden)



A large relief map of the refuge is at the center of the displays. (Rearden)

The visitor center has become an attraction in Bethel. We have been surprised at our visitor guest book revealing visitors from all over the world. We have had limited school visits by local Bethel schools. Outdoor Recreation Planner Dapkus developed an intern information sheet for local teachers to help in guiding their classes through the display.



This mural is attached to the outside of the headquarters facing the highway - it depicts a delta fishcamp. (Rearden)

7. Other Interpretive Programs

In June, Outdoor Recreation Planner Dapkus worked with a professional film crew getting final shots needed for a video contract. Aurora Films of Juneau travelled to several field locations on the coast filming nesting and hatching geese. This summer's work finishes the work started in 1989 on the production. The project should be available for our use in 1991. It will be a welcome addition to our information videos.

8. Hunting

The refuge is open to sport and subsistence hunting, subject to state and federal regulations. However, only limited information is available on hunter effort and harvest. Residents of villages within and adjacent to the refuge rely on all manner of resident and migratory wildlife for food. Two hunting guides on Nunivak Island assist an average of six muskox hunters per year. Each year, a few unguided, non-local hunters travel to the refuge to hunt bear, moose, and other game.

We also aid Alaska Department of Fish and Game in logistics at a moose hunter check station at Paimiut Slough on the Yukon River. In 1990, there were 202 known hunters in the area, taking a total of 83 bull moose. Antler measurements were taken and teeth extracted as part of State Fish and Game effort to age the animals and, with other surveys, gain insight on the herd size and potential growth.

9. Fishing

Fish continue to be the most important commercial and subsistence resource on the refuge. The most important species are king, chum, and silver salmon, herring, Pacific cod, whitefish, blackfish, burbot, northern pike, and halibut. During the summer months, most major rivers are lined with fishcamps, where local residents prepare fish for the winter months. "Fishcamp" is important both nutritionally and culturally to Native Alaskans.

Only a small number of non-local residents travel to the refuge for sport fishing. Salmon, rainbow trout, dolly varden, arctic grayling, and northern pike are taken by sport fishermen. The primary rivers used for sportfishing are the Andreefsky, Aniak, Bek, Kisaralik, Kasigluk, and Kwethluk.

10. Trapping

Furbearer trapping continues to be a major source of income for many local residents. Trappers of beaver, lynx, otter, wolf, and wolverine have mandatory sealing requirements. Table 5 shows the

most recent sealing data, which are the only reliable trapping data available. The estimated harvests for other species not requiring sealing are also provided.

Table 5
Estimated Fur Harvest and Prices, 1990

Species	1989-1990 Take	Average Fur Price	Status 1989-1990 Season
Arctic Fox	~ 500	\$ 30	
Beaver	2,923	\$ 32	
Lynx	7	\$ 150	
Marten	100	\$ 70	
Mink	~5,677	\$ 45	(adult male)
Muskrat	~1,000	\$ 2	
Otter	456	\$ 45	
Red Fox	453	\$ 15	
Wolf	4	\$ 375	
Wolverine	4	\$ 375	

11. Wildlife Observation

Because of the large numbers of birds of all types which occur along the coastal portions of the refuge, some bird watchers travel to the area each year. Most bird-watching activities take place on Native corporation lands, where local communities can provide support services. However, one bird tour group travelled to Curlew Lake in the Andreafsky Wilderness during June to see bristle-thighed curlew. Among North American birders, the bristle-thighed curlew is one of the most sought-after species. The tour group rendezvoused with the refuge's curlew study crew, and then were escorted into the study area to look for curlews. All members of the group got excellent looks at a few of our banded birds.



A male American robin forages for
insects in a patch of labrador tea.
(C. Harwood)

12. Other Wildlife Oriented Recreation

Other recreational activities, such as backpacking, boating, camping, hiking, photography, and river floating occur in small numbers on the refuge. Powerboating and camping are generally associated with subsistence hunting and fishing. There may be an increasing amount of floatboating use occurring on the Kisaralik River. since the refuge is so remote and expensive to get to, this use is exceedingly small, even when compared to other Alaskan conservation system units (all agencies). Activities associated with this floatboating include camping, hiking, wildlife observation, photography, and sportfishing.

