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YUKON DELTA NATIONAL WILDLIFE REFUGE

BETHEL, ALASKA

ANNUAL NARRATIVE REPORT

CALENDAR YEAR 1999

U.S. DEPARTMENT OF THE INTERIOR

FISH AND WILDLIFE SERVICE

NATIONAL WILDLIFE REFUGE SYSTEM

Reviews and Approvals

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MRS. Pearl
Refuge Manager

12/01/00
Date

Refuge Supervisor, South Review Date

Regional Chief, NWRS Date

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INTRODUCTION

The Yukon Delta National Wildlife Refuge (NWR), second largest of Alaska's 16 refuges, encompasses 21,877,769 million acres of land and water on the Yukon-Kuskokwim Delta (Y-K Delta) in southwestern Alaska and stretches from Nunivak Island in the Bering Sea to the village of Aniak, nearly 300 miles to the east. 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 delta, a generally flat marshland containing innumerable lakes and ponds, is the dominant landscape of the refuge. 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 feet.

The Y-K Delta supports one of the largest aggregations of water birds in the world. Over one million ducks and half a million geese breed here annually, and in some summers, up to a third of the continent's northern pintails can be found on the refuge. In addition, nearly 40,000 loons, 40,000 grebes, 100,000 swans and 30,000 cranes return to the refuge each spring to nest. In addition, millions of shorebirds use the refuge for both breeding and staging. In terms of both density and species diversity, the Delta is the most important shorebird nesting area in the country, and the vast intertidal zone is the most important wetland for post-breeding shorebirds on the west coast of North America. The Delta meets all of the criteria for identifying wetlands of international importance under Article 2 of the Ramsar Convention.

The abundance of water in the form of 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. Nesting and brood rearing habitats for waterfowl, shorebirds, or seabirds give it national significance.

Refuge lands 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 refuge. 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 enactment of the Alaska Lands Act, these existing ranges and refuges were combined and enlarged to establish the Yukon Delta NWR. Two areas within the new refuge were designated as wilderness by the Alaska Lands Act: the Andreafsky Wilderness Area (1,300,000 acres) and the Nunivak Wilderness Area (600,000 acres).

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K. FEEDBACK

A. HIGHLIGHTS

Western sandpiper study documents sexual variation in return rates with 71% of males and 29% of females banded in 1998 returning to the study area. D.5

Bristle-thighed curlew survey in the Andreafsky Wilderness area suggests a 25% decline in the population since 1991. The refuge supports about 60% of the global population of this species. D.5

The Mulchatna caribou herd once again migrates onto the refuge. The highest number of caribou documented on the refuge occurred in February when 25,000 animals were counted in the Kilbuck Mountains. D.5

BRD and the University of Alaska continue to conduct long term waterfowl research in several camps on the refuge. D.5

A black brant study is initiated by the refuge to study distribution, abundance, and productivity of satellite brant colonies within the Clarence Rhode Natural National Landmark. The study was partly funded by the National Park Service. D.5

The Outdoor Recreation Planner, Supervisory Wildlife Biologist, and two Assistant Manager positions all vacated during the year. Most positions were refilled by the end of the year. E.1

Harlequin surveys along the rivers flowing from the Kilbuck Mountains indicate an increase of nearly 8% per year since 1994. G.3

Documentation of nesting Caspian terns on Neragon Island represents first confirmed nesting record for the species in Alaska. G.5

Moose survey in the Andreafsky census area indicates a ten-fold increase in moose since 1995. Contributing factors include the refraining from illegal harvests, especially cows, by local residents. G.8

Chum salmon passage on the Andreafsky River weir was the lowest since 1994 at 32,229 fish. G.11

Commercial chum and coho salmon catches on the Kuskokwim river were only seven and five percent respectively of their recent 10 year average. The average value per permit holder was only \$333.53. H.9

C. LAND ACQUISITION

3. Other Items

Three land exchanges continued to progress during the year, albeit slowly. The Division of Realty spent considerable time on background work to implement a bill passed in 1998 that called for transfer of Calista and village corporation holdings to the refuge in exchange for excess Federal property throughout the U.S. To the refuge, the exchange will add 29,579 acres of surface and subsurface estate, 161,998 acres of subsurface estate under village corporation lands, and a 16,998 acre conservation easement along with the subsurface estate on land owned by The Kuskokwim Corporation. Calista will receive credit for \$39.4 million dollars of Federal surplus properties for this exchange. Background documents related to the legislation are expected to be completed in 2000 so that the lands can be transferred.

The community of Newtok approached the refuge in November, 1996, with a proposal to relocate their village to refuge land because of erosion along the banks of the Ninglick River. Although this exchange is not dead, it is certainly in need of life support. The village corporation has been very slow in responding to our proposals or comments on their requests. Main points of contention include the villages desire to keep the exchange small - their original request was for an exchange in the 19,000 acre scale but they have since sought to reduce that - and their insistence on retaining exclusive subsistence rights on the lands they would transfer to the refuge. Meetings were held during the year to discuss the exchange but with little progress.

The NIMA Village Corporation from Mekoryuk on Nunivak Island is entitled to approximately 45,000 acres of land outside of the old Clarence Rhode Refuge boundaries. They have obtained title to, or selected, these parcels near Dall Lake in the southwest portion of the refuge. An exchange with NIMA has been discussed for years whereby the refuge could receive the Dall Lake holdings and NIMA could obtain additional surface, along with some subsurface on Nunivak Island.

Some of the NIMA holdings near Dall Lake are included in the Calista bill described above. Once that action is completed, we will know exactly what holdings NIMA still owns near Dall Lake and we will be able to move forward. A major impetus behind this exchange is the fact that NIMA owns no subsurface estate. Every yard of sand or rock for community projects must be purchased from the refuge. With a port project near the village in the planning stages, it is critical that they obtain access to subsurface estate for both the construction and future sales of material.

D. PLANNING

3. Public Participation

Y-K Delta Goose Management Plan (GMP) Meetings

Only one Waterfowl Conservation Committee (WCC) meeting was held during the year. The spring meeting was held in Bethel on January 21 & 22. No significant issues were addressed and only minor wording changes were proposed for the goose management plan. The fall meeting which is normally held in November or December was delayed until 2000.

Western Alaska Brown Bear Management Working Group (WABBMWG)

This working group met in Bethel on November 2nd and 3rd. Project activities for 1998 and 1999 were reviewed and cub production and survival data collected to date were presented. The data collected thus far continued to indicate that cub productivity and survival is among the lowest recorded in the state, indicating that the population has a very low threshold for sustaining harvest. The 1997 recollaring effort, and the participation by four Native leaders, was reviewed. The working group then agreed with ADF&G and FWS that the existing radio collars need to be replaced next spring, and that the total number of radio collared bears needs to be brought back up to 30 to conclude the cub production and survival aspects of the study. The group continued discussions on how individual villages could collect harvest information and forward it to ADF&G and FWS.

Kilbuck (Qavilnguut) Caribou Working Group

This working group met in Bethel on November 3rd. Status of the Kilbuck caribou herd and Mulchatna caribou herd were reviewed. The November 1998 capture also was reviewed. The working group was informed by ADF&G and FWS that since 1992 they have complied with the wishes of local residents to not use chemical immobilization techniques to capture caribou for deployment of radio collars. However, with no radio collars functioning on year-round resident caribou, it has become critical to perform a capture on the calving grounds, which will require the use of chemical immobilization techniques. While many members of the working group expressed the desire to continue to capture caribou without chemical immobilization, they supported its use as it was the best option available. The fact that a portion of the Mulchatna caribou herd now spends a significant amount of the year in the area and provides for a substantial harvest, has led to a reduced need for this working group to meet.

4. Compliance with Environmental and Cultural Resource Mandates

Lisa Frink, University of Wisconsin, Madison, continued preliminary work at the Nunaraluk site located off the Kashunak River approximately 15 miles south-southwest of

Chevak. Her field work took place from August 7th through the 11th. The entire site includes 353 acres of cultural features and activity areas. A large mound site has intact house pit remains and the remains of the first church established in the village. There is one sod house which has been maintained and is still used for a seal hunting shelter in the spring by a local family. Exterior to the main mound are several smaller mounds which contain many pits of varying sizes. Until Ms. Frink's 1999 work at the site, there had been no subsurface testing or attempts to date the site. Previous to her work, a grave-tempered pottery sherd indicated that the site was in use by AD1600.

Ms. Frink's excavations and mapping focused on the profile excavation of the main mound of Nunarluk and the remains of possible storage pits located around the main mound. A number of items were collected including pieces of wood, pottery fragments, bird bones, and other artifacts. A major focus of the project is community involvement and as in previous years, at the end of the crew's stay in Chevak, the materials collected at the site were displayed for the village at the Chevak Traditional Council Building. All materials analyzed at the University of Wisconsin will be returned and housed in the village. Ms. Frink's research goal is to investigate how early contact with Europeans and Americans may have affected social relations among the Cup'ik inhabitants of the region. The project is part of her doctoral dissertation research.

5. Research and Investigations

Refuge Shorebird Studies

In 1998, Yukon Delta National Wildlife Refuge initiated a long-term study of western sandpipers at Kanagayak, a permanent field station on the central Yukon-Kuskokwim Delta (YKD). In 1999, the camp was staffed by WB McCaffery and Volunteer Dan Ruthrauff. As in 1998, the majority of work involved finding nests, capturing and color-marking adults, and determining the fate of nesting efforts. Among the most intriguing findings was unexpected sexual variation in return rates among those birds originally marked in 1998. Of 31 males banded at Kanagayak in 1998, 22 (71%) returned in 1999, but only 6 of 21 (29%) females returned. Previous studies of this and related species have found that male and female return rates usually differ, but only by a few percent. The dramatic difference found this year at Kanagayak is troubling because the species exhibits at least partial latitudinal segregation on the wintering grounds (females winter further south). As a result, geographically limited mortality factors on the wintering grounds could impact one sex but not the other. We will return to Kanagayak in 2000 to collect an additional year of data in order to generate formal estimates of male and female survival.

The field work at Kanagayak was also noteworthy in that we had our first foreign recapture. A western sandpiper originally captured and banded at Aransas NWR in Texas on April 10, 1999 was recaptured on her nest at Kanagayak on June 21, 1999. This female was in the minority at Kanagayak in 1999 in that her nest hatched. Overall Mayfield nest success (≥ 1 egg hatched) in 1999 was 24%, down from 56% in 1998. Large numbers of

mink and non-breeding long-tailed jaegers on the plot probably contributed to the lower nesting success. We documented brood success (≥ 1 chick fledged) for the first time and it was markedly higher than nest success (observed success of 75% vs. 29%). Two other aspects of our field work were noteworthy. We determined that seven of 52 nests were re-nesting efforts, initiated (on average) 5.8 days after the loss of the preceding nest. Only one of seven re-nests survived to hatching. One female produced three clutches (of 4, 4, and 3 eggs, respectively), but lost all three to predators. We also documented a significant difference in clutch size between ASY (after second-year) and SY (second-year) females. Among ASY females ($n = 41$), 93% produced four-egg clutches, while among SY females ($n = 4$), only one (25%) produced a four-egg clutch; the remaining clutches all had only three eggs.

In 1999, we initiated a study of spring shorebird use of the inland meadows around Kanagayak. During the last two weeks of May, shorebird numbers were higher in lowland than upland meadows. The average density of shorebirds in a lowland meadow during this period was 1,825 birds/km². In this meadow, Pectoral Sandpipers, Dunlins, Long-billed Dowitchers, and Red-necked Phalaropes each averaged over 200 birds/km². Dunlins and Western Sandpipers were the most abundant breeding species in lowland and upland meadows, respectively. We identified six patterns of spring shorebird use of these inland meadows based on : 1) the relative importance of lowland and upland meadows for foraging and nesting, and 2) the proportion of birds using the meadows that remain to breed locally. Our findings suggest that, at least in some years, inland meadows on the central Yukon-Kuskokwim Delta may support at least tens of thousands of pre-breeding shorebirds. The generality of our findings will only be determined by more extensive spatial and temporal sampling.

We also conducted a pilot study of breeding Dunlins in the lowland meadows between the Kanagayak field station and the Aphrewn River. The primary objective was to determine if Dunlins nested at high enough densities to justify a long-term demographic study such as that being conducted on Western Sandpipers. We found 41 nests, and estimated nesting densities in the study meadows to be 1.06 nests/km². This figure approaches the highest densities previously recorded on the Yukon-Kuskokwim Delta, and exceeds those found elsewhere in Alaska. Mayfield nest success was 30%, very similar to that for Western Sandpipers in the upland meadows a few km to the east. If and when funding permits, we look forward to more detailed investigations of this species, which is the second-most abundant sandpiper in the Pacific Flyway.

The bristle-thighed curlew is a rare species of Beringian sandpiper which nests in only two small areas in western Alaska. One of those areas is on YDNWR in and around the Andreafsky Wilderness, which supports about 60% of the global population. The only population estimate for the species was derived from survey data collected in 1989 and 1991. The global breeding population was estimated to be about 3,200 breeding pairs, with about 1,800 of those on YDNWR. In 1999, the refuge coordinated a survey, which replicated work conducted in 1989 and 1991, in order to generate an updated population

estimate. With contributions of money and personnel from BRD, WAES, and MBM-Anchorage, BT Harwood led the survey effort during the last week of May. Survey crews detected 25% fewer curlews than in 1991, which suggests a population decline of >3%/year. In 2000, Harwood will assist personnel from the BRD-Alaska Biological Science Center (ABSC) in an effort to estimate breeding curlew numbers on the Seward Peninsula, the only other confirmed breeding area for the species. At the completion of that survey, we and our cooperators will generate a global population estimate, as well as suggestions as to how to proceed in conserving this rare Alaskan breeding endemic.

In early September, WB McCaffery and BRD-ABSC shorebird project leader Bob Gill studied staging Bar-tailed godwits along the southwest coast of the refuge near Tern Mountain. Previous work along this portion of the coastline has indicated that the outer coast of the refuge supports up to 60,000 bar-tailed godwits during the peak of staging in early September, just prior to their transoceanic flight to the southwest Pacific. Our primary objective was to look for birds that had been banded elsewhere in the East Asian-Australasian (EAA) Flyway in order to better describe wintering areas for those godwits which stage on the Y-K Delta. During our week of field work, we regularly worked a 10-km stretch of shoreline that supported 7,000-9,000 staging godwits. We made 89 observations of banded godwits, 69 of which were color-marked. Based on a combination of color-coding, position of the bands on the legs, location and timing of resighting, sex, and distinctive plumage characteristics, we were able to identify at least 34 distinct individuals. Among these, 10 had white bands or flags, 10 had green, and 14 had orange. These color codes indicate original capture and banding locations in New Zealand, northeast Australia, and southeast Australia, respectively. Significantly, we detected no birds banded in northwest Australia (yellow flags). Our findings were consistent with, and lent considerable support to, recent hypotheses explaining the biogeography of Bar-tailed Godwit populations within the EAA flyway.

