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**YUKON DELTA NATIONAL WILDLIFE REFUGE
BETHEL, ALASKA**

**ANNUAL NARRATIVE REPORT
CALENDAR YEAR 2000**

**U.S. DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
NATIONAL WILDLIFE REFUGE SYSTEM**

Reviews and Approvals


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Calendar Year 2000



Refuge Manager

4/30/02

Date

Refuge Supervisor, South Review

Date

Regional Chief, NWRS Approval

Date

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INTRODUCTION

The Yukon Delta National Wildlife Refuge (NWR), second largest of Alaska's 16 refuges, encompasses 19,131,646 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. 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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SPECIAL DEDICATION

The Yukon Delta National Wildlife Refuge has been uniquely shaped by the vision and contributions of people who have devoted their lives to public service. This narrative is dedicated to Charles F. Hunt (Chuck) for his devotion to conservation and public use at the Yukon Delta National Wildlife Refuge.

Chuck Hunt's contribution to the U. S. Fish and Wildlife Service has been characterized by significant advances in cooperation and understanding between the Service and the Yup'ik Eskimo residents of Alaska. Chuck, a Yup'ik Eskimo was born and raised on the Yukon River delta and continued to work in this region for his entire adult life. He worked for the U. S. Fish and Wildlife Service at the Yukon Delta National Wildlife Refuge from 1979 until his death in May 2000.

Chuck, upon accepting a position with the Service in 1978, began to immediately build bridges between the Service and the Yup'ik people. His superior command of both the Yup'ik language and the English language brought new, and much improved understanding between the Service and Yup'ik residents. Chuck's credibility, directness, and persistence in improving communications brought the Service and the Yup'ik residents of the delta to a much higher level of understanding, and in many cases to cooperative alliance. Chuck's strong defense of the Yup'ik culture brought new understanding to the Service and his unfailing support for Service conservation initiatives brought new understanding to Yup'ik residents.

Chuck's effectiveness and continuing efforts to build bridges between the Service, Native people and others got the attention of the Alaska Outdoor Council. They honored him with the *Fish and Wildlife Officer of the Year Award* in 1998. His award stated, in part: "His ability to craft relationships between seemingly opposing groups has helped both Native people of Alaska and urban dwellers communicate and understand each other better, and ultimately to agree to necessary conservation measures". In 1988 Chuck received a Conservation Education Award from the Wildlife Federation of Alaska for his notable outreach and communication successes with the issue of conservation of declining geese in western Alaska.

For his dedicated service, and invaluable contribution to conservation and improved relationships with the people of Alaska, Charles F. Hunt was awarded the Meritorious Service Award of the Department of the Interior. We continue to remember his work and dedicate this annual narrative for his final year of public service.

A. HIGHLIGHTS

The highest number of caribou were documented on the refuge in 2000. A total of 25,800 caribou were counted South and East of the Kuskokwim river. D.5

A total of 38 brown bears were captured and collared/re-collared. D.5

A total of 20 (64.5%) male and one female (4.7%) western sandpipers were resighted from birds banded in 1998. D.5

Spectacled eider nesting success (Mayfield) was estimated at 75.1 % in 2000 and common eider nesting success was estimated at 71.6 %. D.5

A total of six BRD projects were conducted on the Yukon Delta NWR during the summer of 2000. D.5

Robert Sundown, Subsistence Resource Specialist; Patrick Snow, Refuge Operations Specialist; and Fred Broerman, Supervisory Fish and Wildlife Biologist joined the staff of the the YDNWR. Alex Nick transferred to the subsistence division as the Subsistence RAC Coordinator. The refuge lost longtime employee Chuck Hunt who passed away in May. He was awarded the Meritorious Service Award for his excellent achievements. E.1

Two wild fires occurred in the northern portion of the refuge. One fire received which occurred in late December received statewide media attention and it is estimated that a total of 22,500 acres were burned. F.9

The Kwethluk weir project was revived and operational during the summer of 2000 and agreements struck with the Native Village of Tuluksak for the weir on the Tuluksak river to be operational in the summer of 2001. G. 11

Some of the lowest returns of chum salmon ever recorded returned to the Kuskokwim and Yukon rivers. A total of 22,918 chum passed the East Fork Andreafsky weir project on the Yukon and 11,691 chum passed the Kwethluk weir on the Kuskokwim. G. 11

A black tailed gull was seen and photographed between June 26 and July 1, representing the first refuge record of this Asiatic species. G. 5

An unprecedented number of snowy owls were detected South of Nelson Island. G. 6

A census of moose on the lower Kuskokwim River showed 0.09 moose/mile². G. 8

In July, Wildlife Biologist Brian McCaffery traveled across the globe to reach the Lena-Nordenskiöld Biological Station to attend an Arctic conservation conference. J. 1

C. LAND ACQUISITION

3. Other Items

In the 1999 narrative we reported that the Calista Regional Corporation exchange/acquisition was expected to be completed in 2000. Although much closer, details remained to be completed by the Realty office during the year and final documents are not expected to be complete until sometime in 2001. This exchange, which will implement a bill passed in 1998, will add 29,579 acres of surface with subsurface estate, 161,998 acres of subsurface estate under village corporation lands, and a 16,998 acre conservation easement, plus the subsurface estate under the easement, to the refuge. No field work for this project was done on the refuge during the year.

The exchange with the village of Newtok continued to plug along with no real progress. This land exchange was proposed by the village in 1996 so that the village could be relocated due to erosion along the banks of the Ninglick River. A meeting was held on February 10 in Bethel with Newtok Corporation representatives and their legal council. As a result of the meeting, the Service proposed via a letter dated March 27, a slightly modified exchange that still included approximately 17,000 acres, plus a non-development conservation easement of Newtok lands and approximately the same amount of refuge lands on Nelson Island. A response from Newtok dated October 9 stated that they were only interested in offering 11,105 acres in the Aknerkochik parcel and 800 acres on Qikertag Island (Baird Inlet Island). The Service responded on November 24 rejecting the smaller offer.

The Service's main concerns with this exchange include the likely impacts to upland areas on Nelson Island from four wheelers should the village relocate, and increased impacts to the brant colony on Baird Inlet Island from increased boat traffic past the island to the new village site. We have maintained that the corporation needs to acquire a sizeable amount of property for the new village site so that habitat disturbance is limited to non-refuge lands.

The last exchange involves the NIMA Village Corporation from Mekoryuk on Nunivak Island. NIMA is interested in acquiring additional surface as well as subsurface estate on Nunivak Island in exchange for holdings they have near Dall Lake some 50 miles from the island. Approximately 20,000 acres will be involved in the exchange. Action on this exchange is pending completion of the Calista exchange discussed above. Some of the NIMA holdings are included in the Calista exchange and must be finalized before this one can proceed. A couple of meetings were held between NIMA and the Realty office but mainly to answer questions about the process or provide an update of the NIMA port project being planned for the island, and pending the exchange.

Regulations for the Vietnam Veterans Native Allotment Act, passed as part of ANCSA amendments in 1999, were published on June 30. BLM held a meeting in Bethel on March 13 to receive comments on the proposed regulations with potentially eligible veterans. Approximately 60 people attended the meeting. Estimates of the number of potential applications for the refuge exceed 250 but by the end of the year, only three inquiries had been made. The application period extends through January 31, 2002.

The process to review all ANCSA 17(b) easement across corporation lands began during the year. BLM, with significant involvement of the refuge will be responsible for the review, and recommendations to retain or abandon the easements. This will be a significant amount of work since, by the end of the year, we did not have an inventory of all the easements on the refuge much less any documentation of use for the vast majority of them.

D. PLANNING

3. Public Participation

Western Alaska Brown Bear Management Working Group (WABBMWG)

The working group did not meet in 2000.

Kilbuck (Qavilnguut) Caribou Working Group

The working group did not meet in 2000. The need for this group to meet has diminished significantly with the annual influx of the Mulchatna caribou herd.

4. Compliance with Environmental and Cultural Resource Mandates

Lisa Frink with the University of Wisconsin, Madison, traveled to the Aprun River area from July 3rd through 7th for continued work as part of her doctoral dissertation research. Ms. Frink's work this year was limited to collecting quantitative and qualitative data during experiments comparing the efficiency of ulu knives made from ground slate and steel. She has been doing preliminary archaeological work at the Nunaraluk site off the Kashunak River for several years and plans an excavation in 2001 or shortly thereafter. Ms. Frink's work is the only archaeological work being conducted on the refuge at this time.

5. Research and Investigations

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; we captured and radio collared nine additional females in 2000. As of December 2000, 23 radio-collars continued to function. Aerial telemetry surveys (26 by refuge staff and an additional 13 by Togiak NWR, ADF&G - Bethel, or ADF&G - Dillingham staff) conducted in 2000 documented 315 radio relocations for radio-collared caribou both on and off the refuge. Six caribou radio collared in previous years were found dead during routine radio telemetry flights; one caribou from the capture slipped its collar only one month after the capture and another died in the fall.

The highest number of caribou documented on the refuge occurred in January when 25,800 caribou were counted south and east of the Kuskokwim River. Weather conditions prevented adequate flying to cover the entire area; it is believed that more than 40,000 caribou were present on the refuge. Caribou began migrating off the refuge to their calving grounds in mid-April 2000.

Between June 1 and 9, 2000 we attempted to locate caribou on the "traditional" KCH calving grounds. While more than 2,500 caribou were located in the Kilbuck Mountains, less than 150 calving cows were located. We caught 11 yearling females among the calving groups for radio collaring. The purpose of going onto the calving grounds was to determine if any site fidelity remains and if the KCH can still be considered a distinct herd or is now just a subgroup of the Mulchatna Caribou Herd. Nine of the caribou caught were fitted with radio collars; two capture mortalities made up the balance of the capture. Subsequent monitoring has shown: one caribou slipped its collar only a month after the capture; one caribou died 6 km south from its capture location in the fall; one caribou moved more than 100 km to the southeast; four caribou are grouped together moving north from their capture locations; and two caribou are grouped together moving northwest from their capture locations.

While 7,700 caribou were observed on the refuge in late August, 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. Over 16,000 caribou were observed on the refuge in late September.

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 2,426 caribou classified on this and the Togiak NWR was 44.3:100:24.3, respectively. The results for the proportion of calves is lower than in previous years, but higher than last year.

Kuskokwim Mountains Brown Bear Study

Only 18 bears had functioning radio-collars in January 2000. During 1999, 28 brown bear telemetry flights (10 by the Yukon Delta Refuge, 15 Togiak NWR, and 3 by ADF&G Dillingham) resulted in 461 relocations of radio-collared bears and 44 locations of non-radio-collared bears.

During June 1-9, 2000, we established our camp at Canyon Creek. We planned to capture the existing 18 radio collared bears and capture another 12 females for radio collaring. We

captured and handled 38 brown bears (34 females, 4 males).

Twenty bears were recaptures from previous years; 18 had their radio collars replaced, one had her radio collar removed, and one had a new radio collar attached. Only 10 of the remaining bears were radio collared. Bears that were not radio collared were either the wrong sex (i.e., male) or were too small to carry a radio



John Lamont and Oscar Larson with bear 136.

collar for the next four years without a recapture to adjust the size of the collar. Blood and hair samples were collected from all bears captured. This effort was to replace the aging radio collars and to increase the sample size to improve the reproductive data being collected by the project.

