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

KOYUKUK/NOWITNA REFUGE COMPLEX
Galena, Alaska

ANNUAL NARRATIVE REPORT
Calendar Year
1999

ANNUAL NARRATIVE REPORT

1999

KOYUKUK NWR

NORTHERN UNIT, INNOKO NWR

KOYUKUK/NOWITNA NATIONAL WILDLIFE REFUGE COMPLEX

Galena, Alaska

REVIEW AND APPROVALS

for Complex Manager	12-14-01 Date	Refuges Supervisor-Northern AK	4/6/2 Date
Refuge Chief-NWRS	4/5/02 Date		

INTRODUCTION

This Annual Narrative Report is for the Koyukuk, Northern Unit of Innoko and Nowitna Refuges. These three refuges are administered collectively as the Koyukuk/Nowitna Refuge Complex. Narrative items common to all three units are discussed in the Koyukuk and Northern Unit of Innoko report. Any additional events are reported in respective sections.

The **Koyukuk National Wildlife Refuge** (NWR) is located in west central Alaska, about 270 air miles west of Fairbanks and 330 air miles northwest of Anchorage. The exterior boundaries encompass 4.6 million acres, an area slightly smaller than the state of New Jersey. This refuge lies within the roughly circular floodplain basin of the Koyukuk River. The extensive forested floodplain is surrounded by hills 1500' - 4000' on the north, east, and west, and the Yukon River to the south.

The Koyukuk NWR was established December 2, 1980 with passage of the Alaska National Interest Lands Conservation Act (ANILCA). The refuge was established and is managed for the following purposes:

1. To conserve fish and wildlife populations and habitats in their natural diversity including, but not limited to, waterfowl and other migratory birds, moose, caribou, furbearers and salmon;

2. To fulfill international treaty obligations of the United States with respect to fish and wildlife and their habitat;

3. To provide the opportunity for continued subsistence uses by local residents;

4. To ensure water quality and necessary water quantity within the refuge.

The refuge contains a 400,000 acre wilderness surrounding the 16,000 acre Nogahabara Sand Dunes, one of only two active dune fields in Alaska. Access to the refuge is by boat, aircraft, or snowmobile.

The **Northern Unit of the Innoko NWR** (known locally as the Kaiyuh Flats) encompasses 750,800 acres. Located south of the Yukon River, its northeastern boundary is directly across the river from the town of Galena. The Innoko Refuge was also established by ANILCA and is characterized by a wide, lowland interlaced by sloughs, creeks, and lakes. The gently rolling foothills of the Kaiyuh Mountains along the southeastern border rise to 2,000 feet. Only the first purpose for the Innoko Refuge differs from the Koyukuk Refuge.
This purpose is:

1. To conserve fish and wildlife populations and habitats in their natural diversity including, but no limited to, waterfowl, peregrine falcons, other migratory birds, black bear, moose, furbearers, and other mammals and salmon.

Vegetation types of the Koyukuk and Northern Innoko units are typical of the boreal forest or taiga of interior Alaska. The lowland boreal forest of spruce, birch, and aspen gradually merges with tundra vegetation near 3,000 feet. Black spruce bogs with poorly drained permafrost soils are a dominant feature of the area. Large pure stands of white spruce can be found along rivers where soils are better drained. Dense willow and alder are common along the rivers and sloughs. Winter ice scours sand bars which promotes a lush regrowth of vegetation each year. Numerous fires have set back vast areas to earlier seral stages consisting of aspen, birch, and willow. The most prominent characteristic of these refuges is the extensive mosaic of the vegetation types.

Perhaps the greatest value of the Koyukuk Refuge is its productive breeding areas used by waterfowl from the four migratory flyways. Thousands of waterfowl, primarily wigeon, pintail, scaup, white-fronted geese and Canada geese are joined by both tundra and trumpeter swans on the Koyukuk's lush breeding grounds each spring. Refuge streams and lakes also sustain large fish populations that support subsistence, commercial and sport fisheries. King, silver, and chum salmon migrate up the waters of the Yukon River and its tributaries, including the Koyukuk River. These three fish species are important in the region's subsistence and financial economies.

Major programs of the Complex include resource inventory, management related research, subsistence management, wildfire management, and information/ education programs. Field investigations collect baseline data and quantify fish, bird, mammal, and habitat resources. An information and education program that stresses communications with the eight villages in or near the Complex is vital to the management of these natural resources.

The Complex staff currently has: 9 permanent, 3-7 temporary (varies seasonally), 2 term appointments, and 1 TAPER position. Facilities include a leased office and cold storage facility, three administrative cabins, nine government residences, and several smaller cold storage buildings.

The Koyukuk/Nowitna Refuge Complex headquarters is in Galena, a village located on the Yukon River. Galena was established about 1919 as a supply point for the mining of galena (lead sulphite ore) south of the Yukon River. Galena serves as a transportation hub for nearby villages. More like a town than a village, Galena has the advantages of direct air service to Fairbanks, modern communications, river access, two general stores, a K-12 school, health clinic, and a retail outlet for boats, motors, snowmachines and generators. The population of Galena is approximately 600 and includes approximately equal numbers of Alaska Natives and non-Natives. Many Galena residents depend on a subsistence lifestyle of fishing and hunting. The U.S. Air Force, commercial airlines and general aviation jointly use the Galena Airport. The U.S. Air Force Base formerly supported two F-15 Eagle interceptor aircraft, but the entire base was put in "caretaker" status as of October 1, 1993.

INTRODUCTION

TABLE OF CONTENTS

G. WILDLIFE

H. PUBLIC USE

I. EQUIPMENT AND FACILITIES

J. OTHER ITEMS

K. FEEDBACK

A. HIGHLIGHTS

- *Weather for the Galena area was more normal in 1999,* following "El Nino" in 1997 and "La Nina" in 1998. Temperatures were close to the long term mean. Fall conditions were exceptional due to mild to average temperatures combined with lower than normal precipitation (Section B). However, poor snow accumulation resulted in another year of poor conditions for November moose surveys (Section G.8).

- *The refuge gained two staff members in 1999.* Pilot Max "Joee" Huhndorf III joined the refuge staff in March. Joee, a local hire, previously piloted for one of the local air taxi operators. General Biologist Guy Hughes transferred from Honolulu, HI, in May. (Section E.1)

- *Manuel Ochoa continued the Mexican student exchange program,* instituted in 1998. "Manolo," a recent graduate of the University of Chihuahua, helped monitor the nesting of several goose species in Yukon Delta NWR. He returned to Galena to help refuge biologists conduct goose productivity surveys and banding. Volunteer Ochoa made presentations to the Nulato and Galena tribal councils. He returned to Chihuahua in August to begin a Master's thesis aimed at documenting winter ecology and behavior of white-fronted geese in the central highland states of Chihuahua, Durango, and Zacatecas. (Section E.4)

- *1999 was an excellent year for goose production.* In the most consistently surveyed area, Dulbi River/Dulbi Slough, abundance of young and adults increased in 1999, compared to 1998. On Kaiyuh Flats, where white-front geese have not recently been as abundant as on the Koyukuk, adult numbers and production increased in 1999, following a drop in 1998. (Section G.3)

- The songbird banding station, operated in conjunction with the *Monitoring Avian Productivity and Survivorship* (MAPS) program, was in operation in 1999. This was the final year of our five-year commitment to the program. Compared to previous years, 1999 showed the most adult captures and fewest juvenile captures. Warm temperatures and low rainfall created conditions similar to "El Nino" in 1997. Also, fewer juvenile birds may have been captured because the banding station was closed after July 30. (The August banding session was removed from the MAPS protocol since migrating birds were being captured in addition to residents.) (Section G.7)

- *Aerial moose trend count area (TCA) surveys were conducted in fall 1999.* TCA surveys, conducted on the Koyukuk and N. Unit of Innoko NWRs, were a joint effort by USFWS and ADF&G. Lighter than normal snowcover could have influenced sightability and distribution of moose, resulting in lower density and composition estimates than in a normal snow year. (Section G.8)

- A final month of field work for a study of *Wildland Fire and Yellow-cheeked Vole Populations,* initiated in 1997, was conducted in June 1999. Despite some changes to the trapping sessions, the total number of vole captures was comparable to previous years. Over 50% of the adults captured had been marked in 1998, and one female had been marked as a subadult in 1997. Three other voles were initially marked as adults in 1998, indicating that they were in their third summer. These records are unusual since few yellow-cheeked voles are known to survive two winters. (Section G.10)

- *1999 marked the third consecutive year of extremely low chum salmon spawning returns,* severely impacting local subsistence users. At the weir operated on the Gisasa River, a tributary of the Koyukuk River, chum salmon escapement was only 13% of the average weir counts from previous years. (Section G.11)

- *The 1999 moose harvest in the lower Koyukuk drainage was the highest ever recorded.* Hunters harvested 367 moose (273 bulls, 94 cows), well above the ten year average of 238. Both the Service and ADF&G remain concerned that the rate of harvest is close to the limit of long-term sustainability. (Section H.8)

- *The refuge obtained a permit to pump Yukon River water into Alexander Lake.* Extremely low water level in 1999 prompted the refuge to take action to insure safety of refuge aircraft and personnel. Pumping was continued until the water level was raised sufficiently to allow aircraft to take off and land safely. Although float planes can be docked on the Yukon River near refuge headquarters, they are more susceptible to vandalism and damage during severe weather conditions. (Section I.2)

- *Three replacement vehicles were acquired in 1999:* a Ford Explorer, a Chevy Suburban, and a Dodge utility pickup equipped with a snowplow. (Section I.4)

B. CLIMATIC CONDITIONS

The climate of western interior Alaska is subarctic/continental with warm pleasant summer weather during June, July and August and generally cold, but calm weather from October to early April. The winters in the Galena area tend to fluctuate between periods of extreme cold (usually -40° F to -60° F, but sometimes to -70° F), caused by clear skies and no wind, to milder temperatures (-20° F to +20° F) with clouds, snow, and light to moderate winds. In interior Alaska the moderating effect from Bering Sea and Pacific storm fronts increases the farther west one proceeds. By late winter, the snowpack in the valley bottoms averages 2-3 feet. The months of April and May are transitional, with the arrival of most waterfowl in late April and breakup of the Yukon River ice in early to mid-May. Green-up of the trees and shrubs begins in late May. Summer daytime temperatures in the western Interior generally range from 50-70°F; however, extreme highs have exceeded 90°F. Compared to Fairbanks, summers in the Galena area are generally cooler, with more overcast skies and precipitation. Perhaps the most pleasant time of the year is late August to early October when cool nights, warm days, and dying vegetation spell the end of the bug season and the start of hunting season.

After the unique effects of "El Nino" in 1997 and "La Nina" in 1998, the weather for 1999 was more normal for the Galena area. Temperatures were close to the long term mean throughout the summer months and were just below the long term mean for the winter months (Fig. B.1). The 1999 annual precipitation pattern was more variable than the temperature pattern and was similar to the 1998 pattern, though less extreme. There was less precipitation in the fall and winter months, except January and March, and more precipitation in the summer compared to the long term mean (Fig. B.2). The average temperatures and snowfall in late-winter allowed for a normal thaw and breakup. The Yukon River ice at Galena first moved on May 14, only two days later than the mean. Spring breakup flooding along the Yukon and Nowitna Rivers was low to average because of the low winter snowfall and average late-winter snowfall. Water levels throughout the summer were low to average on the Yukon River. Low snowpack and gradual thawing in the Brooks Range and Koyukuk Valley also caused water levels to be average to low during spring breakup and continued to be low throughout the summer for the Koyukuk River and the surrounding drainages.

Fall conditions were exceptionally good in 1999 because of mild to average temperatures combined with lower than normal precipitation. The clear skies, crisp temperatures, and lack of bugs made 1999 one of the more beautiful fall seasons. The Yukon River ice at Galena stopped flowing on November 4, about a week later than normal (Table B.1). Freeze-up of the lakes was normal and a late snowfall allowed the ice to thicken by early October. Accumulation of snow through October, November, and December was slow, creating another year of poor survey conditions for the November moose surveys.

Table B.1. Break-up and freeze-up dates of the Yukon River at Galena, Alaska.

	Breakup (first ice movement)	Freeze up (ice stoppage)
1983	May 10	
1984	May 18	
1985	May 22	
1986	May 19	
1987	May 17	
1988	May 7	October 14
1989	May 7	October 25
1990	May 7	October 25/26
1991	May 7	November 1
1992	May 25	October 20
1993	May 12	November 3
1994	May 7	November 4
1995	May 2	October 30
1996	May 14	October 21
1997	May 7	October 21
1998	May 8	November 5
1999	May 14	November 4
Mean	May 12	October 26

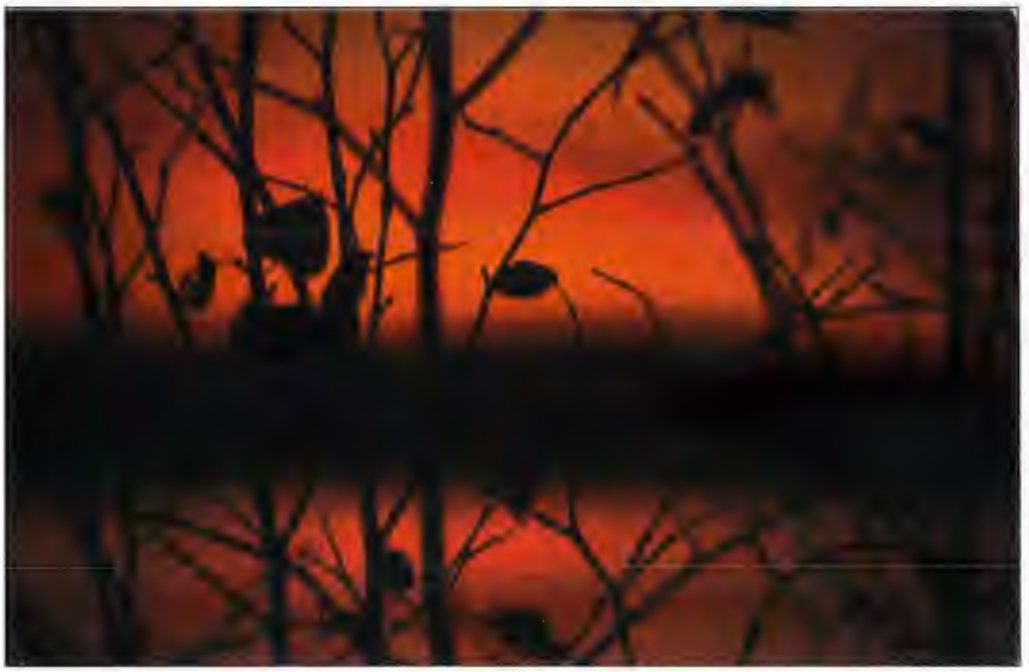


Photo B.1. *An early winter sunset on the Yukon River.*

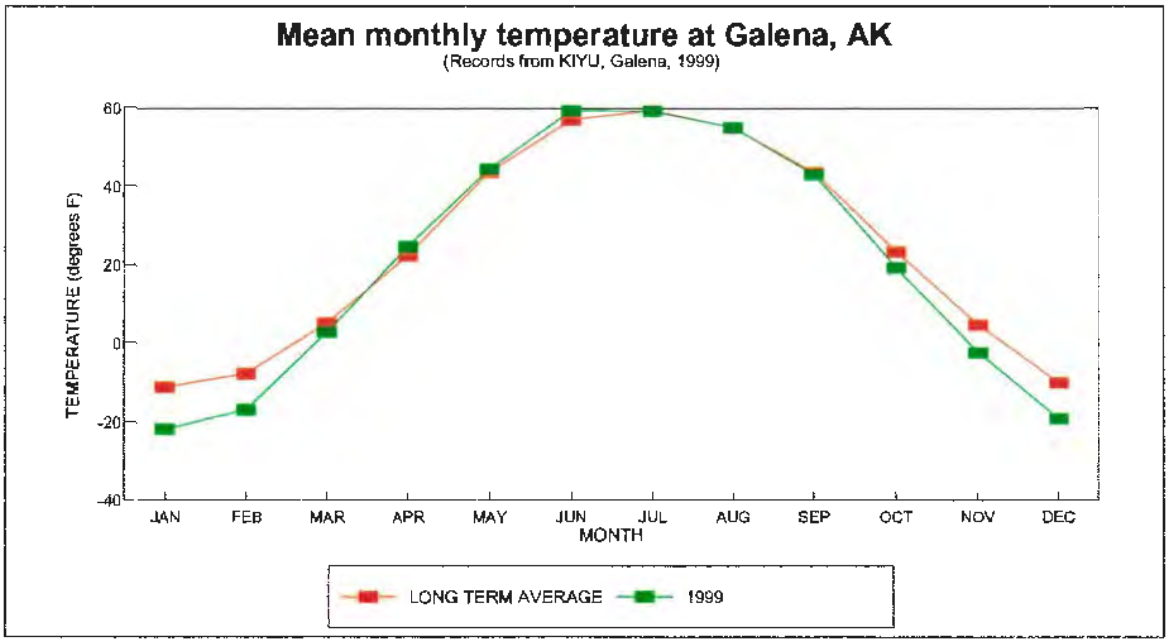


Figure B.1. *Mean monthly temperature compared to long term mean at Galena (data courtesy of KIYU and National Weather Service).*

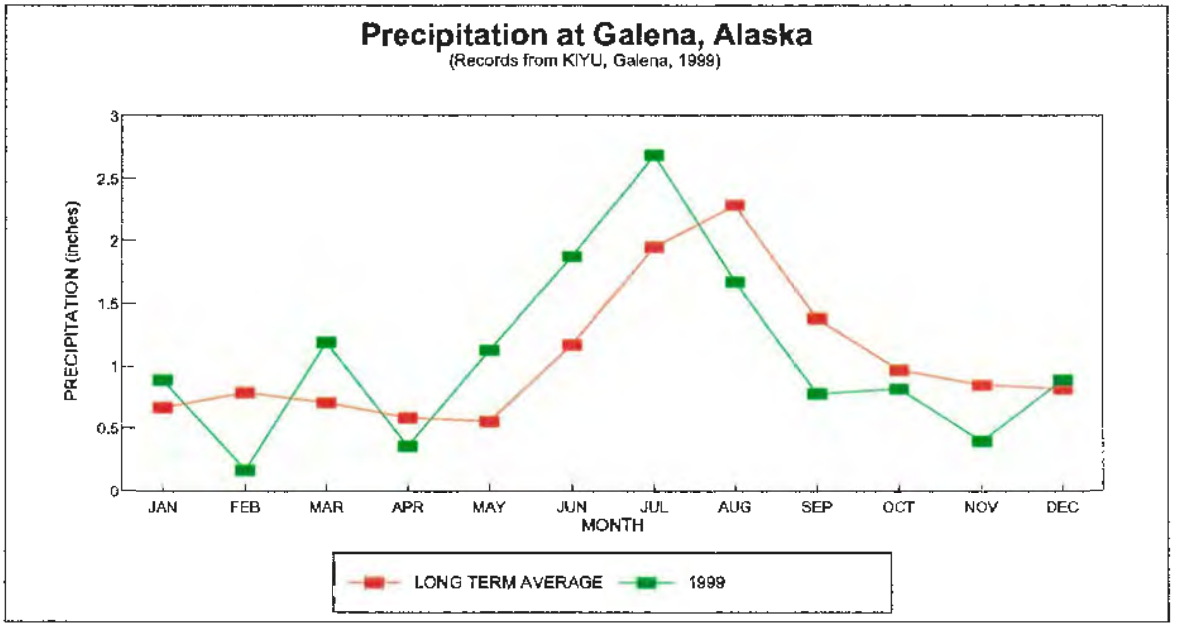


Figure B.2. *Monthly precipitation compared to long term mean at Galena (data courtesy of KIYU and National Weather Service).*

C. LAND ACQUISITION

1. **Fee Title** - *Nothing to report.*

2. **Easements** - *Nothing to report.*

3. **Other** - *Nothing to report.*

D. PLANNING

1. **Master Plan** - *Nothing to report.*

2. **Management Plan** - *Nothing to report.*

3. **Public Participation** - *Nothing to report.*

4. **Compliance with Environmental and Cultural Resource Mandates** - *Nothing to report.*

5. **Research and Investigations**

The following approved refuge wildlife studies were active during 1999. Progress reports are available from the Complex office or the Alaska Resource Library in Anchorage. A brief report from each study is included in the appropriate sections of the Koyukuk and Nowitna narratives.

Nesting ecology and habitat requirements of white-fronted geese (Anser albifrons). This study was originally proposed and approved for Nowitna NWR in 1987. One season of field work occurred in 1987 and a progress report was completed in 1988. The study was then moved to Koyukuk NWR in 1991 because of historically low numbers of the species on the Nowitna, and the indication of a decline from former abundance on the Koyukuk. Results of the 1997-99 work are reported in Section G.3.

Identification of migration and wintering factors contributing to a population decline in greater white-fronted geese nesting in the Boreal Forest of Interior and Northwest Alaska. This study originated as a refuge-generated proposal to the USGS-BRD (Biological Resources Division) to obtain their "quick response" funding in 1997. Approval was received in 1998 and the study was completed in 1999. The study involved detailed analyses of collar resighting and band recovery data by Craig Ely and Joel Schmutz of USGS-BRD at the Alaska Science Center, Anchorage. Results are reported in Section G.3.

Cooperative migration and wintering studies. In response to the realization that an observed white-fronted goose decline was not caused by local factors alone, we became

involved in off-refuge cooperation with other partners. These partners include USFWS Division of Migratory Birds in Region 7 and Region 2, USGS-BRD, Canadian Wildlife Service, Central Flyway Council Technical Committee, Nature Conservancy of Texas, Ducks Unlimited, Universities of Tamaulipas and Chihuahua (Mexico) and SEMARNAP (Secretariat de Medio Ambiente, Recursos Naturales y Pesca).

Wildland fire and Yellow-cheeked vole populations in Interior Alaska- an investigation of fire effects in the boreal forest. Wildland fire is a primary agent of disturbance in Alaska boreal forests, initiating successional patterns, which impact a variety of plant and animal species. Earlier studies on the Complex showed that furbearers, particularly marten and lynx, are greatly influenced by fire succession, and one of the mechanisms influencing their populations is prey abundance. These studies showed that the yellow cheeked vole (*Microtus xanthognathus*) is a major prey item of marten, and that its patchy distribution seemed to be influenced by extent of early post-burn seral stages within the boreal forest. During the summers of 1997,1998, and 1999. University of Alaska graduate student and PR Karin Lehmkuhl initiated a mark-recapture study of these large colonial microtine rodents. The objective of the study was to determine patterns of distribution and abundance, and examine their relationship to habitat features in several recent burns on Koyukuk and Nowitna NWR. The project was completed in 1999 and Karin published her thesis (Lehmkuhl 1999). A summary of results on the study is presented in Section G.10.

Subsistence Waterfowl Harvest Survey: Galena, Huslia, Nulato, Koyukuk, Kaltag, Hughes, Ruby. To assist in defining reasonable and sustainable spring waterfowl seasons and bag limits, the U.S. Fish and Wildlife Service must obtain estimates of regional and total harvest by species, and estimates of average consumption per household and village. Also, because of the regional decline of white-fronted geese, the refuge has sought more accurate estimates of spring harvest of this species. Therefore, in 1999 we continued a regional study began in 1998 to estimate subsistence waterfowl on and near the Complex. Biological Science Technician Deborah Webb prepared a report entitled *Subsistence Waterfowl Harvest Surveys: Galena, Huslia, Nulato, Koyukuk, Kaltag, Hughes, Ruby, 1998-1999.* A summary of the study appears in Section H.8.