We were surprised to find that, among several thousand godwits checked for age, fewer than 3% were juveniles. Such low numbers of juveniles could have been the result of a wide-spread reproductive failure across much of the breeding range in Alaska. Alternatively, the low proportion of juveniles could have been the result of age class segregation in time and/or space along the YKD coast. In 2,000, we hope to visit at least two widely-separated sites on the outer Delta to evaluate these hypotheses.



WB Brian McCaffery surveys bar-tailed godwits along the coast near the village of Chefornak. (BG 9/99)



Up to 60,000 bar-tailed godwits use refuge habitat during the peak of staging in early September, just prior to their transoceanic flight to the southwest Pacific. (BG 9/99)

Kilbuck Mountains Caribou Study

Surveys of the Kilbuck Caribou Herd (KCH) have been conducted annually since 1986 following an approved study plan. The Kilbuck (Qavilnguut) Herd Cooperative Management Plan (1994) calls for radio telemetry applications to document movement, estimate population size, composition, and calving ratio. These data are used to develop harvest parameters.

Between 1986 and 1998, 91 caribou (10 males and 81 females) were radio-collared; 24 radio-collars continued to function as of late October 1999. Aerial telemetry surveys (18 by refuge staff and an additional 13 by Togiak NWR, ADF&G - Bethel, or ADF&G - Dillingham staff) conducted in 1999 documented 214 radio relocations for radio-collared caribou both on and off the refuge.

The highest number of caribou documented on the refuge occurred in February when 25,000 caribou were counted in the Kilbuck Mountains. Caribou began migrating off the refuge to their calving grounds in April 1999, when 19,000 caribou were still on the refuge. By May 3, 700 caribou were found on the refuge in "traditional" KCH calving grounds. Poor weather prevented flights to determine calving areas and success.

While 6,000 caribou were observed on the refuge in early September, large numbers of caribou were not observed on the refuge until mid-September. At this time sufficient caribou were present for RM Rearden to open the Federal subsistence caribou season on the refuge. This opening was again coordinated with the Togiak NWR as portions of Game Management Unit 18 includes that refuge.

The refuge assisted ADF&G with a fall composition count. Due to seasonal mixing between the KCH and MCH since fall 1994, it is assumed that if a sufficient sample size of classified caribou are obtained then the data would be representative for both herds. The bull:cow:calf ratio for the 1,865 caribou classified on this and the Togiak NWR was 52.3:100:16.9, respectively. The results for the proportion of calves is much lower than in previous years. What the reduced calf count indicates is unknown at this time (i.e., one time event or precursor to population crash).

Kuskokwim Mountains Brown Bear Study

There were 25 bears with functioning radio-collars in January 1999, only 19 were alive by the end of 1999. During 1999, only 19 brown bear telemetry flights (13 by the Yukon Delta Refuge and six by Togiak NWR or ADF&G Dillingham) resulted in 256 relocations of radio-collared bears and 102 locations of non-radio-collared bears. Weather and aircraft availability prevented adequate flights during the spring and fall to properly document emergence from, and entrance into dens, respectively.

Six natural mortalities occurred during 1999. Cause of death could not be determined for any of the mortalities. Speculated mortality sources include: old age; caught in spring avalanche; and injuries resulting from fights with other bears.

Plans for 2000 include replacing existing radio collars (as they will be at their projected life span) and increasing the number of radio-collared bears to 30. New radio collars will have a 48 month expected life span. Increasing the sample back to 30 radio-collared females will enable us to complete data collections on productivity and cub survival to weaning as well as seasonal use areas.

Arctic Nesting Goose Studies

Current population estimates for the four goose species of special concern continue to show mixed results. Cacklers (214,700) and whitefronts (413,000, 1998 survey) continue to increase while brant (129,300, 1999 survey) and emperors (54,600) remain stable.

Breeding ground aerial surveys, however, indicated increased population trends for cacklers, emperors, and whitefronts. Pair indices increased between 5-19% and total bird indices increased between 10-19% and remained unchanged for emperors. See below for the 1999 estimate.

In general, 1999 break-up timing was "late", but migration arrival and nesting chronologies were considered "average." Float angles of eggs indicated the latest average predicted hatch dates (June 26 for brant and June 27 for cacklers, emperors, and whitefronts) since 1992. Fox and avian depredation was average and generally good weather occurred during hatch.

The annual assessment of nesting goose populations in the coastal tundra region was done by estimating the number of total nests, active nests, and eggs from single searches of randomly located 0.475 x 0.950 km rectangular plots. The ground-based sampling of the coastal region of the Y-K Delta was based on a new single stratum design intended to improve efficiency and precision of estimates. A total of 59 plots were searched by crews from field camps located at Old Chevak, Tutakoke River, Hock Slough, Big Slough, Aknerkochik River, and Kigigak Island, as well as five mobile crews based at Kanagayak field station. The survey estimated that 88,600 cackler, 26,300 emperor, and 70,700 whitefront nests were initiated on the 4,000 square kilometers of coastal habitat that contains about 90% of all geese on the Delta. While these were all decreases from 1998, only the decrease for whitefronts was statistically significant.

Clutch sizes decreased for all four species from 1998: brant: 3.2 eggs (n = 126), cacklers: 4.1 eggs (n = 931), emperors: 4.5 eggs (n = 224), and whitefronts: 4.2 eggs (n = 246). Nest success was good for all species -- brant (79%), cacklers (87%), emperors (92%), and whitefronts (95%).

Migratory Bird Management continued an aerial survey to document emperor goose production. Data from an aerial transect survey, aerial photography, and estimates of detection rates estimated about 17,000 goslings during late brood rearing. This is similar to the 1998 estimate of 15,000 goslings and more than double the 1997 estimate of 7,000 goslings which was a year with poor egg production due to flooding. Comparison of the estimated number of eggs laid with the number of young in the October population indicates high mortality (average from 1986-1999 was about 89%) between mid- to late incubation and fall staging. An estimate of the number of young geese surviving to late in brood rearing is needed to determine how mortality is partitioned among various periods of the life cycle. The apparent survival rate from eggs in mid-/late incubation to goslings late in brood rearing was 9% in 1994, 7% in 1997, 13% in 1998, and 16 % in 1999. In 1998 and 1999, an estimated 47% and 32%, respectively of goslings apparently perished between brood-rearing and arrival on fall staging areas.

The U.S. Geological Survey's Biological Resources Division (BRD) in Alaska conducted several projects on the refuge.

The first BRD project was aerial videography of brant colonies. Total nests estimated from five colonies (14,359) at Kokechik Bay, Tutakoke River, Kigigak Island, Baird Peninsula, and Baird Inlet Island were 70% of the long-term mean (20,418 nests). Later than average break-up and nesting chronologies along with increased predation by arctic foxes and human activity at some colonies decreased nest densities.

The second BRD project was the fifteenth year of a cackler, emperor, and whitefront nesting ecology study near the Kashunuk River. Nesting plots in this area were first established in 1974. The continuing work provides the best long-term nesting ecology information for these three species. Break-up and nest initiation chronology for the study area was the latest in five years, although only slightly later than long term averages. Nest densities of all three species were 20-50% lower than 1998, but still higher than long-term averages. Clutch size of cacklers was similar to long-term average, whereas both emperors and whitefronts laid significantly fewer eggs than in other years. Nest success for cacklers was approximately equal to long-term averages while those for emperors were 10% lower and whitefronts equal to or higher than other years of the study. Plans for 2000 are under review.

The third BRD project was the ninth year of a study of duck research on the lower Kashunuk River. This was the third year of observing female spectacled eiders during incubation breaks. Behavior and habitat use during a break were recorded by observers in towers. Nest temperature was recorded with the use of dummy eggs as an indication of break duration. Females were trapped at mid incubation and again at hatch to also determine change in body condition during nesting. Forage availability was assessed through invertebrate sampling; conducted at randomly selected ponds, in addition to ponds frequently used by observed females on an incubation break. Invertebrates were collected in the benthos and water column using standard methods. Analyses are ongoing. Results from 1999 are unavailable at this time.



Dave Safine and John Reed with BRD collected information on spectacled eider ducklings from their Hock Slough camp on the lower Kashunuk River. (JM 7/99)



Spectacled eider hens were fitted with transmitters near Hock Slough to record brood rearing success. This BRD project continued in its ninth year of field study. (JM 7/99)

The second year of sampling was conducted in new lead settlement exclosures. This study follows a similar design as the previous experiment, but instead uses five 10 m X 1 m seeded exclosures, divided into one square meter plots. A one square meter plot from each exclosure will be sampled per year using an ice coring device or a modified sediment corer. The new exclosure sites were randomly selected within the previous habitats. All shot in the new exclosures was recovered in the top three centimeters after one year of settlement. Results from 1999 are unavailable at this time.

The fourth BRD project was the sixth year of an emperor goose nesting ecology study at Manokinak River. Work in 1999 was reduced due to budget restraints and consisted of initiating an assessment of: (1) spring migration and prenesting distribution and (2) chronology of movement between the Delta and the Alaska Peninsula and the Aleutian Islands using radio telemetry. A total of 15 and 40 females received satellite and conventional radio transmitters, respectively, to also document the interval between arrival on the Delta and nest initiation and provide information on exposure to subsistence harvest in spring. As of mid-December, 14 of 15 satellite radios were still functional and four birds had moved from the Alaska Peninsula to the Aleutian Islands. Only one of 40 females wearing conventional radios died before leaving the Delta. Sixteen birds were located on the Alaska Peninsula despite limited radio tracking flights. It is hoped much additional information will be gathered during spring migration from the Alaska Peninsula.

Since 1984, the University of Alaska, Fairbanks, supported a study of brant ecology at Tutakoke River. The demographic aspect of the work included leg banding for the first time, observing previously banded birds, recapturing previously banded birds, and web tagging goslings. Analyses of results indicate: (1) handling during banding has no negative effect on first year survival; (2) by age 5 years virtually all females breed every year; (3) as colony size has increased, gosling size and clutch size of females <5 years old have decreased significantly but no trend was detected in clutch size of older females or for the colony as a whole; (4) first year survival has declined from about 70% for the 1986 cohort to about 45% for cohorts in the early 1990's; (5) the largest goslings at capture survive at essentially adult rates (ca 80%) and the lower average first year survival is the result of poor survival by small goslings and explains the decline in first year survival of more recent cohorts. Study of controls over plant communities involved: (1) manipulation of frequency of tidal flooding, (2) manipulation of grazing intensity on *Carex subspathacea*, and (3) use of greenhouses and clipping and fertilization to examine effects of warmer temperatures on production and species composition of coastal communities. Preliminary analysis indicates little effect of weekly flooding. Trampling by biologists associated with performing the experiment converted *C. ramenskii* into *C. subspathacea*, and indicated that trampling by geese plays an important role in maintaining their preferred grazing areas. Vegetation reaches nearly one meter in height inside greenhouses and litter from the additional production of vegetation in salt marsh areas trapped several centimeters of silt during fall floods providing some insight into beach ridge development. New initiatives in 1999 included using radio telemetry to document timing and chronology of migration to fall stopover areas and Mexican wintering grounds and documentation of individual breeding success in relation to known wintering areas. First year results indicated no statistically significant difference in clutch size and nest success among individuals from distinct wintering areas. Mass of nesting females also showed no statistically significant difference among individuals wintering in different areas.

Brant Satellite Colony Survey

In conjunction with development of a brant population model by Dr. J. Sedinger of the University of Alaska, Fairbanks, the refuge initiated a study of distribution, abundance, and productivity of satellite colonies located within Clarence Rhode Natural National Landmark. This study area was chosen in part because a portion of the study was funded by the National Park Service. Objectives included: (1) document chronology of migration arrival and nest initiation, (2) document distribution, abundance, and productivity of colonies, (3) document presence of color-marked birds, and (4) leg band birds in molting flocks with metal and colored, individually coded plastic bands. Two, two-person camps were established near the mouths of Big Slough and the Aknerkochik River. Personnel arrived at camp on April 30. Brant were first observed on May 12 and 9 at Aknerkochik River and Big Slough camps, respectively. Peak arrival occurred between May 16-17 and 19-21 at Aknerkochik River and Big Slough, respectively. Peak nest initiation was May 26-28 and May 27-29 at Aknerkochik River and Big Slough, respectively. A total of 649 and 351 nests with clutch sizes of 3.4 and 3.8 eggs were located at Big Slough and Aknerkochik River, respectively. Peak hatch occurred between June 23-29 and 22-26 at Aknerkochik River and Big Slough, respectively. Forty-six percent of nests were successful at Big Slough compared to 80% at Aknerkochik River. A total of 393 and 529

goslings were web-tagged and 464 and 494 birds were trapped and color-marked at Aknerkochik River and Big Slough area, respectively. It is anticipated that the study will continue at both camps in 2000.



With partial funding from the National Park Service National Natural Landmark program, the refuge initiated a study of satellite brant colonies in the Aknerkochik River and Big Slough areas near Hazen Bay. (SJK 6/96)

Spectacled and Common Eider Nesting on Kigigak Island

In response to listing spectacled eiders as a threatened species, field work on Kigigak Island was conducted for the ninth year. A field camp staffed by two refuge personnel was maintained from April 27 - July 16 with the following objectives:

1. Monitoring spectacled and common eider nesting chronology and productivity.
2. Capturing and marking nesting female spectacled eiders to estimate annual survival.
3. Capturing and placing radio transmitters on long-tailed ducks to document molting areas.
4. Eliminating arctic fox from the island.
5. Assisting with coastal goose/eider production survey.

Spectacled and common eiders were first observed on Kigigak Island on May 14 and 15, respectively. Peak nest initiation occurred between June 1-5 and May 29-31 and peak hatch occurred between July 1-5 and 1-3 for spectacled and common eiders, respectively.

A total of 284 eider nests were found, including 134 spectacled and 150 common. Productivity data are presented in Table D.1. The two arctic fox observed on the island were not eliminated and their subsequent depredation reduced nest success to the study's third lowest level. No active dens were located.