Findings of the project to date include: mean litter size for litters out of the den was 1.9; mean litter size for litters at weaning is 1.6; and mean age of offspring at weaning is 3.09 years. Survival of offspring to weaning increased to 31.9%. Age of first reproduction was established at 7.2 years; however, age of first successful reproduction was 9.0 years. Mean annual



Willard Church and James Berlin with bear 143.

Kaplan-Meier survival estimate for radio collared females dropped to 95.6%. Minimum convex polygon home ranges varied from 103 km² to 2,521 km².

We invited four members of the Western Alaska Brown Bear Management Area Working Group to participate in the capture. Protocol for having non-professionals participate in the capture, developed in 1997, were again followed. Safety to the bear and capture team were of primary importance prior to allowing the working group members to the capture site.

Shorebird Studies at Kanagayak Field Station

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 2000, BT Ruthrauff and Volunteer Rizzolo continued the study. The density of nesting pairs in 1999 and 2000 was 2.95/ha. and 3.01/ha., respectively, among the highest densities recorded for this species. Mayfield nest success on a 16 ha plot from 1998 to 2000 was 0.56, 0.24 and 0.35, respectively. Fledging success, defined as the percentage of nests fledging at least one young, was 75% (12 of 16 hatched nests) in 1999 and 68% (19 of 28 hatched nests) in 2000. Chicks fledged as early as 13 days after hatch, but often required up to 18 days to achieve sustained flight. Among 12 and 19 broods observed in 1999 and 2000, respectively, males tended broods a mean of 11.75 days and 13.2 days after hatch, while mean female attendance was 8 and 6.4 days in those two years. Males and females did not differ significantly in the length of attendance in 1999, but males remained with broods significantly longer than females in 2000. Males demonstrated significant seasonal declines in duration of attendance in both years, while

females exhibited significant seasonal declines only in 2000. Finally, survival estimates based on resightings of banded adults were extremely low for females relative to males at our study site, as well as to breeding female survival estimates from other studies. Of 21 females banded in 1998, only 5 (23.8%) were resighted in 1999, only 1 (4.7%) of which was subsequently resighted in 2000. Of 31 males banded in 1998, 23 (74.2%) were resighted in 1999, and 20 (64.5%) were again resighted in 2000. These return rates yield annual local survival rates of 22% and 80%, respectively, for females and males. Despite finding a combined 99 nests on an additional 35 ha area surrounding our core study plot in 1999 and 2000, we observed no additional banded females. We therefore suspect that the low survival estimate is primarily the result of mortality rather than emigration.

In 1999, WB McCaffery initiated a study documenting spring use of lowland meadows by migrant and breeding shorebirds. In 2000, BT Ruthrauff continued the study, replicating the 1999 work and expanding into additional areas of suitable habitat. In the two years combined, we found 15 shorebird species using lowland meadows in the spring (i.e., 10 May - 5 June). Pectoral sandpipers, dunlins, long-billed dowitchers, and red-necked phalaropes comprised more than 80% of all observations in both years. Pectoral sandpipers, dunlins, and long-billed dowitchers each occurred at average densities of more than 200 birds/km² during spring surveys in both years. The vast majority of pectoral sandpipers and long-billed dowitchers apparently did not remain to breed on the central YKD. Presumably, they continued north to either northern Alaska or, more probably, arctic Russia to nest.

Spectacled and Common Eider Nesting on Kigigak Island

In response to listing spectacled eiders as a threatened species and possible decline in the common eider population, field work on Kigigak Island was conducted for the tenth year. A field camp staffed by three and four refuge personnel was maintained from May 3 to July 8 and July 26 to August 4, respectively 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. Eliminating arctic fox from the island.
4. Assisting with coastal goose/eider production survey.

Spectacled and common eiders were first observed on Kigigak Island on May 16. Peak nest initiation occurred between May 27-June 1 and June 1-2 and peak hatch occurred between June 26-30 and June 28-July 1 for spectacled and common eiders, respectively.

A total of 239 eider nests were found, including 119 spectacled and 120 common. Productivity data are presented in Table D.1. The 7 arctic fox observed on the island were eliminated. Two dens were located.

Table D1. Common and Spectacled Eider Productivity, Yukon Delta NWR, 2000.

Category	Spectacled Eider	Common Eider
Nesting Success (Mayfield)	75.1% (n = 118)	71.6% (n = 120)
Mean Complete Clutch Size	5.0 eggs (n = 117)	5.4 eggs (n = 115)

Sixty-eight female spectacled eiders were nest-trapped between June 17 and July 7. 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-six of these females were new captures and 42 were recaptures, originally banded on Kigigak Island.

Thirty days post-hatch, at least 35 spectacled eider broods, including 29 adult females, 66 local females, and 78 local males were captured. Five of the 29 adult females were new captures and 25 of the marked adult females were trapped on nests this year. Thirty-three broods included marked adult females. A total of 300 adult females and 294 local spectacled eiders have been banded on Kigigak Island since 1992.

A total of 75 of 80 marked adult female spectacled eiders found on nests were identified. Two more marked adult females not found on nests were identified with broods.

Arctic Nesting Goose Studies

Current population estimates for the four goose species of special concern continue to show mixed results. Cacklers (210,440) continue to increase while brant (135,000, 2000 survey) and emperors (62,600) remain stable. The 1999 whitefront survey estimated 266,700 birds which is a 35% decline from 1998. Admitted accuracy problems with this survey in recent years is illustrated by the fact that a breeding ground survey indicated a decline in singles and pairs of 11% and total birds of 4%. As has been recently instituted for cackler population monitoring, a proposal is being considered to use breeding ground surveys to monitor the whitefront population.

For the first time in recent years, breeding ground aerial surveys also had mixed results. Pair and total bird indices were similar to 1999 for cacklers. Pair indices for emperor and whitefronts, however, decreased 22% and 11%, respectively. Total bird index for emperors also decreased (19%) but for whitefronts it was similar to 1999. See below for the 2000 estimate.

In general, chronologies of break-up, migration arrival, and nesting were considered "average." Float angles of eggs indicated average hatch dates of June 23 for brant and emperors, June 24 for cacklers, and June 25 for whitefronts. 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 80 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 Kanaryaraq field station. The survey estimated that 104,300 cackler, 34,700 emperor, and 98,500 whitefront nests were initiated on the 4,000 square kilometers of coastal habitat that contains about 90% of all geese on the Delta. Cackler and whitefront totals are the highest recorded for this survey and the emperor total has increased for the past four years.

Clutch sizes increased for all four species from 1999: brant: 3.7 eggs (n = 372), cacklers: 4.7 eggs (n = 1,509), emperors: 5.0 eggs (n = 344), and whitefronts: 4.5 eggs (n = 478). Nest success was good for all species -- brant (89%), cacklers (95%), emperors (99%), and whitefronts (98%).

Migratory Bird Management continued an aerial survey to document emperor goose production, but results are unavailable at this time. Data from the 1999 survey estimated 17,000 goslings present 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 for 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 life cycle periods. 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 (25,749) at Kokechik Bay, Tutakoke River, Kigigak Island, Baird Peninsula, and Baird Inlet Island were 36% above the long-term mean (18,976 nests) and the highest total since initiating the survey in 1992. No explanation was given but breakup and nesting chronologies were average and microtines were very abundant at some colonies. Such an abundance may have reduced egg loss to arctic fox.

The second BRD project was the sixteenth 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 chronologies for the study area were similar to 1999 and only slightly later than long term averages. Nest densities of all three species were the highest recorded by a margin of 9-20%. Clutch sizes were larger than long-term averages with cacklers, emperors, and whitefronts laying an average of 4.9, 5.0, and 4.6 eggs, respectively. Nest success for cacklers (70%) was higher than the long-term average, while those for emperors (87%) and whitefronts (86%) were comparable to other years of study. Plans for 2001 are under review.

The third BRD project was the tenth year of a study of duck research on the lower Kashunuk River focusing on spectacled and common eiders, greater scaup, and oldsquaw. Objectives include estimating nest success, recruitment rates of marked ducklings, annual survival of adult females, duckling growth and survival during brood rearing, and lead exposure rates. A total of 80 females were harnessed with radios (35 spectacled eiders, 35 greater scaup, 10 oldsquaw) to estimate duckling survival. Results indicated that survival to 30 days of age was 32% for spectacled eiders, 53% for greater scaup, and 9% for oldsquaw. Duckling survival continues to be highly variable across years and between species. Predation pressure may have been lower this year due to an abundance of small rodents. Mark-recapture data from 50 females estimate common eider survival to be 79%. Work in 2001 will again focus on spectacled eiders while continuing to monitor common eiders and increase monitoring of oldsquaw to multiple refuge sites.

The third 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 2000 are unavailable at this time.

The fourth BRD project was the seventh year of an emperor goose nesting ecology study at Manokinak River. Work in 2000 continued to monitor birds implanted with radios in 1999. 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. Forty of the marked birds returned to the Y-K Delta and at least 60% initiated nests. Average time between arrival and nest initiation was 17 days indicating that rapid follicle development is initiated after arrival on the breeding grounds. Two birds migrated to the Chukotka Peninsula, Russia to molt. No further work is planned. New work in 2000 involved using mark-recapture-resight methods applied to nesting birds to measure annual survival rates and assess magnitude of annual variation, as well as to examine the relationship of survival to harvest and relevant winter weather parameters. A total of 44 marked birds were observed incubating eggs. Thirty-one of these birds were banded in

1997 or earlier and 6 were banded as goslings. In 2001 work will continue to involve locating marked birds on a pre-selected set of plots and unmarked birds will be nest trapped to increase the marked population.

The fifth BRD project was a new initiative to document reproductive success, contaminant exposure, and the link between breeding populations and their non-breeding distribution for red-throated loons. A total of 15 birds (five each from the Y-K Delta and two other breeding populations) were implanted with satellite transmitters. Preliminary indications are that these breeding populations do not intermingle at other times of year. On-going analyses of eggs and blood samples have initially found no lead exposure, but comparatively high organo-chlorine presence. Analyses of nest success, chick survival, and foraging behavior are on-going. Work will continue unchanged in 2001.

The sixth BRD project was also a new start involving a one-year study to locate molting and wintering areas for common eiders nesting on the refuge and northern Alaska. A total of 20 incubating birds received implanted satellite transmitters and about half returned to their nests and may have hatched eggs. August and September locations indicated birds were dispersed off-shore during molting from the Kuskokwim Shoals to Hooper Bay. Birds continued to disperse to the south during October-December occupying locations from Kokechik Bay to Port Moller, Alaska Peninsula. Preliminary results suggest most of the refuge's breeding females do not mix with breeders from northern Alaska. Northern birds moved farther west, then south along coastal Russia and St. Lawrence Island. Since pair formation occurs early in autumn, there is probably little mixing among breeding populations.

The University of California, Davis initiated new research at the Kashunuk River study area mentioned previously. Objectives and results are unavailable at the present time.

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. Additional data were collected from 250 nests to document individual breeding success in relation to known wintering areas. New work included manipulating forage available on a traditional brood rearing site by doubling the available forage area through mowing vegetation to a suitable height. Analyses are continuing and results are unavailable at this time.

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 through the Natural National Landmark Program.

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 May 5. Brant were first observed on May 12 and 9 at Aknerkochik River and Big Slough camps, respectively.