Habitat Mapping Project. Koyukuk/Nowitna NWR Complex joined forces with Ducks Unlimited, the Bureau of Land Management, the U.S. Air Force, and Spatial Solutions to form a multi-agency partnership interested in producing land cover maps from satellite imagery. The partnership plans to map over 16 million acres of land in the western interior including our entire 7.7 million acre refuge complex by the summer of 2002. Field work for the northern unit of the Innoko (731,634 acres) was completed in 1998 and a classified map product is expected in the spring of 2000. The field work for a 2.2 million acre portion of the Koyukuk refuge was completed in the summer of 1999 and the remaining 2.3 million acres of the Koyukuk is scheduled to be completed in the summer of 2001 resulting in a finished product for the Koyukuk NWR in the summer of 2002. The Nowitna NWR and the U.S. Air Force's Galena military operation area (MOA), a 5

million acre project area, is scheduled for fieldwork in the summer of 2000 and a final product for the Nowitna NWR is expected in the spring of 2001.

6. Other - *Nothing to report.*

E. ADMINISTRATION

1. Personnel

Photo E.1. 1999 Refuge Staff. (*L to R*) *Gene Williams, Jenny Bryant, Joanna Roberts, Sharon Tunnell, Rosie Cassou, Deborah Webb, Jim Good, Orville Huntington (kneeling), Bob Rebarchik, Karin Lehmkuhl.*

a. Permanent

1. Eugene Williams, Refuge Manager, GS-485-13, EOD 6/7/97, PFT.
2. James R. Good, Deputy Refuge Manager, GS-485-12, EOD 4/28/96, PFT. Retired effective 2-3-00.
3. Michael A. Spindler, Supervisory Wildlife Biologist/Aircraft Pilot, GS-485-12, EOD 2/11/90, PFT.
4. Max (Joee) Huhndorf III, Aircraft Pilot, GS-2181-12, EOD 3/28/99, CS Local Hire.
5. Guy D. Hughes, General Biologist, GS-401-11, EOD 5/23/99, PFT. Transferred from Honolulu, HI.
6. Joanna L. Roberts, General Biologist, GS-0401-9, EOD 5/3/98, PFT.
7. Robert A. Rebarchik, Fire Management Officer, GS-401-11, EOD 9/3/95, PFT.
8. Orville H. Huntington, Wildlife Biologist, GS-486-5, EOD 11/12/95, PFT. Converted to Refuge Information Technician, GS-1001-8, CS effective 8/29/99.

9. Karin L. Lehmkuhl, Park Ranger (Environmental Education/Wilderness Issues), GS-025-7, EOD 5/23/99, PPT.
10. Rosie M. Cassou, Administrative Technician, GS-303-6, PFT Local Hire.
11. Sharon Tunnell, Refuge Clerk, GS-303-5, EOD 8/9/98, PFT Local Hire.
12. Wayne W. Strassburg, Maintenance Worker, WG- 4749-8, EOD 8/16/98, CS Local Hire.
13. Jenny M. (Lowe) Bryant, Biological Technician, GS-404-5, EOD 5/25/97 as Temporary Intermittent (STEP Appointment). Converted to SCEP Student Trainee GS-499-04 on 6/20/99.

b. Temporary

14. Deborah Webb, Biological Technician, GS-404-5, 5/17/99 - 11/16/99.
15. Robert Farmer, Refuge Information Technician, GS-1001-6, EOD 5/13/98, Local Hire, Intermittent.
16. J. D. Baxter, Pilot, Temporary EOD 6/15/99 - 9/25/99.

c. Volunteers

Shannon Jenkins
Brad Josephs
Craig Logsdon
Manuel Ochoa
Randy Shaw

2. Youth Programs - *Nothing to report.*

3. Other Manpower Programs - *Nothing to report.*

4. Volunteer Program

Craig Logsdon. Craig assisted BT Bryant on the Ruby Road BBS route on June 10, 1999. Vol. Logsdon drove the vehicle and assisted BT Bryant in locating survey route marker flags. Vol. Logsdon is a Staff Sargent in the U.S. Air Force and was home in Galena on leave during the BBS.

Shannon Jenkins. Shannon assisted BT Bryant during the duck banding project August 17-23, 1999. Vol. Jenkins recorded banding data, set up traps, and baited sites. Vol. Jenkins is a local resident of Galena and expressed interest in helping with wildlife projects.

Brad Josephs. Brad assisted refuge staff September 20 to October 7, 1999. Part of his time here was during the busy moose hunting season. Vol. Josephs maintained and repaired refuge camping gear, cataloged refuge biological files, and assisted at the

Koyukuk River moose hunter check station at Ella's Cabin. Vol Josephs is a wildlife biologist who has volunteered at the refuge complex previously as an assistant to PR Lehmkuhl during the fire/small mammal relationships project.

Manuel Ochoa. In the summer of 1999, Mr. Manuel Ochoa, a recent graduate of the University of Chihuahua, volunteered for the Alaska-Mexico student program. After initial field safety training at Galena, Manuel went to the Yukon Delta National Wildlife Refuge, where he helped Division of Migratory Birds monitor the nesting of several goose species. In mid-June "Manolo" returned to Galena to help refuge biologists conduct goose productivity surveys and banding. Manuel made presentations to the Nulato and Galena tribal councils about the problems faced by waterfowl wintering in Mexico. Tribal leaders asked numerous questions about the welfare of wildlife and the lifestyle of rural people in Mexico. Manuel returned to Chihuahua in August 1999 to begin a Master's thesis. His research project is aimed at documenting winter ecology and behavior of white-fronted geese in the central highland states of Chihuahua, Durango, and Zacatecas. His study is centered about 500 miles south of El Paso, Texas, and will be funded by the Service for two years.

Photo E.1. *Student exchange volunteer Manuel Ochoa, a recent graduate of University of Chihuahua, assisted with goose surveys and banding.*

Randy Shaw. Randy attended our field safety training session in May 1999, and helped operate the hunter check station at the mouth of the Nowitna River in September 1999. Randy has been accepted by local Ruby residents, and his presence at the check station helped our relations in Ruby. Randy hopes to volunteer for future wildlife survey work in coming years. Randy is a retired University of Wyoming astronomical technician who lives in Ruby and runs an ecotourism kayak guiding business.

5. Funding

The station budget increased from 1998 to 1999, offseting inflation and increasing operational costs (Table E.5.1) and to address maintenance backlog. Subsistence funding was $91K for 1999 (part of 1261 base). MMS funding for 1999 totaled $224K, and was spent on rehabilitation of flammables storage sheds ($10K) for employee quarters, replacement/improvement of float plane dock ($31K) on Yukon River, replacement of unserviceable rain gutters ($10K), and replacement of driveway retaining walls ($173K) at quarters 1-6. Retaining wall work will be accomplished in fiscal year 2000. The

environmental education and outreach programs received $14K in 1999. Program funds for 1261 increased significantly to cover amendment of lease arrangement for entire shop/storage facility previously shared with our landlord, Gana-A'Yoo, Ltd. Shared space was inadequate for our needs. Security was almost nonexistent. Lease costs for shop/storage space increased from $13,290./yr. to $34,704/yr. Occupancy of our additional space will occur effective with the new fiscal year.

Table E.5.1. Koyukuk-Nowitna Refuge Complex Funding, 1995-1999.

Program	FY95	FY96	FY97	FY98	FY99
1231		22,000	12,000		15,000
1261	658,500	977,500	938,000	1,054,000	1,113,000
1262	336,000	140,000	131,000	33,000	224,000
4960			990	1,400	2,108
8610	25,300	25,000	30,000	35,499	31,000
9110	104,000	105,000			
9120	48,000	7,000			
9251			126,000	163,000	128,000
9252			30,000		
Total	1,171,800	1,276,000	1,267,990	1,286,899	1,513,108

6. Safety

Quarterly all-staff safety meetings were held as were safety committee meetings. An all-staff training and safety week was held beginning May 29. Subjects covered included boat and watercraft safety, fireams and bear safety, aircraft safety, first aid and CPR.

Regional safety manager Dale Robinson conducted a safety inspection of all refuge facilities in August. The inspection led to the correction of some minor findings including installation of hand rails at quarters 3 and at the fuel tank in the wareyard. Some old electrical cords were replaced in the wareyard and removed at quarters 3. Engineering, RO, has been providing assistance in determining the weight capacity for the overhead storage area in the cold storage building.

Photo E.6.1. *DRM Good bravely volunteers to become the patient during first aid training conducted by Admin. Tech. Rosie Cassou.*

GFCI's were installed in all quarters in the kitchens around the sinks. Gana-A'Yoo, Ltd., our office

landlord, has been notified that GFCI's need to be installed in the two office bathrooms and the upstairs kitchen.

CDSO Good attended the OSHA 600A Collateral Duty Safety Course, May 24-28, 1999 held at NCTC, Shepherdstown, WV. This was an excellent course and covered a huge amount of material in a very short time.

Photo E.6.2. *The new refuge boat, which lacked a Coast Guard data plate, was finally authorized for use after research by refuge staff with assistance from Dale Robinson, Engineering.*

The 24 ft. custom made refuge boat (PN 706087) was finally authorized for use after much work by the refuge staff and outstanding assistance by Dale Robinson, Engineering. The boat is used to haul fuel and supplies to the Nowitna River moose hunter check station. There was uncertainty as to safe load rating and horse power capacity as the boat lacked a Coast Guard data plate. Following guidance provided by the U.S. Coast Guard, a local boat manufacturer, and a U.S. Dept. of Transportation pamphlet outlining Federal requirements, a maximum horsepower rating was determined to be 200. Maximum weight capacity was set at 2500 pounds.

During the year it was brought to the refuge's attention that there was a cable across the Hog River, about a mile upstream from its confluence with the Koyukuk River. DRM Good and Pilot Huhndorf flew to the site and identified the cable setup as part of the old off-loading rig that had been there for many years, since the 1950's. After some checking, the Taiga Mining Company was contacted and they said they were intending to take the cable down in March of 2000. DRM Good contacted the FAA in Fairbanks to report the aerial cable. It has been put on the latest flight map and identified as a hazard.

7. Technical Assistance - *Nothing to report.*

8. Other - *Nothing to report.*

F. HABITAT MANAGEMENT

1. General

The rivers in the refuge lowlands are characterized by low gradients, meandering courses, and heavy spring flooding. Flooding during spring is common, and it is often mid-summer before most of the flood waters subside. The rivers, particularly the Yukon and Koyukuk, carry a heavy silt load at flood stage. Meandering creeks with steep banks are typically slow and shallow. River and larger creek corridors present a dynamic, shifting mosaic of habitats supporting many important species of wildlife on the refuge. As rivers and creeks move through the flood plain, outside banks and vegetation are eroded into the river and inside banks are built up through the deposition of silt, sand, and gravel. New inside bank soil deposits are well drained and represent deeper soils along rivers and creeks that don't freeze in the winter. Deeper bodies of water also don't freeze through in winter providing a form of insulation against permafrost. These factors create a steep habitat gradient away from river and creek channels represented by willow (*Salix* spp.) and alder (*Alnus crispa*) thickets along gravel bars on the water edge, stands of cottonwood (*Populus balsamifera*) trees higher on the bank, and bands of white spruce (*Picea glauca*) higher on the banks that vary in width depending on the size of the river. White spruce stands typically grade into black spruce (*Picea mariana*) forest farther from the water and black spruce forests grade into treeless bog and wet sedge habitats. On extremely winding rivers large oxbows form with bands of the above mentioned species intermingled with strips of grass lakes. Stands of broadleaf deciduous forest often mix with white spruce forest along river corridors and are also typically found on south facing slopes, steep cliff faces, ridge tops, and on sandy deposits found throughout the northwestern portion of the refuge in the Koyukuk Wilderness Area. Treeless bogs resemble arctic tundra communities and are the predominant vegetation type in the center of the refuge. The vegetation of these bogs consists of various species of cotton grass (*Eriophorum* spp.), dwarf birch (*Betula nana*), bog blueberry (*Vaccinium uliginosum*), Labrador tea (*Ledum palustre*), and sedges and mosses, especially sphagnum moss and peat. On drier ridges, willow, alders, resin birch (*Betula glandulosa*), black spruce and American larch (*Larix laricina*) are found.

2. <u>Wetlands</u>

Lake and pond wetlands include upland basins, ice-formed lakes on the flats, river flooded lowlands, oxbows, and bog lakes. Spring runoff, rain, and river flooding recharge lakes. Water depths and shorelines can vary from year to year. Lake depths seldom exceed 15 feet and usually are much shallower. Water temperatures in shallow lakes reach 70°F or more in mid-summer, creating ideal conditions for growth of aquatic plants and invertebrates. Among the aquatic plants, duckweed (*Lemna* sp.), horsetail (*Equisetum* spp.), water milfoil (*Myriophyllum* sp.), mare's tail (*Hippuris vulgaris*), and smartweed (*Polygonum* sp.) are abundant. One or more of 12 species of pondweed (*Potamogeton* spp.) occur in almost all lakes. Indicators of bog lakes include water lily (*Nuphar polysepalum*), pygmy water lily (*Nymphaea tetragona*), water hemlock (*Cicuta* douglasii, *C. mackenziana*), water parsnip (*Sium suave*), and bladderwort (*Urtricularia macrorhiza*). Several species of graminoids including sedge (*Carex*), bluejoint grass (*Calamagrostis canadensis*), and foxtail (*Hordeum*) provide cover on exposed shorelines. A variety of forbs grow on recently exposed soils along shorelines.

Shallow seasonally flooded basins (locally called "grass lakes") are common along the Koyukuk River. Grass lakes are usually wetlands during spring breakup and flooding, but otherwise are dry meadows with many showing the beginnings of shrub and forest succession. The drier portions of grass lakes are vegetated primarily by bluejoint grass and occasionally arctic-bentgrass (*Arctagrostis latifolia*), an important food for geese. *Carex aquatilis, C. rostrata, C. capitata* and other sedges dominate in the wetter portions. Other species of grass lake habitat include bog rosemary (*Andromeda polifolia*), bog cranberry (*Oxycoccus microcarpus*), sundew (*Drosera anglica, D. rotundifolia*), and the marsh cinquefoil (*Potentilla palustris*). During flooding, sedges, and occasionally bluejoint grass will survive as emergent vegetation in water depths exceeding four feet. Shorelines of bog lakes vary in character, but nearly always contain buckbean (*Menyanthes trifoliata*), wild calla (*Calla palustris*), various sedge species, and burreed (*Sparganium hyperboreum*); cattails (*Typha latifolia*) are less common on the refuge.

3. Forest

Many classes of forest vegetation occur on the refuge including closed needleleaf, closed mixed deciduous, open needleleaf, and needleleaf woodland. Each of these forest classes are arbitrary and mix and typically grade into one another depending on underlying soil moisture regimes creating the opportunity to recognize other subclasses of mixed forest or pure stands dominated by a single tree species. The above generalized forest classes are described in more detail below:

Closed needleleaf forests occur on moist to well drained sites from the lowlands to mountain slopes and is particularly well developed on alluvial sites along the Koyukuk River. Closed forests typically have 60% to 100% cover. The dominant tree species is white spruce, which may grow in excess of 80 feet tall, the highest stature forest found in the refuge. Understory species include northern toadflax, highbush cranberry (*Viburnum edule*), (*Geocaulon lividum*), Azalea (*Rhododendron lapponicum*), prickly rose (*Rosa acicularis*), sweetvetch (*Hedysarum alpinum*), and various species of feathermoss.

Photo F.3.1 *Dwarf birch (Betula nana) often revegetates burned sites. Here it is shown in bloom.*

Closed mixed deciduous forests are found mainly along the major water courses and on warm, dry, south-facing hillsides where drainage is good and permafrost is absent. This type consists of moderately tall (50 feet) to tall (80 feet) white paper birch (*Betula papyrifera*), aspen (*Populus tremuloides*) and cottonwood. Common understory species found in mixed deciduous

forest include highbush cranberry, currant (*Ribes triste*), bunchberrry (*Cornus canadensis*), and prickly rose.

Open needleleaf forests maintain tree cover between 10% and 25% and are scattered throughout the central portion of the refuge. Open needleleaf forests are also common in the northwestern quarter of the refuge in the Koyukuk Wilderness Area. This type is composed primarily of black spruce, but is often associated with willows and are often interspersed with treeless bogs. This type frequently is found on north facing slopes and poorly drained lowlands usually underlain by permafrost. Groundcover species in this forest include bog blueberry, Labrador tea, sedges and mosses. In many areas a thick groundcover of lichen species entirely cover the ground making an open needleleaf lichen association.

Needleleaf woodlands are a variation on open needleleaf forest that occur on poorly drained, lowland sites. Low stature black spruce are the dominant tree species, but the groundcover resembles a treeless bog community dominated by shrub species such as Labrador tea, bog rosemary, bog blueberry, bog cranberry, and crowberry (*Empetrum nigrum*). Various graminoid and moss species also may be common including cotton grasses, sedges, and mosses (sphagnum moss and peat).

4. **Croplands** - *Nothing to report.*

5. **Grasslands** - *Nothing to report.*

6. **Other Habitats**

Upland habitats predominate on the east, west, and north boundaries of the refuge where several small mountain ranges exist. Mountaintops in the refuge typically are scarcely vegetated rock scree that may extend down the mountain in fingers of unstable rock slopes. Below the scree, communities of prostrate dwarf scrub tundra, alpine meadows, and dwarf shrub tussock tundra predominate. These communities grade into subalpine broadleaf scrub communities and a treeline composed of stunted white spruce. Alpine habitats are particularly rich in lichen species such as *Cetraria nivalis*, *C. cuculata*, *Alectoria ochroleuca*, *Thamnolia subuliformis*, *Stereocaulon* spp., *Cladina* spp., and *Cladonia* spp., of which several are an important food source for wintering caribou. Subalpine broadleaf scrub communities are dominated by alder and willow (*Salix planifolia* ssp. *pulchra*), a favored forage of moose.

7. **Grazing** - *Nothing to report.*

8. **Haying** - *Nothing to report.*

9. **Fire Management**

Fire Management goals and procedures for the Complex are contained within the Alaska Interagency Wildland Fire Management Plan (AIWFMP). The Complex is within the original Seward/Koyukuk (1984) and the Kuskokwim/Iliamna Fire Management Planning Units (1983) of the Alaska Interagency Wildland Fire Management Plan which designates levels of suppression throughout the planning area. An update to the refuge Fire Management Plan is being prepared to conform to agency standards. The update will incorporate a number of GIS coverages the refuge has worked on throughout the year.

Although prescribed burning is an approved activity per the comprehensive conservation plans for all three refuges, there were no prescribed fires in 1999. The majority of the fire management program activity is related to managing wildland fires. The Complex lies within a zone of extremely high lightning strike activity which is the source of most wildfire starts. On an average day during June and July, over 500 lightning strikes can be recorded in the immediate area and over 5,000 in the Galena Zone of Alaska Fire Service. With favorable drying conditions, we can expect numerous wildfires from early June until mid-September. The normal Alaska fire season burns nearly 1.6 million acres from an average of 655 wild fires. 1999 was a mild to normal fire season with just over one million acres and a total of 490 wildfires statewide.

Wildfires burned about 1,005,800 acres in Alaska in 1999. There were four wildfires on the Koyukuk Refuge and one on the Northern Unit of the Innoko Refuge during the year. The largest fire (B-447) totaled 5,763 acres and occurred near the center of the Koyukuk Refuge, just west of Roundabout Mountain. Only 1,420 acres of this fire burned on refuge lands, of the remainder 4,185 acres burned on Doyon and Native Corporation land and 158 acres on BIA land. Details for 1999 individual wildfires are shown in Table 9.1.

Table 9.1. Wildfire occurrence on the Koyukuk and Northern Unit of the Innoko NWR's, 1999.

Fire Number	*Acres Burned*	*Cause*	*Option of Protection*	*Discovery Date*	*Declared Out*
B-355	1.0	Lightning	Limited	06/27/99	06/29/99
B-447	5763.0	Lightning	Modified	07/11/99	08/09/99
B-454	5.0	Lightning	Modified	07/12/99	07/14/99
B-463	5.0	Lightning	Full	07/12/99	07/13/99
B-465	1.0	Lightning	Full	07/12/99	07/14/99

10. Pest Control - *Nothing to report.*

11. Water Rights - *Nothing to report.*

12. Wilderness and Special Areas

One needs only to step to the top of a 50-foot high dune within the 400,000 acre Koyukuk Wilderness to recognize the uniqueness of the Nogahabara Sand Dunes. This active dune area contains about 16,000 acres and is only a small part of a Pleistocene dune field that is now mostly inactive. The individual dunes have been recorded to be 50 to 200 feet high and 300 feet or more in length. The dunes are wind-blown deposits of sand that originated in glaciated areas to the northwest and were deposited in the periglacial Koyukuk area.

In addition to the sand dunes, the Koyukuk Wilderness includes the Three Day Slough area of the Koyukuk River. Three Day Slough contains several large meanders of an old Koyukuk River channel which represent the Complex's best moose habitat with the densest concentration of moose. Increasing numbers of moose hunters enter this area by boat each fall. In 1996, 608 hunters passed through the Koyukuk River check station and the bulk of these hunters were headed for the Three Day Slough portion of the Wilderness Area.

The Koyukuk Wilderness was established by Public Law 96-487 (Alaska National Interest Lands Conservation Act) on December 2, 1980, in accordance with subsection 3(c) of the Wilderness Act (78 Section 892).

13. WPA Easement Monitoring - *Nothing to report.*

G. WILDLIFE

1. Wildlife Diversity

The Koyukuk National Wildlife Refuge has a high diversity of habitat types resulting from riverine erosion, deposition, and flooding, the actions of wildfire, and topographical variation. Baseline data continues to be collected to determine the status and distribution of bird, fish, and mammal species. Over 140 bird species, 30 mammal species, and 14 fish species occur on refuge lands. A refuge bird list was published in 1992 following a decade of active field surveys and local observations by staff living in Galena. Fish, mammal, and plant lists, published in the Comprehensive Conservation Plan in 1987, need to be updated and revised.

Included among the biodiversity monitoring efforts on the Complex in 1999 were surveys of spring bird migration phenology (collection of arrival dates), the North American Migration Count, breeding birds (Standard BBS and MAPS), inventory of plant species in goose habitats, and inventories of wintering birds (Christmas Bird Count, see Section G.7) and small mammals (see Nowitna Section G.10).

2. Endangered and/or Threatened Species

The American peregrine falcon (*Falco peregrinus anatum*) is the only endangered animal species known to breed on the Koyukuk Refuge. Delisting has been proposed for the American peregrine; Region 1 is responsible for acting upon the proposal and is gathering information. There is also a proposal to delist the threatened arctic peregrine falcon, which migrates across the refuge. ADF&G has recommended that the American and arctic peregrine falcons be removed from the state's endangered species list but should be considered "species of special concern."

It is unknown if any other threatened or endangered plant species occur on the refuge. Disjunct species occur on the Nogahabara Sand Dunes, and some species found there may represent range extensions. Also, inaccessible alpine and subalpine habitats on the refuge have received little biodiversity survey work to date. The Service should plan on conducting further surveys in the poorly explored habitats that have received little attention to date.

Weather Conditions and Waterfowl Migration Chronology

It is important to monitor arrival chronology and spring breakup conditions because these factors greatly influence waterfowl productivity. Arrival of geese in Galena in 1999 was slightly earlier than usual, and arrival of ducks was slightly later than normal. White-fronted geese arrived on April 18, six days earlier than the long-term mean arrival date (*see* Section G.7, Table G.7.2). Canada geese arrived on April 21, four days earlier than average. Mallards arrived in Galena on April 27, one day later than average, while pintails arrived on April 28, which was three days later than the long-term mean. On April 27, the Dulbi River was 10% free of ice; 8-10 Canada geese were seen along the river. On April 28 the Nulato River was 50% free of ice. On May 4, snow cover around Huslia was estimated at about 70%. Over 7,000 geese were seen in various sized flocks (150-1,000) congregated around openings in the Koyukuk River between Huslia and the mouth of the Kateel River. By May 6, numbers of geese had doubled to over 14,000, and flocks of ducks, swans, and cranes were also observed. Snow cover was estimated to still be about 70% on much of the Koyukuk NWR. For the first time in many years, several flocks of snow geese were observed, totaling 150 birds. On a May 11 flight, snow cover estimates were highly variable: northeast of Huslia, 30-40%; near Galena, ~ 45%; near the Natlaratlan and Dulbi Rivers, 60-70%; upper Huslia River, 70-80%; near Long Stretch, 85%; near the Gisasa River mouth, 100%. The smaller lakes were estimated to have had 40-80% open water near Galena, but the large lakes had only 10% open water. A waterfowl survey of river corridor habitat along the Dulbi River and along the Koyukuk River from the Hog R. mouth down to the Koyukuk confluence with the Yukon indicated an estimated 3,720 ducks, 8,467 geese, 940 swans, and 128 cranes. Biologists and local residents reported larger numbers of ducks, geese, and swans concentrating along the melted areas along the Koyukuk and Yukon River corridors compared to recent years.