Table D1. Common and Spectacled Eider Productivity, Yukon Delta NWR, 1999.

Category	Spectacled Eider	Common Eider
Nesting Success (Mayfield)	66.8% (n = 127)	55.2% (n = 144)
Mean Complete Clutch Size	4.8 eggs (n = 121)	5.0 eggs (n = 134)
Egg Hatching Success (successful nests)	82.6% (n = 98)	84.6% (n = 99)

Sixty-two female spectacled eiders were nest-trapped between June 18 and July 11. All females not previously banded were fitted with a colored, uniquely numbered, plastic tarsal band and Service leg band (steel). Spectacled eiders also received a uniquely numbered nasal disk. Blood was taken for lead and DNA analyses. Twenty-three of these females were new captures and 39 were recaptures, originally banded on Kigigak Island. Four of the 39 were returning nesting females banded as ducklings on Kigigak Island, including one from 1992 and three from 1995.

Thirty days post-hatch, 37 spectacled eider broods, including 27 adult females, 52 local females, and 50 local males were captured. Three of the 27 adult females were new captures and 13 of the marked adult females were trapped on nests this year. Thirty-three broods included marked adult females and 25 broods were from nests monitored this year. A total of 265 adult females and 154 local spectacled eiders have been banded on Kigigak Island since 1992.

A total of 76 of 86 marked adult female spectacled eiders found on nests were identified. An additional 10 marked adult females were identified with broods.



Sixty two female spectacled eiders were nest trapped on Kigigak Island in June and July. Twenty three of these were new captures that were fitted with nasal disks. (TM 6/99)



Veterinarian Dan Mulcahy and BT Tina Moran prepare a long-tailed duck for surgery to implant a satellite transmitter to document molting areas. (GH 7/99)

6. Other

Subsistence Waterfowl Harvest Survey

For the eleventh consecutive year, Migratory Bird Management and Yukon Delta National Wildlife Refuge cooperatively conducted a household survey of subsistence waterfowl harvest. Harvest coordinator Cynthia Wentworth (Migratory Bird Management) and former refuge information technician/field coordinator Abraham Andrew had the lead in carrying out the survey.

Y-K Delta residents harvested approximately 96,000 waterfowl and waterbirds (e.g., cranes, loons, seabirds, etc.) and 22,000 ptarmigan, for a total of 118,000 birds in 1999. This is above the 10-year, 1990-1999 mean of 108,000 birds harvested annually (91,000 waterfowl and waterbirds and 17,000 ptarmigan). The 1999 harvest estimates were lower than in 1998, when 126,000 birds (110,000 waterfowl and waterbirds and 16,000 ptarmigan) were estimated taken. Total goose harvests in 1999 (39,000 geese) were above the 10-year mean (36,000 geese), and total duck harvests (47,000 ducks) were also above the 10-year mean (44,000 ducks). In 1999, white-fronted goose harvests were higher than any other year except 1996. Greater scaup, king eider, and ptarmigan harvest estimates were all higher than in any year since the survey began in 1985. In 1999, approximately 39,000 (33%) birds harvested were geese, 46,000 (40%) were ducks, 9,000 (7%) were swans and cranes, 2000 (2%) were other waterbirds, and 22,000 (18%) were ptarmigan.

Both total numbers of geese taken in 1999 (39,000) and the total numbers of Yukon-Kuskokwim Delta Goose Management Plan species taken (28,000) were above the 10-year means of 36,000 total geese and 25,000 Goose Management Plan species geese respectively. Total goose harvests in 1999 (39,000 geese) were below 1998 harvests (47,000 geese), but were above 1997 harvests (33,000 geese). To put goose harvest figures for recent years into a longer term perspective, in 1964, total goose harvest was estimated at 83,000.

Harvests of pacific white-fronted geese were higher in 1999 than in 1998 (13,300 white-fronts compared with 12,350 white-fronts), and were the second highest recorded (in 1996, 14,600 white-fronts were estimated taken). Harvests of all other goose species were down in 1999 compared with 1998. Harvests of cackling Canada geese (11,000 cacklers) were down significantly from 1998 (15,000 cacklers) but were still above the 10-year mean of 9,700 cacklers.

The 1999 emperor goose harvest estimate (800) was well below 1998's estimate (1,900) and also well below the 10-year mean (2,100). The lack of participation by the key south coast villages of Kipnuk, Kongiganak, and Kwigillingok again in 1999, as well as the lack of participation of these and other key coastal villages in other years, decreases our confidence in emperor harvest estimates.

The black brant estimate (2,700) was lower than in 1998 (4100 brant) and was below the 10-year mean (3,200 brant). Black brant harvest estimates for the Y-K Delta are also affected by the lack of participation of Kipnuk, Kongiganak, and Kwigillingok to an unknown degree.

The 1999 lesser Canada goose harvest estimate followed the pattern of cackling Canada geese and decreased from 11,350 birds in 1998 to 9,350 birds in 1999. The 1999 estimate was slightly above the 10-year mean of 9,000 lesser Canada geese. The 1999 lesser snow goose estimated harvest (1,300) was down from 1998 (2,100) and below the 10-year mean (1,900).

Approximately 47,000 ducks were harvested in 1999, down slightly from 1998's harvest of 50,000 ducks but above the 10-year mean of 44,000 ducks. Harvests of pintails (5,500) and mallards (4,500) were below 1998 harvests and below their 10-year means. Shoveler, greater scaup, goldeneye, and king eider harvests were all above 1998 estimates and above their 10-year means. King eider harvest (4800) in 1999 was the highest recorded since the survey began in 1985 (Table 1).

The estimated number of spectacled eiders taken in 1999 was 78, below the 10-year mean of 170. The 1999 harvest estimate of 42 Steller's eiders is very close to the 10-year mean of 40 Steller's eiders.

Estimated tundra swan harvest in 1999 was 5,100 swans, below the 1998 harvest of 5,900 swans and well below the 10-year mean of 6,700 swans. The estimated 1999 sandhill crane harvest (3,500) was very close to the 10-year mean of 3,400 cranes.

Since 1985, reported egg harvests have been highly variable. This is related to the fact that a relatively small percentage of households on the delta report any egg harvesting. In 1999, total reported egg harvest of all bird species was 12,100. This was very close to the 10-year mean of 11,900 eggs. Total reported goose egg harvest was 5,000, above the 10-year mean of 3,500 goose eggs. A majority of these goose eggs were those of pacific white-fronted and lesser Canada geese. The estimated 1999 harvest of tundra swan eggs (770) was close to the 10-year mean (750). In 1999 1,700 duck eggs of all species were estimated taken, compared with the 10-year mean of 2,100 duck eggs. Egg takes of all shorebirds, gulls, and arctic terns were close to the 10-year means.

In 1999, 925 households in 27 Delta villages participated in the survey during the spring survey period. Our 1999 sample was actually an oversample of villages in some regions. All villages in the mid coast and five of the six villages in the Yukon region were surveyed. The reason for this was to continue to get a more accurate estimate of what was being harvested from both of these regions. We feel that the 1997-1999 harvest estimates from both the mid coast and Yukon River are the most accurate we've collected to date.

In the south coast region, two of the required three villages participated in the survey: Eek and Tuntutuliak. However, none of the three villages at the mouth of the Kuskokwim (Kipnuk, Kongiganak, or Kwigillingok) participated in 1999. This, as in previous years, was the major weakness of the 1999 survey.

In the 28 villages which participated in the survey in 1999, 35 village surveyors obtained household permission and distributed and collected survey forms. The following surveyors in the following villages successfully completed survey work in 1999: Akiachak, Brian Latham; Bethel, Connie and Henry Peter; Chefnak, Alexie Flynn; Chevak, Andrew Boy Scout; Eek, Carl White Jr.; Hooper Bay, Agnes and Larry Carl and Jerry Moses; Lower Kalskag, Joe Atcherian; Kotlik, Benedict Aparezuk; Kwethluk, Henrietta Nicolai; Marshall, Ellen Alstrom; Mekoryuk, Linda Richards; Mountain Village, Valerie Waskey; Napakiak, Anna Middleton; Nightmute, Brian Bosco; Nunapitchuk, Benjamin Stevens; Oscarville, (the late) Koby Wassillie; Scammon Bay, Hazel Kaganak; St. Mary's, Christopher Mike; Toksook Bay, Bernice Therchik-Pitka; Tuntutuliak, David Evan Jr.; Tununak, Elsie Hooper. A total of \$73,000 went directly into local village economies as payments to surveyors with each earning an average of \$2,100.

As part of the harvest survey program, a seminar was held in March to discuss the program with all the current surveyors. In addition to bringing in all the surveyors and refuge RIT's, former Refuge Managers Cal Lensink and Jim King attended to provide an historical perspective of cooperative projects. Their slides and stories about working in the delta in the 60's and 70's were enjoyed by the surveyors and staff.



Yukon Delta NWR Refuge Managers Jim King (1960-1963), Mike Rearden (1995 - present), local Bethel resident J.B. Crow, and Cal Lensink (1963-1975) gathered during the harvest surveyor's seminar in March. (PL 3/99)

E. ADMINISTRATION

1. Personnel



Rearden, McCaffery, Walters, Kovach
Harwood, Hanley, Perry, Paniyak



Cannon, Snow, Jennings
Anvil, Ivanoff, Liedberg



Moses, Sipary, Isaac, Kelly
Asuluk, Hopoff, Nick, Jimmy

Permanent and Intermittent Staff

1. Michael B. Rearden Refuge Manager, GS-0485-14, EOD 6/95, PFT
2. Paul A. Liedberg Deputy Refuge Manager/Pilot, GS-0485-13, EOD 6/96, PFT
3. Gene R. Peltola Jr. Refuge Operations Spec./Pilot, GS-0485-12, EOD 9/26/99, PFT
4. Dave Cox Refuge Operations Spec., GS-0485-9, EOD 9/95, Trans 4/99
5. John R. Morgart Supv. Wildlife Biologist, GS-0486-12, EOD 8/87, Trans 11/20/99
6. George Walters Airplane Pilot, GS-2181-12, EOD 7/87, PFT
7. Charles F. Hunt Native Contract Representative, GS-1040-12, EOD 1/79, PFT
8. Alex S. Nick Interpreter, GS-1040-9, EOD 11/84, PFT
9. Lorrie J. Beck Outdoor Rec. Planner, GS-025-11, EOD 3/93, Trans 1/30/99
10. Donna Hanley Education Specialist, GS-023-9, EOD 8/29/99, PFT
11. Michael L. Wege Wildlife Biologist, GS-0486-11, EOD 4/83, PFT
12. Brian J. McCaffery Wildlife Biologist, GS-0486-11, EOD 10/86, PFT
13. Steve Kovach Wildlife Biologist, GS-0486-11, EOD 12/96, PFT
14. David Cannon Fisheries Biologist, GS-482-11, EOD 7/98, PFT
15. Bernice M. Albright Computer Specialist, GS-0344-9, EOD 12/96, PFT
16. Martha Perry Refuge Clerk, GS-0303-4, EOD 2/87, PFT
17. Phillip P. Paniyak Refuge Clerk, GS-0303-5, EOD 1/92, PFT
18. Peter W. Tony Maintenance Mech., WG-4749-9, EOD 8/91, LWD 4/24/99
19. Pat Jennings Maintenance Worker, GS-4749-8, EOD 12/97
20. Victor Anvil Laborer, WG-3502-3, EOD 7/3/97, Convert PFT 8/1/99
21. Michael A. Jimmy Refuge Info. Tech., GS-1001-8, EOD 11/84, P (Seasonal)
22. Abraham Andrew Refuge Info. Tech., GS-1001-8, EOD 11/91, P (Seasonal)

23. Moses D. Littlefish	Refuge Info. Tech., GS-1001-6, EOD 1/93, LWD 6/99
24. James Sipary	Refuge Info. Tech., GS-1001-7, EOD 2/96, INT
25. Joe Asuluk Sr.	Refuge Info. Tech., GS-1001-7, EOD 1/94, INT
26. Leo Moses Sr.	Refuge Info. Tech., GS-0404-7, EOD 6/90, INT
27. Jacob Isaac	Refuge Info. Tech., GS-1001-7, EOD 2/97, INT
28. Andrew Kelly	Refuge Info. Tech., GS-1001-6, EOD 7/5/98, INT
29. Eva Hopoff	Refuge Info. Tech., GS-1001-6, EOD 7/5/98, INT
30. Chris Harwood	Biological Tech., GS-0404-7, EOD 3/91, PFT
31. Henry E. Ivanoff	Biological Tech., GS-0404-5, EOD 8/91, INT
32. Raymond Ayogan	Biological Tech., GS-0404-5, EOD 4/96, INT
33. John W. Andrew	Regional Council Coordinator, GS-301-11, Reassigned 7/4/99

Temporary Employees

Christine L. Moran	Biological Tech., GS-0404-5, EOD 9/95, SCEP
Patrick Snow	Biological Tech., GS-0404-4, EOD 9/99, SCEP
Stanley Johnston	Biological Tech., GS-0404-5, EOD 4/99, LWD 7/99
Grady Harper	Biological Tech., GS-0404-5, EOD 4/98, LWD 7/99
Chris Nicolai	Biological Tech., GS-0404-5, EOD 4/99, LWD 8/99
Thomas Olson	Biological Tech., GS-0404-5, EOD 4/99, LWD 11/99
Zach Fairbanks	Biological Tech., GS-0404-4, EOD 6/99, LWD 9/99

Volunteers

Amy Quick

Dan Ruthraff

As usual, a number of personnel changes occurred during the year. In January, ORP Lorrie Beck was selected for a position in the Denver Regional Office and she transferred effective January 30. This position was reclassified as an Education Specialist and filled on August 29 when Donna Hanley reported for duty. Donna had most recently been working for the Forest Service and brings many years of experience as an educator to the position.

In March the Deputy Refuge Manager position was filled when Paul Liedberg was selected to assume the duties. He had been serving as an ROS/Pilot at the refuge for the past three years. In September, Gene Peltola Jr. was selected to replace Paul in the ROS/P position. He had served most recently as a Wildlife Biologist/Pilot for the Selawik Refuge in Kotzebue. This move is a return to the refuge for Gene who started as a technician with the refuge days after graduating from high school in Bethel.

John W. Andrew, the Regional Council Coordinator for the Yukon Kuskokwim Delta Regional Subsistence Advisory Council was reassigned from the subsistence division in the regional office to the refuge effective July 4. It was felt that this change was appropriate since nearly all of the federal land in the region is administered by the refuge.