Peak arrival occurred between May 13-15 and 16-18 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 448 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 434 and 529 goslings were web-tagged and 175 and 372 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 2001.

Bristle-thighed Curlews Investigations

Breeding Season

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 50% 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 3,300 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 May 2000, Harwood, assisted 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. Five of the six researchers that surveyed the Andreafsky population returned for the effort. Crews detected 36% more curlews than a decade ago, however over 60% of that increase was accounted for on a single plot, which was censused at a much more opportune time than in 1988. Comparative analyses between the replicated surveys of 1988-1991 and 1999-2000 are ongoing, and spearheaded by BRD-ABSC.

Fall Staging

In 1985-86 and 1988-89, ABSC personnel flew aerial surveys from the mouth of the Yukon to the mouth of the Kuskokwim to document temporal and spatial distribution of bristle-thighed curlews during fall staging on the outer Y-K Delta. In 2000, refuge personnel conducted aerial surveys in the Clarence Rhode National Wildlife Range unit of the refuge, between Nightmute and Kipnuk (north to south), and Dall Lake and Bering Sea (east to west). This area represents a subsample of the "south" section that was originally surveyed by BRD in 1987-88, and was chosen specifically because more curlews had been detected there than any of the other four sections. DRM/P Liedberg, along with observers BT Harwood, SWB Broerman, and WB McCaffery, flew 5 surveys (at 2-week intervals) between July 10 and September 14. Over 1600 km (~1000 mi) of transects were flown during each of periods I, II, and V, while half that were flown in periods III and IV, in the 2,444 km² study area. Very few curlews were detected in the five periods (1-2 individuals in Period I, and 3 in period III). While curlew sightings were scarce, large numbers of snowy owls were detected (see next section, G.6). We do not know enough about curlew use of fall staging areas to account for their presence in the study area in the late 1980's and their absence in 2000.

E. ADMINISTRATION

1. Personnel



(Back L-R) Ray Ayogun, Victor Anvil, James Sipary, Snow, P., Mike Rearden
(Front L-R) Paul Liedberg, Henry Ivanoff, Joe Asuluk, Phil Paniyak

Permanent

- | | |
|------------------------|---|
| 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 5/96, PFT |
| 3. Gene R. Peltola Jr. | Refuge Operations Spec./Pilot, GS-0485-12, EOD 9/99, PFT |
| 4. Patrick A. Snow | Refuge Operations Spec., GS-0485-5, EOD 7/16/00, PFT |
| 5. Fred Broerman | Supervisory Wildlife Biologist, GS-0401-12, EOD 6/4/00, PFT |
| 6. Michael L. Wege | Wildlife Biologist, GS-0486-11, EOD 4/83, PFT |
| 7. Brian J. McCaffery | Wildlife Biologist, GS-0486-11, EOD 10/86, PFT |
| 8. Steve Kovach | Wildlife Biologist, GS-0486-11, EOD 12/96, PFT |
| 9. David Cannon | Fisheries Biologist, GS-0482-11, EOD 7/98, PFT |
| 10. Robert Sundown | Subsistence Resource Specialist, GS-0401-11, EOD 5/21/00, PFT |
| 11. Charles F. Hunt | Native Contact Rep., GS-1040-12, Deceased 5/27/00 |
| 12. Alex S. Nick | Assistant Interpreter, GS-1040-9, EOD 11/84, Transfer 10/8/00 |
| 13. Donna Hanley | Education Specialist, GS-1701-9, EOD 8/99, PFT |
| 14. George Walters | Airplane Pilot, GS-2181-12, EOD 7/87, PFT |

15. Bernice M. Albright Computer Specialist, GS-0334-9, EOD 12/96, PFT
16. Phillip P. Paniyak Refuge Clerk, GS-0303-5, EOD 1/92, PFT
17. Martha Perry Refuge Clerk, GS-0303-4, EOD 2/87, PFT
18. Pat Jennings Maintenance Worker, GS-4749-8, EOD 12/97, PFT
20. Victor Anvil Maintenance Worker, GS-4749-8, EOD 8/99, PFT
21. Chris Harwood Biological Tech., GS-0404-7, EOD 3/91, PFT
22. Henry E. Ivanoff Biological Tech., GS-0404-5, EOD 8/91, INT
23. Raymond Ayogan Biological Tech., GS-0404-5, EOD 5/92, INT
24. Michael A. Jimmy Refuge Info. Tech., GS-1001-8, EOD 11/84, PFT (Seasonal)
25. James Sipary Refuge Info. Tech., GS-1001-8, EOD 2/96, INT
26. Joe Asuluk Sr. Refuge Info. Tech., GS-1001-8, EOD 1/94, INT
27. Leo Moses Sr. Refuge Info. Tech., GS-1001-8, EOD 6/90, INT
28. Jacob Isaac Refuge Info. Tech., GS-1001-8, EOD 2/97, INT
29. Andrew Kelly Refuge Info. Tech., GS-1001-7, EOD 7/98, INT
30. Eva Hopoff Refuge Info. Tech., GS-1001-6, EOD 10/99, INT
31. John W. Andrew Region Coordinator, GS-0301-11, EOD 7/99, Resigned 4/00



**(Back L-R) Pat Jennings, Fred Broerman, Steve Kovach, Dave Cannon
(Front L-R) Michael Jimmy, Robert Sundown, Alex Nick**



(L-R) Mike Wege, Donna Hanley, Jacob Issac, Gene Peltola, Jr., George Walters, Brian McCaffery

Temporary

Christine L. Moran	Student Trainee, GS-0499-7, EOD 9/95, SCEP
Samantha Bartling	Student Trainee, GS-0499-4, EOD 5/00, LWD 8/00
Darren Mayers	Biological Tech., GS-0404-5, EOD 5/00
Marnie Shepherd	Biological Tech., GS-0404-5, EOD 4/00, LWD 10/00
Chris Nicolai	Biological Tech., GS-0404-5, EOD 4/00, LWD 8/00
Aloysius Gump	Biological Tech., GS-0404-5, EOD 4/00, LWD 7/00
Thomas Olson	Biological Tech., GS-0404-5, EOD 4/00, LWD 7/00
William Naneng	Biological Tech., GS-0404-5, EOD 4/00, LWD 7/00
Zach Fairbanks	Biological Tech., GS-0404-4, EOD 6/00, LWD 7/00

Effective July 16, Patrick Snow was converted from a SCEP student to a permanent full time status employee, and is continuing his ROS training. Patrick began training in September of 1999 before returned to the University of Alaska, Fairbanks for the 2000 spring semester to finish his wildlife degree.

Fred Broerman arrived on duty on June 4th to fill the position of Supervisory Biologist. Fred has worked as a Biologist for both the Forest Service, at Six Rivers National Forest, California, and the U.S. Fish and Wildlife Service, at Loxahatchee NWR, Florida, and (most recently) North Mississippi Refuge Complex, Mississippi.

During the summer months the refuge received help from Samantha Bartling, a SCEP student from Colorado. Samantha spent time in a variety of field camps including goose plots at Kanagyak, the brant study camp, and work with an anthropologist. Samantha performed a number of tasks such as literature searches and other work with Realty to broaden her wildlife work experiences. She also managed to stay highly active in her free time helping out within the community, and experiencing Alaskan ways of life, such as spending her weekends at fish-camps with local residents.

As a result of the federal fisheries takeover, a Subsistence Resource Specialist position was created to support management decisions, and to help plan fisheries management with subsistence priority. The

position was filled by Robert Sundown. Originally from Scammon Bay, Robert has worked in Bethel since 1995. His experience includes a Fisheries Biologist position with AVCP, and a Business and Operations Manager position for both Coastal Villages Longline, a high seas fishery company and Coastal Villages Angler, a sportfishing company.

Alex Nick was selected to fill the Regional Regional Council Coordinator position vacated by John Andrew. John resigned in April and Alex was transferred to the position on November 8th. Effective with Alex's appointment, the position was returned to the Office of Subsistence Management in Anchorage. Alex will continue be co-located with the refuge staff.

Louie Andrew was selected to fill the Native Contact Representative position left by Chuck Hunt. He was scheduled to report for work in January 2001.



SCEP Student, Samantha Bartling from Colorado State University spent the summer working on the refuge. (TB 6/00)

Perhaps the most significant event to the refuge in 2000 was the loss of Charles Hunt. Chuck passed away in May of 2000. He was recognized for his superior performance, and exceptional achievements with the Meritorious Service Award, the second highest Departmental honor award that can be granted a career employee.



Although Chuck was no longer here to receive the award personally, a ceremony was held at refuge headquarters in December, at which time Regional Director Dave Allen presented the award to Chuck's mother and brother.

3. Other Manpower Programs

The SCEP (Student Career Experience Program) program has been used by the region and this refuge for several years. The refuge had three SCEP students in place during the year.

Tina Moran was a SCEP student during the year while conducting research for her master's degree. By the end of the year she had completed her requirements for graduation and was awaiting placement in a permanent position. Patrick Snow, who had worked for the refuge as a SCEP student in 1999, completed his requirements for a bachelor's degree in May and was converted to a permanent Refuge Operations Specialist (trainee) with the refuge in July. Samantha Bartling was recruited from the University of Colorado during the year and served her first SCEP position with the refuge from mid May through mid August. Samantha will have one more SCEP assignment before completing her bachelor's degree and being eligible for placement in a permanent position.

With some modifications to the recruitment and selection process which generally resulted in greater involvement by managers, some excellent candidates were found for the program and future employment.

4. Volunteer Programs

The Volunteer program has expanded greatly from last year from two volunteers to 14. Three volunteers worked in the summer field camps. Daniel Rizzodo assisted BT Ruthrauff in conducting shorebird field work at Kanagayak. Tanya Handa assisted BT

Chris Nicolai with duck banding at Kgun Lake, and Zach Fairbanks assisted WB Mccaffery with songbird research at Cape Romanzof. Two volunteers from Chevak, Alaska, Ester Friday and Flora Ayuluk researched and wrote native place names on existing USGS maps. Karen Hollingsworth photographed sights and scenes from the refuge for the 2001 National Wildlife Refuges Calendar. Elyse Williams volunteered to set up and host a salmon game for our National Wildlife Refuge Week Open House. Finally seven volunteers were recruited to staff the visitor center and museum on Saturdays during the visitor center open hours. Total volunteer hours logged for the year was 1,109 hours.

This year we organized and implemented volunteer training on refuge wildlife and projects from each of the biologists, RIT staff and Education Specialist. To date each of the five volunteers have received eight hours of training in biology studies occurring on the refuge, interesting facts on the refuge wildlife to share with visitors, wildlife activities to involve visitors, issues of which visitors might inquire, such as "Where are the fish weirs?", "What birds are of greatest concern?", "Are there penguins on the refuge?", etc.

After assisting with work at the Tutakoke River black brant colony conducted by University of Alaska, Fairbanks personnel, Tanya Handa from St. Lambert, Quebec assisted with duck banding at Kgun Lake from August 4-18.

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-96</u>	<u>FY-97</u>	<u>FY98</u>	<u>FY99</u>	<u>FY00</u>
1230/31 (Mig Birds)	56K	40K	40K	70K	135K
1260 (Refuge Ops)	1,993K	2,080K	2,340K	2369K	2423K
1937 (Subsistence Fisheries)					75K
1971 (NPS)		76K	19K	17K	17K
1113 (End. Species)		13K		15K	
Total	2,049K	2,209K	2,399K	2,471K	2,650K

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 FY00 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 a Cup'ik place names project was approved and \$6,000 was allocated for the project. The refuge worked with representatives from the village of Chevak to document the Cup'ik names of many of the sites on the refuge surrounding the village.