This was probably because spring breakup was delayed in the more coastal habitats northwest of Koyukuk NWR.

Snow melt on much of Koyukuk NWR was almost complete by mid-May. Snow cover was estimated near Galena at ~5%, and <2% along the Dulbi River on May 13. Flooding in the region was minimal in1999. An aerial survey on May 13 indicated that the Dulbi River was flowing bank to bank; however, water had not spilled out onto the floodplain. The ice on the Yukon River at Galena started moving on the evening of May14, which was two days later than the long term average. Timing of snow melt and river break-up appeared to be close to the long-term average. This average timing and lack of flooding in 1999 suggested that waterfowl production would be average to above average, which proved to be the case (*see* Section G.3, Figures G.3.1-3, Table G.3.2-3). By comparison, the early break-up and early arrival of waterfowl in 1998 did not automatically result in early nesting, because there was a dramatic cooling in early May, which delayed nesting. Similarly, the lack of spring break-up flooding in 1998 did not seem to guarantee that nesting conditions would be ideal, because an early June flood caused by unusually high rainfall in the Brooks Range caused flooding along the Koyukuk River, which resulted in poor nesting success.

Ducks.

Production. Annual duck production surveys were conducted on the Koyukuk NWR and the Northern Unit of Innoko NWR from 1983 to 1993. The estimated number of ducklings produced on both refuges ranged between a minimum of 62,050 in 1989 to a maximum of 199,155 in 1990 (Saperstein, L.B. 1997. *A summary of ten years of duck production surveys, Koyukuk NWR, AK, 1983-93*). The estimated number of adults occurring on both refuge units between 1990-93 ranged from 61,664 in 1993 to 117,449 in 1992.

Breeding population. Following cessation of duck brood surveys in 1993, the only indication of trends in duck abundance on the refuge was the aerial duck breeding pair survey conducted by the Service's Division of Migratory Birds in Juneau. Estimates of the abundance of key duck species in the Koyukuk stratum (including Koyukuk and Kanuti NWRs) are presented in Table G.3.1. In 1999, indices of abundance of four duck species/groups, American wigeon, northern pintail, scaup and scoter, were below the long-term mean. In 1999 only northern shovelers were above their long term mean. It should be noted that the estimates in Table G.3.1 apply to the entire Koyukuk stratum, of which Koyukuk NWR is only a part. A comparison of the breeding pair estimates for the Koyukuk stratum (Table G.3.1) with estimates of adults summering on the refuge (based on 1990-93 brood survey extrapolations) suggested that, depending on the year, the Koyukuk NWR represented approximately 36-65% of the ducks estimated for the entire Koyukuk stratum. The mean estimated breeding duck population in the Koyukuk Stratum was 194,200 ducks, May 1984-1999 (Table G.3.1). Similarly, the mean estimated population for Koyukuk NWR was 70,000-120,000, using the percentages given above.

These figures corresponded well with the July post-breeding estimates of 62,000-117,000 presented by Saperstein (1997).

Expanded breeding population survey. In 1996 and 1997 the Division of Migratory Birds conducted an expanded breeding population survey in the Koyukuk stratum, including Koyukuk and Kanuti NWR's, and the Hog River/Pah River Flats. This intensive transect survey, which had parallel flight lines spaced every nautical mile over all wetland habitats in the Stratum, resulted in the best quality estimates of duck numbers available for the region. The 1997 expanded breeding population survey estimated 211,600 ducks in the Koyukuk stratum, while the standard breeding population survey estimated 199,000 ducks the same year.

Table G.3.1. Estimated ducks (in thousands) and coefficient of variation (CV) for the Koyukuk stratum, including Koyukuk and Kanuti NWRs, based on aerial breeding pair survey, USFWS, Migratory Birds, Juneau, AK.

	YEAR																		
Species	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	Mean	S.D.	C.V.
Mallard	18.8	9.4	17.5	8.8	28.2	20.7	14.9	18.7	12.3	10.2	22.0	22.3	22.7	24.5	41.6	19.0	19.5	7.9	0.41
Wigeon	49.5	19.6	50.9	36.5	49.3	46.5	40.9	39.7	29.4	29.6	41.0	43.8	38.5	78.6	63.6	36.1	43.3	13.4	0.31
G.-w.teal	13.7	15.6	36.1	20.5	20.5	26.4	11.7	19.6	14.1	22.8	19.1	39.6	42.8	20.9	30.0	24.6	23.6	9.0	0.38
Shoveler	11.0	6.3	19.3	22.4	19.7	10.2	14.9	10.7	14.4	24.4	16.1	25.8	24.4	14.8	32.6	19.2	17.9	6.7	0.37
Pintai	180.2	38.1	75.1	53.8	47.7	44.7	48.3	32.1	20.8	24.4	19.8	24.3	29.8	23.2	25.7	25.4	38.3	18.2	0.47
Scaup	47.7	28.2	38.7	39.7	38.6	48.6	27.1	31.5	33.6	24.6	35.3	17.5	22.2	21.2	20.1	25.1	31.2	9.3	0.30
Scoters	6.1	8.9	10.6	9.3	6.5	5.2	7.5	2.8	6.4	5.0	3.3	2.5	6.5	7.4	4.5	3.4	6.0	2.3	0.39
Other	17.3	13.4	24.1	14.8	19.7	14.9	19.7	15.2	8.0	19.5	13.2	9.8	10.8	8.0	11.8	8.3	14.3	4.7	0.33
Totals	244.3	139.5	272.3	205.8	230.2	217.2	185.0	170.3	139.0	160.5	169.8	185.6	197.7	199.0	230.0	161.1	194.2	36.6	0.19

Geese

Production surveys. River float-trip surveys have been conducted each summer on the Koyukuk NWR to assess goose production and record observations of other wildlife. In 1999 float surveys were conducted on four areas specified in the wildlife inventory plan: Dulbi River, Dulbi Slough, Kaiyuh Slough/Khotol River, and Huslia River. On the Koyukuk NWR, abundance of adult white-fronted geese declined in the 1990's compared to the 1980's (Fig. G.3.1), which prompted several studies (see below). During 1995-97, and again in 1999, production of young was excellent (mean of ~50%), which suggested that recruitment into the population was adequate for population stability. In the most consistently surveyed area, Dulbi River/Dulbi Slough, abundance of adults and young increased in 1999, compared to 1998. The Huslia River, which has not been surveyed regularly, showed an increase in adults and young in 1999, compared to the most recent prior surveys conducted in 1993 and 1994 (Table G.3.2). This increase may indicate a recovery to the former levels of abundance present in the 1970's. A comparison of the only two years in which the entire navigable length of the river was surveyed, in 1976, and 1999, showed similar numbers of adults and young (Table G.3.3).

In contrast to white-fronts, there has not been a discernable long-term trend of Canada geese on the Koyukuk (Fig. G.3.2). The long-term trends were much more variable than for white-fronts. Canada geese had excellent production in 1995-97, showed a drop in adults and young in 1998, but returned to above average abundance in 1999. We believe that the June 1998 flooding along the Koyukuk River was the main cause of the drop in adult and young geese of both species.

On Kaiyuh Flats, where white-fronts have not recently been as abundant as on the Koyukuk, adult numbers and production increased in 1996, 1997, and 1999. Similar to the Koyukuk, production dropped in 1998 (Fig. G.3.3). Adult white-front abundance matched the long-term average in 1999, while abundance of young was above average. Canada geese, which have showed a generally lower abundance than white-fronts on the Kaiyuh, showed above average adults and below average young in 1999.

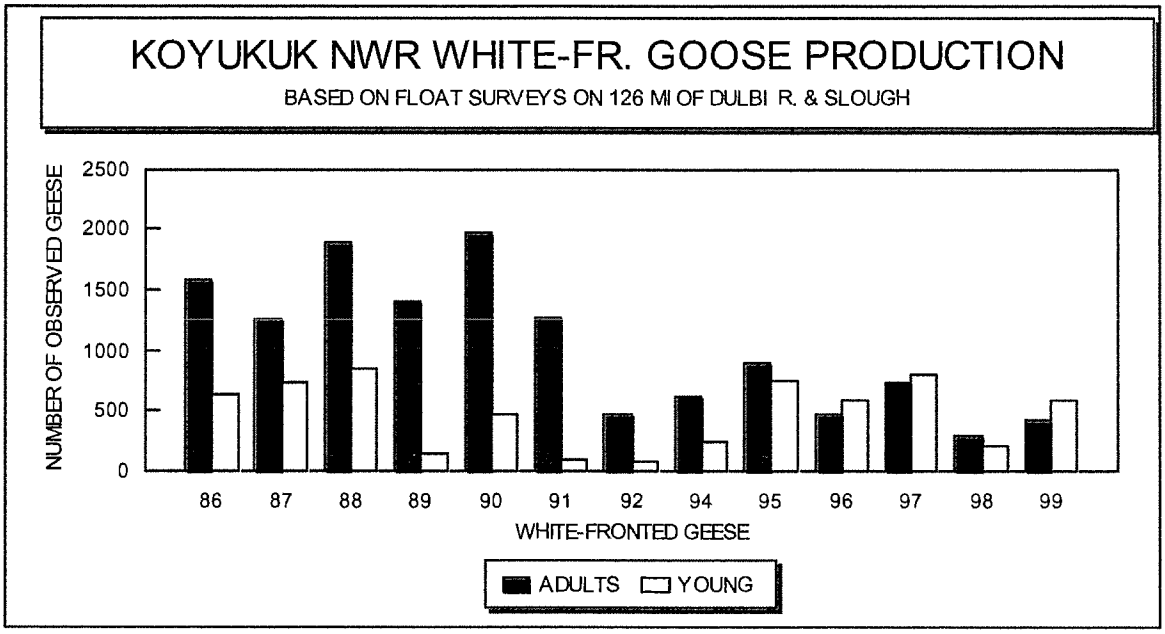


Fig. G.3.1. Results of white-fronted goose counts on Dulbi River and Dulbi Slough, Koyukuk NWR, Alaska, July 1986-99.

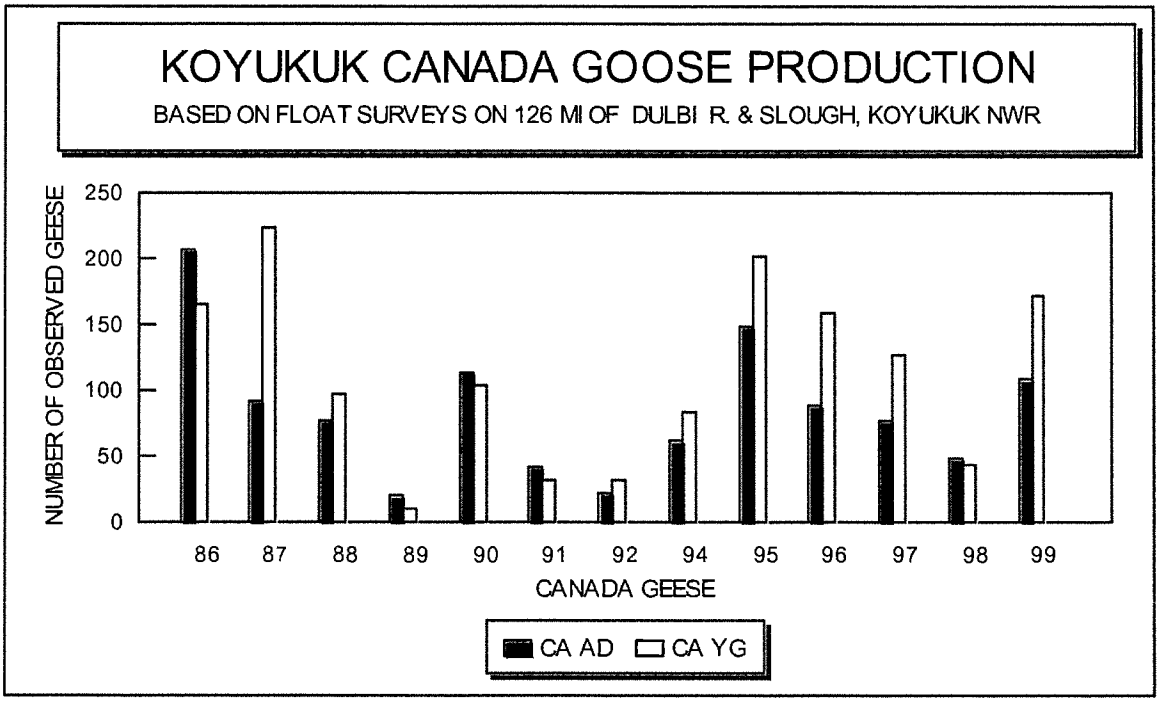


Fig. G.3.2. Results of Canada goose counts on Dulbi River and Dulbi Slough, Koyukuk NWR, Alaska, July 1986-99.

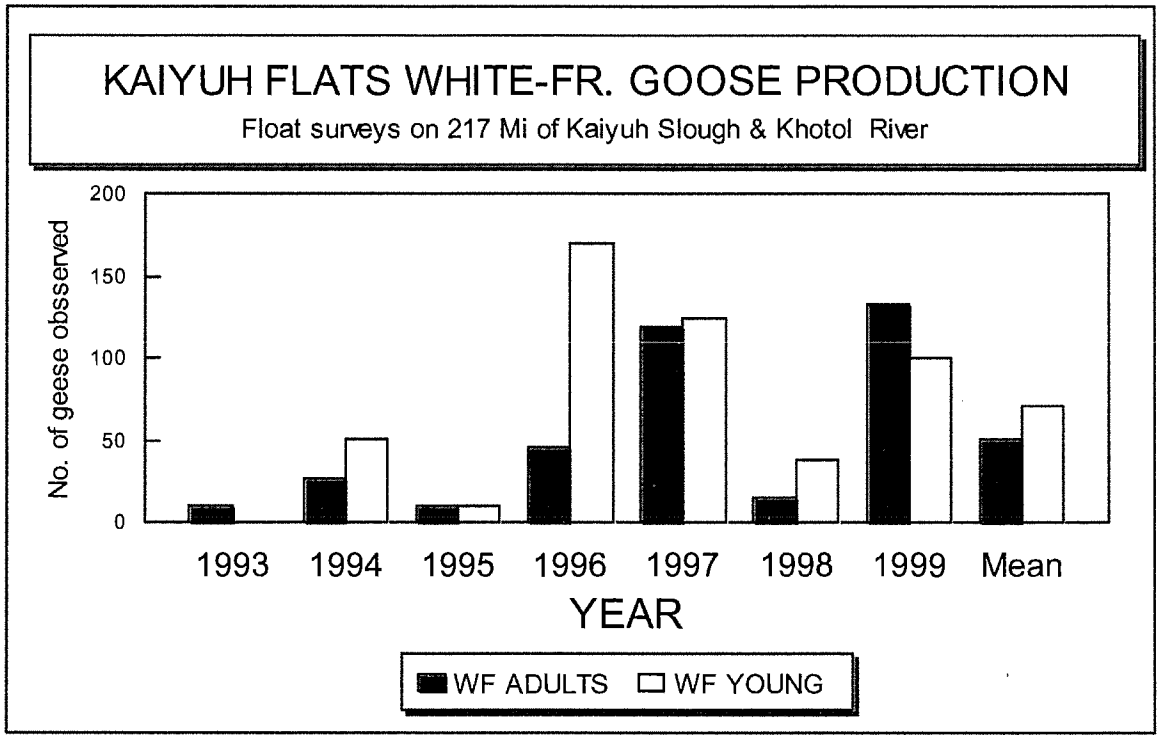


Fig. G.3.3. Results of white-fronted goose counts on Kaiyuh Slough and Khotol River, N. Unit, Innoko NWR, Alaska, July 1993-99.

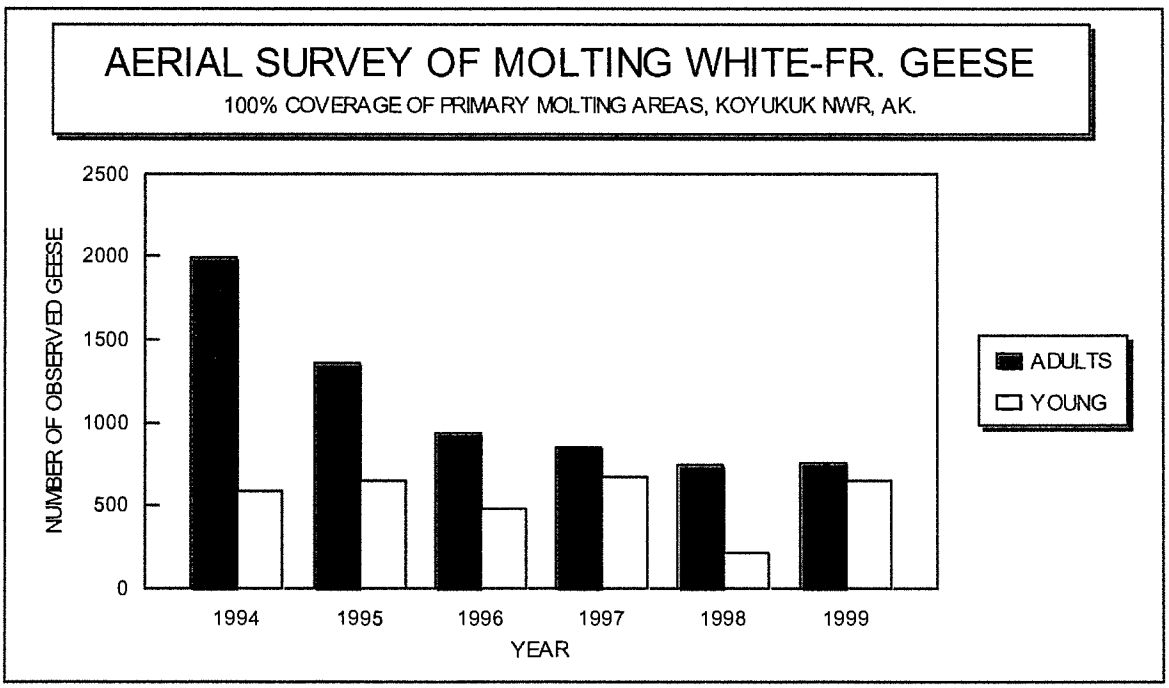


Fig. G.3.4. Estimated abundance of white-fronted goose adults and young during intensive aerial surveys of primary molting areas (Three Day Slough, Dulbi River, and Dulbi Slough), Koyukuk NWR, Alaska, July 1994-99. Sample area was 304 mi^2 1995-99, and 197 mi^2 in 1994.

Table G.3.2. Adults and goslings observed during the comparable 103 miles of the Huslia River, Koyukuk NWR, 1993, 1994, and 1999.

YEAR	1993	1994	1999	Mean	Sd
WF Adults	29	51	139	73	77.78
WF Young	50	104	245	133	137.88
% young	63	67	64	64.66	0.707
CG Adults	7	2	0	3	3.60
CG Young	0	4	0		
% young	0	66	0		

*Excluded geese from 1999 lower 24 miles are 4 adult and 7 gosling white-fronted geese. No Canada geese were observed during the 1999 survey.

Table G.3.3. Adults and goslings observed during historical goose production float trips on Huslia River, Koyukuk NWR, 1976 and 1999.

YEAR	*1976	1999	Mean	Sd
WF Adults	150	143	146.5	4.949
WF Young	*280	252	266	19.798
% young	65	64	64.5	0.707

*WF young in 1976 was an estimate of the average brood size (4) and the number of broods (76) observed. No Canada geese were observed during these two surveys.

Population estimation surveys. We recognized that the river float surveys were best suited for monitoring production of young and indexing abundance of adult geese. The decline in white-fronted geese that was first detected by these surveys necessitated more reliable means to estimate the refuge population. Therefore, we conducted a study to devise an accurate procedure for estimating goose populations on the refuge. Much of this work was funded by the USFWS Division of Migratory Birds. In 1998, a draft report entitled *Evaluation of aerial and float surveys of geese on the Koyukuk National Wildlife Refuge* was prepared by M. A. Spindler, J. Y. Fujikawa, J. M. Lowe, and R. A. Stehn. The report presented the results of methods testing and summarized abundance trends of white-fronts in the aerial survey area. Results of the 1999 aerial survey showed a level of adult abundance similar to 1998, and increased production of young in 1999, and similar to 1997 and 1995 levels (Fig. G.3.4).

Nesting ecology and habitat requirements of white-fronted geese (Anser albifrons): White-fronted goose telemetry study. Prior to 1994, we lacked even basic knowledge about seasonal movements and habitat preferences of the boreal forest nesting segment of the mid-continent population of white-fronted geese. These geese, which reach their greatest abundance on Koyukuk, Kanuti, Selawik, and Innoko NWRs, are unique by virtue of their early nesting in boreal forest compared to the majority of the population, which nests later in tundra areas across the Alaska North Slope and Canadian arctic. In the mid-1990's we were unable to determine whether local conditions on the nesting and summering areas, or other more distant factors, were contributing to the decline. In 1994 and 1995 a total of 42 white-fronted geese were fitted with radio-transmitter neck collars to determine nesting, brood rearing, molting, and staging habitat. Another 30 radio collars were deployed by Kanuti NWR as part of a coordinated study. Much of this work was funded by the USFWS Division of Migratory Birds.

Several radioed geese had high nesting site fidelity from year to year. In four cases radioed females placed their nest within 20 meters of the nest location in the previous year. These findings strengthened Lensink's (1987) and Ely & Dzubin's (1994) assertions that white-fronts have high nesting area fidelity. A small proportion of nests were located in upland areas that are immune to effects of flooding. Recent flood years (1993, 1994, 1998) had significantly reduced production. During four years of study, a majority of nests were within the floodplain and were vulnerable to extreme flooding. Brood-rearing areas are usually near the nest site; however, there were extremes that ranged from many miles away from the nest site, to some that were immediately surrounding the nest site. There were at least five cases where an upland nesting female led her brood 5-10 miles to a wetland complex for brood rearing. In all cases movements were minimal (<3 miles) once reaching the brood-rearing wetland complex. Failed breeders sometimes molted near the nesting area, but in two cases, failed breeders went to Selawik for the molt. Nearly all the Koyukuk radio-collared white-fronts made a pre-migratory staging movement to the Kotzebue Sound coastline. This movement usually occurred by the first week of August and occurred just a few days after fledging. Along the coast, white-fronts

used estuarine meadows for grazing and upland tundra to feed on berries. At Kanuti, a westward pre-migratory staging movement was not documented, but rather some birds began their eastward migration directly, stopping along the Yukon River before proceeding southeastward.

Cooperative migration and wintering studies. By 1997 it had become apparent that the decline in white-fronted geese on Koyukuk NWR was probably not caused by local factors alone. We then became involved in off-refuge cooperation with other partners (USFWS Division of Migratory Birds in Region 7 and Region 2, USGS-BRD, Canadian Wildlife Service (CWS), Central Flyway Council Technical Committee, Nature Conservancy of Texas, Ducks Unlimited, Universities of Tamaulipas and Chihuahua (Mexico) and SEMARNAP (Secretariat de Medio Ambiente, Recursos Naturales y Pesca)).

Canada. One of the hypotheses regarding Interior-Northwest Alaska white-fronted geese decline is that these early migrating and nesting geese arrive in prairie Canada in early September, before other population segments arrive. Such early arrival could increase vulnerability of the Interior-Northwest Alaska population to hunting. However, observers did not observe significant hunting early in the season when only Canadian citizens can hunt. Hunting increased markedly by the third week of September, when many lower-48 U.S. citizens go north to hunt geese. The Service must continue close monitoring the situation in the future, especially in light of proposals to allow non-Canadian citizens to hunt geese in prairie Canada in early September.