Other regional coordinators work with multiple land management agencies and therefore continue to be supervised by the subsistence division.

Patrick Snow joined the staff in September as a SCEP student. The ROS position held by Dave Cox was restructured into a ROS Trainee slot and Pat occupied this position while completing his educational requirements. Pat is scheduled to finish school during the spring 2000 semester at the University of Alaska Fairbanks and return to the staff as a GS-5 ROS Trainee. The refuge intends to always have a manager trainee slot in place with rotation on two year cycle.

Eva Hopoff was selected in October as a new Refuge Information Technician from the village of Lower Kalskag. She will mainly serve the villages in the upper Kuskokwim River region.

Supervisory Wildlife Biologist John Morgart accepted a position with the Cabeza Prieta NWR in Arizona and transferred in November. John had occupied his position with the refuge for 12 years.

4. Volunteer Programs

Only two volunteers worked for the refuge during the year but they contributed 1,190 hours of their time. Amy Quick worked on a number of projects including the brant study at Big Slough and the waterfowl plot survey at Kanagayak. Dan Ruthroff, as part of his graduate work, conducted the first year of a western sandpiper study at Kanagayak.

5. Funding

The funding table for the past five years and a discussion follow.

Table E1. Funding for the Yukon Delta NWR, FY-95 thru FY-99.

<u>Activity Code</u>	<u>FY-95</u>	<u>FY-96</u>	<u>FY-97</u>	<u>FY98</u>	<u>FY99</u>
1230/31 (Mig Birds)	67K	56K	40K	40K	70K
9100 (Fire Mgt)	32K				
1260 (Refuge Ops)	1,915K	1,993K	2,080K	2,340K	2369K
1971 (NPS)			76K	19K	17K
1113 (End. Species)			13K		15K
Total	2,014K	2,049K	2,209K	2,399K	2,471K

As was normal for the past several years, funding to operate the refuge came from a number of sources. Through the National Park Service (NPS), the refuge was given

\$17,000 in FY99 to study satellite black brant colonies in the Clarence Rhode National Natural Landmark which encompasses portions of the former Clarence Rhode NWR. This program directs the NPS to support National Natural Landmark landowners in the protection of landmark resources. The work associated with this project is discussed in section D.5.

A challenge cost share proposal to fund the Western Alaska Natural Science Camp was again approved and \$20,000 was allocated for the project.

The subsistence division again funded several projects. One wildlife biologist position along with overhead and support was funded for a total of \$73,000. In addition they provided \$30,000 to continue the Kilbuck brown bear study which included a census and working group coordination, \$5,000 to conduct a moose survey, and \$38,000 for the Kilbuck caribou herd monitoring. Subsistence funding provided \$146,000 - approximately 6% of the station budget.

Migratory Birds (1231) provided \$25,000 for mallard and pintail banding, \$25,000 to conduct steel shot clinics, \$10,000 for law enforcement, \$5,000 to support a western sandpiper study at Kanagyak, and \$5,000 to conduct cackling Canada goose banding.

Western Alaska Ecological Services provided \$10,000 to partially offset a shortfall for conducting the spectacled eider project at Kigigak Island, and \$5,000 for a bristle-thighed curlew survey.

One Maintenance Management System project was funded for \$10,000 to make repairs to the roof at the Nunivak Island buildings in the village of Mekoryuk.

6. Safety

Bear and Firearms Safety Instructor/Biologist Steve Kovach conducted bear and firearms safety training for eight refuge staff, eight volunteers, five Alaska Department of Fish and Game staff (cooperator), one Association of Village Council Presidents, Inc. (cooperator), and one law enforcement staff during the spring and summer of 1999.

7. Technical Assistance

The refuge continued to be involved in meetings concerning the Hovercraft project which began providing bypass mail and transportation on the Kuskokwim River in 1997. The project is a US Postal Service demonstration project contracted to Lynden Transportation Services. RM Rearden and SWB Morgart attended meetings as part of an advisory panel for environmental studies related to the project.

F. HABITAT MANAGEMENT

1. General

Yukon Delta NWR encompasses approximately 21.9 million acres within the northern boreal zone of southwestern Alaska. About 70% of the refuge is below 100 feet in elevation and consists of a broad, flat delta dotted with countless waterbodies. The delta was created by the Yukon and Kuskokwim rivers and their tributaries. The Yukon River delta is in the process of building up, while the Kuskokwim delta is slowly being eroded by normal river processes. Many streams and sloughs are former tributaries of the two major rivers. Flooding of riverine and lowland areas is common, particularly in spring. The refuge's extensive tidal wetlands are scarcely above sea level and is frequently inundated by Bering Sea tides.

The coastal plain is contrasted by uplands and mountains to the north, east, and south. Several small mountain groups are scattered across the coastal plain. The southern extension of the Nulato Hills is located near the refuge's northern boundary. These rounded hills, rising from 1,000 to 3,000 feet in elevation, are the western extension of this large geographic feature. The Askinuk Mountains are located along the refuge's western coast, immediately south of Scammon Bay. They are approximately 10 by 40 miles in size and are the only part of the coastal plain that has been glaciated. The Kusilvak Mountains are located approximately 40 miles west of the village of St. Mary's and are directly south and east of Nunavak Lake. They are eight miles from north to south, and five miles east to west, rising 2,300 feet. The Ingakslugwat Hills north of Baird Inlet are a group of small volcanic cones, lava flows, and craters. The tallest of these is 650 feet. These hills may be one of the most recently active volcanic areas on the Delta. The Kilbuck Mountains are the southern extension of the Kuskokwim Mountains and are located in the southeast part of the refuge. These mountains range from 2,000 to 4,000 feet in elevation.

Two major islands are located within the refuge. The million-plus acre Nunivak Island lies 20 miles off the coast and is of volcanic origin with several peaks from 1,000 to 1,600 feet. Coastal bluffs range from 100 to 450 feet high. Sandy beaches along the southern coast merge into active sand dunes greater than 100 feet in height. These dunes are particularly susceptible to erosion because protective foredunes and extensive beaches are absent. The second largest island is Nelson Island which is separated from the mainland by the Ninglick River to the north, Baird Inlet to the northeast, and the Kolavinarak River to the east. The southern portion of the island is low-lying and covered with small lakes and streams. To the north, the terrain becomes more rugged with several peaks ranging over 1,300 feet in elevation.

Refuge vegetation 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 in the eastern interior areas. Alpine tundra occurs in the mountainous areas at higher elevations. Most of these habitats remain essentially untouched by man.

Virtually no habitat management as practiced in the lower 48 states occurs on the refuge. Habitat related activities involve mapping and inventory efforts associated with specific wildlife studies and wildlife management.

2. Wetlands

The two largest rivers in Alaska, the Yukon and the Kuskokwim, flow across the refuge and are the primary elements which created the refuge's landscape. Approximately half of the refuge is covered by water, with innumerable ponds, lakes, and sloughs. For the most part, aquatic habitat on the refuge is considered to be relatively unaltered, but past and present mining activities have simplified stream habitat in several areas adjacent to the refuge boundary (e.g., Tuluksak River), and may have reduced those streams overall productivity levels.

Most of the refuge is a vast, flat wetland/tundra complex dotted by countless ponds, lakes, and meandering rivers. The refuge's most productive wildlife habitat 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 selected acreage on and adjacent to this coastal strip could eventually be conveyed to Native corporations.

3. Forests

Less than five percent of the refuge is forested. Narrow bands of riparian, black spruce-hardwood, mixed black spruce-balsam poplar, and balsam poplar woodlands extend onto 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 Andreafsky Mountains. None of the wooded areas contain commercially harvestable timber.

7. Grazing

As one of the establishing criteria for the Yukon Delta National Wildlife Refuge, Section 303(7)(C) of ANILCA states that "...subject to such reasonable regulations as the Secretary may prescribe, reindeer grazing, including necessary facilities and equipment, shall be permitted within areas where such use is, and in a manner which is, compatible with the purposes of this refuge." Currently, the only special use permit authorizing reindeer grazing on the refuge is for Nunivak Island.

Reindeer were first brought to Nunivak Island in 1920 by the Lomen's, a private company with commercial reindeer operations on the mainland. Nunivak was an ideal location to establish a herd because it was considered unclaimed open range; it was large (>1.0 million acres); lacked major competitors and predators; provided favorable habitat (in terms of an abundance of critical lichen winter forage); restricted reindeer movements to a

controllable area; and had a cheap local labor force (Cu'pik Eskimo residents of the island). Eighty-one reindeer comprised the first transplant. Ten caribou bulls were introduced to the island in 1925 in an effort to cross-breed reindeer and caribou and improve the overall breeding stock. In 1928 an additional shipment of 523 female reindeer were released on the island. Following this latter introduction, the reindeer population expanded dramatically.

On April 15, 1929, Executive Order 5095 created the Nunivak Island Reservation and reserved it, in part "...for the use of the Department of Agriculture in conducting experiments in the crossing of reindeer and caribou." On September 1, 1937 the U.S. Congress passed the Reindeer Act (50 Stat. 900, 48 U.S.C. para. 250). In essence, this Act authorized the purchase of all non-Native reindeer by the U.S. Government, restricted ownership of reindeer to Alaska Natives, turned responsibility for management of reindeer over to Native people, and directed the Bureau of Indian Affairs (BIA) to aid them in establishing a self-sustaining reindeer industry. In effect, the Lomens maintained ownership and control of the reindeer on Nunivak Island until 1939 when the Secretary of the Interior purchased their 17,000 head of reindeer.

The BIA continued directing commercial reindeer meat production on Nunivak Island until 1970 when management of the herd was finally transferred to the village of Mekoryuk. Reindeer ownership was transferred to the residents of Mekoryuk in 1990.

Reindeer numbers on Nunivak Island have fluctuated widely over the years, generally because herd managers lacked an understanding of realistic carrying capacities, and the lack of a tightly controlled herd management program. Reindeer numbers have fluctuated from an estimated high of 30,000 animals in the mid-1940's to a low of <1,000 in the mid-1970's. Overgrazing throughout the years has caused a serious degradation of lichen range sites that provide critical winter forage for reindeer. Approximately 32% of the island (330,000 acres) is considered lichen range. Most lichen-producing ranges on Nunivak Island exhibit years of grazing damage; 75% of the winter lichen range is in poor to fair condition.

In 1992, the U.S. Fish and Wildlife Service, Alaska Department of Fish and Game, Alaska Soil and Water Conservation District, Bering Sea Reindeer Products Inc., Bureau of Indian Affairs, NIMA Corporation, and Soil Conservation Service (renamed Natural Resource Conservation Service), signed a cooperative management agreement for reindeer (and muskox) on Nunivak Island. At the time the management plan was signed, the reindeer herd was estimated to be in excess of 7,000 animals. Part of the terms of the agreement is to reduce the reindeer herd to 2,000 animals as measured in March or April of each year. Maintaining a pre-calving herd size at this level should allow lichen ranges to begin the slow process of recovery, yet allow the island herders to remain commercially viable.

An aerial survey to count reindeer on Nunivak Island was not flown in 1999 because of exceedingly poor weather conditions throughout the month of March, and the loss of snow

cover in April. The last survey was flown on March 19, 1997 when a total of 3,510 animals were counted.

In 1994, the refuge received a request from Ted and Marie Katcheak for a permit to graze reindeer on a part of the refuge which includes the Andreafsky Wilderness. Prior to making a decision on the request, the refuge has had to undergo an extensive compatibility determination process. A range survey was conducted in late summer of 1995 and 1996 to estimate the quantity and quality of potential winter range in the grazing allotment and determine if habitat in the area could support a reindeer herd without detriment to the natural abundance, diversity, and quality of existing plant communities. Work was nearly completed on the compatibility determination in 1999.

9. Fire Management

Only one fire was recorded on the refuge during the year. On June 29 the Alaska Fire Service dropped six smoke jumpers to a small fire near the Pastoliak River on the northern portion of the refuge. The fire was in a full suppression area and contained at less than 10 acres.

This year marked the 16th operating season under the Alaska Interagency Fire Management Plan used by all agencies and most private landowners in the state. The plan incorporates four management options for wildfire suppression, ranging from limited to critical suppression areas. Approximately 50% of the refuge is contained in the modified category, which dictates suppression during critical burning dates, but allows less suppression after those dates. The remainder of the refuge is in the full suppression category.

Fire suppression responsibilities on the refuge have been delegated to the Alaska Fire Service. The State of Alaska, Department of Natural Resources, conducts wildfire suppression on the refuge from their base of operations in McGrath - some 150 miles from the nearest point on the refuge and 450 miles from the farthest refuge holding.

12. Wilderness and Special Areas

Two wilderness areas occur on the refuge, the Andreafsky Wilderness which contains approximately 1,300,000 acres, and the Nunivak Wildernesses containing approximately 600,000 acres. Both were established by ANILCA in 1980. Both are remote and receive little public use.

The Andreafsky River and all its headwaters, including its East Fork, were designated as a Wild River under ANILCA. This designation covers approximately 265 miles, of which approximately 198 are within the Andreafsky Wilderness, 54 miles cross private lands, and 13 miles cross non-wilderness refuge lands. There are presently no commercial fishing, wilderness, or float-boating guides operating on the Andreafsky River. The upper half of

both forks of the river receive almost no float-boat use because of limited aircraft access, and a lack of suitable landing locations.

Little activity occurred during the year on a requested commercial reindeer herding operation on portions of the Andreafsky Wilderness Area. Ted and Marie Katcheak from St. Michael applied for a permit several years ago to graze part of the refuge which includes the very northern part of the Andreafsky Wilderness. An environmental assessment was basically completed but additional information needs to be supplied by Mr. Katcheak and incorporated. A range survey was completed in 1997 concluded that adequate forage was available for the number of reindeer proposed for the area.

Portions of the old Clarence Rhode National Wildlife Range and the Hazen Bay Migratory Waterfowl Refuge were designated the Clarence Rhode National Natural Landmark in 1968. This is the only "Special Area" presently designated within the refuge. A plaque identifying this designated area is displayed in the refuge headquarters entry.