The subsistence division again funded several projects but unfortunately, they failed to fund a \$38,000 caribou monitoring project that was initiated in 1986 and has received subsistence funding for a number of years. One wildlife biologist position along with overhead and support was funded for a total of \$73,000. In addition they provided \$40,000 to continue the Kilbuck brown bear study which included a census and working group coordination, and \$10,000 to conduct a moose survey. The brown bear funding was far short of what was needed to conduct the final recollaring necessary to complete this study. Subsistence funding provided \$123,000 - approximately 4.6% of the station budget. This is down from \$146,000 and 6% of the station budget in FY99.

Migratory Birds (1231) provided \$15,000 for mallard and pintail banding, \$15,000 to support the Kigigak Island spectacled eider study, \$5,000 to conduct cackling Canada goose banding, and \$100,000 to conduct the waterfowl harvest survey. Due to changes in personnel, the coordination of the waterfowl harvest survey was shifted from Migratory Birds to the refuge office which accounted for the additional \$100,000 in these funds.

Two Maintenance Management System projects were funded for a total of \$45,000. These included \$20,000 to replace a boat and \$25,000 to replace fish weir panels. For the first year we received AMMS funds totaling \$21,000. These funds, directed at conducting needed maintenance before projects hit the MMS list, were used for replacing the eight tiring circulating pumps in the headquarters boiler room, complete the installation of new fuel tanks at the Kanagyak field station, and purchase of some equipment for the hangar restroom facility.

For the first year we received funding in the 1937 account to support management of subsistence fisheries on the refuge. Two positions were funded which included a Subsistence Resource Specialist and a Refuge Law Enforcement Officer.. A total of \$75,000 was provided in this account.

6. Safety

Bear and Firearms Safety Instructor/Biologist Steve Kovach conducted bear and firearms safety training for 12 refuge staff, two volunteers, one Alaska Department of Fish and Game staff (cooperator), and one Association of Village Council Presidents, Inc. (cooperator) during the spring and summer of 2000. Kovach also provided a bear safety lecture for both Boy Scout Troops in Bethel in early summer.



Grizzly taking five (SK)

Intermountain Technical Solutions, Inc., from Cortez Colorado was contracted by the Denver Engineering Center to write a spill prevention and control plan for the refuge. A representative visited the headquarters site in Bethel and the Kanagyak field station on September 18 to collect information and write the plan. This had not been completed by the end of the year.

A representative from the National Rural Water Association based in Eagle River, Alaska prepared a report in May of our drinking water facilities. Unbeknown to us, this is a report that is due annually and makes the public aware of our water test results and quality of our system.

F. HABITAT MANAGEMENT

7. Grazing

An aerial survey to count reindeer on Nunivak Island was not flown in 2000 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.

9. Fire Management

Two unusual fires were recorded over the course of the year, both of which occurred in the northern portion of the refuge. The first fire was reported 35 nautical miles northeast of Emmonak on the 23rd of June. When first sighted, the fire was estimated to be 65 acres and approximately ½ miles long, moving east-southeast. Although no structures were threatened, the fire was in



Photo of the 14,000 acre fire near Kotlik, taken December 28. (GW 12/00)

a full suppression area. Eight smoke jumpers were deployed and had begun their attack within five hours of the initial fire report, by which time the size of the fire had grown to an estimated 80 acres. Late that evening the smoke jumpers had contained the fire, and by the morning of the 24th it had been declared out, after consuming 95 acres of tundra.

It was speculated, by smoke jumpers at the scene, that the fire was human caused. There was a campfire site and firewood near the origin, which appeared to have been utilized shortly before the fire was reported. However, due to lack of evidence, no further investigation was performed.

A second fire 20 miles east, southeast of Kotlik was reported to Refuge headquarters on December 28. The fire was reportedly started by a snow machine back-fire that occurred on December 27. However, having never heard of this or seen it before, it is more likely that the fire was caused by an unattended campfire. Pilot George Walters and

Supervisory Fish & Wildlife Biologist Fred Broerman flew over the fire at 1350 hrs on December 28 and collected GPS way points along its perimeter. A similar reconnaissance flight was conducted on December 29 which found the fire's activity less aggressive than the day before.



Another angle of the 14,000 acre fire near Kotlik, taken December 28.
(GW 12/00)

Weather conditions prevented surveillance flights originating from Bethel until January 3. A Hageland Aviation pilot who flew the January 3 surveillance with Wildlife Biologist Fred Broerman, and had made regular flights from St. Mary's to Kotlik during the last days of December, indicated that the fire had been out since December 31.

GPS waypoints were loaded into the refuge's GIS software and the acreage of the fire's perimeter was calculated at 8,000 acres on December 28, and 14,500 acres on December 29; 10 miles long (north-south) and 4 miles wide (east-west) at its farthest points. The fire was situated north of the Pastoliak River, west of the Andreafsky Wilderness, and southeast of Hogback Hill. There were no dwellings or inhabited structures in the vicinity of the fire.

Year 2000 was the 17th 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 Andraefsky 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 Andraefsky 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 Andraefsky 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 Andraefsky 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. There is one large game guide, Eric Williamson, who operates out of the Andraefsky Wilderness area. This year two brown bears were successfully harvested in the Andraefsky area through Williamson's guiding operation.

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. A plaque identifying this designated area is displayed in the refuge headquarters entry.

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. In 2000, the Andraefsky Wilderness and vast expanses of the refuge's coastal meadows were designated as a hemispheric reserve in the Western Hemisphere Shorebird Reserve Network (WHSRN).

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 2000 population for emperor geese - 62,600 - remained near the average 59,500 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 2000 estimate for cacklers and the 1998 estimate for whitefronts are 210,440 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. Results from the 2000 breeding pair survey are currently unavailable, but historically, 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 2000 estimate was about 2,900 breeding pairs. Sea ducks in general have been declining throughout the continent and region; long tailed duck 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. Evidence continues to accumulate that a tiny breeding population of Steller's eiders exists on the coastal tundra of the refuge. Most of the Alaska-breeding population, however, nests on the North Slope. Before 2000, we did not know whether or not the flocks migrating and/or molting along the refuge's coast include any individuals from this threatened population. In summer 2000, cooperators from Northern Alaska Ecological Services (FWS) and the North Slope Borough attached satellite transmitters to four Steller's eiders at Barrow, the most well-known and predictable breeding location on the North Slope. All four birds left the Barrow breeding grounds on fall migration. One died on the Seward Peninsula, but the other three continued south. All three stopped at the Kuskokwim Shoals along the refuge's southwest coast. One stopped only briefly, but the other two stayed on the shoals for at

least 2 months (where they presumably molted) before continuing on to the Alaska Peninsula in November. These detections are the first data to explicitly link the threatened breeding population with the birds molting in the shallow waters just off the refuge coastline.

3. Waterfowl

Biological Technician Harwood and ROS/P Peltola conducted the harlequin duck breeding pair survey on May 25 along the same 181 km of streams surveyed from 1994-1999, 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 2000, 374 harlequins were counted along the five survey streams. Between 1994 and 2000, 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 = 0.972)

On September 5, 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, 17, and 23 harlequin duck groups were detected in this area in the years 1995-2000, respectively. These groups included 172, 104, 50, 43, 75, and 83 total birds (i.e., young and hens) during the same six years, respectively.

Pintail banding was again conducted in 2000 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 2000 totals.

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.

Nesting biology data were collected for red-throated and pacific loons on Kigigak Island. Sixty red-throated and 12 pacific loon nests were found. Peak nest initiation dates for red-throated and pacific loons were 1 June-5 June (range = 28 May-13 June) and 5 June -

6 June (range=31 May-17 June), respectively. Peak hatch dates for red-throated and pacific loons were 1 July-3 July (range=28 June-9 July) and 2 July (26 June-7 July), respectively. Productivity data are presented in Table G.1.

Table G1. Red-throated and Pacific Loon Productivity, Kigigak Island, Yukon Delta NWR, 2000.

Category	Red-throated Loon	Pacific Loon
Nesting Success (Mayfield)	60.1% (n = 58)	39.1% (n = 11)
Mean Complete Clutch Size	1.84 eggs (n = 60)	1.77 eggs (n = 12)

5. Shorebirds, Gulls, Terns, and Allied Species

On July 12, SFWB Broerman and Subsistence Resource Specialist Sundown conducted counts of nesting gulls and terns on Neragon Island and Aniktun Islands located offshore of Scammon Bay and south of Cape Romanzof, respectively. About 107 glaucous gull nests were counted on Neragon Island, as well as nine pairs of Arctic terns and ten young Caspian terns. A single adult slaty-backed gull was also seen on the island. It exhibited low swooping behavior, typical nest defense for gulls, but nesting was not confirmed due to there being many glaucous gull nests in the immediate area which have very similar looking eggs and nests. One hundred and thirty-eight glaucous gull nests were found on Aniktum Island.



One of ten Caspian tern chicks found on Neragon Island on July 12. (7/00 RS)

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, just south of Cape Romanzof. One pair nested there in 1996 and 1997. Slaty-backed gulls are also rare but regular visitors to Nunivak Island. Between June 26 and July 1, 2000, a second-summer black-tailed gull was seen and photographed at Cape Romanzof. This bird represents the first refuge record for this Asiatic species.

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, three 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.

Cliffs on the southwest side of Nunivak Island provide nesting sites for an estimated 500,000 seabirds, primarily common murres 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.

6. Raptors

Nineteen species of raptors have been recorded on the refuge, including golden eagles, bald eagles, and peregrine falcons. The coincidence of high populations of both small rodents and hares on the refuge in 2000 may have led to the abnormally high abundance and/or productivity of several raptor species (including northern goshawk, golden eagle, snowy owl, northern hawk owl; see following).

The Kisaralik River is among the most important areas on the refuge for nesting raptors, and supports one of the densest populations of breeding golden eagles in North America. For the tenth consecutive year, the refuge conducted a helicopter survey for cliff-nesting raptors in the Kisaralik watershed (to include the Kisaralik River and Quicksilver Creek). Along approximately 100 km of river in early May, WB McCaffery located 28 active cliff nests, including four rough-legged hawk, 18 golden eagle, and six gyrfalcon nests within 1.6 km of the river (study area = 320 km²). The density of breeding golden eagles was the highest ever recorded in the long-term study area. In 2000, we also had the opportunity to determine raptor territory occupancy in an additional 680 km² area surrounding the core, long-term, study area. This expanded 1000 km² survey area supported nine occupied rough-legged hawk territories, 30 golden eagle territories, and 14 gyrfalcon territories.

Although golden eagle productivity in the core study area was the lowest ever recorded in 1999, productivity increased dramatically in 2000. Both the total number of young fledged (21) and the number of fledglings per successfully nesting pair (1.91) were the highest recorded during the ten-year survey.