U.S. Lower-48 states. Flyway-wide, it is estimated that most (40%) of the hunting pressure on the mid-continent white-fronted goose population presently occurs in Texas. It is unkonwn how much of this harvest affects the Interior-Northwest Alaska population. James Anderson and David Haukos (Texas Tech University) identified a major stopover area, the Winchester Lakes Region of the Texas panhandle. In addition to spring and fall migration stopover, there was some wintering activity at and near Winchester Lakes, and there was some exchange between this area and the coastal Texas rice prairies. About 69% of the neck-banded geese observed in north central Texas were from Alaska. The banding data analysis by USGS-BRD showed a cluster of recoveries for Interior-Northwest Alaska birds in this area, however, neck collar resighting showed a significant portion of the population migrated directly between Canada and Mexico, especially in the fall.

A study entitled *Identification of migration and wintering factors contributing to a population decline in greater white-fronted geese nesting in the Boreal Forest of Interior and Northwest Alaska* was completed by USGS. The study was conducted by Craig Ely and Joel Schmutz of the Alaska Science Center, Anchorage. Using detailed analyses of collar resighting and band recovery data they determined: (1) the Interior/northwest Alaska white-fronted geese migrated earlier in all phases of their fall and spring

migration, and that differential vulnerability could occur in areas other than Canada; (2) a cline of wintering distributions was identified; east-most nesters (Central Canada) winter farther east in Louisiana and east Texas, while and west-most nesters (Interior/northwest Alaska) winter in the most western locations, mainly in the central highlands of Mexico; and (3) of all Mexico band recoveries, the Interior/northwest Alaska white-fronts showed up most frequently in the Central Highland states of Chihuahua, Durango and Zacatecas.

Ely and Schmutz reported different annual survival rates of the various stocks contributing to the population. Interior/northwest Alaska white-fronts had an estimated annual survival rate of ~0.60, which was significantly lower than the ~0.70 for the other segments that are not declining (North Slope AK, Western Canadian Arctic, and Central Canadian Arctic). A separate analysis to determine if these survival rate estimates differed due to factors in spring/summer on the nesting grounds or in fall/winter due to factors in migration or on the wintering grounds was conducted. This was not successful due to the limited sample size once the data were subdivided, and because a large amount of hunting mortality occurred in the middle of one major resighting period, September-October. There are few other opportunities to resight a sufficient number of samples during other times of the year. Ely and Schmutz concluded that the band recovery estimates were less likely to be biased than collar resight estimates, and that the lower annual survival estimate of ~0.60 for the interior-Northwest Alaska white-fronts could be associated with the population decline observed on the refuge.

Mexico. Almost a decade ago, when float surveys first suggested flood-related decreases of Koyukuk white-fronted goose abundance and production, few biologists in Alaska would have guessed that the observed decreases could also be related to wintering conditions 3,000 miles away in another country. While a majority of band returns from the mid-continent white-fronted goose population are from Texas, mainly the Gulf Coast, it is estimated that a third of the population winters in Mexico, from the Gulf coastal plain in the state of Tamaulipas westward to the central highland states of Chihuahua, Durango, and Zacatecas. Therefore the refuge contributed to several cooperative studies to better define the wintering areas. These efforts involved many partners (Bill Eldridge, Division of Migratory Birds, Anchorage; Jeff Haskins, Migratory Bird Coordinator in Region 2; John Taylor, Bosque del Apache NWR; Dan Nieman, Canadian Wildlife Service; Texas Chapter of The Nature Conservancy; Rod Drewien, Hornocker Wildlife Institute, and the Mexican universities in the northern states of Tamaulipas, Nuevo Leon, and Chihuahua).

The most basic portion of the Mexico work was to identify white-front wintering areas. From 1990 until January 1999, teams of University students, professors, NGO biologists, and participants from FWS and CWS cooperated to search likely wetland and agricultural areas across a huge expanse of northern Mexico. This resulted in the identification of the main wintering area of the Interior/Northwest Alaska white-fronts as the central highlands

of Mexico (the states of Chihuahua, Durango, and Zacatecas). In the winter of 1998-99, Dan Nieman of CWS determined that the ratio of marked/unmarked birds was rather high, ~100 on the highlands, compared to ~1000 on the Mexico and Texas Gulf Coast. These findings concurred with Ely's findings (based on band recoveries) that the main wintering habitat of the Interior/Northwest Alaska white-fronts is most probably the Central Highlands. Dan Nieman summarized results of the 10-year neck-band resighting project in a paper at the Neotropical Ornithological Congress in Monterrey, Mexico in October 1999. His paper (presented by Gustavo Quintana, Univ. of Chihuahua) was entitled *Breeding ground origin and winter distribution of white-fronted geese in Mexico.*

A result of the Mexican student volunteer program in 1998 and 1999 (*see* Section E.4) was that the Service had an opportunity to economically obtain white-fronted goose winter ecology and behavior data from two major wintering areas: Tamaulipas and Durango.

Tamaulipas. 1998 refuge volunteer and University of Tamaulipas student Ms. Fabiola Yepez spent the winters of 1998-99 and 1999-2000 working on a senior thesis entitled *Wintering behavior of white-fronted geese in the central region of the state of Tamaulipas, Mexico.* Based on our positive experience with her as a refuge volunteer, we contributed $2,500 to fund logistics costs of her senior thesis project. To produce a study area map, USFWS Region 7 Migratory Birds and the refuge funded acquisition of satellite imagery, and Ducks Unlimited of Mexico (DUMAC) then performed land cover classification. The refuge received an annual progress report from Fabiola in fall 1999. After her first season of field work, some tentative findings were:

1. A series of artificial reservoirs (*presas*) constructed for agriculture were very important to wintering white-fronted geese.

2. Eighty-two percent of observations were in these *presas*, while 18% were in cultivated fields. In her study area, 56% of the land area was cultivated; 16% was pasture and savannah; 14% natural vegetation, 12% hennequin (*Agave*); and 2% water.

3. Disturbance of white-fronts was 52% natural (snow geese, raptors, other animals, etc), 31% man-caused; and 9% unknown. Interspecific competition between snow geese and white-fronts over resting and feeding areas was observed.

Durango. Veteran Mexico waterfowl observers Dan Nieman (CWS), Rod Drewien (Hornocker Wildlife Institute), and John Taylor (Bosque del Apache NWR) believed the best chances of conducting a successful wintering ecology study of white-fronted geese in the highlands were in the state of Durango. However, there would be several challenges

to surmount. Unlike Tamaulipas, the wetlands in the arid state of Durango are dispersed over a very large area, and access is more difficult and costly. Dan Nieman believes that crop failures due to a series of droughts in the last decade and displacement of white-fronted geese away from the limited feeding fields by expanding numbers of snow geese may be major contributors to the white-front decline we have been observing in Interior/Northwest Alaska. In 1999 we were interested in starting a winter ecology study, similar to Fabiola's, but in the main wintering area of Durango. We recruited a volunteer, Manuel Ochoa, from the University of Chihuahua (the Univ. of Durango does not have a wildlife program). After a summer of helping with the goose study on the Koyukuk/ Nowitna NWR, he discussed with us several possible objectives for a masters-level thesis project. We obtained a significant amount of consultation and advice from Rod Drewien, Dan Nieman, and John Taylor. Dr. Rod Drewien agreed to be a thesis committee advisor, along with Dr. Alberto Lafon, of Univ. of Chihuahua. The refuge allocated $7,500 for logistical support to the Wildlife Management Institute in Washington, D.C., which then transferred the funds directly to the Mexican workers. Tentative objectives and proposed methods included:

1. Identify preferred wintering habitats of white-fronted geese in the main highland wintering area. Conduct a literature review and collect past observations from other workers. Select some representative and accessible wetlands for field study. Throughout the winter, make repeated visits to various use areas at regular intervals. Determine general movements among wetlands, activity budgets, habitat availability, habitat use, hunting intensity, and other sources of disturbance.

2. Examine the relationship of white-fronted goose wintering activities with precipitation, agricultural production, and hunting variables. Assess quantity and quality of forage, including field study and obtaining information from government agencies that collect agricultural statistics. Make preliminary determination of major forage sources through activity observations and examination of birds obtained from hunters.

3. Additional/incidental observations will be made to examine: (a) the effects of long-term drought on winter success of white-fronted geese; and (b) the effects of increasing populations of Snow/Ross' geese. These will be addressed mainly by qualitative field observations, field interviews, and climate records.

4. Identify other factors that could negatively affect wintering white-fronted geese and what factors future studies could focus upon.

By the end of December 1999 Manuel had visited dozens of wetlands with Rod Drewien and John Taylor, and had selected two study sites for repeated visits: (1) Lagunas Santiaguillo and Las Grullas (north of Ciudad Durango); and (2) a wetland complex named Cienegas de Malaga (northeast of Cd. Durango). The plan was to return to these sites in January 2000 and remain there until the geese left for spring migration in February.

Swans

Swans are considered a key indicator species because their production trends tend to correlate well with that of other waterfowl species, they are sensitive to nest disturbance, and swan sightability is high during aerial surveys. For these reasons, swan surveys have been conducted on the Koyukuk NWR. In 1989 the staff selected six 1:63,360 trend maps to monitor swan population and production according to the refuge wildlife inventory plan. Surveys in 1985 and 1987 indicated that abundance of tundra swans increases as one proceeds north of the Koyukuk River. Both trumpeter and tundra swans nest on the refuge. Late summer aerial production surveys have necessarily grouped the two species simply as "swans."

Aerial censuses of all swan habitat on Koyukuk NWR and Kaiyuh Flats indicated that the population has increased. In the five years between the 1990 and 1995 censuses, swan estimates on the Koyukuk and Kaiyuh Flats increased 63% from a total of 617 to a total of 1,006. The estimated annual growth rate of the adult component was 12%. By comparison, the expanded breeding population aerial survey estimated 1,386±565 swans in June 1997.

The most recent swan survey on the Koyukuk NWR was conducted in August 1998. The adult population has continued to grow, as indicated by increasing numbers of pairs and total adults. Percent of pairs with broods was 22%, among the lowest observed since the mid-1980's. We attribute the decline in production in 1998 to the wet, windy, and cold May, combined with June flooding along the Koyukuk River. Even though overall production declined in 1998, the average brood size was high, at 3.4, and was among the highest ever observed on the Koyukuk (mean=2.5).

4. Marsh and Water Birds

Photo G.4.1. *Sandhill cranes are frequently observed on the refuge.*

A number of marsh and water birds are commonly observed on the refuge, including: common, Pacific, and red-throated loons; red-necked and horned grebes; and sandhill cranes. Yellow-billed loons are occasionally observed. Past duck production surveys indicated that red-necked grebes, common loons, and sandhill cranes were the most common marsh and water bird species.

5. Shorebirds, Gulls, Terns, and Allied Species

The following shorebird species are commonly observed on the refuge: lesser and greater yellowlegs, Arctic tern, glaucous, Bonaparte's, mew, and herring gulls, long-tailed jaegar, semipalmated plover, common snipe, spotted, least, pectoral, and solitary sandpipers, northern phalarope, Hudsonian godwit, and whimbrel. A Hudsonian godwit nest was found at Birch Lake, six miles south of Huslia on June 1, 1997, during goose nest searches. The species is believed to be an uncommon nester on the Koyukuk NWR.

6. Raptors

The refuge supports a diversity of raptor species. Raptors are generally sensitive to disturbance and, therefore, act as important indicator species. Raptors that nest on the refuge include rough-legged hawks, merlin, sharp-shinned hawks, northern harriers, red-tailed hawks, goshawks, great horned owls, great gray owls, boreal owls, northern hawk owls, American peregrine falcons, and bald eagles. Raptor surveys have been conducted periodically on the Yukon River between the villages of Ruby and Kaltag and along the Koyukuk River just above Koyukuk village. The purpose of this survey is to monitor general trends in the number of raptors utilizing nesting sites along the river. The USFWS Endangered Species Office conducted the survey from 1979 to 1991, while the refuge conducted the survey from 1992-1994. This survey is next scheduled for June 2000.

7. Other Migratory Birds

Monitoring efforts for passerines in the Galena area during 1999 included surveys of spring bird migration phenology (collection of arrival dates and North American Migration Count), breeding birds (Standard Breeding Bird Survey - BBS, Monitoring Productivity and Survivorship - MAPS), and wintering birds (Christmas Bird Count). Migrant songbirds commonly seen in the summer include alder flycatcher, olive-sided flycatcher, tree swallow, bank swallow, ruby-crowned kinglet, American robin, Swainson's thrush, gray-cheeked thrush, varied thrush, northern waterthrush, yellow warbler, blackpoll warbler, orange-crowned warbler, yellow-rumped warbler, rusty blackbird, savannah sparrow, dark-eyed junco, American tree sparrow, white-crowned sparrow, fox sparrow, and Lincoln's sparrow. Common winter residents are common redpolls, common raven, gray jays, black-capped and boreal chickadees, and pine grosbeaks.

Phenology. These analyses are used to relate annual differences in temperature, precipitation, timing and duration of flooding, etc., with observed patterns in wildlife populations and productivity. Records of annual spring arrival dates for common and conspicuous birds were summarized to compare spring migration phenology among years (Table G.7.1). In 1999 six species for which we have long-term data arrived earlier than their long-term mean arrival date, and six species arrived later than the long-term mean. Arriving earlier in 1999 were Canada and white-fronted goose, slate-colored junco, American robin, American tree sparrow, and tree swallow.

Table G.7.1. Spring arrival dates of common birds at Galena, Alaska, 1999.

Species	1999	Mean (1982-99)
Snow bunting	28 Ma	26 Ma
Northern pintail	28 A	25 A
Mallard	27 A	26 A
Canada goose	21 A	25 A
White-fr. goose	18 A	24 A
Slate-colored junco	21 A	26 A
Ruby-crowned. kinglet	1 M	29 A
Mew gull	nd.	30 A
American robin	20 A	29 A
American tree sparrow	28 A	2 M
Common snipe	7 M	6 M
Tree swallow	4 M	8 M
Olive-sided flycatcher.	26 M	24 M

Months are indicated by letters: Jan=January, F=February, Ma=March, A=April, M=May, J=June. No data= n.d.

Migration Counts. The North American Migration Count was begun in 1992 to provide a "snapshot" of spring migration across the continent. Always held on the second Saturday in May, the count coincides with International Migratory Bird Day and provides a good opportunity for public involvement. In 1999 totals of 433 individuals of 30 species were recorded in the Galena area, compared to 642 individuals and 43 species in 1998 and 421 individuals of 34 species in 1997.

Breeding Bird Survey. The refuge assists with national monitoring of songbirds, many of which are neotropical migrants, by conducting standardized Breeding Bird Survey (BBS) routes in taiga habitats near Galena. Two BBS routes were conducted on Koyukuk NWR in 1997-1999 (a third route was run along the Ruby to Poorman mining road; see Nowitna NWR Narrative, Section G.7). The Nikolai Slough survey route is 4-10 miles northwest of Galena and run by boat, which makes it especially challenging to complete within the allotted time limits. However, the route encompasses some excellent songbird habitat and is one of the most productive in terms of species diversity and abundance (TableG.7.2).

Table G.7.2. Results of the Nikolai Slough Breeding Bird Survey, June 1997-99, compared to long term (1986-99) mean, standard deviation (SD) and Coefficient of Variation (CV).

Species	1997	1998	1999	Mean	SD	CV
Trumpeter swan		1	2	0.4	0.50	1.32
Greater white-fronted goose	9	43	3	5.1	12.6	2.48
Canada goose		2	5	1.0	1.8	1.83
Green-winged teal	2			1.6	2.5	1.49
Mallard		4	3	4.0	9.4	2.34
Northern pintail			13	2.5	3.7	1.48
Northern shoveler			14	4.9	7.6	1.57
American wigeon	18	33	34	17.1	11.0	0.64
Scaup	1			0.3	0.5	1.65
Canvasback	1			0.1	0.00	0.00
Black scoter	3			0.6	1.00	1.75
Common goldeneye	4	6	8	4.7	3.5	0.74
Bufflehead	2	5		2.1	2.3	1.06
Red-breasted merganser			2	0.6	0.0	0.00
Bald eagle			2	0.4	0.5	1.40
Red-tailed hawk	3	1	1	1.6	1.2	0.75
Ruffed grouse		1		0.9	1.20	1.30
Sandhill crane	3	12	10	5.1	3.5	0.68
Lesser yellowlegs	11	13	6	10.3	4.5	0.44
Solitary sandpiper	3	5	2	4.1	2.6	0.62
Spotted sandpiper	22	21	22	13.4	8.9	0.66
Common snipe	57	61	46	35.6	12.8	0.36
Bonaparte's gull		1	3	1.3	2.3	1.81
Mew gull	14			4.8	6.3	1.32
Herring gull	1	1	5	1.3	1.5	1.15
Belted kingfisher	3	1	7	3.6	2.4	0.65
Three-toed woodpecker	1			0.1	0.0	0.00
Northern flicker	1			0.7	0.9	1.26
Olive-sided flycatcher	11	16	14	11.4	4.6	0.40
Alder flycatcher	28	27	19	18.5	5.9	0.32
Tree swallow	1	12	9	4.1	3.6	0.88
Violet-green swallow			6	0.4	0.0	0.00
Bank swallow	14	10	6	40.5	38.1	0.94

Species	1997	1998	1999	Mean	SD	CV
Gray jay	21	25	6	12.9	6.4	0.50
Common raven	5	4	4	4.4	2.5	0.58
Boreal chickadee	2	3	2	2.1	1.3	0.64
Ruby-crowned kinglet	7	11	6	5.2	3.1	0.60
Gray-cheeked thrush		6	6	5.9	4.0	0.68
Swainson's thrush	74	49	88	54.4	22.6	0.42
American robin	22	13	16	25.4	19.6	0.77
Varied thrush	21	25	15	20.1	11.6	0.58
Orange-crowned warbler	29	42	18	14.2	11.2	0.79
Yellow warbler	15	8	9	12.6	5.5	0.43
Myrtle warbler	29	43	37	22.9	10.3	0.45
Blackpoll warbler	4	3	2	2.4	2.8	1.19
Northern waterthrush	61	60	63	41.1	16.6	0.40
Wilson's warbler	1	4	2	0.9	1.2	1.43
Fox sparrow	6	12	16	10.5	8.2	0.78
Lincoln's sparrow	1	2	2	0.5	0.9	1.83
White-crowned sparrow	3	3	4	8.9	5.3	0.60
Slate-colored junco	40	40	50	37.5	7.1	0.19
Rusty blackbird	10	10	8	9.4	3.1	0.33
Pine grosbeak	3	1		1.0	1.3	1.34
White-winged crossbill	12		3	3.6	5.4	1.52
Common redpoll	44	9	7	13.3	12.8	0.96
TOTAL	623	649	606	477.1	77.5	0.16

The second local BBS route is the Galena road system, which covers all 12.5 miles of the main roads available. This route is considered by USGS-BRD as an unconventional *half-route* (25 stops instead of 50 stops) and is therefore not analyzed nationwide with other full BBS routes. The Galena route is useful for monitoring local birds even though its diversity is lower than the Nikolai route. Both ADF&G and USFWS Division of Migratory Birds have been particularly interested in the counts of long-distance neotropical migrants (particularly flycatchers) from this route (Table G.7.3). Results of all recent Breeding Bird Surveys were made available on the Worldwide Web through USGS-BRD. In 1999 we accomplished our data entry over the internet.

Galena road BBS— This survey was conducted on June 10, 1999; a total of 331 individuals of 34 species was recorded (Table G.7.3). This year represents an increase over the long term mean of 257 individuals. In recent years, totals of 256 and 316 individuals were recorded in 1997 and 1998, respectively. Total individuals in 1999 was similar to the previous year, while the 1997 total was lower and close to the long term mean. The range in number of species observed has been 28-34 in the last three years. More waterfowl species were observed in 1999 compared to previous years. Notable increases in the 1999 counts compared to the long-term means were observed for seven species: sandhill crane, tree swallow, common raven, myrtle warbler, blackpoll warbler, northern waterthrush, and Lincoln's sparrow. Species that decreased from the long-term mean were olive-sided flycatcher and gray-cheeked thrush; both are long-distance neotropical migrants. Agencies are concerned about abundance trends of these species because declines have been noted elsewhere in Alaska. Alder flycatcher, another long-distance migrant with abundance concerns based on previous years' counts, arrived about five days later than usual in 1999; however, this year's count was up from the previous two years and close to the long-term mean.

Nikolai Slough BBS— This survey was conducted on June 11. A total of 606 individuals of 45 species was observed in 1999. Total individuals decreased slightly from the previous two years, but was above the long term average. A similar number of species, 45, was observed in 1999 compared to the two previous years (42 and 44, respectively). Counts above the long-term average were observed for thirteen species, northern pintail, northern shoveler, American wigeon, common goldeneye, sandhill crane, spotted sandpiper, common snipe, olive-sided flycatcher, Swainson's thrush, myrtle warbler, orange-crowned warbler, northern waterthrush, fox sparrow, and slate-colored junco. Counts that were below previous years or below the long-term average were recorded for eight species: lesser yellowlegs, bank swallow, gray jay, American robin, varied thrush, yellow warbler, white-crowned sparrow, and common redpoll. The increased abundance of olive-sided flycatchers at Nikolai was opposite from the decrease shown in the Galena count.

Table G.7.3. Results of the Galena Road Breeding Bird Survey, June 1997-99.

Species	1997	1998	1999	Mean	SD	CV
Common loon		1		0.1	0.0	0.00
Red-necked grebe		1	1	0.9	1.2	1.30
Trumpeter swan		1		0.1	0.0	0.00
White-fronted goose			2			
Canada goose			3			
American wigeon			3			
Sandhill crane		1	4	1.6	1.0	0.63
Lesser yellowlegs	1		4	3.7	3.2	0.86
Solitary sandpiper	7	3	3	2.1	2.0	0.96
Common snipe	5	14	8	8.2	4.1	0.50
Mew gull	9	3	3	2.5	2.6	1.04
Olive-sided flycatcher	1	4	1	2.9	2.0	0.67
Alder flycatcher	17	17	30	33.7	12.6	0.37
Tree swallow	25	6	14	6.4	6.1	0.96
Violet-green swallow	2	6	2	1.5	2.2	1.48
Bank swallow	1			1.3	3.4	2.63
Cliff swallow			1			
Gray jay	2	3	5	1.2	1.3	1.04
Common raven	1	2	14	2.1	4.2	2.05
Black-capped chickadee	1	1		0.3	0.0	0.00
Boreal chickadee		1		0.1	0.0	0.00
Ruby-crowned kinglet	8	10	9	3.9	3.3	0.86
Gray-cheeked thrush	4	7	1	4.7	3.0	0.65
Swainson's thrush	29	41	38	31.0	13.3	0.43
American robin	18	21	19	18.4	6.9	0.38
Varied thrush	1	5	5	4.3	2.5	0.58
Orange-crowned warbler	13	31	12	12.9	9.3	0.72
Yellow warbler	30	22	23	21.0	12.2	0.58
Myrtle warbler	9	17	22	7.6	4.8	0.63
Blackpoll warbler	3	6	9	2.3	2.4	1.05
Wilson's warbler		2		0.1	0.0	0.00
Northern waterthrush	23	22	26	13.1	9.7	0.75
Savannah sparrow	3	10	7	7.1	2.3	0.33
Fox sparrow	8		3	2.7	2.2	0.82
Lincoln's sparrow	8	10	8	3.6	3.2	0.91
White-crowned sparrow	8	16	18	20.1	6.4	0.32
Slate-colored junco	14	22	21	16.1	5.0	0.31
Rusty blackbird		1	7	1.1	0.7	0.58
White-winged crossbill		4	3	2.2	8.1	3.64
Common redpoll	5	5	3	8.2	5.6	0.69
SPECIES	28	33	34			
TOTAL	256	316	331	256.6	45.6	0.18

MAPS Station. During summers 1995-1999 we have operated a banding station in conjunction with the Monitoring Avian Productivity and Survivorship (MAPS) program that is coordinated by the Institute for Bird Populations (IBP). The MAPS program coordinates the efforts of bird banders all over North America with the goal of providing long-term population data on neotropical migrants. This was the final year of our five-year commitment to the program

Photo G.7.1. *Several Pine Grosbeaks were captured at the MAPS Station, including this feamale.*

Our MAPS site is five miles east of Galena in a closed stand of alder/willow scrub. The site is adjacent to the Yukon River and subject to periodic flooding. It is bordered on one side by white spruce. A few small cottonwood stands occur within the transition between spruce and alder/willow. We chose a location close to Galena (versus a remote site on the refuge) to reduce operational costs.