G. WILDLIFE

1. Wildlife Diversity

The refuge hosts approximately 80% of the continental breeding population of black brant and nearly all emperor geese. As mentioned earlier, the brant population has remained stable and averaged 135,000 birds since 1981. The 1999 population for emperor geese - 54,600 - remained near the average 59,100 since 1983. This species has not responded well to the local goose management plan. Cackling Canada and Pacific greater white-fronted geese numbered about 400,000 and 500,000, respectively, 30 years ago. The 1999 estimate for cacklers and the 1998 estimate for whitefronts are 214,700 and 413,000, respectively. Undoubtedly, these four species have been a significant factor in shaping the coastal ecosystem.

Despite the reduction in geese from historical levels, the refuge still supports large numbers of ducks. The 1999 breeding pair survey estimated 1.7 million ducks on the refuge in early June. The principal species were northern pintail, green-winged teal, and greater scaup. Mallards, American wigeon, and northern shovelers are also regularly reported in good numbers. Harlequin ducks breed in many of the watersheds draining the Kuskokwim Mountains, as well as other suitable habitats. Common eiders are locally "common" in the vicinity of some brant colonies, while Steller's eiders are virtually extinct as a breeding species. The formerly abundant spectacled eiders have declined precipitously over the last 25 years. From an average breeding population of about 100,000 birds in the early 1970's, the population declined to a low of about 1,800 breeding pairs in 1993. The 1999 estimate was about 3,800 breeding pairs. Sea ducks in general have been declining throughout the continent and region; long tailed ducks and black scoter have been added to the refuge's list of species of concern.

2. Endangered and/or Threatened Species

Small numbers of threatened Steller's sea lions haul out on the rocks at Cape Romanzof and on Nunivak Island. Two races of peregrine falcons occur on the refuge, the American and the Arctic. The former was delisted in 1999, the latter in 1994. Peregrine falcons (subspecies unknown) have been reported nesting at St. Michael, in the Askinuk Mountains, and along the Yukon River; the species is more widely distributed in migration. Yukon-breeding peregrines probably belong to the American race. The identity of peregrines nesting on the refuge away from the boreal forest is unknown. Eskimo curlews formerly staged in both spring and fall on the tundra near St. Michael, but they have not been detected there in this century. In 1993, the spectacled eider was listed as a threatened species under the Endangered Species Act. Field work on spectacled eiders is described in Section D.5. Much of the world's population of Steller's eiders stages each spring along the refuge's southern coastline prior to moving to their arctic breeding grounds, and tens of thousands migrate south past Cape Romanzof in the fall. In addition, several thousand molt each fall along the shoreline of Nunivak Island. The Alaska breeding population of Steller's eiders represents only a small fraction of the world's population, and was listed as threatened during the summer of 1997. It has yet to be determined whether the flocks migrating and/or molting along the refuge's coast include any individuals from this threatened population. Evidence continues to accumulate that a tiny breeding population of Steller's eiders exists on the coastal tundra of the refuge.

3. Waterfowl

Pintail banding was again conducted in 1999 as part of a cooperative program within the Pacific Flyway. Swim-in traps were used within marshy areas of Kgun Lake, which is located in the north-central part of the refuge. See Section G.16 for 1999 totals.

Biological Technician Harwood and SWB Morgart conducted the harlequin duck breeding pair survey on June 4 along the same 181 km of streams surveyed from 1994-1998, including the upper Kwethluk River (27 km), Gold Creek (17 km), North Fork (26 km), Quicksilver Creek (38 km), and the upper Kisaralik River from Quartz Creek to Kisaralik Lake (73 km). In 1999, 347 harlequins were counted along the five survey streams. Between 1994 and 1999, the harlequin duck population along the surveyed streams has increased at a rate of nearly 8%/year, with almost no variation about the calculated log-linear regression line (adjusted r-squared = 0.954)

On August 30, WB McCaffery conducted a helicopter duck brood survey along streams in the Kilbuck and Kuskokwim mountains. The primary focus of this survey was harlequin ducks. Because of the difficulty in distinguishing some female harlequins from older Class III ducklings and the uncertainty of female departure dates, tightly-bunched ducks are referred to here as "groups" rather than "broods." The survey area included 99 km of streams within the Kisaralik watershed which have been surveyed during brood-rearing annually since 1995. Thirty-two, 25, 11, 11, and 17 harlequin duck groups were detected

in this area in the years 1995-1999, respectively. These groups included 172, 104, 50, 43, and 75 total birds (i.e., young and hens) during the same five years, respectively.

During late July, refuge personnel conducted an emperor brood survey along the Kolavinarak River from Baird Inlet to the coast and then south to Tern Mountain. A similar survey was conducted in 1963 and 246 broods totaling 885 goslings were observed along 53 river miles. In 1999, 55 broods totaling 183 goslings were observed over the same distance. An additional 65 broods totaling 241 goslings were observed along sloughs entering the Kolavinarak River. It does not appear that these areas away from the main river were surveyed in 1963. Lastly, four broods totaling 7 goslings were observed between the Kolavinarak River mouth and Tern Mountain.

4. Marsh and Water Birds

Loons, grebes, and sandhill cranes are widely distributed on refuge wetland areas. Populations of red-throated loons have declined dramatically in the tundra habitats of western Alaska over the last 20 years. On the Y-K Delta, populations estimated from aerial surveys have declined from over 11,000 in 1977 to fewer than 6,000 in 1997. Aerial survey data indicate that populations of pacific loons have remained stable over the same period. Sandhill cranes are quite abundant on the refuge and constitute an important component of the ecosystem, including subsistence harvest.



Red-throated loons nest on the refuge but their population has declined dramatically in the past 20 years. (SJK 6/96)

5. Shorebirds, Gulls, Terns, and Allied Species

Shore and water birds visiting the refuge each year number in the millions. Many shorebirds come to breed on refuge tundra, shorelines, and mountaintops. By August, they flock to coastal, lacustrine, and riparian mudflats to build fat reserves for long migrations. Over half a dozen bays on the Y-K Delta's outer coast would independently qualify as hemispheric reserves under the criteria of the Western Hemisphere Shorebird Reserve (WHSRN). By the end of 1999, the refuge and MBM-Region 7 were close to finalizing a nomination package for the Yukon-Kuskokwim Delta to be considered a hemispheric reserve within WHSRN.

Arctic terns are common and widespread breeders on the refuge, and Aleutian terns have nested at several widely scattered sites as well. In 1996 and 1997, 3 pairs of Caspian terns nested on Neragon Island, just north of the Askinuk Mountains. Although ornithologists have suspected that Caspian terns nest in low numbers around Prince William Sound, the birds at Neragon Island represent the first confirmed nesting records for the species in Alaska. We hope to return to Neragon in future years to determine the status of this tiny population.

Gulls, particularly glaucous gulls, are common along the entire refuge coastline from spring through autumn. Glaucous-winged, mew, herring, Sabine's, and Bonaparte's gulls also nest on the refuge. The only continental nesting records for slaty-backed gulls are from Aniktun Island in Kokechik Bay. One pair nested there in 1996 and 1997. Slaty-backed gulls are also rare but regular visitors to Nunivak Island.

Cliffs on the southwest side of Nunivak Island provide nesting sites for an estimated 500,000 seabirds, primarily common murre and black-legged kittiwakes, but also pelagic and red-faced cormorants, glaucous-winged and glaucous-winged/glaucous gull hybrids, horned and tufted puffins, parakeet and crested auklets, and pigeon guillemots. Fork-tailed storm-petrels are not known to nest on the refuge, but they are occasionally seen near shore during autumn storms.



These rock sandpipers on the coast of the refuge near Tern Mountain are just a few of millions of shorebirds that utilize the refuge throughout the summer. (9/99 BG)

6. Raptors

Seventeen species of raptors have been recorded on the refuge, including golden eagles, bald eagles, and peregrine falcons. The Kisaralik River is among the most important areas on the refuge for nesting raptors, and supports one of the densest population of breeding golden eagles in North America. For the ninth consecutive year, the refuge conducted an aerial survey for cliff-nesting raptors in the Kisaralik watershed (to include the Kisaralik River and Quicksilver Creek). Along approximately 100 km of river, we located 19 active cliff nests, including 10 golden eagle, 6 gyrfalcon, and 3 rough-legged hawk nests.

7. Other Migratory Birds

In addition to work on the Lower Kuskokwim River (see below), the refuge monitored populations of neotropical migrants and other landbirds with two Breeding Bird Surveys (BBS). BT Harwood and RIT Isaac conducted the Gweek River BBS for the fifth consecutive year and WB McCaffery and RM Rearden conducted the St. Mary's BBS for the seventh consecutive year.

Lower Kuskokwim River Breeding Bird Survey

From June 8 - 24, BT Harwood and RIT Isaac conducted breeding bird surveys of 12 sloughs and tributaries of the Lower Kuskokwim River, between Aniak and Napaskiak. Like last year's Lower Yukon River survey, the purpose of the project was three-fold: (1)

to evaluate the feasibility of a Refuge-specific monitoring program (2) to evaluate the feasibility of monitoring "Species of Concern" for the Western Alaska Bioregion (3) to remedy the lack of ornithological data in the study area.

Survey protocol followed that of standard river-run Breeding Bird Surveys (BBS). Eleven of 12 routes were completed (1 route contained 40, not 50, stops). Stops totaled 590 and were distributed over >300 river-miles.

Including official surveys and incidental observations, 85 species of birds were detected during the project. While most species were detected on the surveys proper, some were only detected incidentally on routes or during travel along the Kuskokwim River proper (some 155 miles between Aniak and Napaskiak). Comparisons of species abundance and distribution presented here are restricted to detections made during official survey periods.

The most abundant species (based on individuals detected per stop) on the survey was northern waterthrush, almost a full "individual" more than the next highest. Additionally, waterthrush was the most widespread species based on detection frequency (i.e., percentage of stops on which detected), being detected nearly at every stop (Table 2).

Abundance indices for "Species of Concern" were also analyzed. The 11 species for the Western Alaskan Bioregion (as determined at the 1997 Alaskan Boreal Partners in Flight Working Group meeting) include: rough-legged hawk, golden eagle, gyrfalcon, short-eared owl, Arctic warbler, gray-cheeked thrush, northern shrike, blackpoll warbler, golden-crowned sparrow, McKay's bunting, and rusty blackbird. It appears from detection frequencies/rates that this survey, in conjunction with the Yukon BBS, can help to monitor four of the species. Two of the passerines (golden-crowned sparrow, McKay's bunting) were not detected, while one was rarely detected (northern shrike). None of the raptors of concern was detected.

Funding permitting, we hope to conduct the two river surveys in alternate years, which will still allow us to monitor trends in a reasonable time frame. Additionally, we intend to conduct habitat analyses of all route stops to complement the surveying.

8. Game Animals

Muskox

Muskox are probably the refuge's most important game mammal in terms of public use and interest. Muskox were introduced to Nunivak Island from Greenland in 1935. The population grew at an average rate of 16.2% from 1947 to 1968 when it was estimated to number 750. Hunting of muskox on Nunivak Island was initiated in 1975. Hunters are allowed to harvest 70-90 muskox/year (evenly split between bulls and cows). This harvest regime is designed to maintain the island population at 500-550 animals.

In 1967 and 1968, muskox were transplanted to Nelson Island from Nunivak Island. Muskox numbers on Nelson Island typically range between 200-300 animals. Nelson Island muskox have dispersed onto the Y-K Delta for the past 20 years, crossing frozen rivers between the island and the mainland. Growth of the mainland muskox population is limited by illegal hunting. Both the Service and ADF&G are attempting to promote growth and expansion of the refuge's mainland muskox population and are working with local villages to obtain their support.

A combined muskox and reindeer fixed-wing aerial survey of Nunivak Island is generally conducted in mid-March of each year. The survey was only partially completed in 1999, however, because of poor weather conditions. A muskox composition survey of Nunivak Island was flown by ADF&G in a Robertson R-44 helicopter on October 13-15. The animal's immediate response to the helicopter is to run, but upon overtaking, they immediately bunch and face the hovering aircraft. Larger herds were easily broken up into smaller units to facilitate classification. Muskox were scattered across the island as single males, small bands of bachelor males, and breeding herds. Breeding herds were often comprised of the harem bull, one to five older cows, and several two-year-olds and yearlings of both sexes. In addition, there were often several three-plus-year-old bulls associated with each herd as well. The dominant harem bull generally kept other bulls at the periphery of the main herd, however. A total of 620 animals of the following age and sex composition were observed: 158 four-year-old and greater males; 135 four-year-old and greater females; 69 three-year-old males; 58 three-year-old females; 39 two-year-old males; 48 two-year-old females; and 113 short yearlings. The herd appears healthy, however, herd size currently slightly exceeds population levels established in the cooperatively developed Nunivak Island Reindeer and Muskox Management Plan.

A muskox composition survey was also flown on Nelson Island by ADF&G on July 18 using a C-172 aircraft. The 297 muskox found consisted of 60 calves and 237 adults.

Moose

Prior to 1950, moose were rarely seen on the Y-K Delta. During the following years, their numbers increased as they colonized the refuge's eastern boundary and riparian woodlands along the Yukon and Kuskokwim Rivers. Moose numbers are highest on the refuge (particularly in winter) along the Yukon River between Russian Mission and Holy Cross. In summer, moose are more widespread and are occasionally found as far west as the Bering Sea Coast. Overall, moose numbers are very low on the refuge.

Five census areas have been identified on the refuge (three along the Yukon River; one along the Kuskokwim River; and one in the Kilbuck Mountains). The refuge, in cooperation with ADF&G, attempts to conduct one census each winter. Complete snow cover is required to conduct a census. Ideally, censuses would be conducted prior to the antler drop in December so that herd composition data could be collected during the census. However, the refuge rarely has adequate snow cover in November to conduct a

census. Therefore, censuses have traditionally been conducted in late February or early March when snow cover is more predictable and day-light hours are longer. Inadequate snow conditions in 1996 and 1997 prevented any census from being completed.

In 1999 we utilized a new moose census protocol to evaluate its utility on our very low density populations. This new protocol utilizes spatial statistical procedures and eliminates the dependence of using polygons that follow topographic features (which may or may not be present depending on the depth of the snow cover).

On March 11-15, 1999, the Andreafsky census area was covered using three PA-18 Super Cub aircraft. This census area encompasses 5,903 km² (2,279 mi²) along the Yukon River from Pilot Station to Mountain Village. We randomly selected and censused 98 (1,585 km² or 612 mi²) of the 365 census blocks and located 41 calves and 124 adults. Using the previous methods to calculate estimated population size yielded an estimate of 515 moose, or 0.09 moose/km² (0.23 moose/mi²); the 95% confidence interval is 32.2% of the point estimate. Using the new spatial statistics method, the population estimate was 524 moose with the 95% confidence interval only 28.9% of the point estimate. While the difference between the estimates was only 9 moose, the spatial method did provide for increased precision of the estimate. In fact, the confidence interval was greatly increased due to one low density census block that contained 10 moose. Eliminating this one census block reduced the estimate to 519 moose and reduced the 95% confidence interval to 21% of the point estimate.