In 2000, WB McCaffery also completed cliff-nesting raptor surveys in the Ingakslugwat Hills ("Mud Volcanoes") east of Chevak, as well as in the Askinuk Mountains between Kokechik and Scammon bays. Common ravens were included in both surveys because their nesting requirements, nesting chronology, and (at least occasional) predatory

behavior are all similar to cliff-nesting raptors (see also G10, Other Resident Wildlife for additional information on ravens). Possible territories were identified by the presence of at least one bird at an established nest site. On the volcanic cones and lava flows of the Ingakslugwat Hills, we identified 10 rough-legged hawk territories, five golden eagle territories, eight gyrfalcon territories, and five common raven territories. In the Askinuk Mountains we located 32 rough-legged hawk territories, two golden eagle territories, 11 gyrfalcon territories, and seven common raven territories.

During the 1998 Lower Yukon BBS, BT Harwood made only two observations each of goshawks and hawk owls. Although the data in the two years are not statistically comparable, the increased frequency of sightings in 2000 probably reflects real population increases. Both goshawks and hawk owls were reported more frequently than normal in wooded habitats and shrublands elsewhere on the refuge in 2000. Observations ranged from the breeding season to the early winter.

The refuge did not independently assess the relative abundance of hares in 2000. Thus, the hypothesis that increased hare numbers supported larger and/or more productive populations of some raptor species in 2000 is based solely on the number of hare-eating raptors counted (e.g., northern goshawk, golden eagle). Observations of great horned owls (a species that also concentrates on hares during population highs) along the Yukon River, however, were not clearly consistent with this hypothesis in 2000. Although Harwood detected more adult owls in 2000 relative to 1998 (27 vs. 20), he saw virtually the same number of pairs (five vs. six), and fewer broods and young (two broods totaling 2 young in 2000, 6 broods totaling 14 young in 1998). As a result, the hypothesis that there was a major peak in hare numbers on the refuge in 2000 must remain a hypothesis.

Snowy owls were detected in unprecedented numbers south of Nelson Island during aerial surveys originally intended for documenting distribution and abundance of fall staging bristle-thighed curlews (see previous section, G.5). Aerial estimates for the five periods surveyed are presented in the table below.

In the riparian spruce woodlands visited during the Lower Yukon Breeding Bird Survey (see section G.7), BT Harwood's discovery of 11 red-tailed ("Harlan's") hawk nests further enhanced our ability to characterize the breeding range of this species near the western edge of its range. Nests were recorded on seven of nine routes within the spruce belt; individuals were detected on nine of nine. Nesting details are as follows:

- 1) 1 nest - Lower Paimiut Slough BBS
- 2) 3 nests - Twelvemile Slough BBS
- 3) 1 nest - Talbiksok River BBS
- 4) 3 nests - Igevraq Slough BBS
- 5) 1 nest* - Reindeer River BBS (pair appeared to be building nest)
- 6) 1 nest - Five Day Slough BBS
- 7) 1 nest - Driftwood Slough BBS

During the course of the same survey, BT Harwood recorded 5-7 goshawks. Interestingly, goshawks were detected on rivers located in the downriver half of the study area. All but one observation occurred in habitats beyond the spruce/birch line (i.e., in riparian poplar woodlands). Observations are detailed as follows:

- 1) 6/14/00 - 1 adult attacking American wigeon over Center Slough
- 2) 6/21/00 - 1 adult on Driftwood Slough
- 3) 6/22/00 - 1 adult alarm calling (mobbing?) at great horned owl on Pektotolik Slough (nesting?)
- 4) 6/24/00 - 1 female in nest on Nanvaranak Slough
- 5) 6/25/00 - 1 adult carrying food on Takwaklanuk Slough (Aproka Pass BBS)
- 6) 6/25/00 - 1 adult on Aproka Pass, 6 miles from #5 (same as #5?)
- 7) 6/25/00 - 1 adult hunting over Driftwood Slough (same as #2?)

BT Harwood also recorded northern hawk owls on three dates on three different rivers during the Lower Yukon River Breeding Bird Survey (see section G.7). Details are as follow:

- 1) 6/13/00 - 3 adults on 3 different stops represented 1-3 birds on the Talbiksok River route; raspy "razor" call suggested local nesting
- 2) 6/14/00 - 1 adult seen on Reindeer River BBS
- 3) 6/15/00 - 3 adults (including probable pair) on 2 stops on Reindeer River (not including seemingly same bird from 6/14 in same tree)
- 4) 6/15/00 - 1 adult on Center Slough

During the 1998 Lower Yukon BBS, BT Harwood made only two observations each of goshawks and hawk owls. Although the data in the two years are not statistically comparable, the increased frequency of sightings in 2000 probably reflects real population increases. Both goshawks and hawk owls were reported more frequently than normal in wooded habitats and shrublands elsewhere on the refuge in 2000. Observations ranged from the breeding season to the early winter.

Snowy owls were detected in unprecedented numbers south of Nelson Island during aerial surveys originally intended for documenting distribution and abundance of fall staging bristle-thighed curlews (see previous section, G.5). Aerial estimates for the five periods surveyed are presented in the table below.

Survey Period	Period Dates	Estimated Snowy Owl Population	95% Confidence Interval
Period I	July 10-12	76	30 - 122
Period II	July 24-25	126	70 - 182
Period III	August 7-8	178	96 - 260
Period IV	August 21-22	220	83 - 357
Period V	September 11-14	136	76 - 196

Snowy owls were not evenly detected throughout the 2,444 km² study area; densities were markedly higher in the southern half (Cheforak to Kipnuk). Several juvenile birds, apparently attended by adults, were detected in the two latter surveys and may have represented local nesting. Regional arvicoline (i.e., *Dicrostonyx*, *Lemmus*, and *Microtus*, spp.) highs occur on the refuge every presidential election year, although this is the largest only concentration of summering snowy owls that we have documented on the refuge during any of the present staff's tenure here. We suspect that a considerably higher than normal amplitude in the arvicoline high in this area partly explains the abundance of snowy owls there. Migratory Bird Management personnel, however, conducting a concurrent aerial survey for emperor geese north of Nelson Island, observed only one snowy owl in their study area. The absence of snowy owl in this region in late summer is particularly surprising given the locally high nesting densities of short-eared owls found there earlier in the year.

7. Other Migratory Birds

In 1998, the refuge initiated a widescale landbird monitoring program of the Lower Yukon and Lower Kuskokwim rivers. 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 and, (3) to remedy the lack of ornithological data in the study areas. Eighteen (Yukon) and 12 (Kuskowkim) breeding bird survey routes were established in each watershed. The Yukon and Kuskokwim routes are run in even- and odd-numbered years, respectively.

Between June 8 - 27, 2000, BT Harwood conducted breeding bird surveys of 13 sloughs and tributaries of the Lower Yukon River, between Holy Cross and Emmonak. The number of routes was reduced (from 18 done in 1998) to a more manageable effort, which also provides a cushion against foul-weather days. Harwood was ably assisted by RIT Isaac and ROS Snow, who split duties as boat driver. Survey protocol followed that of standard river-run Breeding Bird Surveys (BBS). Stops totaled 650 and were distributed over >325 river miles.

Including official surveys and incidental observations, 90 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 Yukon River (some 265 miles between Holy Cross and Emmonak). Comparisons of species abundance and distribution presented here are restricted to detections made during official survey periods.

As in 1998, the most abundant species (based on individuals detected per stop) on the survey was bank swallow (3.7 individuals/stop), though it was only detected on 32% of the stops. Sixty-two percent of the bank swallows were detected on one route, which includes 2 enormous colonies. Interestingly, bank swallow detections on this route were about half those of 1998, perhaps due to the presence of nesting peregrine falcons!

The second-most "abundant" species (again, based on individuals detected per stop) was northern waterthrush (2.8 indiv./stop). Additionally, waterthrush was the most widespread species based on detection frequency (i.e., percentage of stops on which detected), being detected on 97% of all stops. Seven species averaged ≥ 1 indiv/stop in 2000, versus five in species in 1998.

Abundance indices for "Species of Concern" were also analyzed. The eight species for the Western Alaskan Bioregion (as determined at the 1999 Alaskan Boreal Partners in Flight Working Group meeting) include: gyrfalcon, gray-cheeked thrush, varied thrush, blackpoll warbler, golden-crowned sparrow, McKay's bunting, rusty blackbird, and hoary redpoll. It appears from detection frequencies/rates that this survey, in conjunction with the Kuskokwim BBS, can help to monitor three to four of the species (i.e., gray-cheeked thrush, varied thrush, blackpoll warbler, and probably rusty blackbird). Gyrfalcon, golden-crowned sparrow, and McKay's bunting were not detected, while no attempt was made to distinguish hoary redpoll from its congener, the common redpoll.

Funding/personnel 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 surveys.

In addition to the work on the LowerYukon River, the refuge monitored populations of neotropical migrants and other landbirds with two Breeding Bird Surveys (BBS). BT Harwood and ROS Snow conducted the Gweek River BBS for the seventh consecutive year and WB McCaffery and RM Rearden conducted the St. Mary's BBS for the eighth consecutive year.

8. Game Animals

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.

Two census areas have been identified on the refuge (one along the Yukon River; one along the Kuskokwim River and Kilbuck Mountains). The refuge, in cooperation with ADF&G, attempts to conduct one census each winter (Kuskokwim River/Kilbuck Mountains in even numbered years). 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.

We continued to utilize the new spatial census protocol. On March 8-12, 2000, the Kuskokwim River subsection of the Kuskokwim River/Kilbuck Mountains census area was covered using two PA-18 Super Cubs and one A-1 Aviat Husky aircraft. The census subsection encompasses 2,349 km² (907 mi²) along the Kuskokwim River from the Gweek River to Upper Kalskag. We randomly selected and censused 60 (996 km² or 384 mi²) of the 141 census blocks and located 11 calves and 59 adults. Using the new spatial statistics method, the population estimate was 86 moose (for a density of only 0.09 moose/mi²) with the 95% confidence interval only 26.4% of the point estimate. In contrast to the two previous census efforts on the Yukon River, this census found only 19 calves per 100 adults whereas we recorded 33 calves per 100 adults in two Yukon River census subareas in two different years.

The only other time this area was censused was in 1993. At that time 49 moose were observed and the estimated population was 200-250. Notes collected during the census indicated that crews were having a difficult time observing moose and many did not have much confidence in the numbers being collected. Taken at face value, this latest census indicates that the population is less than half its former size. We do not believe that the population has declined to this extent, but we are confident that the population has declined to some degree.

With the latest census data, managers (both state and Federal) must carefully consider future management efforts, including opening of any hunting seasons.

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.

9. Marine Mammals

On August 1, RM Rearden and SFWB Broerman conducted a beached mammal survey using the station's Cessna 206. The survey was flown from Kuskokwim Bay to the mouth of Okwega Pass in Pastol Bay. The survey found 62 marine mammal carcasses, 49 were Pacific walrus, 4 seals (one was identified as a bearded seal) and 9 whales, all of which appeared to be beaked whales. Ninety-four percent of the beached mammals seen on the survey were south of Cape Romanzof and 53% were south of Nelson Island. RM Rearden and DRM Liedberg returned to one of the whales in September to collect samples of the carcass which were sent off to be analyzed to find out its identity. At the time of this writing we had not received results from the analysis.

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.