15. Off-Road Vehicling

Transportation on the Yukon-Kuskokwim Delta is limited to aircraft, boats, and off-road vehicles, except in the immediate vicinity of villages. Snowmachines are used heavily, both for recreational and subsistence uses. Most snowmachine use is not a problem, although some residents occasionally use these vehicles when there is insufficient or no snow cover. Three and four-wheeler use is common in and around villages, but is not permitted on refuge lands.



Fireweed starts to bloom when
the berries begin to ripen.
(C. McCaffery)

We are beginning to make local residents aware of refuge regulations regarding the use of off-road vehicles and snowmachines. There is a specific exhibit on the fragility of tundra in the new visitor center.

16. Other Non-Wildlife Oriented Recreation

Sled dog racing remains a popular winter activity. The most visible dog racing activity is the "Kuskokwim 300," a race which originates in Bethel, follows the Kuskokwim River to Aniak, and goes overland to Whitefish Lake and Tuluksak before rejoining the Kuskokwim on the way back to Bethel. Most of this race occurs on Native corporations lands, although some of it occurs, and is permitted, on refuge lands.

17. Law Enforcement

Deputy Refuge Manager Strom and Assistant Manager/Pilot Rearden attended the annual 40 hour refresher course in Marana, Arizona. The training course was good and the time away from the Alaskan winter was enjoyable.

Law enforcement activities in the spring were directed at field work associated with the policy regarding harvest of migratory birds in Alaska during the closed season. Several flights were made in May as waterfowl arrived on the delta.

Three special agents from Anchorage spent a week on coastal flights in an unsuccessful effort to locate individuals egging geese. Some hunting activities were noted, but the agents were unable to determine if the activities were related to waterfowl.

The first week in September, Assistant Refuge Manager/Pilot Rearden and Deputy Refuge Manager Strom flew the Johnson River to look for moose hunting activities. No new evidence of four-wheeler traffic was noted in area's we have had problems the past few years.

Like the lower 48, locals have discovered it is easier to ride than walk. The damage four-wheelers do to the wet tundra will be visible for many years in some areas.

18. Cooperating Associations



Christine McCaffery manning the Alaska Natural History Association Sales outlet -- the fastest growing in the state. (Rearden)

The Yukon Delta National Wildlife Refuge operates a small sales outlet for the Alaska Natural History Association. When the museum/visitor center is complete, we expect sales to increase especially during the summer months. The sales outlet has already been appreciated by local residents and should be a benefit to all visitors who desire additional information/mementos of the delta and Alaska. We have several books specifically about the delta and its people, posters of delta birds and mammals, and have plans to offer new items about delta wildlife in 1991.

I. EQUIPMENT AND FACILITIES

1. New Construction

Two 8'x8' storage buildings were built this year as specified by Engineering in the Regional Office. One was built to house the VHF and the HF radio systems and was placed near the base of both antennas. The other was built to house the furnace that heats the water that circulates through the trailer residences to keep the pipes from freezing. Both storage buildings were wired with

a heat lamp and thermostat to maintain a 40 degree temperature.

The maintenance staff built eaves over the walkway on the south side of the headquarters building. In the past there have been some close calls when snow fell off of the roof and crashed onto the walkway below. The eaves contribute significantly to the safety of pedestrians on the outside walkways.

2. Rehabilitation

The water and electrical system at Kanagyak was rehabilitated after many years of disuse. A gasoline powered pump was purchased to move water to a series of 55 gallon drums connected with a manifold which was in turn connected to a pump with a pressure switch which is connected to a hot water heater which is connected to a shower. Hot showers in the field camp do a lot for morale.

The Lister diesel generator was moved from Old Chevak and connected into the existing electrical system at Kanagyak. The reduced fuel usage, steadier electrical output and less noise is preferred to the small gasoline powered generator used previously.