The only other time this area was censused was in 1995. At that time 32 moose were observed and the estimated population was only 51. This latest census result indicates that the population has grown by ten-fold. This population increase is due to reproduction by resident moose and immigration of additional moose from up river into the census area. The local residents are also partly responsible for this dramatic growth in the moose population by refraining from illegal harvests, particularly of cow moose.

With the success in the Andreafsky moose census area we have determined that the five census areas previously identified on the refuge (three along the Yukon River; one along the Kuskokwim River; and one in the Kilbuck Mountains) could be consolidated into two census areas (the Yukon River and the Kuskokwim River/Kilbuck Mountains). This will provide census data much more frequently, but at the cost of some precision. The trade off between increased frequency of data collection and slightly decreased precision in the point estimates has been estimated to be a net gain, overall, in our management of this resource.

Caribou

Historically, caribou occurred on the Y-K Delta in large numbers and were the most abundant ungulate. 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 Andreafsky Mountains. In recent years, the Western Arctic Caribou Herd (WACH) has occasionally migrated as far south as the middle portion of the Andreafsky River, but generally remain only a few weeks. A small segment of the WACH was last documented on the refuge as far south as the Yukon River in January 1998. Residents of Marshall reported harvesting caribou just south of the Yukon River near that community in December 1997.

An aerial survey by ADF&G in January 1998 documented mixing of the WACH and the Mulchatna Caribou Herd (MCH) along the Yukon River between Russian Mission and Holy Cross. This was the first documented mixing of these two herds in recent history. These herds had been speculated as routinely mixing in winter on the Y-K Delta prior to 1900.

After 10 years of intensive study, we have a better understanding of population status and distribution of the small resident Kilbuck Caribou Herd (KCH). Before 1985, the KCH was considered by many to be part of the expanding MCH; however, we have documented two distinct calving sites in the Kisaralik Lake area (1987 to 1994). Movements of radio-collared caribou over a six-year period (1988 to 1994) indicated the herd is expanding its range as evidenced by changes in seasonal distributions of bulls and cows. During the course of the initial study (1986 to 1992) and subsequent surveys (1993 to present), the KCH has increased in size. Although the original study supports the hypothesis of a distinct, resident herd, significant increases in numbers and radio telemetry observations have documented annual mixing with the MCH since 1995.

Seasonal distribution of caribou in the Kilbuck Mountains starts with movement to higher, wind-swept slopes in January and February to forage on open ridges. When previously snow-covered browse at lower elevations is exposed, usually after April, there are movements to these areas. Cows return to the high mountains near North Fork Lakes or to tundra lowlands east of the refuge in May to calve. Bulls remain at lower elevations along major drainages during May. After calving, the cows, calves, and yearlings congregate in large groups to feed in the lower river valleys, but remain separate from bulls. Snow fields are frequented during summer by both herd segments for relief from biting insects and heat. In late September and October, the sexes mix at the lowest elevations of the year for the rut. They remain in the lowlands where exposed tundra is available during late fall and early winter.

A discussion of the Kilbuck Mountains caribou herd study and more information on the annual influx of the Mulchatna caribou herd is found in Section D.5.



In early October, caribou from the Mulchatna caribou herd moved into the refuge. This small group is crossing the Kwethluk River. (PAL 10/99)

9. Marine Mammals

Bering Sea marine mammals add an interesting diversity to the refuge's wildlife plus provide a vital subsistence resource for coastal villages. Pacific walrus, spotted seals, ringed seals, and Pacific bearded seals are hunted on the ice in spring, and some seal hunting continues during summer in bays and estuaries. Other marine mammals include harbor and Dall porpoises, northern fur and harbor seals, and beluga, fin, gray, killer, and minke whales.

The Marine Mammals Division, Ecological Services, Anchorage, manages polar bears, walrus, and sea otters in Alaska. The National Marine Fisheries Service, National Oceanic and Atmospheric Administration, has responsibility for all other marine mammals. This is part of the delta's ecosystem, but is treated like a separate entity.

Alaskan Natives who dwell on the refuge coast (primarily Yup'ik Eskimos) may take walrus and other marine mammals for subsistence purposes. Sport or recreational hunting of marine mammals is illegal. Authentic Native articles of handicrafts or clothing may be sold or transferred to a non-Native, or sold in interstate commerce as long as the materials for these crafts were taken incidental to the subsistence harvest. Furthermore, handicraft articles must be "significantly" altered. For example, polishing or carving initials or signature on an ivory tusk would not qualify as a significant alteration. New Service regulations require that all walrus tusks, polar bear hides and skulls, and sea otter hides and skulls taken by Native hunters be marked and tagged by a designated tagger. Resident Native taggers are now located in many coastal villages.

10. Other Resident Wildlife

A reindeer census, normally conducted in conjunction with the muskox census in March of each year, was not completed this year due to poor weather conditions.

11. Fisheries Resources

Nearshore ocean habitats harbor Pacific herring, Pacific halibut, starry flounder, and Pacific tomcod. The Yukon and Kuskokwim Rivers, which flow through the refuge, support internationally significant salmon fisheries and provide habitat for at least 35 other species of fish. Tributary streams throughout the refuge contribute substantially to the salmon stocks harvested in Kuskokwim Bay and Norton Sound, and support anadromous runs of five species of Pacific salmon; chinook, chum, coho, sockeye, and pink. Other important species include several species of whitefish, sheefish, Alaska blackfish, burbot, northern pike, grayling, and lake trout.

This past decade, southwestern Alaska experienced several severe economic and social hardships as a consequence of unusually poor salmon runs. It's believed that significant atmospheric and oceanic changes such as warmer water temperatures (up to 10°F), lighter winds, reduced currents, lower levels of nutrient upwelling, and algal blooms) in the North Pacific Ocean and Bering Sea during 1997 and 1998 had profound effects on the entire marine ecosystem, resulting in a reduced food base for developing juvenile and maturing adult salmon. Besides the lack of fish, other anomalies have been noted: later run timing, smaller than average fish, altered migration pathways, and reports of higher incidences of parasites and increased signs of predation. These conditions demonstrate how complicated ecosystems can be, and that far-off environmental influences can have significant implications here on the refuge.

Fisheries Enumeration Projects

The vast size, remoteness, and fluvial diversity of the Yukon and Kuskokwim river drainages presents tremendous challenges in determining accurate salmon escapement numbers. Successful management requires accurate and timely knowledge about migration periods, run strength, and escapement levels. Within these drainages there are numerous projects operated individually by agencies or organizations, or through cooperative efforts. Unfortunately, considering the complexity of the systems, comprehensive information is generally deficient regarding the abundance and in-season dynamics of local salmon spawning populations. Any addition to the existing inventory of knowledge would make a significant contribution to the overall management of the aquatic resources.

Perpetuating healthy salmon runs is essential for the following reasons: 1) local people have relied heavily on the abundant aquatic resources for subsistence use, sustaining

cultural values, and providing incomes, and 2) adequate salmon escapement is crucial for maintaining ecosystem health. Decaying salmon carcasses provide "marine derived nutrients" which are linked to both aquatic and terrestrial ecosystem productivity levels.

East Fork Andreafsky River Salmon Escapement Study

In 1994 the Service started operating the Andreafsky River (tributary of the Yukon River) weir, after the catastrophically low chum salmon returns of 1993. The original intent was to monitor chinook and chum salmon escapement into the East Fork of the Andreafsky River, but in 1995 weir operations were extended into September to include the coho salmon runs. The extension was prompted by a growing interest to develop a late-season commercial coho salmon fishery and was funded through a partnership with the Bering Sea Fishermen's Association. The Association has continued to provide assistance with the project, and this year provided two crew members who were from the village of St Marys.

This past summer the Kenai Fisheries Resource Office experimented with underwater video equipment and constructed a cabin at the site to house the equipment. It's hoped that this technology will enable personnel to observe and record fish passage 24 hours a day. Potentially the signal may be transmitted to the nearby village of St. Marys where villagers will be able to observe the fish as they pass the weir and acquire first hand knowledge of the run characteristics.

Although the weir facilitates Service monitoring of refuge spawning salmon stocks and other resident species, scale pattern analysis, age/sex/length, and run timing and abundance data are shared with ADF&G. The state uses the information for managing the commercial and subsistence chinook and summer chum salmon fisheries. Information is also used in the Yukon River Joint Technical committee U.S./Canada Pacific Salmon Treaty negotiations.

This summer the weir was operated from June 17 to September 11, with most species showing up about a week later than usual. The chum salmon escapement of 32,229 was the lowest since 1994; in comparison, the 1994-1996 escapements ranged from 108,450 to 200,981 fish. Less than 55,000 chum salmon passed the weir each of the past three years. A total of 3,347 chinook salmon escaped into the river compared to 4,011 in 1998. The past two year's chinook returns are low relative to 1994 and 1995, 7,801 and 5,841, respectively. This year a total of 2,963 coho salmon were counted past the weir, well below the 1995 and 1996 returns of 10,901 and 8,037 fish, respectively. However, due to the later arrival of coho, the weir was removed before all of them had entered the river. Considering other enumeration projects within the Yukon River drainage and reported fish harvests, it's believed that this year's coho run was weaker than normal. Other salmon returns included 112 sockeye and 751 pinks, while 3,723 whitefish, 8 Dolly varden, 27 northern pike, and 1 grayling were counted passing through the weir. Weir counts on the resident species is not indicative of their abundance because most of them are able to squeeze between the pickets and move about undetected.

Strong pink salmon runs occur during even years on the Andreafsky River, when counts have been as high as 316,530 such as in 1994. Picket spacing on newer weir panels was made wide enough to permit passage of most pink salmon; therefore, counts for pink salmon may represent only $\frac{1}{2}$ to $\frac{2}{3}$ of the actual escapement, and are primarily used to indicate run timing and relative abundance. Since this is an odd numbered year, only 751 pink salmon were counted passing through the counting chute.



John Tobin with the Kenai Fisheries Resources Office has been instrumental in coordinating the Andreafsky River weir for several years. Among many other duties, John coordinated the construction of a Weatherport frame for use at the camp. John is an otherwise clean-cut guy. (DJC 8/99)

Kuskokwim River Tributary Salmon Escapement Studies

Chinook and chum salmon returning to refuge waters of the lower Kuskokwim River must pass through an intense mixed stock commercial fishery, as well as one of the state's largest subsistence fisheries. The local commercial fishery in the Kuskokwim River is directed primarily at chum and coho salmon, while chinook salmon are the principal target of subsistence users; however, substantial numbers of chinook and sockeye salmon are taken incidentally by the commercial fishermen. In previous years chinook salmon were harvested in a directed commercial fishery, but because of low escapement numbers and increasing subsistence harvest levels in the late 1980's, state management biologists eliminated their directed harvest. Although coho salmon in the Kuskokwim River drainage are heavily exploited, little information is known about run timing, spawning distribution, and population dynamics for virtually all its tributaries. Similarly, little information exists for pink salmon or other exploited species such as northern pike, sheefish, burbot, various species of whitefish, and Alaska blackfish.

Several previous efforts by the Service to enumerate salmon abundance in the Lower Kuskokwim have ceased before comprehensive salmon life cycle data had been collected. The Kenai Fishery Assistance Office operated a fish weir in the Tuluksak River from 1991 to 1994, and on the Kwethluk River in 1992, but local opposition to both projects arose and they were discontinued. Unfortunately, these were the only projects which provided important annual fisheries data for Kuskokwim River tributaries on the refuge.

A fish counting tower has been in operation since 1996 on the Kwethluk River, and is discussed below. Talks were initiated with the Association of Village Council Presidents (AVCP) and ADF&G late in 1997 to resurrect the Tuluksak project using potential disaster relief funding through the Department of Commerce and State of Alaska funds. Since the Tuluksak River remains an important river from which to index other systems in the lower Kuskokwim River drainage, local support is continually being sought by AVCP and other interested groups. In addition, when the weir was operable in 1991, as few as 700 chinook salmon were observed passing the weir. Of those 700, only about 210 were females; therefore, it's crucial that this particular stock be monitored. All other presently operating escapement projects are located upstream of the refuge, in what is considered to be the middle portion of the Kuskokwim River between the towns of Aniak and McGrath.

Kwethluk River Fish Counting Tower

For the past four years, the Association of Village Council Presidents has obtained funding from the Bering Sea Fisherman's Association to operate a counting tower on the Kwethluk River on refuge administered land. Tower operations commenced on July 15 and continued through August 18. Due to several high water events, the tower was not operable during the entire chinook and chum salmon migrations. As a result, an estimated 873 chinook, 702 chum, 228 sockeye, 678 pink, and 681 coho passed the tower. When escapement projects (such as the weir in 1992) have operated throughout the season, as many as 9,675 chinook, 30,596 chum, 1,316 sockeye, 45,952 pink and 45,605 coho salmon were estimated to have escaped into the system. A disadvantage of the counting tower is that no age, sex, or length data are collected which are important in assessing the run's population dynamics. Throughout the year negotiations with the Village of Kwethluk have been ongoing, and an agreement has been made to reinstall the weir in 2000.

Kwethluk River Rainbow Trout Survey

Over the past few years, anglers and recreationists have shown a growing interest in the lesser known streams of southwestern Alaska. Several streams on the refuge are gaining popularity with anglers as other rivers have become more heavily used. Increased angling pressure is of concern to fisheries managers because rainbow trout in the Kuskokwim River drainage are at their northernmost distribution, are slow growing, and mature after 6-8 years which makes them vulnerable to over-exploitation. Fish population shifts demonstrated by declines in abundance and size structure alterations has prompted ADF&G to enact seasonal gear and harvest restrictions in other systems in southwestern Alaska (e.g.; Kanektok and Goodnews Rivers).

To better understand the population dynamics of the Kwethluk River, a mark and recapture study was conducted between July 11 and July 22, and August 1 and August 12, to estimate rainbow trout age, sex, and fork length composition in a 79 km section of river. See the Marking and Banding Section of this report for more detailed information.