Bristle-thighed curlews reach their highest breeding densities in the southern Nulato Hills, south of Allen Creek and west of the north fork of the Andreafsky River. In this region, breeding common ravens are the most serious predator of bristle-thighed curlew eggs and chicks. In order to determine the abundance of nesting ravens in this area, WB McCaffery and RM Rearden completed a fixed-wing survey on April 27 and 28. Within the 31-township survey area, we randomly selected and surveyed 10 townships. We flew by and/or circled all poplar groves and potential cliff-nesting habitat within each of the sampled townships. In addition, we also surveyed along all major streams in the study area, again specifically checking all poplar groves and cliff habitat. We located 20 active raven nests, 13 in upland poplar groves and seven in riparian poplar groves. Among the 20 nests, 15 were found in sampled townships (10 upland, five riparian). The estimated number of pairs nesting in the survey area based on data from the 10 sampled townships was 46.5 ± 21.6 (i.e., 25-69 pairs).

This estimate does not incorporate a visibility correction factor. The nests are believed to be in poplar groves. On more than one occasion, a nest was found on the first or second pass over a grove, and then not observed on several subsequent passes. This occurred more frequently in the larger groves where there was more habitat to scan. One of the factors making observations difficult in the poplar groves was the prevalence of melt-holes at the base of most trees. From the airplane, each melt-hole appeared as a large dark circle, which was the same basic search image as for nests. Although melt-holes were not confused for nests, the presence of melt-holes (and the time required to confirm their identity) may have distracted us from detecting actual nests nearby. In general, the progress of snow melt made for an extremely variegated landscape. The patchy high contrast made searching less than optimal. In addition, ravens do occasionally nest in spruce in the Andreafsky watershed. We neither saw nor actively searched for raven nests in spruce trees because of the low probability of detecting them from the air.

Although there were not many spruce groves within our study area, their presence almost guarantees that our estimate of nesting pairs is a minimum.

11. Fisheries Resources

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 (chinook, chum, coho, and sockeye) commercially harvested in Kuskokwim Bay, Norton Sound, the lower Yukon River and Bethel areas. Other important species include several species of whitefish, sheefish, Alaska blackfish, burbot, northern pike, and grayling. Nearshore ocean habitats harbor Pacific herring, halibut, tomcod and starry flounder.

This past decade, southwestern Alaska experienced several severe economic and social hardships as a consequence of unusually poor salmon runs; unfortunately, this year was no different. 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. Considering that many of the salmon species spend three to five years in the ocean and the time it takes for stocks to rebuild, it'll be at least a few more years before we can hope for near "normal" returns. 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 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. However, the following results do not bode well for future returns of salmon into refuge streams.

East Fork Andreafsky River Salmon Escapement Study (Yukon River drainage)

The East Fork of the Andreafsky River weir was operated again by the Kenai Fisheries Resource Office in 2000. The weir facilitates Service monitoring of refuge spawning salmon stocks and other resident species, scale pattern analysis, age/sex/length, run timing and abundance data. All data are shared with ADF&G. The state uses the information for managing the commercial and subsistence chinook and summer chum salmon fisheries. This information is also used in the Yukon River Joint Technical committee U.S./Canada Pacific Salmon Treaty negotiations.

This summer the weir operated from June 29 to September 23, with the chums, pinks, and coho showing up later than usual. The chum salmon escapement of 22,918 was the lowest since 1994; in comparison, the 1994-1996 escapements ranged from 108,450 to 200,981 fish and less than 55,000 chum salmon passed the weir each of the past five years. A total of 1,344 chinook salmon escaped into the river compared to 4,011 in 1998 and 3,347 in 1999; 1994 and 1995 had 7,801 and 5,841 fish, respectively. The bright spot in this year's return were the coho salmon, of which 8,225 passed the weir; by comparison 1995 and 1996 returns were 10,901 and at least 8,037 fish, respectively. Other salmon returns included 77 sockeye and 37,069 pinks, while 5,005 whitefish, 18 Dolly varden, 25 northern pike, and 8 grayling were counted passing through the weir. Weir counts on the resident species are not very indicative of their abundance because most are able to squeeze between the pickets and move about undetected.

Strong pink salmon runs occur during even numbered years in western Alaska. The weir has had counts as high as 316,530 such as in 1994. By comparison, the 37,067 fish that passed the weir in 2000 is quite low. In both the Yukon and Kuskokwim drainages it appears that pink salmon numbers were low overall, but no one is certain why. An important concern that cannot be overlooked is the reduced amount of marine derived nutrients which will not be available for terrestrial and other aquatic species which are highly dependant on them.

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. Throughout the Kuskokwim River drainage, the combined annual commercial and subsistence harvests have been as high as 1.5 million chum, 100,000+ chinook, and 900,000+ coho. Considering these high exploitation rates, there is very little information available about fish populations and their status in the lower Kuskokwim River, in particular on refuge waters. 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 Aniak and McGrath. The relatively few projects are considered indexes, and are intended to be indicative of what populations are doing throughout the drainage.

Kwethluk River Weir

The Kwethluk weir was the only monitoring project on the refuge in the Kuskokwim drainage, and is used to assess run abundance, timing, and age and sex composition. This project was funded by federal subsistence dollars which came about due to the Federal Government acquiring responsibility for fisheries subsistence



The Kwethluk River weir panels are flown in. (DC 6/00)

management on federal waters in 1999. A weir had been in place in 1992, but the local perception that weirs killed fish resulted in the Village of Kwethluk insisting that it be removed. After negotiations with the village in 1999 and 2000, approval was given to the refuge to reinstall the weir. A formal Section 809 agreement was signed and it was constructed in Bethel in the spring by the Kenai Fisheries Resource Office with the help of two individuals from the Village of Kwethluk. The components were then flown to the site via helicopter in early May, and it was installed by mid June and the counting of fish began on June 22.

The results from this year's project will be compared to 1992, but unfortunately two years of data that far apart in time are hard to interpret; especially since the various species of salmon have different and varied life history patterns among the same species. Overall, 1992 was considered an average to above average year for commercial and subsistence harvests, but over half of the escapement projects throughout the entire drainage did not reach escapement goals.

Table G2. Comparative escapement years for the Kwethluk weir.

Year	Chinook	Chum	Sockeye	Pink	Coho
1992	9,675	30,596	1,316	45,952	45,605
2000	3,547	11,691	1,049	1,407*	25,610

*The spacing of the pickets on the weir in 2000 were a little further apart than what was in place in 1992, this allowed many of the pink salmon to squirt through without being counted. However, since 2000 was an even numbered year (pink runs are strong) and if it was close to being a "normal" sized run, more pinks should have used the counting chute. This low return is cause for alarm, not only for pinks but for the chinook, chum and coho because of the marine derived nutrients which salmon provide to the entire ecosystem.

Kisaralik River Float

The Kisaralik River was floated by FB Cannon, BT Mayers, and SWB Broerman from August 7th through the 14th. The purpose of the trip was for FB Cannon and SWB Broerman to become familiar with the river's fisheries and avian resources and its recreational float use; the refuge is concerned with increased float use and its effects on other resources. FB Cannon observed the preferred spawning habitat for chinook and chum salmon habitat with the intent of determining the feasibility of habitat quantification for setting carrying capacities as they relate to the State's Biological Escapement Goals. Unfortunately most of the spawning habitat was underutilized due to the low salmon returns for 2000. It rained the majority of the trip which reduced the water's visibility. This reduced visibility and low returns resulted in only about 60 chums being observed and an undetermined amount of chinook (at least 40); very few chum (< 10) or chinook (3) carcasses were seen. Even though conditions deteriorated as the trip progressed downstream, more fish would have been observed if the run strength was stronger.

Eek River Float

The Eek River was floated by FB Cannon, BT Mayers, and Bob Lafferty of the Alaska Department of Fish and Game, Sport Fish Division between July 18 and 23. The purpose of the trip was to get familiar with the river, and assess the potential for quantifying the habitat to determine carrying capacities for chum and chinook salmon. Overall about 154

chinook salmon were observed and only 13 chums; turbidity was moderate due to continual rain, which only allowed for seeing actively spawning chum salmon.

Nunivak Island Stream Surveys

BT Mayers and FB Cannon surveyed five streams that drain into Duchikthluk Bay (Difjakamiut, Kowikarurmiut, Kangiktoolikmiut, Kyagamiut, and Duchikmiut). Chum salmon were observed spawning in all but the Kowikarurmiut. Most streams on the island are relatively short (less than 15 miles) and support chum salmon, coho salmon, and Dolly Varden. These streams are good candidates to assess potential carrying capacities because of their length and the ability to determine accurate subsistence harvest levels. It may be possible to determine a methodology to accurately quantify carrying capacities at this smaller scale, then refine the technique and expand it to larger systems like the Kisaralik, Kwethluk, or Andreafsky Rivers.



BT Mayers snorkeling one of the Nunivak Island Streams. (DC 7/00)

Fishing

With an estimated 500,000 lakes and ponds, and the two largest river systems in the state running through the refuge, sport, commercial, 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 (i.e., 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 sticklebacks 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. 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. Fish play an important part in the subsistence activity and account for a large 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 substantial quantities of 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.

For the first time ever, subsistence fishing restrictions were imposed on the Kuskokwim to conserve chinook salmon. This took place in the form of mesh size restrictions with no gillnet greater than six inches stretch mesh permitted. Similarly, restrictions were also imposed on the Yukon River in an attempt to fill subsistence needs to upriver fishers for chinook and chum salmon.

Within the refuge boundary on the lower Yukon River, 70,163 summer chum salmon were harvested compared to the previous five year average of 97,002; 6,925 fall chum were harvested compared to the previous five year average of 10,229; 20,815 chinook salmon were harvested compared to the previous five year average of 21,609; and 3,128 coho were harvested compared to the five year average of 5,332.

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 2000, the lower portion of the Kuskokwim River yielded approximately 64,917 chinook salmon compared to the previous five year average of 83,288; 51,705 chum salmon compared to the previous five year average of 59,584; 41,801 sockeye salmon compared to the previous five year average of 38,379; and 33,794 coho compared to the previous five year average of 31,914 salmon for subsistence use.

Commercial Fishing

The commercial harvest of salmon 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 commercial fishery in the Kuskokwim River is directed primarily at chum and coho salmon. Commercial salmon fishing occurs in the Yukon River 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 rivers are of mixed stocks, with many of the fish originating from refuge waters.

Salmon returns in 2000 were among the lowest on record, therefore, commercial fishing periods were reduced severely in both the Kuskokwim and Yukon River drainages. Because of the weak chinook run and the potential for their incidental catch, only one commercial period targeted at chums occurred on the Kuskokwim River. The commercial fishery for coho salmon did not start until the incidental catch of chum salmon was thought to be low enough to not harm their stocks. The lack of fish resulted in the 2nd lowest amount of fishermen (532) fishing since 1972, 1999 being the lowest at only 509 permit holders participating; normally there are over 800.

Only 11,570 chum salmon were harvest in the Kuskokwim commercial fishery in 2000 compared to a five year average of 673,777 from 1988-1992. A total of 444 chinook salmon were incidentally caught which is the lowest amount since 1960; from 1960-1999 the total harvest of chinook salmon has ranged from 25,000 to 140,000 fish. The coho run appeared strong early on, and fishing began on August 1st. A total of twelve commercial periods occurred totaling 72 hours which harvested 259,721 coho salmon. The parent year for this year's return (1996) was very strong, and saw 937,299 coho commercially harvested. Unfortunately in 2000, the run didn't maintain itself and the commercial harvest was considered below average.

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.