Photo G.7.2. *PR Karin Lehmkuhl bands a bird at the MAPS station.*

Between 1995 and 1999 we banded between 53-141 adults and 70-260 young. In 1999 birds from 18 species were banded (Lesser Yellowlegs was an unbanded mortality). This year we captured one Tree Sparrow, a species not previously captured at our station. In comparison to previous years, 1999 showed the most adult captures and fewest juvenile captures (Table G.7.4). Captures of adult alder flycatcher, black-capped chickadee, blackpoll warbler, northern waterthrush, Lincoln's sparrow, and pine grosbeak were the highest recorded during the past five years. Twenty-five of the 141 adult birds captured were returns from previous years, including the return of the only Pine Grosbeak previously banded at the station. Although numbers of adult captures were high, productivity was very low. This year's warm temperatures and low rainfall were similar to 1997 "EL Niño" conditions. Mosquito abundance was observed to be particularly low. Also, fewer juvenile birds may have been captured because the banding station was closed after July 30. (In previous years an additional banding session occurred in August when more juveniles have fledged. This session was removed from the MAPS protocol since migrating birds were being captured in addition to residents.)

Major responsibility for the MAPS station in 1999 went to PR Karin Lehmkuhl with field assistance from BT Jenny (Lowe) Bryant, BT Deborah Webb, GB Joanna Roberts and others, with direction by SWB/Pilot Mike Spindler.

Table G.7.4. Captures[1] of adult and juvenile birds at the Galena, Alaska MAPS station, 1995-99.

	Adult/AHY					Juv/HY				
Species	95	96	97	98	99	95	96	97	98	99
Sharp-sh. hawk	0	0	0	0	0	0	1	0	0	0
Olive-sid. flycatcher	0	0	0	0	1	2	0	0	0	0
Alder flycatcher	6	0	10	11	23	4	3	2	0	0
Hamm. flycatcher	0	12	0	0	0	0	1	0	0	0
Gray jay	0	1	0	0	1	0	2	1	2	0
Bl.-cp. chickadee	2	2	0	2	9	8	6	12	10	2
Boreal chickadee	0	0	0	0	0	1	0	0	2	0
Arctic warbler	0	0	1	0	0	0	0	0	0	0
Ruby-cr. kinglet	1	2	0	3	3	29	4	0	3	3
Gray-ch. thrush	1	0	1	0	0	1	0	1	6	0
American robin	1	0	0	2	1	0	0	0	3	0
Swainson's thrush	33	11	6	5	13	12	17	4	6	10
Orange-cr. warbler	17	1	6	10	14	18	6	5	38	12
Yellow warbler	13	12	4	0	9	8	2	8	1	3
Myrtle warbler	14	5	3	4	6	40	7	0	8	4
Blackpoll warbler	3	2	4	7	8	4	0	2	6	7
N. Waterthrush	14	5	7	5	22	13	10	11	19	3
Wilson's warbler	0	16	3	0	0	3	1	0	0	0
Am. Tree sparrow	0	0	0	0	1	0	0	0	0	0
Fox sparrow	1	4	1	0	0	1	4	4	0	0
Lincoln's sparrow	2	0	2	4	14	25	12	10	15	4
White-cr. sparrow	5	6	1	1	0	18	11	1	0	1
Sl.-colored junco	8	11	8	4	11	65	14	8	5	13
Pine grosbeak	0	0	1	0	3	0	0	0	0	0
Common redpoll	4	1	0	0	1	9	0	0	0	1
Lesser Yellowlegs	0	0	0	0	1	0	0	0	0	0
Total	125	91	53	58	141	261	97	70	118	63

[1]Does not include recaptures.

Wintering birds. Resident songbirds were monitored with the standardized Christmas Bird Count conducted by refuge staff and local volunteers on December 19, 1999. In previous counts, 1997 showed below-average total individual bird counts but above-average total species (Table G.7.5). By comparison, 1998 showed the lowest total individual count of any year, even though the 1998 species count was still above average. The count procedure is sensitive to amount of effort expended in terms of participants, party-hours, and miles traveled. In 1999, number of participants and party hours, and total miles traveled were above average. Count day temperature in 1999 was about average. Since 1998, nation-wide Christmas Bird Count data and individual count data-entry has been available over the internet (birdsource.cornell.edu).

Table G.7.5. Species counts in the 1998 and 1998 Christmas Bird Count at Galena compared to 1982-1998 means. CW= species present on count week but not counted on the count day.

Species	***1997***	***1998***	***1999***	***Mean***
Northern goshawk		CW		*0.4*
Gyrfalcon	1			*0.1*
Willow ptarmigan	6	17	45	*10.5*
Spruce grouse	CW	2	4	*0.7*
Ruffed grouse			1	*0.7*
Grouse spp.				*0.1*
Northern hawk owl	1		1	*0.3*
Boreal owl				*0.0*
Great gray owl		CW		*0.2*
Great horned owl				*0.0*
Downy woodpecker		1	1	*0.5*
Hairy woodpecker	1	2		*0.3*
Three-toed woodpecker	1			*0.8*
Gray jay	20	3	12	*12.1*
Common raven	117	23	65	*177.9*
Black-capped chickadee	41	24	83	*18.7*
Siberian tit				*0.1*
Boreal chickadee	23	5	42	*19.3*
Red-breasted nuthatch	1			*0.1*
Bohemian waxwing	CW			*0.0*
Northern shrike				*0.0*
White-crowned sparrow	CW			*0.0*
Slate-colored junco			1	*0.1*
Snow bunting				*5.9*
Pine grosbeak	2	1	1	*6.0*
White-winged crossbill	45			*6.5*
Common redpoll	252	14	36	*83.7*
Hoary redpoll		6	4	*1.0*
Total Individuals	***511***	***98***	***296***	***362.4***
Total Species	***13***	***11***	***13***	***8.6***
Participants	*8*	*5*	*11*	*6.5*
Party Hours	*16.25*	*13.5*	*23.7*	*18.5*
Party Miles	*36.5*	*35*	*68.4*	*81.1*
Low Temperature	*-10*	*11*	*-10*	*-9.5*

8. Game Mammals

Moose

Trend Count Areas. In the most important moose hunting areas trends in density, age and sex composition are monitored annually by aerial surveys of Trend Count Areas (TCA's) along river drainages where moose concentrate in late fall and early winter. Moose abundance is generally highest in riparian habitats along the river and lowest away from the Koyukuk River corridor. Within the corridor, moose abundance is lowest in northern Koyukuk NWR, and highest in the central part, near Dulbi River Mouth and Three Day Slough.

Since the mid-1980's, aerial surveys of the moose TCA's have emphasized consistent application of methods and standardized survey areas that are aimed at sampling identical units each year to simplify comparisons. These surveys, which focus intensively on the more popular hunting areas, are not able to produce estimates of overall population. Previous large-scale population estimation surveys estimated the refuge moose population at 11,000 in the late-1980's. More recently, census work in 1997, combined with trend count surveys, provided a late 1990's estimate of about 8,500 moose.

In fall 1999, aerial moose trend count area (TCA) surveys were conducted jointly by the Service and ADF&G on the Koyukuk and N. Unit of Innoko NWRs. Lighter than normal snow cover in November 1999 could have influenced sightability and distribution of moose compared to years of more normal snow cover (Photo G.8.1). Therefore, some density and composition estimated for 1999 may be lower than they would have been in a normal snow year.

We thank ADF&G for their contribution to the moose surveys on Koyukuk NWR areas, which are so indicated. Following is a summary of the 1999 moose trend surveys on the refuge, from north to south:

Koyukuk NWR

Mathews Slough. Concerns about moose abundance along the Koyukuk River were expressed at an August 1997 moose co-management meeting at Hughes, so the refuge and ADF&G agreed to cooperate and conduct trend surveys in this area. Two historic trend areas, Mathews Slough and Batza Slough, that were surveyed in the 1980's, were resurveyed in 1997-99 by ADF&G (with funding by USFWS the first two years). At Matthews Slough, density was low, at 1 moose/mi^2 in 1983 and 1998. The 1997 and 1999 surveys must have been affected by shifts in moose distribution because density was extremely low, at about a third the 1983 and 1998 levels. The 1998 survey showed adult and cow abundance slightly greater than the 1983 survey, however numbers were considerably lower in 1997 and 1999. Composition ratios were unreliable due to low moose numbers.

Batza Slough. At the Batza Slough TCA, total moose has increased gradually between, 1986 and 1999; however, density was low at 1.9 moose/mi^2 in 1999. The bull:cow ratio was healthy, at 60 bulls:100 cows in 1999. A ratio of 12 calves:100 cows showed poor production in 1999, although recruitment was good, at 6 yearling bulls:100 cows.

Treat Island. At a May 1997 moose co-management meeting in Huslia, concern was expressed about the potential effects of guided hunting on local subsistence, so the Service conducted trend surveys in the affected area. Increasing levels of hunting, especially by guides based near Treat Island, may have contributed a drop in both total moose and bulls. Moose numbers at Treat Island appeared to have peaked between 1993 and 1998, then declined (Fig. G.8.1). The 1999 total density was 4.2 moose/mi^2. Total moose in 1999 was 26% less than the peak. Bulls decreased markedly, down 41% in 1999 from the high observed in 1993. The productive segment of the population, cows, dropped 22% from 1998 to 1999. The bull:cow ratio decreased from a high of 39 in 1993 to the low of 21 in 1999. Productivity, at 15 calves:100 cows was low and recruitment of 5 yearling bulls:100 cows was poor.

Dulbi Slough. This area receives mainly local subsistence hunting pressure, but non-local pressure has increased recently, causing concerns over sustainability. In 1999 the moose density was 4.6 moose/mi^2, a slight decrease from the 4.9 moose/mi^2 observed in 1996. Bull abundance, however, dropped markedly from 24 to 11 bulls:100 cows in 1999. Productivity was acceptable, but slightly low at 24 calves:100 cows. Recruitment was very low, at 3 yearling bulls:100 cows.

Dulbi River. Dulbi River receives relatively high local and non-local hunting pressure, although the non-local activity has increased markedly in recent years. Density has averaged 4.7 moose/mi^2 from 1982 to 1999. Moose abundance peaked in 1997, and dropped 20% from then until 1999 (Fig. G.8.2). The bull:cow ratio dropped from 41 in 1992 to 24 in 1999. Productivity was healthy, at 42 calves:100 cows. Recruitment was poor, at 4 yearling bulls:100 cows.

Three-Day Slough. ADF&G has surveyed the Three Day Slough TCA almost annually since 1981. This area had among the highest recorded moose densities in Alaska in the 1990's: 13.0 moose/mi^2 were observed there in 1993. Density gradually decreased from 1995 to 1999 to 6.6 moose mi^2 (Fig. G.8.3). The average of density estimates since 1994 have shown a decline. The 1999 estimate was closer to the 4-6 moose/mi^2 values which are typical of the lower Koyukuk. In 1999 the sex ratio was 17.6 bulls:100 cows, which was below the long-term average of 33 bulls:100 cows of all surveys conducted since 1981. Calf production was 13.7 calves:100 cows in 1999, which was the second-lowest level ever recorded. The 1999 yearling ratio of 2.9 yearling bulls:100 cows was well below the long term average (10 yearling bulls:100 cows, respectively). The Service and ADF&G are concerned that this population has peaked and has recently stabilized at a lower level. Agencies and locals are concerned that this area will not be able to sustain the present level of hunting pressure over the long term. These concerns were addressed

in late 1999 by ADF&G's Koyukuk River Moose Management planning process (see Section H.20).

Koyukuk River Mouth. The moose population at the mouth of the Koyukuk River averaged 3.9 moose/mi^2 from 1984-1999. The population appears to have peaked in 1996, and has stabilized since then (Fig. G.8.4). In 1999 the sex ratio was healthy at 36 bulls:100 cows. Productivity dropped from former healthy levels to 19 calves:100 cows. Recruitment was excellent, at 10 yearling bulls/100 cows.

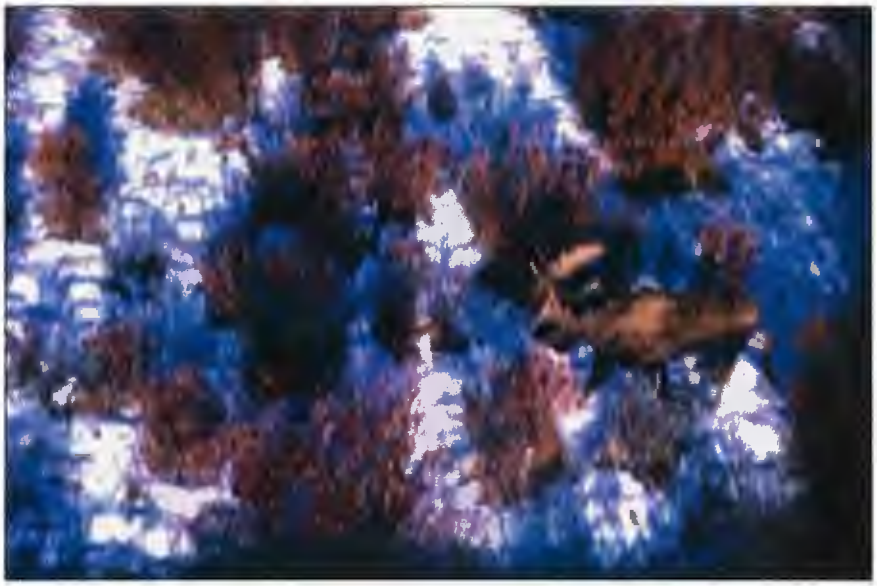


Photo G.8.1. *In fall 1999, aerial moose trend count area (TCA) surveys were conducted jointly by the Service and ADF&G on the Koyukuk and N. Unit of Innoko NWRs.*

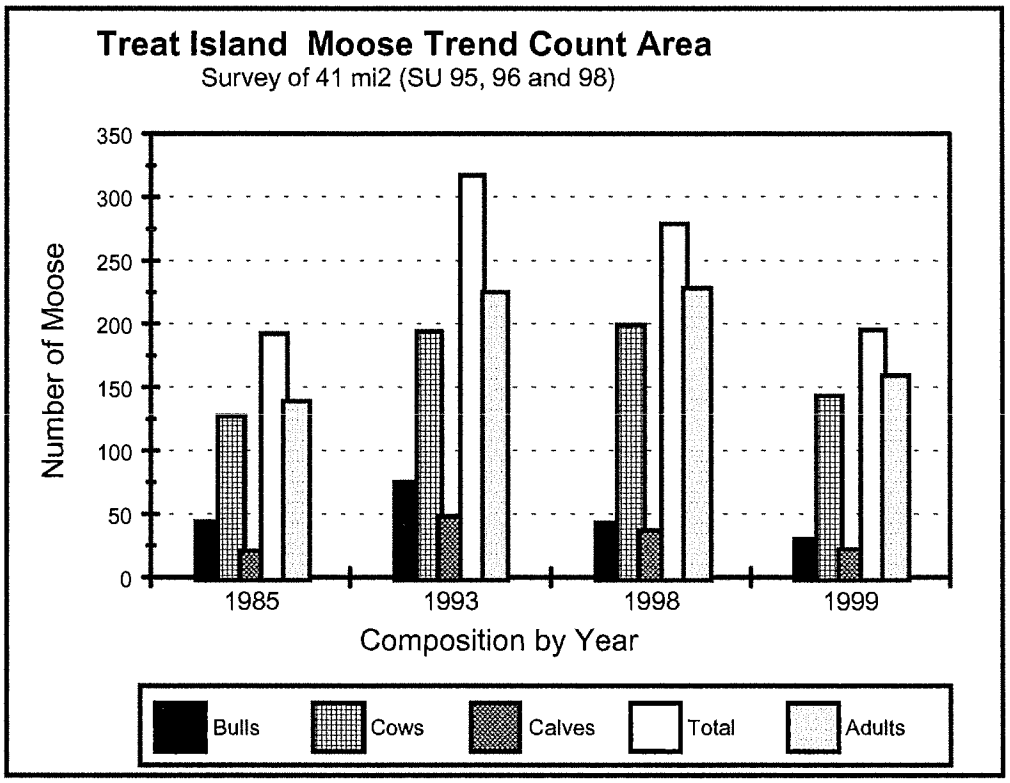


Figure G.8.1. Moose trends on the Treat Island moose trend count area, Koyukuk NWR, Alska, 1985-99.

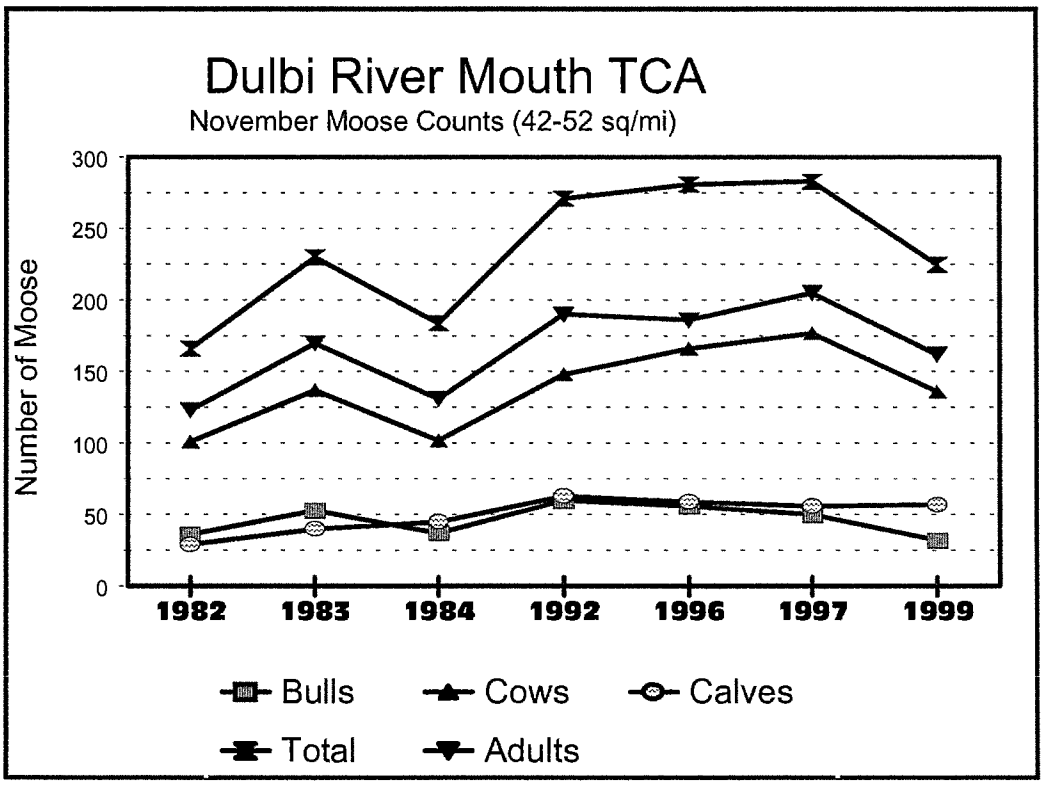


Figure G.8.2. Moose trends on the Dulbi River Mouth moose trend count area, Koyukuk NWR, Alaska, 1985-99.

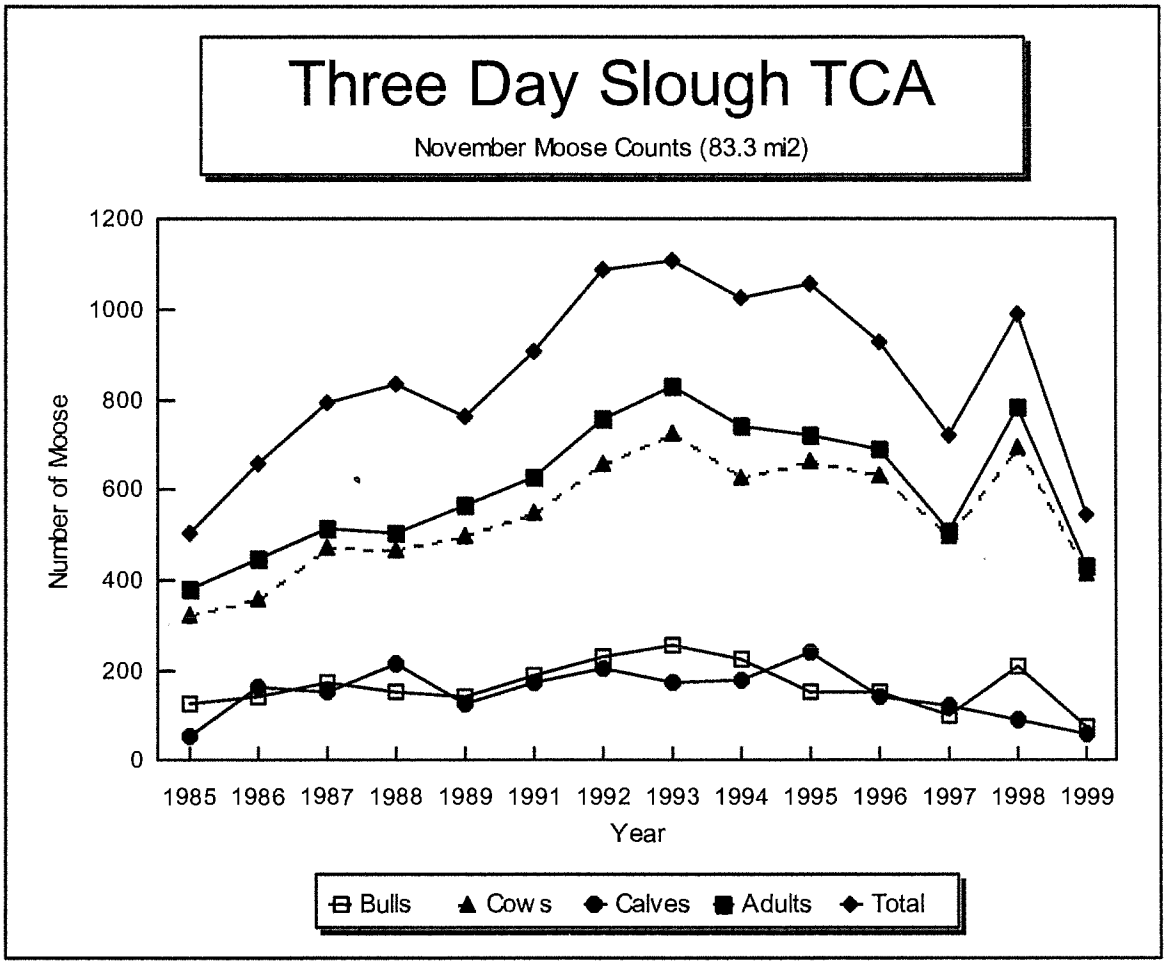


Fig. G.8.3. Moose trends on the 83mi^2 Three-Day Slough Trend Count Area, Koyukuk NWR, Alaska, 1985-99. It should be noted that the surveys in November of 1991, 1995, 1997, and 1999 had lighter than normal snow cover, which could have influenced sightability and distribution of moose compared to years of more normal snow cover.