Float participants preparing for the trip by having a dinner of beef wranglers before departing down river. Contrary to what it appears to be, and according to FB Dave Cannon, these are not hot dogs! (DJC 7/99)

16. Marking and Banding

The USGS-BRD banded 633 cackling Canada geese near Old Chevak in July as part of their demographic study. Refuge personnel banded 250 cacklers at the usual banding location 16 km northwest of Chevak. As part of project to determine what effect ten years of habitat restoration, preservation, and management have had on waterfowl wintering in the Central Valley of California, neck collars containing a radio transmitter were placed on 57 adult female whitefronts. Refuge personnel banded an additional 146 whitefronts caught along with those receiving radio transmitter collars. USGS-BRD personnel also banded 63 emperor geese and 8 whitefronts as part of a continuing demographic study.

As part of the brant satellite colony study, refuge personnel with the assistance of University of Alaska, Fairbanks staff attached metal and coded plastic tarsal bands to 958 individuals in the vicinity of study areas at Aknerkochik River and Big Slough.

At Kigigak Island, refuge personnel banded (metal Service and yellow plastic tarsal bands with letters and numbers) 26 spectacled eider adult females as part of continuing nesting ecology study. During brood rearing, an additional 102 ducklings were banded with metal leg bands.

The refuge continued to participate in a cooperative program to band mallards and northern pintails within the Pacific Flyway. Ducks were trapped along the northwest shoreline of Kgun Lake and adjacent lakes from August 4-9, 16-22. Waterfowl concentration areas were baited with whole corn and birds were captured using clover-leaf, swim-in traps. A total of 918 northern pintails, 159 green-winged teal, and 48 mallards were banded by refuge staff. One, one, one, three, one, and 8 pintails banded at Kgun Lake in 1992, 1994, 1995, 1996, 1997, and 1998, respectively, were recaptured in 1999. The only bird previously recaptured (1998) was one the three birds banded in 1996. Eight of these 15 birds were banded as AHY males, five as AHY females, one as a HY male, and one as a HY female. Additional recaptures included a male and female mallard originally banded as adults in 1996 and 1994, respectively.

Table G1. Total numbers, age, and sex of waterfowl leg and/or neck-banded under station permit on Yukon Delta NWR, 1999.

Species	Age and Sex					Total
	AHY-M*	AHY-F	HY-M	HY-F	Unk.	
Cackling Canada geese	126	122	0	0	2	250
Northern pintail	641	150	60	67	0	918
Green-winged teal	65	10	46	38	0	159
Mallard	36	6	5	1	0	48

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

Bethel Fall Migration Mist-netting Station

From July 20 - September 11, BT Harwood along with intermittent help from Volunteer Quick, BT Harper, Student Trainee Moran, and WB McCaffery, operated a fall migration mist-netting station on USFWS land (~1 ha) at Hangar Lake. Five nets were deployed for 47 work-days, for a total of 1300 net-hours (nh).

Twenty-five species, totaling 1262 individuals, were banded during the period (Table G.2). An overall capture rate of 97 individuals per 100 nh was achieved. Yellow warbler (22%) and American tree sparrow (21%) comprised over 40% of all bandings. Six species not captured in 1998 (i.e., common snipe, boreal chickadee, myrtle [yellow-rumped] warbler, golden-crowned sparrow, slate-colored junco, pine siskin), were added to the site list (now at 30). This pine siskin record is the first confirmed record for the refuge.

Unlike 1998, 1999 netting began near the start of migration. Capture rates increased from 1998 for species such as alder flycatcher, blackpoll warbler, northern waterthrush, and Lincoln's sparrow, suggesting that these species are earlier migrants. The highest capture date for individuals was September 3 (237/100 nh; 60 of 71 individuals were tree

sparrows). The highest capture dates for species were August 4 and 13(14 spp. each). As in 1998, the last date when new captures exceeded 1bird/nh was September 3.

Fourteen of 727 (2%) birds banded in 1998 were recovered in 1999, including 8 tree sparrows, three yellow warblers, two white-crowned sparrows, and one gray-cheeked thrush. Given the limited size of the netting array (~1 ha), this return rate seems high.

Because of the limited FWS land and the wet conditions (habitat, not weather), fall banding will not be conducted at Hangar Lake in the foreseeable future. The only other option for a long-term banding operation in Bethel is on FWS land near an old BIA site about two miles from the Bethel airport. Before we initiate a long-term local operation, we may elect to do some sampling throughout the refuge to improve our understanding of migration movements (both temporal and spatial) outside the local area.

Table G.2. Birds banded during fall migration mistnetting at Hangar Lake, Bethel, 1999.

SPECIES	AHY	HY	UNK	TOT
Common Snipe	1	2		3
Alder Flycatcher	22	5		27
Black-capped Chickadee	2	14	1	17
Boreal Chickadee		2		2
Arctic Warbler		1		1
Gray-cheeked Thrush	8	49		57
American Robin	3	18		21
Varied Thrush		3		3
Northern Shrike		2		2
Orange-crowned Warbler	9	33		42
Yellow Warbler	77	195	2	274
Myrtle Warbler		5		5
Blackpoll Warbler	6	10		16
Northern Waterthrush	13	90	3	106
Wilson's Warbler	3	50	1	54
American Tree Sparrow	63	198	2	263
Savannah Sparrow	8	83	4	95
Fox Sparrow	1	31	4	36
Lincoln's Sparrow	2	9		11
Golden-crowned Sparrow		1		1
White-crowned Sparrow	5	26		31
Slate-colored Junco		2		2
Rusty Blackbird	7	1		8
Common Redpoll	83	43		126
Hoary Redpoll	37	22		59
Pine Siskin **				0
TOTAL OF ALL SPECIES	350	895	17	1262
CAPTURE RATE (#/100nh)	27	69	1	97

** 1 HY Pine Siskin was captured but not banded....first YDNWR record

Kwethluk Rainbow Trout Tagging

A multiple-census mark/recapture method for estimating the rainbow trout population in the Kwethluk River was conducted this past summer on a particular stretch of river. A total of 354 fish were captured on the first marking trip, and 590 were captured on the second trip. Each fish was tagged with a numbered floy anchor tag, and coordinate locations and fork length measurements were recorded before releasing them at the point of capture. Recaptures during these sampling trips will provide the data needed to estimate the population size. Future recovery of tagged fish will allow for monitoring growth rates and provide a better insight into fish movement patterns.

H. PUBLIC USE

1. General

More than 90% (estimated) of the refuge's public use involves subsistence activities (hunting, fishing, trapping, and berry picking). Other public use activities include sport hunting, mainly for moose, caribou, bear and muskox; fishing for salmon, rainbow trout, grayling, dolly varden, and other species; river floating; and wildlife viewing.

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

The major public relations activity in 1999 continued to be the information and education efforts associated with the Y-K Delta Goose Management Plan and the four goose species of concern. The Refuge Information Technicians (RIT) conducted school programs during the year, discussing the Goose Management Plan and other refuge issues with students. While in the villages, they presented programs to an estimated 600 community and council members.

2. Outdoor Classrooms--Students

The Western Alaska Natural Science Camp held one seven-day session from July 19-26, hosting 12 students (ages 13-16) from across the Y-K Delta. Because of health and safety issues that arose at the Nyac site in the Kilbuck Mountains, the camp was moved this year to Kako, a former gold mining camp that has been converted to a mission. Kako is located approximately 10 miles north of Russian Mission. Students learned about plants, birds, fish and their habitats. They also compared and contrasted traditional Alaska Native natural resource knowledge with western scientific approaches to resource management. Yup'ik elders and traditional leaders from the Y-K Delta attended the camp and provided information on traditional Eskimo culture, values, and knowledge. RIT's Abe Andrew and

Michael Jimmy provided bear protection for the camp and campers. NCR Hunt provided bear safety training for staff and students.

The camp was made possible through the Challenge Cost Share program. Matching grants and in-kind contributions were provided by our partners --the Association of Village Council Presidents, Alaska Department of Fish and Game, National Audubon Society, Calista Corporation, and the Lower Kuskokwim School District.

In conjunction with the East Fork Andreafsky River weir, a science camp for juniors and seniors of the Andreafsky High school in St. Marys was held during the last week of August and the first of September; sixteen students and two adults participated. The students were able to observe and partake in most of the daily weir operations as well as conducting water chemistry analyses, fish seining, snorkeling, and making Japanese gotaku fish printed teeshirts. This science camp was funded, organized, and conducted by the Kenai Fisheries Assistance Office.

6. Interpretive Exhibits/Demonstrations

The refuge visitor center is known as a location in Bethel for learning about big game, birds, and wildlife habitat, as well as Yup'ik culture. According to our guest register we had over 500 visitors. Eighty per cent have local addresses with the remainder coming from Anchorage and the lower 48.

7. Other Interpretive Programs

Bird Walks/Slide Shows

BT Chris Harwood conducted two bird slide shows/walks in May for International Migratory Bird Day attracting 21 community members. In June Chris led a birding boat trip on the Gweek River for six passengers sponsored by Kuskokwim College Campus in Bethel. Kuskokwim Wilderness Adventures provided the boat for this event.

Unfortunately, demand greatly exceeds the capacity in the boat - the only one in Bethel certified to conduct this commercial enterprise - and each year a number of people have to be turned away.

National Wildlife Refuge Week

Events to celebrate the 5th annual National Wildlife Refuge Week were held 1-5pm on November 20. The afternoon featured the 15 minute Video, "America's National Wildlife Refuge System" at the top of each hour and a 45 minute biologist seminar for the remainder of the hour. Seminar topics included "Song Bird Banding in Bethel" presented by BT Chris Harwood; "Salmon Counting Project" presented by FB Dave Cannon; and "The RIT Program" presented by Interpreter, Alex Nick. Other highlights were the free exchange of steel shot for lead shot, free wildlife posters, and distribution of the new berry

buckets with a message about emperor goose conservation on the side. We had over 100 community members in attendance and averaged 25 people per seminar.

Goose Calendar Contest

The goose calendar contest also helped facilitate the educational effort. Of the 14 schools that participated in the contest across the Y-K Delta, 7 students from these schools or 30% of the total winners represented the Delta and were recipients of the final round of first, second and third place prizes and awards. The prizes were supplied by the National Audubon Society -Alaska/Hawaii Region. Once again, Ducks Unlimited, Incorporated, contributed \$40,000 towards the publication of the calendar. Approximately 7,500 calendars were distributed to school children and community members on the Y-K Delta.

8. Hunting

Moose Check Stations

The refuge continued to cooperate with the local ADF&G biologist in running moose check stations. In 1997 and 1998 two check stations, one each on the Yukon and Kuskokwim Rivers, were operated; in 1999, however, only the check station on the Yukon River was operated due to reduced funding levels. The Yukon River check station was begun by ADF&G to improve both harvest reporting and to obtain better information on the locations moose were being harvested. Specifically, the Yukon River check station is used largely to determine the number of moose harvested up-river of the refuge, by residents from the refuge.

This was the fourteenth year the Yukon River check station has been operated. The check station was open from September 1-25. Thirty-seven moose and two black bears were checked.

A refuge muskox season is held yearly on Nunivak and Nelson Islands. The Nunivak Island drawing hunt for one bull and registration hunt for one cow took place from February 1 through March 15 and September 1 through September 30. Forty permits for cows and 35 for bulls were issued for the late winter hunt; 4 permits for cows and 5 for bulls were issued for the fall hunt. Two cow permit holder did not hunt, resulting in 82 of the 84 possible animals being harvested.

The Nelson Island herd has only a winter hunt. Fifteen bull and 15 cow permits were issued and all were filled during the season which ran from February 1 through March 25.

Two registered big game guides - Ed Shavings and Fred Don - have traditionally taken out hunters in need of those services. However, in the past several years the two transporters working on the island - Abe David and Charlie Spud - have taken a significant amount of business from the guides. Most hunts last only a day or two and the major component of

the guiding or transporting service is to simply get the client to the animals. Consequently, although the definition and regulations related to the two services differ, in effect, there is a small amount of difference in the actual operations of the two services on Nunivak Island. The transporters of course charge considerably less for their services.

It is thought that the illegal harvest of muskox on Nunivak Island is minimal. The illegal harvest on Nelson Island is not known.

The reported harvest of caribou and moose is unreliable at best. Harvest tags are required for all caribou and moose hunts in the unit but it is assumed that many are not returned to ADF&G. Although caribou from what is most likely the Western Arctic Caribou Herd occasionally enter the refuge through the Nulato Hills in the north, only a small number are available for harvest.

Big game guides reported taking the following animals as part of their operations on the refuge in 1999.

	Clients	Days Hunted	Species Taken
Ed Shavings Sr., Nunivak Island Guide Service	8	20	7 muskox
Fred Don Sr., Nunivak Outfitters (did not hunt)	0	0	0
Bob Adams, Adams Guide Service	0	0	0
Eruk Williamson, Eruk's Wilderness Floats	0	0	0

The transporters permitted to operate on the refuge reported the following animals taken as part of their operations.

Abe David, Nunivak Island Experiences	11	12	10 muskox
Charlie Spud, Spud's Transporting and Tendering	17	23	17 muskox
Steve Williams, Ptarmigan Air	0	0	0

One emergency order affecting hunting seasons was carried over from 1998. The order opened the caribou season south of the Yukon River and closed it on March 31. Caribou were still in the unit and being harvested until the closure took effect.

A similar emergency order was put into effect for the 1999/2000 season. The influx of the Mulchatna caribou herd into Game Management Unit 18 took place in late August and early September. As a result, the emergency opening became effective September 16 and was scheduled to run through March 31, 2000.

9. Fishing

With an estimated 500,000 lakes and ponds, and the two largest river systems in the state running through the refuge, sport and subsistence fishing are very important activities for

many of the region's residents. Though only a small number of non-local residents travel to the refuge for sport fishing, this contingent is expected to increase among the less used fishing waters of the Kwethluk, Kasigluk, and Kisaralik Rivers. During the winter months, ice fishing for pike and whitefish occurs on many of the region's lakes and rivers to fulfill subsistence needs. Rainbow trout, Dolly varden, grayling, pike, and five species of salmon are sought by sport fishers. Burbot, Alaska blackfish, herring, sheefish (inconnu), and three-spined and ninespine stickleback are all harvested at various levels for subsistence.