Because of the lack of data, there is concern that excessive commercial harvest of this mixed stock fishery may place refuge stocks in jeopardy of being over-fished during years of low returns. As previously mentioned in the Kwethluk weir section, only 25,610 coho escaped into the Kwethluk River in 2000, when 45,605 escaped in 1992. These low numbers coupled with the poor showing of chinook, chum, and pinks is cause for alarm for future generations of anadromous and resident species. Nutrients released from decaying carcasses enrich the environment of anadromous and resident juveniles by affecting the entire food chain, while adult resident species (e.g., rainbow trout, Dolly Varden, and grayling) consume rotting flesh and stray eggs. Without adequate nutrients, refuge streams may experience reduced productivity levels for many years to come.

Three 6-hour commercial salmon fishing periods occurred within in the entire U.S. portion of the Yukon River, and all were within the refuge boundary. For the first time since Alaska statehood, no commercial fishing occurred in the upper portion of the Yukon River. During the commercial periods, only 8,518 chinook salmon were harvested, which was 91 percent below the 1990-1999 average. Similarly, only 6,624 summer chum salmon were harvest which was 96 percent below the previous 10 year average of 155,022. The average income for commercial fishers this year was \$1,306.00.

Because incomes are low and other types of employment are scarce, the importance of sustaining adequate harvest levels becomes very clear.

Pacific herring are harvested in three commercial districts along the refuge coast, Cape Avinof, Nelson, and Nunivak Islands. Commercial fishing for whitefish is limited, but could expand in the future; just recently there was a request for a large scale permit within the refuge in the Yukon River. 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.

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. Native 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.

14. Scientific Collections

In an effort to increase the number of viable radio collars on caribou we captured and handled 11 yearling female caribou in June 2000. Nine received radio collars, the other two died during handling from stress. This capture was timed to capture yearling females on the calving grounds of the remnants of the Kilbuck Caribou Herd.

We captured and handled 38 brown bears (34 females, 4 males) in June 2000. Twenty bears were recaptures from previous years; 18 had their radio collars replaced, one had her radio collar removed, and one had a new radio collar attached. Only 10 of the remaining bears were radio collared. Bears that were not radio collared were either the wrong sex (i.e., male) or were too small to carry a radio collar for the next four years without a recapture to adjust the size of the collar. This effort was to replace the aging radio collars and to increase the sample size to improve the reproductive data being collected by the project.

Blood samples were taken from 76 spectacled eiders on Kigigak Island. One spectacled eider male and female were salvaged from Kigigak Island and sent to NWHC, Madison, WI for contaminant analysis.

15. Animal Control

Fox control was conducted at two study areas - Kigigak Island and Big Slough. Two dens were found and seven fox were shot, including one adult male, one adult female, and five kits on Kigigak Island. At Big Slough, two adult males and three adult females were shot.

16. Marking and Banding

At Kigigak Island, refuge personnel banded (metal Service and yellow plastic tarsal bands with letters and numbers) 31 and recaptured 66 spectacled eider adult females as part of continuing nesting ecology study. During brood rearing, an additional 144 ducklings were banded with metal leg bands.

The USGS-BRD banded 633 cackling Canada geese near Old Chevak in July as part of their demographic study. Refuge personnel banded 138 cacklers at the usual banding location 16 km northwest of Chevak and an additional 182 birds at a site on the Aknerkochik River 55 km southeast of Chevak.

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 547 individuals in the vicinity of study areas at Aknerkochik River and Big Slough.

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 7-29. Waterfowl concentration areas were baited with whole corn and birds were captured using clover-leaf, swim-in traps. A total of 1,217 northern pintails, 995 green-winged teal, 47 mallards, three greater scaup, one northern shoveler, and one small Canada goose were banded by refuge staff. One, one, three, four, four, eight, and nine pintails banded at Kgun Lake in 1992, 1994, 1995, 1996, 1997, 1998, and 1999, respectively, were recaptured in 2000. The only bird previously recaptured (1996,1998) was one the three birds banded in 1995. Fifteen of these 30 birds were banded as AHY males, six as AHY females, three as a HY male, five as a HY female, and one as a local female. Additional recaptures included a female mallard originally banded as an adult in 1994 and recaptured in 1999 and two green-winged teal originally banded as a HY female and AHY male in 1999.

Table G2. Total numbers, age, and sex of waterfowl leg and/or neck-banded under station permit on Yukon Delta NWR, 2000.

Species	Age and Sex					Total
	AHY-M*	AHY-F	HY-M	HY-F	Unk.	
Cackling Canada geese	137	169	9	5	2	320
Northern pintail	246	198	376	397	0	1,217
Green-winged teal	209	65	382	339	0	995
Mallard	32	1	12	2	0	47

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

H. PUBLIC USE

1. General

It is estimated that 90% 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 2000 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 2,278 community school and council members.

Goose Calendar Contest

The goose calendar contest also helped facilitate the educational effort. Of the 28 schools that participated in the contest and of the over 700 combined poster and literature entries across the Y-K Delta, four students from these schools were recipients in the final round of first, second and third place prizes and awards. As of special note, the Grand Prize poster winner this year, John Flynn, age eight, hails from the Y-K Delta village of Tunnunak. Ducks Unlimited, Incorporated, contributed \$30,000 of the \$40,000 total

towards the publication of the calendar. The remainder was contributed through a Challenge Cost Share grant for the design. A new designer was contracted with this year with Cara Brunk of Blue Mud Productions. Prizes were supplied by the National Audubon Society, Alaska/Hawaii Region. Approximately 7,500 calendars were distributed to school children and community members throughout the Delta.

2. Outdoor Classrooms--Students

Due minimal student attendance and per student expense, it was decided to reevaluate the effectiveness of the Western Alaska Natural Science Camp. The Yukon Delta NWR did not participate in this years science camp.

Again this year the refuge was invited to participate in the Bethel Regional High School Career Day held on October 10, 2000. ROS Patrick Snow and RC Alex Nick attended for a half day and spoke to approximately 35 high school students.

3. Outdoor Classrooms--Teachers

Teachers have been directly and indirectly involved with the refuge's many information programs. Much of the interest centers around the annual goose calendar contest, "Arctic Nesting Shorebirds" and "Teach About Geese" curricula and activities.

Heather Johnson and Donna Hanley conducted two teacher workshops on April 8-12 at Tunnunak and Cheforak for 25 teachers on the "Arctic Nesting Shorebird" and "Learn About Seabirds" curricula. In conjunction with the workshops they presented a chosen activity from the curricula to each grade in the schools, reaching over 400 students.

In September Education Specialist, Donna Hanley, spoke at three meetings, twice to visiting site administrators and once to first and second year teacher's orientation training in order to introduce herself, to explain what the refuge can offer teachers and students, and to ask how the refuge can help meet our mutual education goals. Total staff contact was over 347 educators.

Last spring we presented two slide shows, one on refuge fish and another on refuge shorebirds to over 300 students as a part of a student academic decathlon held in Akiak, Alaska.

During the summer one of our volunteers, Sarren Fred Weston, read wildlife children stories one week day afternoon per week to children at the Bethel Youth Center. His total attendance was over 200 children.

6. Interpretive Exhibits/Demonstrations

The refuge visitor center is known as a location in Bethel for learning about refuge big game, birds, fish, plants 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. During 2000 several interpretive programs were offered either planned for the public or spontaneously presented. One new popular program was, "Grocery Store at Your Feet", a 30 minute slide show on the nutritional values within the native tundra flora. The show was offered by visitor center volunteer, Sheila Shilling. She presented two evening presentations, it drew a first time enthusiastic total attendance of over 35 local residents.

This year two visitor center volunteers, Bobbi Fuller and June Johnson, are contacting local Brownie, Boy Scout, Girl Scout and 4-H leaders asking them how we can help them meet their wildlife badge requirements and/or wildlife study requirements. To date three troop leaders have shared their requirements and two troop leaders have brought their troops in to work on their badges. A total of 25 scouts have visited the refuge visitor center.

7. Other Interpretive Programs

Bird Walks and Boat Trip

Back by popular demand, and in conjunction with International Migratory Bird Day Celebration on the Refuge, BT Harwood conducted four bird walks, and two boat trips, twice as many as last year. Chris averaged over 30 species sightings per trip and had a total of over 50 people attend.

Wildlife at the Movies

Every Saturday from 1-4 pm the visitor center exhibits a wildlife movie every hour. One of the five visitor center/museum volunteers staffs the visitor center and is also available to answer visitor questions. To date we are averaging 12 people per Saturday with some Saturdays reaching 25 visitors.

National Wildlife Refuge Week - Open House

On Saturday, October 14 events to celebrate the 6th annual National Wildlife Refuge Week and Open House were held from 10-4 pm. Scheduled were biologist seminars, "Guess Who" slide show, "Fish Maze", and "Making Tracks" activities for children plus "Scavenger Hunt" and "Find the Refuge" activities for all ages. Volunteers and staff made "Kidsnacks" for the visitors and there was drawing for free books and games. We had over 150 visitors in attendance, mostly children with their parents.

8. Hunting

Moose Check Station

The refuge continued to cooperate with the local ADF&G office in operating the moose hunter check station along the Yukon River. The check station program was initiated to acquire more detailed harvest data, including the location of and total number of harvested animals.

The 2000 effort represented the fifteenth year the Yukon River check station has been operated. The check station was operational from August 25 until September 22 and was staffed by a total of nine individuals. Twenty-seven moose were checked by Service and State representatives. Samples were taken from twenty-two animals for age-determination analysis (cementum annuli cross section).

Musk Ox Harvest

A muskox hunting season is scheduled for Nunivak and Nelson Islands on an annual basis. A total of 90 animals are available for harvest on Nunivak Island via a registration and drawing permit system. A total of three registration (cow) and nine (bull) drawing permits were issued for the fall hunt. All but one hunter which possessed a cow permit were successful during this hunt. Forty-two registration (cow) and 36 drawing (bull) permits were issued for the spring (2001) hunt. All but one of the hunters which were targeting bulls harvested an animal, while 40 of the 42 cow permits were filled; one hunter was not successful, while the other mistakenly harvested a young male, rather than a female. A total of 87 of the possible 90 animals were harvested.

Nelson Island normally has only a winter hunt which runs from February 1 to March 25 of every year. Survey data revealed that the current population level (233 animals) was lower than the threshold (250) called for in the Nelson Island Management Plan, therefore the spring hunt was cancelled.

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 two transporters working on the island, Abe David and Charlie Spud, have taken an increasing 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, while that which may occur on Nelson Island is unknown.

The reported harvest of caribou and moose is unreliable at best. Harvest tags are required for all caribou and moose hunts in game management units which are encompassed by the refuge borders, although many harvested animals go unreported. Caribou, most likely from the Western Arctic Caribou Herd occasionally enter the refuge through the Nulato Hills in the north, but only a small number are available for harvest. In recent years the majority of caribou which are available for harvest on the refuge are members of the Mulchatna Caribou Herd. This herd has increased its migration into the eastern portion of the refuge during the fall in recent years. A significant portion of this herd has overwintered on the flats adjacent East and South of the Kuskokwim river.

Transporter and Guide Activity

Big game guides reported taking the following animals as part of their operations on the refuge in 2000.