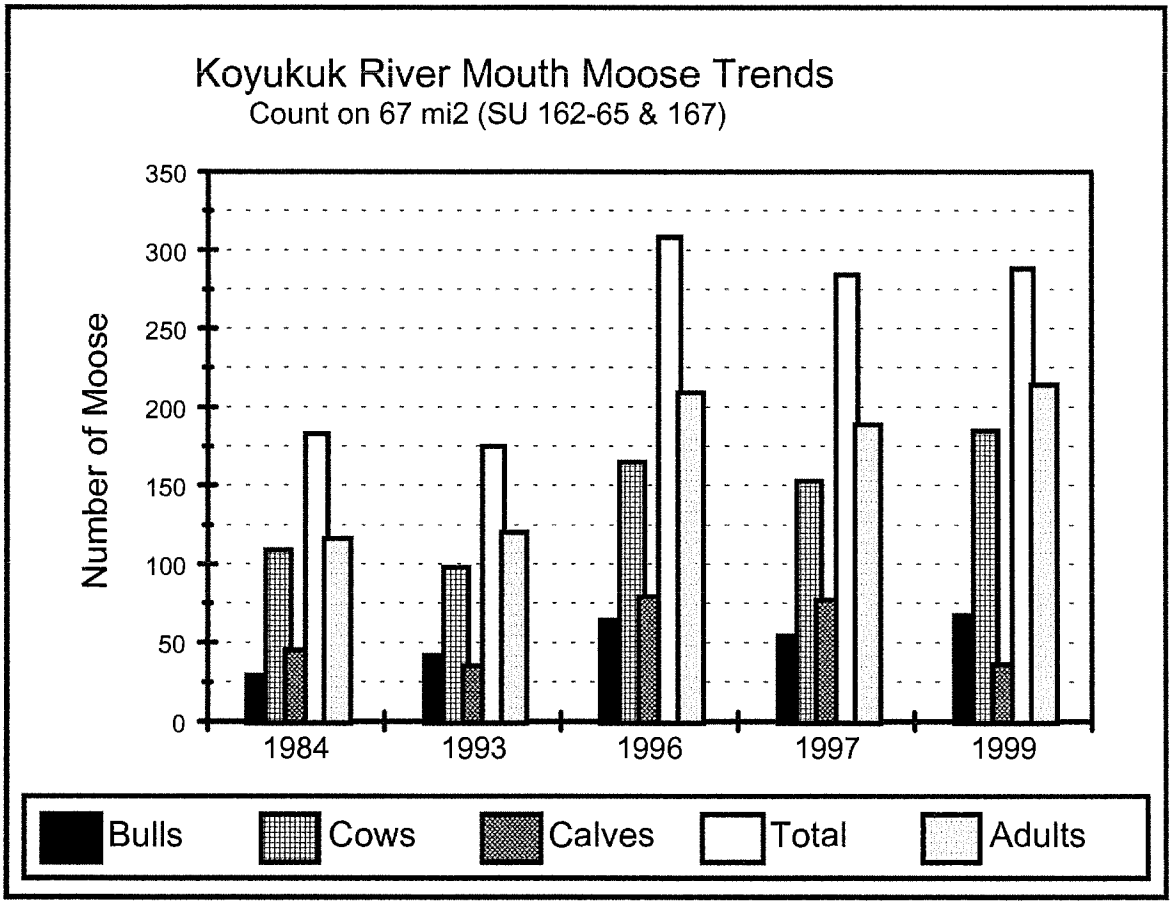


Figure G.8.4. Moose trends on the 67mi2 Koyukuk River Mouth trend count area, Koyukuk NWR, Alaska 1984-99.

Kaiyuh Slough. This area receives mainly local subsistence hunting pressure. Moose density at Kaiyuh Slough in 1999 was 1.9 moose/mi^2, a drop from the 2.7 moose/mi^2 observed in 1998, and the long-term average of 2.02 moose/mi^2 (Fig. G.8.5). Most composition ratios appeared healthy in 1999 (39 bulls/100 cows, 22 calves/100 cows, 12 yearling bulls/100 cows).

Squirrel Creek-Pilot Mountain Slough. This area, located between Galena and Koyukuk village received intense local subsistence harvest and increasing non-local hunting pressure. In 1999 moose density was 6.6 moose/mi^2, which was equal to Three Day Slough as the highest on the refuge. The moose population appears to have peaked in 1998, and declined 16% between 1998 and 1999 (Fig. G.8.6). Composition ratios were healthy, with 41 bulls:100 cows, 32 calves:100 cows, and 13 yearling bulls:100 cows.

Moose Browse Study. High moose densities have resulted in obvious browse pressure on willows in certain areas of Koyukuk NWR. Past studies, however, suggested that the moose range was not yet overbrowsed (Kielland and Osborne. 1998. *Moose browsing on feltleaf willow: optimal foraging in relation to plant morphology and chemistry.* Alces 34). Their study found that the high quality of browse in the study area may help explain the sustained high density of moose in Three-Day Slough. Kielland and Osborne believed that browse was not overexploited at the time of the study because moose bite diameter utilization was below the threshold level of decreased digestibility. In March 1999, habitat researcher Don Spalinger, and area biologist Glenn Stout, both of ADF&G, and Innoko NWR refuge biologist Bob Skinner visited Galena and Three Day Slough in March 1999 to reassess the moose browse situation. All agreed that the range did appear overbrowsed, and that future studies should be planned. Accordingly, the refuge will plan on reviewing historic moose browse data and initiating renewed browse studies in 2000.

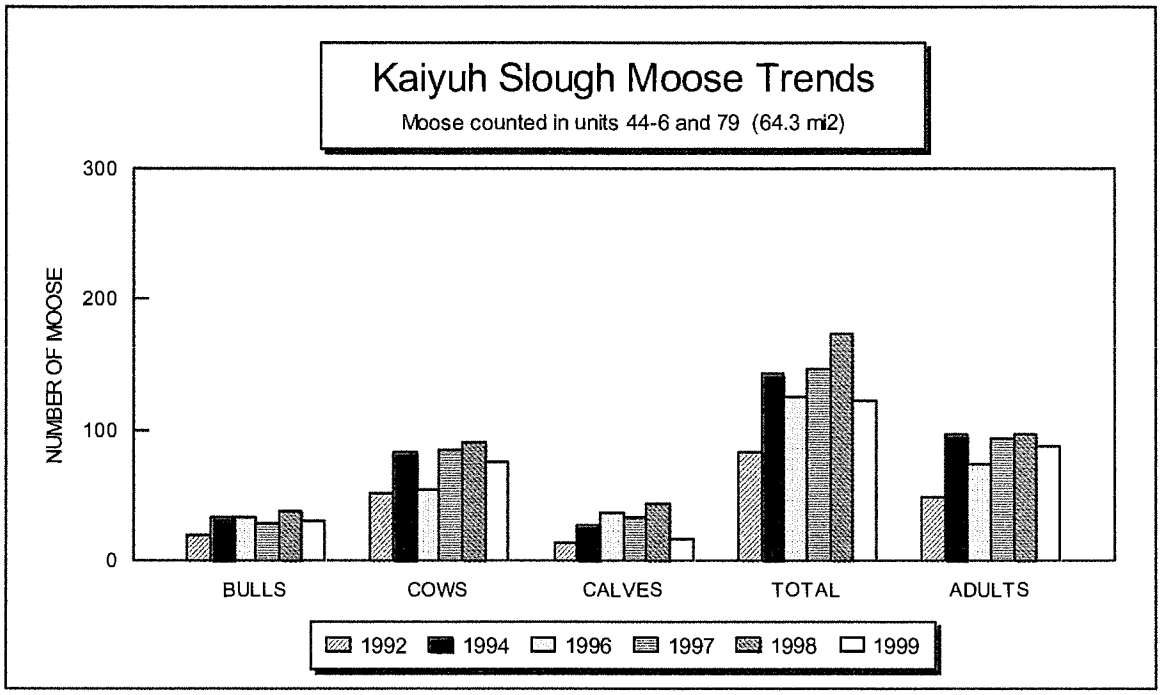


Fig. G.8.5. Moose trends on the Kaiyuh Slough trend count area, Northern Innoko NWR, Alaska, 1992-99.

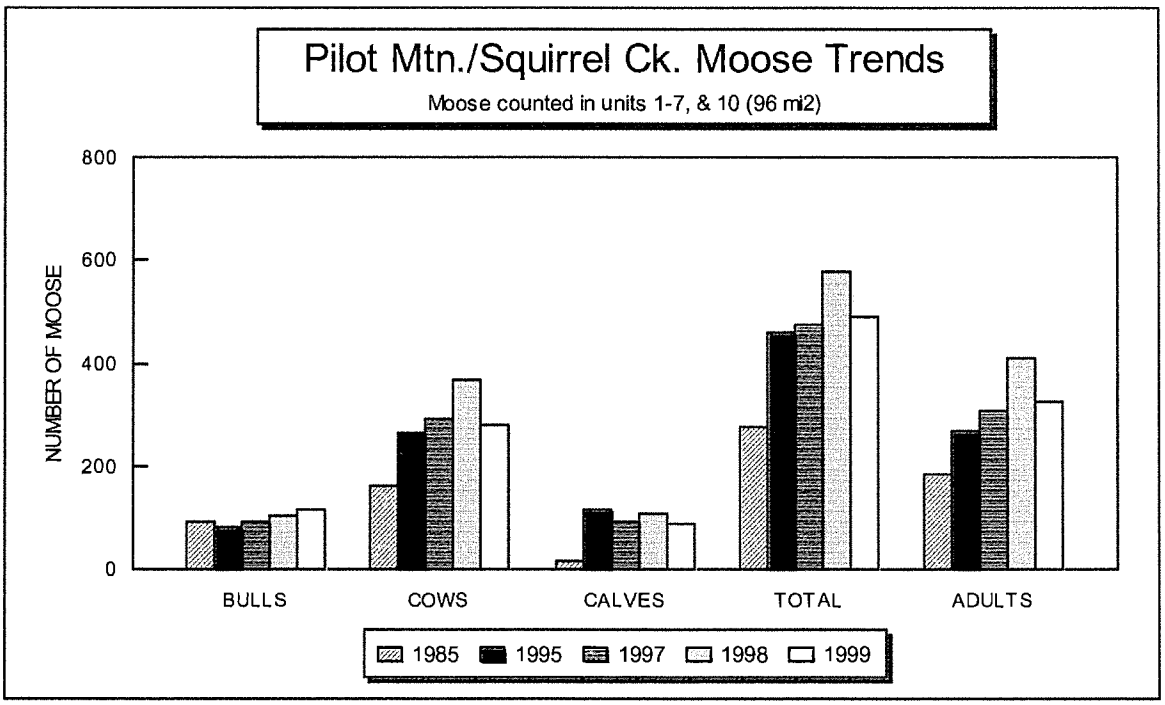


Fig. G.8.6. Moose trends on the combined Pilot Mountain Slough-Squirrel Creek trend count areas, Northern Innoko NWR, Alaska, 1985-99.

Caribou

Two caribou herds normally occur on the Koyukuk and N. Unit of Innoko NWR refuges: the Galena Mountain Herd (GMH) and the Western Arctic Herd (WAH). The GMH is a small resident herd of approximately 300 animals that winter north of Galena and calve east of the Koyukuk NWR in the western Kokrines Hills. The WAH is currently estimated at about 500,000 caribou. Portions of the WAH winter on northern and western sections of the Koyukuk NWR, but in the winters of 1989-1990, 1990-1991, 1992-1993, and 1998-99 WAH caribou wintered southeast of the Koyukuk River from the mouth of the Koyukuk, northeast to the village of Hughes. Normally, caribou hunting is closed in Game Management Unit 21D in winter to protect the GMH, which is not large enough to sustain a significant harvest. When the WAH enters the Unit in sufficient numbers (so that GMH numbers are only 10% of total caribou), ADF&G may open a hunting season by emergency order.

On December 23, 1999, SWB Spindler and ADF&G Area Biologist Glenn Stout conducted a caribou transect flight between Galena and the Dulbi River to assess the number of WAH caribou wintering in the GMH traditional wintering area. A total of 89 caribou were seen on the transects, which covered 33% of the area. Unfortunately, marginal lighting conditions did not allow us to have much confidence in this count. On February 15, 2000, SWB Spindler and Pilot Joee Huhndorf repeated most of the above transect grid, and found fewer than 20 caribou. Tracks indicated that GMH caribou began moving east of the refuge back towards alpine terrain.

A refuge-wide caribou distribution survey was conducted on March 2, 2000. For the Galena Mountain Herd, we found two areas of cratering (perhaps 20-30 animals) at the southern part of the traditional Hozatka Lakes wintering area. By March 3, most of the GMH appeared to be located in the upper Holtnakatna Creek drainage and the western foothills of Galena Mountain. Evidence was observed suggesting that segments of the Western Arctic Caribou Herd had wintered in the open tundra expanses south of Hughes. At Hughes, Lester Sam and Wilfred Beatus told Spindler and Huhndorf that most caribou left these flats after the snow got deep in late January. They said that most caribou moved to Indian Mountain and the hills northwest of Hughes. They said that when snow gets deep on the flats, caribou go up to the wind-blown alpine areas. There was not much sign of caribou near Huslia. Ross Sam and Fred Lee Bifelt of Huslia reported that most caribou harvest from their village has been taking place in the upper Dakli River drainage from the second crossing along the hot springs trail up to the pass at the hot springs. Old caribou tracks were observed on the Huslia River flats and along the south side of the Purcell Mountains. It appears that Western Arctic Herd use of the refuge during winter 1999-2000 was minimal, with small numbers in some of the usual places, near Hughes, the Dakli R., and the south side of Purcell Mountains.

Bear

There are two main species of bear on the Koyukuk and N. Unit of Innoko NWRs. Black and interior Alaska grizzly bear inhabit both refuges. Grizzly bear are regulated according to the Northwest Alaska management plan implemented by ADF&G. Most black bear harvest is for subsistence purposes, but a few are taken by recreational hunters visiting the area. Grizzly bears are required to be sealed, but only black bears taken out of the State are required to be sealed. There are many bears on the Complex, but no inventory has been conducted due to the high expense (mark-recapture), and perceived abundance. ADF&G and the refuge are working on estimating the subsistence harvest of bears through a household harvest survey. Koyukon Athabascans in the local villages have many beliefs relating to the bears in their area. Sometimes in the fall, the local Natives use the black bear for a 'Bear Party' where all the men go to hunt, cook, eat fresh bear meat, play games and tell stories.

9. Marine Mammals - *Nothing to report.*

10. Other Resident Wildlife

Wolves

Wolves are common to abundant on the refuge and are sought after by local hunters and trappers. Wolf furs are prized for parka ruffs and a wolf pelt is a distinguished gift in local Koyukon Athabascan memorial potlatch ceremonies. Wolves are one of the most significant predators of the refuge's major subsistence resources, moose and caribou, therefore population and predation rate information is important to refuge ungulate management decisions. Wolf populations on the Koyukuk NWR have increased. Estimates of wolf density on the portion of Koyukuk NWR within GMU 21D were estimated at 8.7 wolves/1000 km^2 in March 1994, and 12.4/1,000 km^2 in March 1999. Wolf survey activities in 1999 included a March aerial track count and abundance survey in cooperation with ADF&G.

The following summary of the March 20-22 1999 wolf survey was taken mainly from a trip report prepared by Glenn Stout, ADF&G area biologist:

"Observation conditions did not allow for the implementation of the SUPE survey method that was initially planned. Although we received 3-5 inches of new snow between the 13th and 15th, persistent low level clouds, intermittent snow, and poor light through the 19th delayed survey efforts. By the time conditions allowed flying on the 20th, the snow had aged significantly. During early flights on the morning of the 20th, it was apparent that tracking efficiency was too low and that identification of tracks less than two to three days old was not feasible. Violations of the assumptions of Becker's SUPE method would have occurred as a result of these conditions, so we implemented an intensive aerial wolf

reconnaissance in order to obtain a minimum estimate on the wolf population in this important high density moose area.

The survey area was generally bounded by the eastern and western boundaries of the Koyukuk NWR, the Yukon River to the south, the Huslia River to the north. The area is comparable to the sub-unit surveyed in the 1994 wolf survey for GMU 21D. The survey encompassed 3,935 mi^2, and was divided into three blocks that each survey team was directed to cover. The survey was conducted using three planes consisting of pilot-observer teams. Each team recorded flight paths, the number of tracks encountered and locations, the number of wolves observed, color patterns and location, and other notable wildlife observations.

Photo G.10. *Conditions proved to be less that ideal during aerial wolf surveys due to poor tracking conditions.*

"In all cases of wolf pack identification, we were able to distinguish packs from one another using one or several of the following criteria: 1) tracks were followed from the point of origination to a pack which was visually observed, 2) packs were visualized and color patterns or number of wolves were distinguished, 3) tracks were followed exhaustively and isolated spatially from tracks of other packs, 4) visualized packs or their tracks were plotted on a single map and compared to historical telemetry locations and expert knowledge of pack distribution. We did not encounter any situation where tracks of one pack intersected those of another pack. On two occasions, we did encounter single wolves that were separated from the primary packs by several miles but their tracks were contiguous with the larger group. In both cases, the primary pack was visualized, enumerated, and the single wolf was assumed to be a member of the pack, and simply added to the total pack count. Although this may have a downward bias in the enumeration of total number of packs in the survey area, it does not effect the total wolf count.

"Combined, the three survey planes logged 52.3 hours (0.31 min./km^2) of flight time conducting this survey. We had visual confirmation of 87 individual wolves that we are confident were not double counted. We identified 20 packs, 14 of which we had visual observations of members from the packs (Table G.10.1). We had additional track observations of 6 packs with a total of 39 wolves that were distinguishable from observed wolf packs, for a total of 126 wolves. Pack size ranged from 1 to 21, with the mean pack

size of 6.3 (median = 5.5). Density of wolves is estimated to be 12.36/1,000 km^2 for the 10,192 km^2 (3,935 mi^2) survey area. Several single tracks were observed, but only three single wolf visuals were documented. Single wolves were particularly difficult to track under the conditions presented. The number of single tracks observed however suggests that we were beyond the optimum time for a spring wolf survey and that pack members were dispersing.

Table G.10.1. Results of March 20-22, 1999 aerial wolf survey covering a 10,192 km^2 area of southern half of Koyukuk NWR (data courtesy ADF&G).

Pack Location	Visuals	Tracks	Total
Bear Cr.	9		9
Galena Mtn.	4		4
Koyukuk Mouth		4	4
Upper Dulbi	7		7
Holtnakatna Cr.	5		5
Natlaratlen R.	3		3
Nikolai Slough	2		2
Cottonwood Cr.	11		11
Lower Dulbi	5		5
Three-Day Slough	21		21
Gisasa R.	5		5
Lower Kateel	6		6
Colville Bend	6		6
Tom Cook Hill		3	3
Boat Lake	1	6	6
Old Town		6	6
Nulitna		6	6
Dunes	2	8	8
Middle Huslia		4	4
Upper Huslia		5	5
Total	87	39	126
Mean	-	-	6.3
Median	-	-	5.5
Density (wolves/1000 km^2)	-	-	12.36

"Two important points for consideration in this year's survey analysis are: 1) the area that we surveyed is contiguous with the 21D-NWR subunit of the 1994 survey, but 2) the current estimate was not derived from a statistical sampling procedure so we cannot make any statistical inferences. ....Wolf numbers in the current survey [probably] reflect a notable population increase because: 1) the current survey count represents a minimum number of wolves that is substantially higher than the upper confidence limit estimate of the 1994 survey (17%; 66% greater than the lower CI), 2) the survey is particularly conservative due to the difficulty encountered in locating dispersed single wolves (single wolf tracks were not counted as part of the pack totals), 3) moose populations are at, or near, the highest levels ever recorded and could reasonably support higher wolf numbers, and 4) local perception based on observations is that wolf numbers have increased."

Small Mammals

A final month of field work for a study of yellow-cheeked vole populations on the Koyukuk and Nowitna Refuges was conducted in June 1999 by PR Karin Lehmkuhl with assistance from WB Guy Hughes. In May 1997, paired 250m^2 grids of 100 Sherman live traps were established within three areas: Grids 1 & 2 were located on the Koyukuk River near the confluence of the Hogatza River in an area of regenerating black spruce (*Picea marianna*). This portion of the Koyukuk National Wildlife Refuge burned in 1988. Grids 3 & 4 were located in the same burn, in an area of regenerating white spruce *(Picea glauca*). Grids 5 & 6 were located near Round Lake on the Nowitna National Wildlife Refuge in regenerating black spruce which burned in 1985. Intensive live trapping was conducted at these sites in 1997 and 1998[1]. Trapping resumed on a more limited scale in June 1999 with the goal to assess the number of marked voles remaining on site from previous years, and to detect population changes.

Trapping was conducted earlier in the season this year than in previous years. Many of the adult females encountered were pregnant or had recently given birth. No juvenile voles were captured until the third week of trapping (Grids 5 and 6) (Table G.10.2). In previous years, juvenile voles were captured at the earliest sessions. Trapping grids were run for three days, with a total of 9 capture events. This was shortened from a four day, 12 session trapping schedule used in previous years. Despite these changes, the total number of vole captures was comparable to those from previous Junes (Table G.10.3). The number of adults captured was similar to 1998, which had increased over 1997 counts. Over 50% of the adults captured had been marked in 1998, and one female had been marked as a subadult in 1997. Three other voles were initially marked as adults in 1998, indicating that they were in their third summer. These records are unusual since few yellow-cheeked voles are known to survive two winters.

---

[1]Lehmkuhl, K L. 1999. Wildland fire and yellow-cheeked vole populations in Interior Alaska: and investigation of fire effects on the boreal forest (Preliminary report). U.S. Fish and Wildlife Service, Galena AK. 32pp.

Unusual color variations in yellow-cheeked voles have been seen in the floodplain sites, particularly at Grid 2. In 1997 a single white subadult female was captured at this site, as well as several "light" colored individuals (Photos G.10.1 & G.10.2). In 1998 three white adult females were captured in addition to some light colored voles. No white voles were captured in 1999, but two very light colored individuals were captured at Grid 3. The white voles have brown eyes, and do not appear to be albino.

Photo G.10.1. *"White" Yellow-cheeked vole.*

Photo G.10.2. *"Light-colored" vole.*

Photo G.10.3. *Normal colored Yellow-cheeked vole.*

Table G.10.2. Yellow-cheeked vole trapping project - Koyukuk River sites, June 1999

Grid	Habitat	# voles caught	New voles	Recap from 1998	Total # captures
G1	Floodplain white spruce	8	4	4	23
G2	Floodplain white spruce	14	10	4	25
G3	Floodplain black spruce	30	14	16	105
G4	Floodplain black spruce	33	16	17*	156
G5	Upland black spruce	10	4	6	45
G6	Upland black spruce	18	12	6	51
Total		113	60	53	405

*includes 1 vole initially tagged as a subadult in 1997.

Table G.10.3. Yellow-cheeked vole captures 1997-99 (adult vole numbers in parentheses).

	June					
	Individuals				Total captures	
Grid	1997	1998	1999		1997	1997	1999
1	22 (5)	9 (7)	8 (8)		50	23	23
2	12 (10)	18 (11)	14 (14)		20	44	25
3	23 (9)	42 (31)	30 (30)		42	97	105
4	26 (21)	44 (43)	33 (33)		43	159	156
5	34 (4)	22 (5)	10 (7)		76	81	45
6	18 (4)	9 (3)	19 (7)		26	28	51
totals	*135 (53)*	*144 (100)*	*113 (99)*		*257*	*432*	*405*

11. Fisheries Resources

Of the 19 fish species with published ranges that include the Koyukuk NWR, 14 have been documented by field investigations in the last two decades. Major fish resources on the refuge include anadromous species such as salmon, dolly varden, and sheefish, and resident species such as pike, burbot, whitefish, blackfish, and suckers. Salmon are of particular importance to subsistence and commercial fisheries. For example, the Yukon River had a peak reported annual salmon catch of 1.2 million, of which an estimated 200,000 were from sections of the Yukon adjacent to or within the refuge (Koyukuk NWR Fisheries Management Plan). In addition to salmon, other important subsistence fisheries include pike, whitefish, and burbot.