Subsistence Fishing

The population of the Yukon-Kuskokwim Delta is among the largest of any similar native/aboriginal occupied region in Alaska. Throughout much of the refuge, subsistence use of salmon is of great importance. Fish play an important part in the subsistence cash economy and account for 30-60 percent or more of the yearly food supply in most Yukon-Kuskokwim Delta villages. Approximately 1,300 families participate in the annual harvest of salmon in the Kuskokwim drainage alone. Chum, chinook, and coho salmon are the most heavily exploited salmonids, while several whitefish species, northern pike, sheefish, Alaska blackfish, burbot and Pacific herring are also harvested. As evidenced by the following discussion, most of the available subsistence information pertains to salmon; with very little known about the other species. Over the years, questions have arisen about the population status of whitefish and northern pike for several areas within the refuge.

Beginning on October 1 of 1999, the Federal Government assumed responsibility for management of subsistence fisheries on most federally administered lands (approximately 60 % of the state's inland waterways) in Alaska. The state had been managing fish and wildlife applying a rural subsistence priority, but in 1989 it was determined that a rural priority violated the Alaska Constitution. In 1990 the Federal Subsistence Board began managing subsistence wildlife harvests, but not fisheries. It wasn't until a lawsuit in 1995 which directed the federal government to also manage fisheries as stated under the Alaska National Interest Lands Conservation Act of 1980 (ANILCA). Between 1995 and 1999 a moratorium between the Department of Interior and the State of Alaska was agreed upon to allow the state to amend it's constitution and comply with the Act. However, no amendment was passed and the Federal government assumed fisheries responsibilities on Federal land. It's estimated that over 50 percent of all of the state's rural fisheries subsistence activities occur within the Yukon and Kuskokwim River drainages, much of which is located within the refuge's boundaries.

Results from the 1999 subsistence harvest will not be completed until the spring of 2000, but data from 1998 will demonstrate the importance of salmon to local subsistence users. Within the refuge boundary on the lower Yukon River, 61,002 summer chum salmon were harvested compared to the previous five year average of 69,041; 9,240 fall chum were harvested compared to the previous five year average of 11,799; 21,602 chinook salmon were harvested compared to the previous five year average of 21,242; and 5,217 coho were harvested compared to the five year average of 7,409.

During 1993 the Kuskokwim River chum salmon run was so weak the subsistence fishery was closed for the first time for a portion of the season. The closure was enacted to allow for more escapement into tributaries, and since that time the runs have sufficiently increased to allow for subsistence and commercial harvest. However, commercial use was again curtailed in 1997, 1998, and 1999 to accommodate subsistence needs. Subsistence harvest in the entire Kuskokwim River drainage for chinook salmon alone generally ranges between 85,000 and 90,000 fish, most of which (90%) is taken from the lower section of river. In 1999, the lower portion of the Kuskokwim River yielded approximately 69,001 chinook salmon; 39,788 chum salmon; 40,159 sockeye salmon; and 22,671 coho salmon for subsistence use. Unlike the Yukon River, there were no subsistence harvest restrictions imposed in the Kuskokwim River drainage, although the state did consider it.

Commercial Fishing

The commercial harvest of salmon from within the refuge on the Kuskokwim and Yukon rivers is of economic and nutritional importance to local residents of the Y-K Delta. Commercial fisheries within the refuge are concentrated in the mainstem rivers, and along the western coastline and Nunivak Island. The commercial harvest of salmon in the Kuskokwim River began in the early 1900's and has grown dramatically from 1960 to the present. The local commercial fishery in the Kuskokwim River is directed primarily at chum and coho salmon. Commercial salmon fishing began in the Alaska portion of the Yukon River about 1918, and presently occurs along the entire 1,200 mile length for chum and chinook salmon. In both river systems, the majority of commercial effort (approximately 75 % in the Yukon and 90% in the Kuskokwim) occurs within their lower sections which lie within the refuge's external boundary. All salmon fisheries in both drainages are comprised of mixed stocks, with many of the fish originating from refuge waters.

Salmon returns in 1999 were among the lowest on record, therefore, commercial fishing periods were reduced severely in the Kuskokwim River. Only two commercial opening periods occurred in 1999, one directed at chum salmon and the other at coho. Chum and coho catches were only seven and five percent of their recent 10 year averages, respectively. The lack of fish resulted in the fewest amount of fishermen fishing since 1972, with only 509 permit holders participating; normally there are over 800. The average value per permit was only \$333.53. In the lower Yukon River, 643 permit holders participated in the fishery and received \$1.9 million for their catch, or an average of \$3,014 per fishing permit. These amounts were down from the 1988-1996 averages of \$3.9 million on the Kuskokwim and the five year average (1991-1995) of \$6.9 million on the Lower Yukon River. Because incomes are low and other types of employment are scarce, the importance of sustaining adequate harvest levels becomes very clear.

From an economic standpoint, coho salmon significance in the Kuskokwim River has steadily grown in recent years and harvest levels have averaged more than 500,000 over the

past ten years. Although the significance continues to grow, knowledge of timely escapement data from refuge rivers has not kept pace. In fact, comprehensive information on the status of individual coho stocks returning to refuge rivers is nonexistent. Improved harvest efficiency of the commercial fleet in a mixed stock fishery may place refuge stocks in jeopardy of being over-fished during these years of low returns.

Salmon runs were very poor in the Yukon River during 1998 and 1999. The 1999 Alaskan commercial harvest level for chinook salmon (69,562) was expected to be low and was the third lowest on record since Alaska statehood (1998 being the worst). Preliminary results show that summer chum salmon commercial catch was extremely low (29,412), and was 72 percent of the previous year average (1998 being 76 percent below the previous five year average).

Commercial fishing for whitefish is limited, but could expand in the future. Because there is little known about this fishery, and since subsistence use is quite extensive, more biological data is needed to properly manage this species. Pacific herring are harvested in three commercial districts along the refuge coast, Cape Avinof, Nelson and Nunivak islands.

Sportfishing

Sportfishing pressure on the refuge is currently low, but tributaries feeding the Kuskokwim and Yukon rivers provide anglers with an excellent variety of trophy fish. Some of these rivers are just now being discovered by people from outside the region. Salmon, rainbow trout, dolly varden, Arctic grayling, northern pike, whitefish and sheefish (inconnu) make up the list of fish accessible to anglers on many of the refuge tributaries. Favored rivers for sportfishing include the Aniak, Kwethluk, Kasigluk, Kisaralik and Andreafsky. People from the village of Akiak were the first in the lower Kuskokwim River to enter into the sportfish guiding business. For some time, anglers and floaters have been accessing the Kisaralik River from Dillingham and Anchorage via float planes. The current river management plan does not allow for guided use on the Kisaralik River, but anglers (and outfitters) will continually search out new uncrowded waters. Because of an ever increasing demand, air taxi operators in the Bethel area have added additional float planes to carry anglers to the remote lakes and rivers on the refuge. Proactive management is necessary to maintain subsistence fisheries and protect resident fish populations.

10. Trapping

Furbearer trapping continues to be a supplemental source of income for many local residents although depressed fur prices for a number of years have greatly reduced the number of villagers that derive significant income from the activity. Trappers focus their efforts on beaver, otter, mink, fox, and muskrat. Other less abundant species such as wolf, wolverine, marten, and lynx are also sought. Trappers of beaver, otter, wolf, wolverine, and lynx have mandatory sealing requirements under State regulation. Trapping success

during the past five years is well below historical average harvest, mostly due to low fur prices paid for raw pelts.

Only five species of furbearer are required to be sealed by the State of Alaska. Many of the furbearers, and especially beaver and land otter, are crafted into hats, mittens, etc. and used or sold in the local area. It is known that many of these are not made available to ADF&G for sealing.

12. Other Wildlife Oriented Recreation

Other recreational activities, such as backpacking, boating, camping, hiking, birding, photography, and river floating occur to a small extent on the refuge. Power boating and camping are generally associated with subsistence hunting and fishing. Since the refuge is so remote and costly to access, this use is low in comparison to that of many other refuges. Activities associated with rafting include camping, fishing, hiking, wildlife observation, and photography

15. Off-road Vehicling

Transportation on the refuge is limited to aircraft, boats, and snowmachines. Snowmobiles are used heavily, both for recreational and subsistence uses. Three- and four-wheeler use is common in and around villages, but is not permitted on refuge lands. This is not to say that they are not used on the refuge. We are aware of at least several instances where ORVs have been or are beginning to be a problem.

Snowmachine use in the spring, after much of the snow has melted, has caused disturbance of the surface vegetation mat on many established trails. The regulations state, in essence, that snowmachines are allowed as long as there is adequate snow cover to prevent resource damage. Snowmachine travel is a way of life in villages throughout Alaska where they provide necessary transportation between villages or for winter and spring hunting. When spring arrives it is not uncommon to have snowmachines traveling on trails or overland when there is less than fifty percent snow cover. With some 20,000 village residents living in villages surrounded by over 20,000,000 acres of refuge land, the regulation is difficult at best to enforce. Our practice has been to focus enforcement on the gross misuses of the machines.

Early in the year, the refuge sent a letter to all of the village corporations on the refuge addressing the issue of ATV and inappropriate snowmachine use on public and private land throughout the region. The letter offered assistance in addressing the issue in a cooperative manner. Positive responses were received from five or six village corporations and further action will be taken in the future.

16. Other Non-wildlife Oriented Recreation

Sled dog racing remains a popular winter sport. The most popular race in the area is the "Kuskokwim 300" which occurs in January each year. The race route originates from Bethel, follows the Kuskokwim River to Aniak, then goes overland to Whitefish Lake and Tuluksak before rejoining the Kuskokwim River on its way back to Bethel. Though most of the race occurs on Native Corporation lands, it does cross refuge lands for a short distance along the trail's northern portion. A permit was issued during the year to the non-profit corporation that sponsors and directs the race.

17. Law Enforcement

Law enforcement efforts related to spring waterfowl hunting followed similar patterns to recent years. A combination of special agents and refuge officers worked during the April-May period. A number of lead shot citations were issued but no cases of taking emperors, spectacled eiders, or Steller's eiders were found.

Law enforcement during the fall hunting season was minimal due to staff shortages.

18. Cooperating Associations

The refuge operates a small sales outlet for the Alaska Natural History Association (ANHA). FY99 sales are nearly identical to FY98 at a little over \$3,000 deposited. The biggest increase over last year came in the 4th quarter total sales which were 20% greater than of FY98. The ANHA educational materials were displayed and sold at two cultural and craft shows during the year --National Wildlife Refuge Week celebration and the Bethel Council on the Arts Craft Show. Almost 30% of our annual sales originated from these two special festivals. Adjusting the product line to reach our target market has yielded higher volume sales in a shorter period of time. Approximately 20% of our total sales came from the sale of topographic maps. We're quickly becoming known as the only local place to purchase topographic maps.

By the end of Open House on Nov 20, we had recruited four volunteers to work in the visitor center and run the bookstore on Saturdays. At this writing we have one very enthusiastic volunteer and she will be a valuable asset to our outreach program.

I. EQUIPMENT AND FACILITIES

2. Rehabilitation



Chris Dau, who worked for the Yukon Delta in the 1970's and who did the original paintings on the Old Chevak church when there was only a Clarence Rhode NWR, touched up his original artwork during the year. (PAL 8/99)

3. Major Maintenance

A MMS project provided funds to replace the roof on the buildings in Mekoryuk on Nunivak Island. The buildings were originally constructed to support muskox transplants and are now used as a bunkhouse and storage facility.

The refuge Cessna 206, N5408X, was flown to St. Paul, Minnesota in November to have a passenger side door installed, plus a new interior and exterior paint. With the new paint job, the airplane came out with a new number also - N740. The 700 series numbers for aircraft were at one time reserved for the Department of Interior fleet but unfortunately, most of them have been lost due to sales of old airplanes and purchase of new ones with the new numbers. As we can, we intend to renumber the refuge aircraft with the 700 series to retain this bit of history.

4. Equipment Utilization and Replacement

Two new Suburbans were ordered during the year to replace similar models that have been in place since 1986.

J. OTHER ITEMS

3. Items of Interest

During a fall storm in 1998 the barge "Martha Key" had to be released while being pushed down the Kuskokwim River and became grounded on the refuge near the village of Tuntutuliak. A permit was issued to Coastal Marine Transport for removal of the barge. Following several unsuccessful attempts, they were finally able to remove it. Although the site is flooded with every high tide, rehabilitation will be required.



The barge "Martha Key" spent the winter on the refuge after being released by a tug during a fall storm. A cable was stretched to the nearby slough shown in the photo with hopes that high incoming water would move the barge closer to what would eventually be open water. (PAL 3/99)

4. Credits

The biological staff of WB's Wege, McCaffery, and Kovach, FB Cannon and BT Harwood teamed up to write sections D.5, F.1-3, 6 and 7, G1-11 and 14-17. WB Kovach also wrote or contributed to sections D.3 and 5, E.6, G8, 10, and 16, and H.8. FB Cannon wrote H.9. ES Hanley wrote portions of sections H.1-3, 6, 7, 11, 12, 16 and 18. Cynthia Wentworth (MBM) wrote the harvest survey summary in D.6. RM Rearden provided the Feedback section. ROS Liedberg wrote sections C.3, D.4, F.9 and 12, and compiled, edited, and finalized the report.

K. FEEDBACK

During my career with the Service I have seen several cycles of the diversity issue. These cycles usually involve frantic attempts to improve the composition and therefore the diversity of our organization. Inevitably there are accusations by some that we are hiring merely for the sake of diversity and political correctness and in some cases I believe that has been true. We often try to "improve" our diversity through the wrong means. There are those that implore us not to use the term "quota," even though they have them, but just call them something else. Diversity is a very good thing for our organization. It grieves me when the benefit of diversity is soured in the context of programs that, in my view, artificially bolster our "target" composition. This only tends to remove the dignity of work, ignore professionalism and cause contempt. The ones that suffer the most from these radical cycles are the highly qualified minorities that we hire based on their abilities and qualifications.

The SCEP program, however, is a good example where I believe we are on the right track toward naturally diversifying our organization, and bringing with it the tangible benefits of broader thinking, different perspectives, and a rejuvenation of our organization.

Managers from Alaska traveled to several colleges and interviewed students that were interested in the SCEP program in Alaska. They focused on finding qualified candidates and selecting the very best of them. The men and women that were selected for the program were exemplary and diverse--and every one was chosen because they were the best qualified--and the rest of the workforce knows that too. It shouldn't really be a surprise that college students in the wildlife field represent, to a great extent, the natural diversity that exists in our society.

Their enthusiasm and professionalism bodes well for the future of the Service. I'm convinced this is the right way to achieve natural diversity, and bring with it the pride, and dignity that our organization needs.