	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	0	0	0
Charlie Spud, Spud's Transporting and Tendering	18	26	18 muskox
Steve Williams, Ptarmigan Air	9	36	7 moose
Yukon Aviation	0	0	0

An influx of the Mulchatna caribou herd into Game Management Unit 18 took place in late August and early September. As a result, an emergency order opened the caribou season south of the Yukon River on September 9 and remained in effect until the closure which occurred on March 31.

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. The majority of the non-local resident sport fishing pressure is centralized on the drainages which are located on the eastern edge of the refuge. This contingent has become more of a presence in recent years on the Aniak, Kwethluk 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 nine-spined stickleback are all harvested at various levels for subsistence.

Subsistence Fishing

Beginning in October 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 and 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 dictated the Federal government 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 its constitution and comply with the Act. However, no amendment has 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 boundary.

Results from the 2000 subsistence harvest will not be completed until the spring of 2001, but data from 1999 demonstrates the importance of salmon to local subsistence users. Within the refuge boundary, harvest along the Yukon and Kuskokwim River drainages, subsistence harvest was estimated at: 97,669 chinook salmon; 103,730 chum salmon; 32,818 coho salmon; and 49,388 sockeye salmon (Kuskokwim only).

The Kuskokwim River chum salmon run was so weak during 2000, the subsistence fishery was limited for the first time for a portion of the season through the use of gear size restrictions. The closure was enacted to allow for increased escapement into the region's tributaries. Subsistence harvest in the entire Kuskokwim River drainage for chinook salmon alone generally ranges between 70,000 and 90,000 fish, of which approximately 80% are taken from the lower section of river. The lower portion of the Kuskokwim River yielded approximately 61,581 chinook salmon; 35,417 chum salmon; 36,584 sockeye salmon; and 19,721 coho salmon for subsistence use. Unlike the Yukon River, there were no subsistence harvest restrictions imposed in the Kuskokwim River drainage.

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, along the western coastline, Nelson and Nunivak Islands. 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 2000 were once again lower than projected and were among the lowest on record, therefore, commercial fishing periods were reduced severely. The Yukon River fishery received the brunt of restrictions imposed on the Refuge's river systems. Only three commercial opening periods occurred in the two lower districts of the Yukon (three districts are encompassed by the refuge borders). A combined harvest of 8,518 chinook salmon for these two districts was 91% below the 1990-1999 average harvest of 89,939 fish. The combined harvest of 6,624 chum salmon for these two district was 96% below the recent 10-year average harvest of 155,022 fish.

A total of 562 permit holders participated in the Yukon chinook and summer chum salmon fishery, and the average income was \$1,306 per permit. The lack of fish resulted in the fewest amount of fishermen ever recorded. 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.

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 four commercial districts along the refuge coast. Cape Avinof, Nelson, Nunivak islands, and Cape Romanzof.

Sportfishing

Sportfishing pressure on the refuge is centralized on the Aniak, Kisaralik, and Kwethluk rivers, but an ever increasing pressure continues to be focussed on the Kasigiluk, Eek,

and Adreafsky rivers. These tributaries of the Kuskokwim and Yukon rivers provide anglers with an excellent variety of trophy fish. 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. 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 and Kwethluk River from Dillingham, Anchorage, and Bethel via float planes. The current river management plan does not allow for guided use on the Kisaralik River, nor are permits issued for this activity on any other river on the refuge. 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. Since 1984 the lower Yukon and Kuskokwim drainages have seen a 122% increase in reported sport fishing activity, measured in sport fishing days. The current level observed is in excess of 6,000 sport fishing days, which is compressed into a three month period (June through August). 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. Trappers in the region have suffered diminished income from the depressed fur prices in recent years. Trappers focus their efforts on beaver, otter, mink, fox, and muskrat. Other species such as wolf, wolverine, marten, and lynx are also highly sought. Trapping success during the past five years continues to be well below historical average harvest, mainly due to depressed fur prices.

Only five species of furbearer are required to be sealed by the State of Alaska. Many of the furbearers, especially beaver and land otter, are crafted into hats, mittens, etc. and used or sold in the local area. Harvest information provided to ADF&G based on sealing requirements are most likely under-representative of the actual harvested population.

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. 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 many 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.

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 harvest were conducted with an alternative method of transportation this past spring. For the first time, a contract R-44 helicopter was utilized as a means of transport. This provided for a very effective and efficient means of transporting special agents and refuge officers. But, the new approach was not accepted very well by the residents of the southern coastal villages of the Kuskokwim Bay. A few very tense confrontations occurred between local residents and special agents in the field, but all were resolved with no one being injured. A total of 115 hunters were contacted in a total of 106 person-days effort, resulting in 11 NOV's being issued for violations of the Migratory Bird Treaty Act and the Yukon- Kuskokwim Goose Management Plan.

Law enforcement during the fall hunting season was centered along the Middle Yukon and Kashunuk rivers. A week's effort was executed by a Refuge Officer and a visiting Special Agent. No violations were encountered during the fall subsistence or sport moose hunting season.

ROS/P Peltola attended the Land Management Training Program (January through March 2000) and Refuge Officer Basic School (October 2000), bringing the number of commissioned officers at the Yukon Delta NWR station up to two.

Two new Fish and Wildlife Protection troopers moved to Bethel to fill a post that had been vacant for about six months when Jim Pagel moved to Aniak. Charlie Yoder occupies the Sargent position and Matt Dobson moved in as a second officer.

18. Cooperating Associations

The refuge operates a small sales outlet for the Alaska Natural History Association (ANHA). FY 00 gross sales were \$7,300, a 143% increase above last year's total of \$3,000. Once again the biggest sales occur in April, October and November-December when we either rent a table at a craft shows or host an event at the visitor. Rivaling the past sales in topographic maps are Alaska wildlife cards, bird song CD's and Alaska wildlife books. Contributing to the total sales volume, and sharing sales totals equally were the weekday and Saturday sales. Weekly sales increases credit is probably due to the continuous presence of RIT Michael Jimmy at the front desk. Saturday sales are due to our increased accessibility of being open on Saturdays.

Currently five volunteers rotate ANHA bookstore duties and staffing of the visitor center on Saturdays. All of them are over half way to reaching their first 100 hour mark!

I. EQUIPMENT AND FACILITIES

2. Rehabilitation

The refuge administrative headquarters and nine single-family residences were first occupied by refuge staff in 1986. For the most part, the major components of the buildings infra-structure have functioned flawlessly. The year 2000 was when the exceptions to this generality started to occur.

The mechanical room of the headquarters building, which supports the main office, bunk house, and two residences had new copper tubing, gate valves, and circulating pumps installed. The system which was removed consisted of components which were either no longer made, or replacement parts were no longer available.

Two of the nine single family residences received maintenance as personnel changes occurred within the refuge staff. At both locations new carpeting was installed. Painting and major repairs were complete before the units were occupied by new employees.

Elements of the Kanagayak Field Station were repaired to address safety concerns. New boardwalks were constructed, oil stove heating systems were upgraded, and the electrical systems were updated.

3. Major Maintenance

A MMS project provided funds to install a bathroom at the refuge's hanger facility. This project was initiated during the later part of 2000, and was completed early in 2001.

The refuge's shop floor was treated to a new coat of paint. The process was more complicated than planned as the concrete floor was first cleaned thoroughly, then etched with acid, then painted with several layers of epoxy paint.

September of 2000 brought a much needed upgrade to the refuge's road which accesses the old administrative site. A total of 60 cubic yards of sand and 90 tons of crushed rock were delivered and spread by a local contractor. Access to the three single-family residences which now stand on the site has drastically improved.

4. Equipment Utilization and Replacement

Two new Suburbans that were ordered last year arrived on one of the first barges at the Bethel dock. These new vehicles will replace similar models that have been in-service since 1986.

A MMS project provided funds to purchase two new boats. These additions to the refuge's fleet of boats will greatly reduce the wear and tear to other similar models which have been in-service for up to a decade or more.

5. Communication Systems

Several new hand held radios were ordered and entered into service in the refuge's VHF communication system. These units will be utilized by mobile crews to access the VHF repeater system. Throughout the year several site visits were conducted to remote repeater locations throughout the refuge. Such visits are conducted on an annual and as needed basis. With the advent of satellite telephone technology, our VHF system currently utilized may very well become obsolete.

8. Other

As previously mentioned, the refuge administrative complex, bunk house facility, and nine single-family residences, and associated mechanical and structural systems are approaching their seventeenth year of existence. As time brings wear and tear, these systems are starting to fail, and will continue to fail. We are entering a phase within the life of our facilities where we can expect increased maintenance. In some instances, the existing systems are either obsolete, or replacement parts are no longer available. Unfortunately, this means that complete systems either have to be reworked, or replaced, and it appears that we are just starting this phase of maintenance with respect to our facilities.

J. OTHER ITEMS

1. Cooperative Programs

In late July, WB McCaffery traveled nearly around the globe (Bethel-Anchorage-Seattle-Amsterdam-Moscow-Tiksi) to attend the International Workshop on the Occasion of the 5th Anniversary of the Biological Station Lena-Nordenskiöld, "Perspectives for Russian Arctic Conservation in a Circumpolar Context" (July 22-29, 2000). The biological station is located on the Lena River Delta, thirty minutes (by helicopter) west of the Arctic Ocean port town of Tiksi. The station is the base for most scientific research within the Lena Delta State Nature Reserve (or "zapovednik"). At 61,320 km², the Lena Delta zapovednik is the largest protected area in Russia. McCaffery was one of four Americans at the conference, which included representatives from Russia, Norway, Sweden, Iceland, Germany and the Netherlands. While at the WWF-sponsored conference, McCaffery gave a talk on spectacled eider conservation, served as secretary for the second day of the meeting, and, as the designated representative of the four-person American contingent, regaled the international audience with American rap and folk music at the closing banquet. He also initiated discussions (on behalf of RM Rearden) with the zapovednik manager and his staff about initiating a sister refuge relationship (to include sharing of biological expertise) between the Lena Delta reserve and the Yukon Delta refuge. The response to the suggestion was so enthusiastic that cooperation between the two protected areas was identified as one of 17 specific recommendations generated by the conference participants. As a result of this progress, Yukon Delta refuge is planning to host members of the zapovednik staff as early as the 2001 field season.

3. Items of Interest

The old Bureau of Indian Affairs school site in the village of Nightmute is, unfortunately, under the control of the refuge. The associated hazardous materials that exist on the property including asbestos, potentially contaminated soil, and other items have become an increasing concern for the village over the past several years. Partly, this is because even though boarded up, the village kids find a way to enter the property. In September, the Phukan Corporation traveled to the site to collect samples and prepare an Environmental Site Assessment and Cost Estimate. This assessment was provided to Engineering late in the year for use in developing budget requests. Complicating the funding request is the fact that any oil contamination will utilize cleanup funds, lead and asbestos removal will use resource management and MMS funds, and demolition will use construction funds. We are hopeful that some funding will be available in 2001.

4. Credits

The biological staff of SWB Broerman, WB's Wege, McCaffery, and Kovach, and FB Cannon wrote sections D.5, F.7, G1-11 and 14-16. DRM Liedberg wrote sections C.2-3, D. 2-4, and 6, E. 3, 5, and 7. ES Hanley wrote portions of sections E.4, H.1-3, 6-7, 11-12, and 15-16. ARM Peltola wrote the activity summary in H.8-10, 17 and I..2-5 and 8. RM Rearden provided the Feedback section. SRS Sundown compiled, edited, and finalized the report.

K. FEEDBACK