Windows were replaced in all of the trailer residences. The new Alaska windows seal much tighter and are triple paned. The old Coleman furnace in each trailer was replaced with a brand new unit. New back porches were built onto two of the trailers. All of this work was done to bring the residences up to standards of livability so that employees can remain in them until the 6-plex that is planned is completed.

3. Major Maintenance

All snowmachine suspensions at Mekoryuk were completely overhauled. Some snowmachines are obviously designed for weekend outings on groomed trails--and the Nunivak snowpack is anything but that.

4. Equipment Utilization and Replacement

A surplus full sized Ford was transferred from Marine Mammals in the Regional Office to replace the Chevrolet S-10 which was destroyed in an accident. After major work on the suspension and some engine and body work it was turned into a serviceable shop truck.

5. Communications Systems

This was the first year of the upgrade from the existing HF system to a VHF system. A base radio was set up in Bethel, Chevak and St. Mary's and connected to a phone patch. All field

camps were issued either handheld radios or field radio systems with a 30' antenna. There were some kinks in the system but all-in-all it showed a lot of promise, especially with aircraft communications. The line-of-site restriction caused some problems with remote camps and in the vicinity of mountains, so it appears that we'll need to maintain the HF system until we get a repeater system installed.

One of the greatest problems with radio systems in rural Alaska is finding qualified technicians to work on them. We're extremely lucky to have such an individual in Bethel--he has had to rig antennas, repair components and program radios for us on a regular basis.

7. Energy Conservation

All fluorescent light tubes on the second floor of the headquarters building were replaced with improved lower wattage tubes that provide the same amount of light. This action should, if the tubes work as advertised, save the refuge over \$5,000/annum, once all tubes in the building are replaced. The initial expenditure was under \$600 for the purchase of the tubes.

8. Other

The battle to maintain the 15'x 30' weatherport at Chevak continue. It is a covered wagon shaped structure, covered with reinforced vinyl in which all of the summer field camp equipment is stored--over \$100,000 worth. The wind and snow ravage it fiercely and the maintenance staff at Chevak spends considerable time protecting the integrity of the structure from vandalism and the elements. The proposed construction of a shop/bunkhouse facility there will come none too soon.

J. OTHER ITEMS

1. Cooperative Programs

Cooperative agreements were initiated with the Soil Conservation Service and the University of Alaska, Anchorage to jointly study range relationships on Nunivak Island. Approximately 15% (157,000 acres) of Nunivak Island is considered lichen range. Excessive ungulate numbers (reindeer and muskox) have caused overgrazing and severe degradation of these sites. Most lichen-producing ranges on Nunivak Island exhibit years of grazing damage and it was estimated in 1985 that 75% of the winter lichen range is in poor condition. A qualitative assessment of lichen-producing areas in 1989 indicated further degradation of these sites over 1985. The purpose of this project is to work jointly with the cooperating agencies to establish a series of permanent range plots and gather baseline information on plant species diversity and density for the long-term monitoring of range

condition and trend on Nunivak Island.

A cooperative agreement between the Service and the Sea Lion and Paimiut Native Corporations was established for 1990. The purpose of the agreement was to allow the refuge to continue to maintain a field camp and conduct waterfowl investigations on Native-owned land in the Kokechik Bay area and to provide employment and training to local youth in biology. Accordingly, the Service hired a Native youth from Hooper Bay for the summer. In addition, the Service, in cooperation with the Kuskokwim College conducted a two-week biology field camp for 2 high school students from Hooper Bay. The Service provided all logistical support and living accommodations, while the college provided an instructor.

4. Credits

Chuck Hunt: C.1-3, E.18
Ron Perry: D.1-3, K.
Biology Crew (John Morgart, Mike Wege, Brian McCaffery, Rick Ernst) D.7, F.1-7, G.1-17, J.1.
Dennis Strom: F.9,12, H.1-19
Mildred Prince: E.1 and compilation
Martha Perry: Typing
Xenia Black: construction
Mike Rearden: E.2,4,7,8,I.1-7, J.2,3, coordinating and editing
Cynthia Wentworth: D.5.b.

K. FEEDBACK

No comments in 1990.



Sunset over the Yukon Delta.
(C. McCaffery)