Salmon

The mainstem of the Yukon River and other rivers within the drainage are subject to commercial and subsistence fishing. Part of the Yukon River drainage lies within the Koyukuk and Northern Innoko refuges. The villages of Kaltag, Nulato, Koyukuk, Galena, Huslia, and Hughes depend upon the fish resources of Koyukuk and N. Innoko NWRs. Annual surveys to estimate escapement of chinook and chum salmon were first conducted on the Gisasa, Kateel, Hogatza, Indian, and Dakli Rivers by ADF&G in 1960 and 1961. No surveys were conducted again until 1974. Since then, ADF&G has surveyed selected index streams every year, although the same streams are not surveyed each year. Until 1994 escapement estimates for salmon stocks using the Koyukuk Refuge rivers were limited to five tributary streams with multi-year aerial survey data; these are the Gisasa, Kateel, Hogatza, Indian, and Dakli Rivers. The distribution of chum and coho salmon within the Koyukuk River drainage has not been documented, and aerial escapement estimates over the years have been highly variable. Therefore the Service (Fairbanks FRO) began a program to obtain such baseline information. The above-listed five rivers were considered for potential weir sites, and the Gisasa River was selected. In 1994 they established a weir site on the Gisasa River, a major tributary of the lower Koyukuk River. The weir has been operated during the summer chum and chinook salmon runs each year since 1994. Maximum counts of 157,589 (1996) chum salmon and 4,023 (1995) chinook salmon have been observed; however, 1999 showed the lowest chum returns since the weir has been operated.

The 1999 weir data were summarized in a FRO progress report by D. Wiswar: *Abundance and Run Timing of Adult Salmon in the Gisasa River, Koyukuk National Wildlife Refuge, Alaska, 1999.* U.S. Fish and Wildlife Service, Fishery Resources Office, Fishery Data Series Number 2000-1. The abstract from the report follows:

> From June 23 to August 7, 1999 a resistance board weir was operated on the Gisasa River, a tributary to the Koyukuk River in west central Alaska. This was the sixth year of operating the weir at this site. A total of 2,631 chinook salmon *Oncorhynchus tshawytscha* and 9,920 summer chum salmon *O. keta* passed

through the weir. The most abundant resident species was the longnose sucker *Catostomus catostomus* (N=104). Chinook salmon escapement was low but fell within the range of weir counts from 1994 to 1998. Most of the chinook salmon (56%) passed through the weir between July 20-26. Females made up 29% of the chinook salmon sampled. Age groups 1.3 and 1.4 accounted for 70% of the run. Chum salmon escapement was only 13% of the average weir counts from previous years. Females comprised 52% of the chum salmon sampled. Age 0.4 chum salmon made up 54% of the run.

From 1995 to 1997 a combination weir and counting tower were used to assess chum salmon run timing and escapement in Clear Creek, a tributary of the Hogatza River at the northern edge of the Koyukuk NWR. The project was operated by Tanana Chiefs Conference (TCC), Dept. of Fish, Wildlife, and Parks, in cooperation with the US Bureau of Land Management, ADF&G, and USFWS. This project was prompted by applications to BLM by Taiga Mining to expand gold mining operations at the Hog River Mine, which is located on a tributary of Caribou Creek, just downstream of Clear Creek. It was well documented that the area contained spawning chum salmon, but escapement estimates were unreliable. In a few prior years ADF&G had conducted aerial surveys at Clear Creek. They counted a minimum of 8,000 fish, and estimated 24,000 fish with their expansion factor of 3.0. Surprisingly, the 1995 weir/tower count indicated that 116,735 chum entered the creek between June 21 and July 21. In 1996 a total of 100,912 chum entered between June 21 and July 19. In 1997 a total of 76,454 chum passed between June 21 and July 1997. The abstract to a progress report written in 1999 by Kevin Van Hatten of TCC follows: *In 1998, no comparable data were obtained. In 1999 a total of 11,838 chum was counted at the Clear Creek tower.*

12. Wildlife Propagation and Stocking - *Nothing to report.*

13. Surplus Animal Disposal - *Nothing to report.*

14. Scientific Collections - *Nothing to report.*

15. Animal Control - *Nothing to report.*

16. Marking and Banding

Total banding activities are summarized in Table G.16.1. Banding was divided into three main efforts: geese, ducks, and songbirds (MAPS project).

Geese. Totals of 211 white-fronted geese and 52 Canada geese were banded by Refuges and Migratory Birds staff on Selawik and Innoko NWRs as part of the regional goose study.

Ducks. A total of 194 ducks was banded at Loafing Lake, northeast of the village of Koyukuk, August 17-23, 1999. Totals were Green-winged Teal, 120; Northern Pintail, 58, and Mallard, 16.

Songbirds. A total of 199 birds of 17 species was banded as part of the MAPS program (See Section G.7.)

Table G.16.1. Summary of bird banding at Koyukuk/Nowitna NWR during 1999.

Species	1999
Canada goose	52
White-fronted goose	211
Green winged teal	128
Mallard	16
N. pintail	58
Lesser yellowlegs	1
Alder flycatcher	23
Gray jay	1
Black-capped chickadee	11
Ruby-crowned kinglet	6
Swainson's thrush	23
American robin	1
Orange-crowned warbler	26
Yellow warbler	12
Myrtle warbler	10
Blackpoll warbler	15
N. waterthrush	25
Am. Tree sparrow	1
Lincoln's sparrow	18
White-crowned sparrow	1
Slate-colored junco	24
Common redpoll	1
Total	664

17. Disease Prevention and Control - *Nothing to report.*

H. PUBLIC USE

1. General - *Nothing to report.*

2. Outdoor Classroom - Students

In September several class activities were conducted with students from the Galena City Schools. PR Karin Lehmkuhl worked with 7th graders who were studying forests. During one school visit, students learned about mammal identification, adaptations and habitat using the Refuge's Boreal Forest Mammals teaching kit. The following week students learned about differences between boreal forests and tropical rainforests, and about bird migration.

Galena's 1st graders visited a local wetland with PR Karin Lehmkuhl and BT Jenny Bryant for two afternoons of investigation (Photo H.2.1). On the first day the students collected and examined specimens of pond plants and invertebrates (Photo H.2.2). The second day included wetland activities, a sharing time and a "pond dance!" A similar field trip for 3rd graders was led by BT Jenny Bryant and BT Deborah Webb.

Photo H.2.1. *PR Lehmkuhl and BT Bryant are joined by enthusiastic 1st graders in wetland investigations.*

Photo H.2.2. *Galena 1st grade teacher Claudette Greene introduces her students to pond life.*

3. Outdoor Classrooms - Teachers

PR Karin Lehmkuhl assisted in developing village-based watershed and non-point source water pollution curriculum. The project is part of a cooperative effort by Louden Tribal Council, Tanana Chiefs Conference, Galena City Schools and Koyukuk/Nowitna NWR to develop watershed education in area villages. To assist in this effort, a Yukon-Koyukuk Intertribal Environmental Conference was held in Galena January 18-22, 1999. Teachers and residents of several area villages attended the conference to learn about environmental issues facing villages, and how to develop survey, monitoring, education and cleanup programs.

4. Interpretive Foot Trails - *Nothing to report.*

5. Interpretive Tour Routes - *Nothing to report.*

6. Interpretive Exhibits/Demonstrations

Several new displays were developed for the refuge office and information kiosk. Artwork created by students that participated in wetlands field trips (Section H.2) was used in a refuge display on wetlands. Also included was a flying pair of green-winged teals and a pair of northern shovelers that were mounted by Jack Moermond. Jack and his wife Jean were volunteers at our complex several years ago, and Jack has provided our office with a variety of waterfowl mounts that have been excellent educational tools.

A fire ecology display was created for the information kiosk for display during the summer months. The kiosk was relocated to the boat landing on the Yukon River for the month of September. Updated hunter information panels and land use maps were used in the display. A new "meat care card" for hunters was available at the kiosk, Refuge office, hunter check stations, and from local hunting guides. Maps of the Koyukuk Wilderness Area, combined with information on special use restrictions, were also displayed.

7. Other Interpretive Programs

PR Lehmkuhl gave a presentation on her yellow-cheeked vole research at the AAAS (American Association for the Advancement of Science) Arctic Science Conference meeting (Sept 19, 1999, Denali, Alaska). She received the Robern I. Larus Student Prize for her presentation.

8. Hunting

Waterfowl. As a result of 1997 amendments to the Migratory Bird Treaty Act that allow for legal spring and summer hunting of waterfowl in Alaska by subsistence users, the U.S. Fish and Wildlife Service began a process to formulate new regulations. In order to develop reasonable and sustainable waterfowl seasons and bag limits, estimates of regional and total harvest by species, and estimates of average consumption per household and village are needed. In addition, the Central Flyway Technical Committee has expressed a need for more accurate estimates of spring harvest of white-fronted geese in response to the Service's concern over a regional decline of that species. Therefore, in 1998 the refuge initiated a study to estimate subsistence waterfowl on and near the Complex. Biological Science Technician Deborah Webb completed two years of subsistence waterfowl harvest surveys in seven regional communities and prepared a report entitled *Subsistence Waterfowl Harvest Survey: Galena, Huslia, Nulato, Koyukuk, Kaltag, Hughes, Ruby, 1998-1999.* A portion of the report abstract follows:

> In 1998 and in 1999 households interviews were conducted in May and early June to estimate spring harvest, and in October interviews were completed to estimate summer and fall harvest. Harvest estimates varied considerably between years and seasons. In 1998, the overall annual subsistence waterfowl harvest was estimated at 2,733 birds; 64% of these birds were taken in the spring. In 1999, the overall annual subsistence waterfowl harvest was estimated at 2,064 birds, and 75% of these birds were taken in the spring. In 1998, more ducks (59%) were harvested than geese (40%), in 1999, more geese (57%) were harvested than ducks (43%). However, in terms of edible weight, geese dominated the subsistence harvest in both years. The reported waterfowl harvest represented an estimated total usable weight of 6,717 pounds in 1998, and an estimated total usable weight of 6,103 pounds in 1999. Species most commonly taken were Canada goose, white-fronted goose, mallard, American wigeon, and northern pintail. Households using waterfowl comprised 50% of interviewed households in the spring, and 38% of interviewed households in the fall of 1998. In 1999, households using waterfowl amounted to 61% of interviewed households in the spring and to 33% of interviewed households in the fall.

Results from the survey indicate that current subsistence waterfowl harvest in the Koyukon Region is lower than harvest reported in surveys conducted elsewhere in Alaska recently. In addition, harvest estimates in this study are much lower than estimates from surveys conducted in the same region previously. The reported decline in harvest is likely due to changing socio-economic conditions in the region, which have changed as the availability of jobs, freezers and moose have increased in the past 20 years.

Spruce grouse. During fall waterfowl harvest surveys, residents of Kaltag and Nulato, which are adjacent to the N. Innoko NWR, were also asked to report summer and fall

spruce grouse harvests. Twenty households in Kaltag reported harvesting 137 spruce grouse, while 32 households in Nulato reported harvesting a total of 362 spruce grouse in 1999.

Moose. Since 1983, ADF&G has conducted a hunter check station at Ellas's Cabin, which is just south of the refuge boundary on the Koyukuk River. The entire Koyukuk River within the Koyukuk NWR boundary is part of the Koyukuk Controlled Use Area, where aircraft access for moose hunting is prohibited. Therefore, the Ella's Cabin check station provides a consistent source of harvest information for the majority of refuge hunters who gain access to the refuge from the Yukon River or Nikolai Slough. This includes most residents on the Yukon and virtually all non-resident hunters, except for those who float down river from above the Controlled Use Area boundary. The check station has been a mandatory stop since 1990.

Temperatures during the September 1999 moose harvest season were very warm for the duration of the season. The warm weather, in combination with low water, affected the distribution of both moose and hunters in the Controlled Use Area. The popular Three-Day Slough area was inaccessible for nearly all of the season, which concentrated hunter efforts in other localized areas of the drainage. Meat was checked thoroughly by staff at the check station in 1999. Although some poorly cared for meat was encountered, the majority came out in game bags and in good condition.

Traditionally, refuge staff have not been involved in operations at Ella's Cabin. Due to excellent relations between ADF&G Biologist Glenn Stout and the refuge, GB Joanna Roberts spent 4 days working at the check station in 1999. The Refuge gained considerable insight into hunting conditions on the Koyukuk, and will strongly support future requests for assistance.

A total of 731 permits were issued for the combined subsistence and general registration hunts in the Koyukuk Controlled Use Area in 1999 (699 at check station, 32 in Huslia). Numbers of registered hunters in 1999 increased 17% over 1998 numbers (626). This represents the highest number of hunters ever recorded in the Controlled Use Area during a September season.

Hunters harvested 367 moose (273 bulls, 94 cows) in the lower Koyukuk drainage during the 1999 registration hunts. The 1999 harvest was also the highest ever recorded, and well above the ten year average of 238 (Tables H.8.1 & H.8.2). Both the Service and ADF&G remain concerned that the rate of harvest is close to the limit of long-term sustainability. ADF&G and refuge staff are concerned about the number of cows being harvested in the lower Koyukuk and are supportive of actions to cease all cow harvest in the unit until productivity and recruitment increase or browse quality and quantity is sufficient to support the population.

On the N. Unit of Innoko NWR, most hunting on the Kaiyuh Flats and Bishop Creek drainages is done by residents of Kaltag, Nulato, Koyukuk and Galena. The majority of hunting there is for subsistence purposes by local residents. Some non-locals do hunt in the area, but harvest is thought to be minimal. Hunting pressure in the Kaiyuh Flats was considerably lower in 1999 than in recent years due to very low water conditions, which restricted access.

Table H.8.1. Number of moose hunters by residency class checked through the Koyukuk River Check Station.[1] Data courtesy ADF&G, Galena.

Regulatory Year	Non-local AK. Residents	Non-Residents	Local Rural Residents	Total Hunters
1989-90	125	23	154	302
1990-91	133	36	137	306
1991-92	189	55	136	380
1992-93	173	39	145	357
1993-94	132	34	115	281
1994-95	194	56	106	356
1995-96	260	63	124	446
1996-97	306	89	213	608
1997-98	278	89	157	524
1998-99	341	126	159	626
1999-00	365	173	193	731
Mean	227	71	149	447

[1] Checking in and out of Ella's Cabin was not mandatory until 1990, and compliance was lower during the initial years 1983-89.

Table H.8.2. Harvest by moose hunters and harvest rate by residency class checked through the Koyukuk River Check Station[1]. Data courtesy of ADF&G, Galena.

Regulatory Year	Non-Local AK. Residents [2]	Non-Residents [2]	Local Rural Residents [2]	Total Moose Harvest [2]
1989-90	89 (71%)	14 (61%)	55 (36%)	158 (52%)
1990-91	105 (79%)	30 (83%)	48 (35%)	183 (60%)
1991-92	121 (64%)	38 (69%)	49 (36%)	209 (55%)
1992-93	103 (60%)	19 (49%)	45 (31%)	167 (47%)
1993-94	109 (83%)	28 (82%)	48 (42%)	185 (66%)
1994-95	127 (65%)	41 (73%)	34 (32%)	202 (57%)
1995-96	188 (72%)	50 (79%)	49 (40%)	287 (64%)
1996-97	198 (65%)	66 (74%)	90 (42%)	353 (58%)
1997-98	185 (67%)	55 (62%)	66 (42%)	306 (58%)
1998-99	203 (60%)	73 (58%)	69 (43%)	345 (55%)
1999-00	204 (56%)	91 (53%)	71 (37%)	366 (50%)

[1] Checking in and out of Ella's Cabin was not mandatory until 1990.

[2] Moose harvest is followed by estimated percent hunter success in parentheses.

Photo H.8.1. *Moose hunting continues to increase in popularity on the Koyukuk River. These guided hunters from Austria were attracted to the refuge by its world-renowned high moose densities, which continue to fall annually. (JLR)*

Photo H.8.2. *Moose hunting in the Koyukuk Controlled Use Area is highly regulated and is monitored from Ella's Cabin, ADF&G's mandatory check station. (JLR)*

9. **Fishing** - *Nothing to report.*

10. **Trapping** - *Nothing to report.*

11. **Wildlife Observation** - *Nothing to report.*

12. **Other Wildlife Oriented Recreation** - *Nothing to report.*

13. **Camping** - *Nothing to report.*

14. **Picknicking** - *Nothing to report.*

15. **Off-Road Vehicling** - *Nothing to report.*

16. **Other Non-Wildlife Oriented Recreation** - *Nothing to report.*

17. **Law Enforcement**

Refuge Officer Good conducted five aerial law enforcement surveillance flights over the Koyukuk and Kaiyuh Flats Refuges during the moose season.

Little activity was noted on the Kaiyuh Flats area which was probably due to low water. Minimal hunter activity was observed on the Koyukuk Refuge outside of the Controlled Use Area. The popular Three-Day Slough and Dulbi River areas within the Controlled Use Area where hunters were concentrating were patrolled by two visiting USFWS special agents and a state of Alaska wildlife protection officer. Illegal tranporter/guiding activity has been rampant. Law enforcement efforts have been targeted toward stemming the tide.

18. **Cooperating Associations**

Our small Alaska Natural History Association (ANHA) outlet continued to provide books of regional interest, maps, refuge t-shirts and other items for sale. Sales were lower in 1999 than in the previous year, primarily due to limited staffing and less involvement in community sales. No ANHA funds were used for special projects in 1999.

19. **Concessions** - *Nothing to report.*

20. Subsistence Management

The Koyukuk NWR Complex supports many uses which occur on a checkerboard of Federal, State, Native corporation, and privately owned lands within refuge boundaries. In terms of use-days, the most significant public use of Federal lands within the Complex is subsistence by rural residents. *Wildlife* subsistence activities occurring on Federal lands and waters and subsistence *fishing* activities occurring on navigable waters within or adjacent to Federal lands are administered by the Service. On state and Native corporations lands, navigable waters, and on certified Native allotments within the Complex, subsistence and other recreational consumptive use of *wildlife* are managed by ADF&G. ADF&G also manages recreational and commercial fisheries on those same lands and waters. Since 1990, the arrangement of dual Federal-State subsistence management has presented residents of the area and the Service with many new challenges. These challenges increased considerably in October of 1999, with the Federal assumption of subsistence fisheries management in waters in and adjacent to refuge boundaries.

GB Joanna Roberts continued to serve as the Subsistence Coordinator for the Complex. In fiscal year 1999, the Complex received $58,000 in subsistence funds, of which $50K was for salary and $8K for travel. Most of the designated subsistence funds were again used for subsistence harvest surveys, subsistence wildlife surveys, and for travel to meetings, seminars and villages.

Federal Advisory Council

The Western Interior Regional Advisory Council (WIRAC) represents the residents of the western Interior Alaska region with nine seats. The function of the Council is to convey the needs and opinions of its constituency to the Federal Subsistence Board and to submit regulation proposals and comments. Included on the Council in 1999 were Acting Chairman Ronald Sam, Alatna; Carl Morgan, Aniak; Raymond Collins, McGrath; Benedict Jones, Koyukuk; Angela Demientieff, Holy Cross; Henry Deacon, Grayling; Jack Reakoff, Wiseman; Michael Stickman, Nulato; and Sampson Henry, Allakaket. Vince Mathews of USFWS, who is stationed in Fairbanks, served as the USFWS Regional Council Coordinator for the Western Council. He is an employee of the Office of Subsistence Management in the Regional Office. The Council held two regular meetings in 1999. The spring meeting was held in Galena March 10-11, and attended by DRM Good and WB Spindler. The fall meeting was held in Aniak October 13-14, and attended by GB Roberts and RIT Huntington. GB Roberts reported on recent and upcoming refuge activities, including fall moose survey plans, Nowitna moose hunter check station harvest data, law enforcement efforts, and wolf and waterfowl harvest surveys.

The primary issues and concerns addressed at the spring 1999 meeting involved the continually increasing hunting pressure on the Koyukuk River and cooperative moose management planning efforts directed at resolving conflicts in the area. ADF&G Planner Randy Rogers expressed concern that the Middle Yukon and Koyukuk River Local Advisory Committees did not support ADF&G's cooperative moose management planning efforts for the Koyukuk River. This resulted in the Council drafting and supporting a resolution strongly encouraging direct involvement of all affected Local Advisory Committees in the proposed cooperative planning process.

Taylor Brelsford, OSM Chief of Planning in the Regional Office, gave a status report on the Federal assumption of subsistence fisheries management, with an overview of the Final Ruling, funding available for implementation if the State failed to comply with ANILCA's rural priority by October 1, and a proposed implementation update.

During proposal review and recommendations, the Council voted to recommend the Federal Subsistence Board defer action on Proposal 44, which would close the northern unit of the Innoko NWR to non-Federally qualified subsistence users. Deferral was recommended to allow agency staff additional time for analysis of moose population and harvest data, as well as to recognize concerns of affected local villages.

During the fall 1999 meeting in Aniak, the primary concern expressed by Council members was again increasing numbers of hunters, but the focus now shifted to include the entire Western Interior Region. All members agreed they would like to see more regulation in the air taxi business, which is currently regulated by the State Dept. of Commerce. The Council supported extra efforts made by agencies in law enforcement during the fall moose hunting season, and expressed their desire to see the increased efforts continue in the future.

An overview of the Federal Subsistence Fisheries Implementation Plan was presented, and it was emphasized that regulations published in January of 1999 govern the 2000 season, which will have very few disparities from State regulations for the 2000 fishing season. Additional discussion focused on how to best coordinate fisheries issues between the Yukon drainage and Kuskokwim drainage. The Council voted to form a Coordinating Council, in which 2 members from each of the three Councils currently involved in Yukon and Kuskokwim River issues will work together on a consensus basis and feed back into the existing Councils.

During proposal deliberations, the Council drafted several proposals to align Federal and State subsistence seasons and harvest limits. The drafted proposals would allow the harvest of one grizzly bear every regulatory year by State permit in Unit 21(D), and expand the harvest limit for coyotes in Units 19, 21 and 24 to 10 coyotes. In addition, a proposal was drafted to change the February moose season to ten days later in Unit 21(D).

The Council also voted to write a letter of support for a State proposal to establish a controlled use area in the Kaiyuh Flats area of Unit 21(D).

Federal Subsistence Board

The Federal Subsistence Board met May 3-6 to make rulings on 63 proposals to make changes to Subpart D of the Federal subsistence regulations on seasons and bag limits. Proposal 44 was submitted by Western Interior Federal Subsistence Advisory Council to close federal lands on the Kaiyuh Flats to non-local moose hunters. The proposal was written because Nulato residents were concerned about declining moose numbers on the Kaiyuh Flats and anticipated that non-local harvest in their hunting area would increase as a result of more restrictions to non-locals on the lower Koyukuk River. The Service and ADF&G analyses agreed that since the majority of the moose and the majority of moose hunting occurred below the mean high water mark and within State jurisdiction, the Federal proposal would not address the concern of potential harvest increases. Upon recommendation from the Staff Committee and the Western Interior Regional Council, the Federal Subsistence Board deferred Proposal 44 for a year to allow additional time for Federal, State and local interests to become more informed about the issue and to work toward a mutually agreeable resolution.

Koyukuk River Moose Hunters' Working Group

In May of 1999, the Koyukuk River Moose Hunters' Working Group was organized in response to widespread concerns about the increasing numbers of hunters and moose harvested on the Koyukuk River. A citizen-based group, the Working Group is composed of representatives of local and non-local State Fish and Game Advisory Councils, representatives from the Western Interior Regional Advisory Council, and commercial guides. In addition, numerous wildlife and land management agencies, including the Koyukuk/Nowitna NWR, have participated in the planning process as technical advisors, providing harvest and survey data, and biological information. The Working Group began work on a 5-year Koyukuk River drainage moose management plan to be presented to the Alaska Board of Game in March 2000, and also drafted proposals to change current regulations. RM Williams and GB Roberts attended Working Group meetings in Fairbanks in May, June, August, October and December.

As of the final meeting in 1999, a few of the key actions recommended in the draft plan include: (1) expanding the area of general and subsistence registration hunts RM 830 and RM 832 to apply within the entire Koyukuk Controlled Use Area; (2) modifying the subsistence registration hunt season to begin and end five days earlier; (3) applying discretionary permit authority of ADF&G to manage the harvest of cow moose; and (4) instituting resident and non-resident permit drawing hunts in place of the RM830 general hunt. The Refuge supports the recommendations of the Working Group--how the plan is perceived by the Board of Game remains to be seen!

Photo H.20.1. *The Western Interior Regional Advisory Council held its annual spring meeting in Galena. This Council represents rural communities and submits regulation proposals and comments to the Federal Subsistence Board. (JRG)*

State Fish and Game Local Advisory Committees

The Middle Yukon, Ruby, and Koyukuk River local Fish and Game Advisory Committees continued to function under minimal funding by the State Boards of Game and Fish. The Complex continued to work with the Committees and attempted to attend meetings whenever possible. In October, GB Roberts attended the Joint Middle Yukon/Koyukuk River Advisory Committee Meetings in Huslia. The main topic of discussion was Koyukuk River moose management. Local and non-local representatives of the Koyukuk River Moose Hunters' Working Group presented the Group's preliminary recommendations for comment. The joint meeting promoted communication and understanding of the different perspectives involved in managing moose in the Koyukuk drainage.

I. EQUIPMENT AND FACILITIES

1. New Construction - *Nothing to report.*

2. Rehabilitation

MMS projects included replacing flammables storage areas at residences with outdoor vinyl storage units.

Portable float plane dock systems in use on Alexander Lake and on the Yukon River were enlarged/improved with the purchase of additional components - interlocking units - for securing refuge floatplanes.

In an effort to improve float plane access to Alexander Lake, the refuge applied to the Alaska Department of Natural Resources for a temporary water rights permit to pump water from the Yukon River into the lake. Several winters of low snowfall and negligent spring flooding resulted in an ominously low water level. Although planes can be docked on the Yukon River when necessary, they are much better sheltered from vandalism and severe weather conditions at Alexander Lake. The project, originally intended for late May/early June, was not completed until July due to delays in assembling the proper equipment for the project. The refuge rented a pump, ten 400

Photo I.2. *Extremely low water in Alexander Lake prompted the refuge to obtain a permit to pump Yukon River water into the lake.*

ft. sections of discharge hose, and three 25 ft. sections of suction hose, all of which had to be shipped from Anchorage. Galena resident Don Lowe granted permission for the pump to be located on his property adjacent to the river, and water was pumped through a 6-inch hose into the lake . A culvert under the main thoroughfare allowed placement of the hose to avoid traffic. The water in Alexander Lake was brought to a satisfactory level and benefitted other local floatplane pilots as well.

Rain gutters were installed at quarters 2, 4, 5 and 6.

New carpet was installed in quarters 3, and general repairs and maintenance were performed in preparation for new occupants.

3. Major Maintenance - *Nothing to report.*

4. Equipment Utilization and Replacement

The refuge auto fleet was showing its age. Most refuge vehicles have relatively few miles for their age due to Galena's extremely limited road system, but dirt roads, flying gravel, and arctic winters inevitably take their toll. In 1999, three replacement vehicles were acquired: a Ford Explorer, a Dodge utility pickup equipped with snowplow, and a Suburban. Due to time constraints of the summer barge season, new vehicle acquisitions must be planned well in advance.

Photo I.4. *This new Suburban replaces a 1986 model.*

5. Communications Systems

1999 was the fourth year that the BLM Alaska Fire Service was contracted to maintain the U. S. Fish and Wildlife Service radio communications system in Alaska. Eighteen portable hand held radios, five repeaters, four Remote Automated Weather Station (RAWS) sites, and our base station radio were given annual service or maintenance during the year. Overall the radio system worked remarkably trouble free for most of the year. The only real problem continued with the radio patch to our Kaiyuh RAWS not functioning properly. Hopefully, 2000 will bring a trouble free fully operational radio system.

6. Computer Systems

Every permanent, professional, administrative and technical staff member has either a laptop or desktop computer to work with. There are twelve desktop work stations and five laptop computers in use by refuge staff by the end of 1999. Our current network is set up using a peer- to-peer network using Windows for Workgroups. A peer-to-peer network does not require a server and generally requires less administration than a server-based network. All our pc's are running using Windows95 or Windows98 operating systems. All staff members have email access through the server and router system using Ccmail that was installed and set up by regional office staff members Hedy Saccone and Ben Sherburne.

A number of peripherals were added to the network in 1997 and 1998 including an HP Scanjet Plotter, HP Deskjet color printer, Olympus slide and print scanner, and an Olympus digital camera. Seven new Pentium Windows desk top computers and two new pentium laptops along with a new NT computer (our GIS computer) were purchased to replace older workstations.

7. Energy Conservation - *Nothing to report.*

8. Other (Aircraft)

The Complex used three aircraft in 1999: one Cessna 185 (N714KH), one Piper Super Cub (N4343), and one Maule M-7 (M-7). The Cessna 185, Maule, and Super Cub aircraft are configured with floats during the summer and skis during the winter. Wheels are used only for a few weeks during transitions between seasons. The three airplanes and two refuge pilots flew a total of 391 hours in 1999 (Table I.8.1). This was done without incident, which represents this station's 16th year without an aviation accident or incident. Our flying activities have declined due to completion of several aerial radio-telemetry studies and wildlife census projects, and because of increased bureaucracy and difficulties in obtaining aircraft maintenance.

Three aircraft are essential to accomplish field operations over the entire refuge Koyukuk/Nowitna NWR Complex because: (1) there are no aircraft maintenance facilities in Galena, when a plane is in town for maintenance, it is usually gone for several weeks; (2) field work and outreach efforts can be most effectively accomplished with three pilots on staff; and (3) most of the flying occurs in two seasonal peaks (summer--waterfowl inventory, banding, other field studies, fire management; and early or late winter--moose, wolf, and caribou surveys, village meetings and EE visits). Most of these wildlife inventories have narrow phenological and weather windows in which we can accomplish the work; for example, two weeks for geese in late June-early July, and one month, November, for moose.

Three pilots worked on the staff in 1999: one dual-function GS-486 Wildlife Biologist (Spindler), one full time permanent GS-2181 Pilot (Huhndorf), and one seasonal GS-2181 Pilot (Baxter). Refuge pilots and aircraft provide the flexibility to schedule and conduct several types of work simultaneously, or to conduct similar comparative work in several areas of the Complex, and accomplish it despite the unpredictable weather and limited daylight of the subarctic winter. We also chartered local bush pilot Colin Brown (a former employee) with Yukon Eagle Aviation. Charters are good when existing personnel and aircraft cannot do the job, such as during the extremely busy months of June and July, or during special moose and wolf censuses.

Government aircraft are "owned" and maintained by the Office of Aircraft Services who bill the Service for hourly flight time and monthly availability rates. In fiscal year 1999 the annual cost of operating our three aircraft was about $90,000, for an average cost of $180 per flight hour (not including pilot salary). Maintenance for our remotely-located aircraft was complicated and expensive because there were no private mechanics in Galena who could assist with breakdowns. If there was a breakdown, and the aircraft could not be ferried to town, we had to pay for overtime and travel for OAS or contract mechanics to travel from Anchorage or Fairbanks to Galena. Also, in 1999 there were numerous delays in aircraft maintenance caused by OAS staff.

Table I.8.1. Summary of flight hours by refuge pilots in government aircraft at Koyukuk/Nowitna NWR Complex, 1990-1999.

FY	M. Spindler	C. Brown	P. Liedberg	J. Huhndorf	J.D. Baxter	Total
1990	442	547	245			1234
1991	308	545	212			1065
1992	436	497	295			1228
1993	183	467	199			849
1994	315	397	232			944
1995	288	250	122			660
1996	306	206	40			552
1997	207	225	na			432
1998	252	249	na			501
1999	98[a]	50[b]	na	163	80	391

[a]Total hours lower than usual due to broken leg

[b]Charter hours with Yukon Eagle Air Service

J. OTHER ITEMS

1. **Cooperative Programs** - *Nothing to report.*

2. **Other Economic Uses** - *Nothing to report.*

3. **Items of Interest** - *Nothing to report.*

4. **Credits**

DRM Jim Good prepared sections E5-6, H17, and I2 (part).
SWB Mike Spindler prepared sections B, D5, E4, G1-7, G10 (part) G11-17, I8.
FMO Bob Rebarchik prepared sections F9 and I5, and digitized photos.
PR Karin Lehmkuhl prepared sections G10 (part), H2-3, H6-7, H18.
GB Joanna Roberts prepared sections H8 and H20.
RC Sharon Tunnell prepared sections A, I2 (part), I4, and compiled and edited the final report.

K. FEEDBACK

ANNUAL NARRATIVE REPORT

1999

NOWITNA NWR

KOYUKUK/NOWITNA NATIONAL WILDLIFE REFUGE COMPLEX

Galena, Alaska

REVIEW AND APPROVALS

Complex Manager	Date	Refuges Supervisor-Northern AK	Date 4/6/2
Refuge Chief-NWRS	Date 4/6/02		

INTRODUCTION

The Nowitna National Wildlife Refuge was created on December 2, 1980 with the passage of the Alaska National Interest Lands Conservation Act. Purposes for which the refuge was established are:

1. To conserve fish and wildlife populations and habitats in their natural diversity including, but not limited to, trumpeter swans, white-fronted geese, canvasbacks and other waterfowl and migratory birds, moose, caribou, marten, wolverine and other furbearers, salmon, sheefish, and northern pike;

2. To fulfill international treaty obligations of the United States with respect to fish and wildlife and their habitats;

3. To provide the opportunity for continued subsistence uses by local residents;

4. To ensure water quality and necessary quantity within the refuge.

The refuge lies approximately 200 miles west of Fairbanks in the Central Yukon River Valley. It comprises 2.1 million acres of forested lowlands, hills, lakes, marshes, ponds, and streams. The Nowitna River, a nationally designated Wild River, drains the refuge from south to north. The lowlands along this river are prime waterfowl production and migration habitat. The river and its tributaries support king and chum salmon runs, a large pike population, and one of only three resident sheefish populations in the state. The Yukon River, which forms the northern boundary of the refuge, has a salmon fishery of international significance and is an important transportation corridor. The refuge's very productive marten habitat prompted specific reference in ANILCA to its outstanding furbearer value. Other species of interest common on the Nowitna are moose, wolves, black and grizzly bears, beaver, wolverine, lynx and several species of raptors including nesting bald eagles.

Access to the refuge is possible by airplane, boat, snowmachine, foot, or dog sled. The Complex's aircraft, two Super Cubs and a Cessna 185, as well as three river boats and several snowmobiles provide transportation. The refuge headquarters is located in Galena, a village of approximately 600 people. See the Koyukuk report for a description of Galena. In 1989, the Nowitna Refuge was fused into a complex with the Koyukuk NWR and the Northern Unit of the Innoko NWR. Items common to all refuges are presented in detail under the Koyukuk report.

INTRODUCTION

TABLE OF CONTENTS

G. WILDLIFE

H. PUBLIC USE

I. EQUIPMENT AND FACILITIES

J. OTHER ITEMS

K. FEEDBACK

A. HIGHLIGHTS

- *Habitat conditions were estimated to be excellent for nesting waterfowl in 1999.* However, white-fronted goose adult counts declined sharply in 1999, and production was the lowest observed on the refuge since surveys began in 1985. Canada goose adults continued to increase slightly for a second year, following a steady decline from 1991-1997. (Section G.3)

- *The Ruby Breeding Bird Survey (BBS) was conducted in June.* The route, established in 1994, follows a 50-mile long gravel road near the Nowitna NWR and serves to monitor Passerine birds in western interior Alaska. The route was run for the first time using a truck (instead of a four-wheeler) and an assistant, both of which vastly improved conditions. Observations of 472 individuals of 23 species were recorded in 1999. (Section G.7)

- *Aerial moose surveys were conducted in two Trend Count Areas (TCA's) in November.* The Sulatna/Nowitna Confluence TCA showed a marked decline in total moose numbers. The bull:cow ratio declined sharply, suggesting a high level of exploitation. In the Nowitna River Mouth TCA, total moose numbers were at the lowest level since surveying began in 1983. (Section G.8)

- *The fall moose hunt continued to increase in popularity on the Nowitna NWR.* Hunting accounts for the majority of public use activity on the refuge. A voluntary moose hunter check station on the Nowitna River mouth was open from September 2-27, 1999. A total of 155 hunters harvested 45 moose. Unseasonably warm weather may have had a negative impact on hunter success, which was the lowest since 1996. Hunters heard and saw few bulls until the end of the month, when the weather got cooler. (Section H.8)

B. CLIMATIC CONDITIONS

See section B of the Koyukuk report.

C. LAND ACQUISITION

1. **Fee Title** - *Nothing to report.*

2. **Easements** - *Nothing to report.*

3. **Other** - *Nothing to report.*

D. PLANNING

1. **Master Plan** - *Nothing to report.*

2. **Management Plan** - *Nothing to report.*

3. **Public Participation** - *Nothing to report.*

4. **Compliance with Environmental and Cultural Resources Mandates** - *Nothing to report.*

5. **Research and Investigations** - *See section D.5 of the Koyukuk report..*

6. **Other** - *Nothing to report.*

E. ADMINISTRATION

1. **Personnel** - *See section E.1 of the Koyukuk report.*

2. **Youth Programs** - *Nothing to report.*

3. **Other Manpower Programs** - *Nothing to report.*

4. **Volunteer Program** - *See section E.4 of the Koyukuk report.*

5. **Funding** - *See section E.5 of the Koyukuk report.*

6. **Safety** - *See section E.6 of the Koyukuk report.*

7. **Technical Assistance** - *Nothing to report.*

8. **Other** - *Nothing to report.*

F. HABITAT MANAGEMENT

1. General

Habitat types on the Nowitna NWR are characteristic of interior Alaska but the refuge has more forested lands than most Alaskan refuges (see Section F.2). The lower Nowitna drainage has some especially high quality white spruce measuring over 18 inches in diameter and over 100 feet high. Approximately 36 % of the refuge is dominated by black spruce, while only around 2% is dominated by white spruce. Local residents primarily use spruce only for house logs and firewood, although small commercial sawmills have operated in Tanana, Ruby and Galena. The majority of the highest quality timber on the refuge grows along the Nowitna River. The Comprehensive Conservation Plan for the refuge precludes commercial timbering. Local interest in commercial logging operations on islands of the Yukon River has been expressed.

2. Wetlands

The Nowitna refuge's many river watersheds and thousands of lakes provide an abundant aquatic resource. The principal rivers on or adjacent to the refuge include the Yukon, Nowitna, Sulatna, Big Mud, Little Mud and Grand Creek. With the exception of the Nowitna, all of these rivers carry a heavy sediment load.

The Nowitna River is the heart of the refuge. This meandering river is constantly creating a diversity of new habitats for fish and wildlife. The river's main channel is 283 miles long, of which 223 miles are within the refuge. The river width ranges from 150 to 450 feet wide and has a mild gradient and all Class I water. The main channel in the lower river is typically 20-30 feet deep in early summer. Limestone in the Kuskokwim Mountains, near the headwaters of the Nowitna, contributes carbonates that buffer the acidic qualities of the river and make it more productive than many of its interior Alaskan counterparts. The river flows into the Yukon River, which is the fifth largest river system in North America.

Lowlands of the Nowitna Refuge are dominated by ponds and marshes, most of them smaller than ten acres. There are approximately 14,000 lakes and ponds on the refuge, and wetland acreage is estimated at about 30,000. No active manipulation of the wetland habitats takes place on the Nowitna Refuge.

3. Forests

The Nowitna's vegetation forms part of the circumpolar northern coniferous forest. On the Refuge, forests dominate at elevations below treeline. Open stands of black spruce are common in low-relief terrain. White spruce, occasionally growing with white birch and aspen, can be found in the better-drained and warmer sites.

Seven major vegetation classes were distinguished in a mapping process conducted by Talbot and Markon in 1985 using Landsat images. (Talbot, S. S., and Carl J. Markon. 1986. Vegetation Mapping of Nowitna NWR, Alaska Using Landsat MSS Digital Data. Photogrammetric and Remote Sensing. Vol 52, No. 6. June 1986, pp 791-799.) They defined the forest class site as one with trees at least 16 feet tall. Included in this category are intermediate successional stages, or secondary tree growth temporarily less than 16 feet. Forests are the most widespread vegetation type, covering 88% of the refuge. Of the five recognized subclasses, open needleleaf forest and broadleaf forest are the most extensive, comprising almost 1.5 million acres or 72% of the surface area of the Refuge. The five forest subclasses are described as following:

Closed needleleaf forest - This subclass has 60 to 100% cover, occurs on moist to well-drained sites from the lowlands to mountain slopes and is particularly well developed on alluvial sites along the Nowitna River and on some islands in the Yukon River. The dominant tree species is white spruce, which may grow in excess of 100 feet tall along the Nowitna River. White birch and balsam poplar are secondary species. This subclass comprises 2% of the Refuge surface area.

Open needleleaf forest - This subclass has 25 to 60% tree cover and is found on moderately to poorly-drained soils. It is usually dominated by black spruce or larch. This subclass comprises 42% of the Refuge surface area.

Needleleaf woodland - This subclass, which is sometimes called "muskeg" has 10 to 25% tree cover and is found on moderately to poorly drained soils. Black spruce is the most common tree and dwarf shrubs such as Labrador tea, bog blueberry, lingonberry, and small cranberry are important in the understory. Sphagnum moss covers much of the ground, insulating the permafrost layer beneath. This subclass comprises 10% of the Refuge surface area.

Broadleaf - This subclass has 25 to 100% cover and occurs in well to imperfectly-drained sites. White birch, aspen, and balsam poplar dominate the overstory. Other types of broadleaf deciduous forests occur on hills where strips of birch forest line many hillside streams, and aspen is present on south-facing sandy hillsides. This subclass comprises 30% of the Refuge surface area.

Mixed forest -This subclass has 25 to 100% cover. It consists of deciduous broadleaf and evergreen needleleaf trees distributed over large areas of moderately to well-drained soils on the lower mountains. It grows tallest in lowlands along rivers and on islands in the Yukon River. Principal species are white birch, aspen, and white spruce. This subclass comprises 4% of the Refuge surface area.

4. **Croplands** - *Nothing to report.*

5. Grasslands - *Nothing to report.*

6. Other Habitats

In addition to the forest vegetation classes described in F.3, Talbot and Markon (1986) described several other vegetation/cover classes that occur on the Nowitna Refuge. With the exception of the water classes, the others are described here.

Scrub, composed predominantly of deciduous shrubs ranging from 1.5 to 16 feet in height, covers over 4% of the refuge surface area. Three subclasses occur within the scrub type and include 'lowland broadleaf', 'alluvial broadleaf', and 'subalpine broadleaf'. Dominant species within these subclasses include *Alnus crispa, A. incana, Salix planifolia, and S. alaxensis.* Chief understory species include *Vaccinium vitis-idaea, Linnaea borealis, Calamagrostis canadensis, and Equisetum arvense.*

The dwarf scrub class, or tundra, contains slow-growing dwarf shrubs less than 1.5 feet tall, chiefly in the heath and crowberry families. One subclass includes 'dwarf scrub-graminoid tussock peatland,' which is located on poorly drained organic soils. Mosses and lichens cover the surface. Dominant species include *Ledum decumbens, Vaccinium uliginosum, V. vitis-idaea, Betula glandulosa, Eriophorum vaginatum, Carix bigelowii, Rubus chamaemorus, Sphagnum* spp., *Dicranum spp., Cladina* spp. and *Cetraria* spp. The second subclass is 'prostrate dwarf shrub tundra,' which characterizes relatively bare alpine communities. It is dominated by matted dwarf shrubs and is also rich in lichens. Dominant species include *Dryas octopetala, Salix phlebophylla, Vaccinium uliginosum, V. vitis-idaea, Empetrum nigrum, Diapensia lapponica, Salix arctica, Arctostaphylos alpina, Sphaerophorus globosus, Cetraria nivalis, C. cucullata, Alectoria ochroleuca, Thanmolia subuliformis,* and *Sterocaulon* spp. The dwarf scrub class accounts for 1.9% of the Refuge surface area.

The herbaceous vegetation class is dominated by herbaceous plants and includes grasses, sedges, and flowering plants. The primary subclasses are 'graminoid bog', 'marsh', and 'meadow'. 'Graminoid bog' has a mossy surface underlain by peat that is often saturated with water. Typical graminoids in this subclass are *Eriophorum russeolum, Carex limosa, Carel chordorrhiza.* 'Graminoid meadow' is relatively dry and dominated by *Calamagrostis canadensis.* It is often associated with old river meander scars. 'Graminoid marsh' primarily occurs at the margins of lakes and ponds. The most important graminoids in this subclass are *Carex aquatilis, and Carex rostrata.* This class occurs along the margins of most wetlands on the refuge. Approximately 1. 8 % of the Refuge is comprised of this class.

The scarcely vegetated areas class includes the subclasses 'scarcely vegetated floodplain,' and 'scarcely vegetated scree'. In this class, plants are scattered or absent and bare mineral soil or rock dominates. The 'scarcely vegetated floodplain' subclass includes river alluvium areas recently colonized by *Populus balsamifera, Salix alaxensis,*

Epilobium angustifolium, E. Latifolium, Artemisia tilesii, Achillea sibirica, Equisetum arvense, Arenaria physodes and several grasses. Less than 0. 2 % of the Refuge is comprised of this class.

7. **Grazing** - *Nothing to report.*

8. **Haying** - *Nothing to report.*

9. **Fire Management**

The normal Alaska fire season burns nearly 1.6 million acres from an average of 655 wild fires. Nineteen ninety-nine was pretty average with 1,005,800 acres burned in a total of 490 fires statewide. The Nowitna refuge had four wildfires in 1999 (see Table 9.1 for details). Lightning started all of the fires in Limited suppression zones. Fire number B-486 was the largest fire burning about 2,800 acres in late July and early August.

Fire management activities concentrated on the Fire Management Plan , GIS fuels mapping, the permitted cabin inventory, and the conclusion of the small mammal study being conducted in the Round Lake area.

Table F.9.1. Wildfire Occurrence on the Nowitna NWR, 1999.

Fire Number	*Acres Burned*	*Cause*	*Option of Protection*	*Discovery Date*	*Declared Out*
B-467	535.0	Lightning	Limited	07/12/99	08/03/99
B-475	575.0	Lightning	Limited	07/13/99	08/03/99
B-486	2,800.0	Lightning	Limited	07/14/99	08/03/99
B-487	1,320.0	Lightning	Limited	07/14/99	08/03/99

10. **Pest Control** - *Nothing to report.*

11. **Water Rights** - *Nothing to report.*

12. **Wilderness and Special Areas** - *Nothing to report.*

13. **WPA Easement and Monitoring** - *Nothing to report.*

G. WILDLIFE

1. Wildlife Diversity

The Nowitna Refuge supports a diverse group of wildlife that includes most of the species found in interior Alaska. Thirty-seven species of mammals, 147 birds, 20 fishes, and 1 amphibian are known to occur on or near the refuge. A draft bird list for the refuge was completed in 1992. It will not be published until adequate field and literature review can be accomplished. Particularly lacking are observations and documentation of upland and alpine-breeding species.

2. Endangered and/or Threatened Species

The American peregrine falcon was the only endangered animal species known to breed on the Nowitna refuge and was delisted in June 1999. The threatened arctic peregrine falcon, which migrates across the refuge, was also delisted in 1994. ADF&G has recommended that although the American and arctic peregrine falcons have been removed from the state's endangered species list they should be considered "species of special concern."

3. Waterfowl

Wetlands in the Nowitna River floodplain support large waterfowl populations. Principle duck species breeding on the refuge include American wigeon, northern pintail, mallard, green-winged teal, surf scoter, white-winged scoter, common and Barrow's goldeneye, bufflehead, and lesser scaup. Less abundant breeding ducks include northern shoveler, red-breasted merganser, greater scaup, canvasback, ring-necked duck, redhead, black scoter, and oldsquaw. Arctic, red-throated, and common loons also nest on the refuge, as do horned and red-necked grebes. Canada geese, white-fronted geese, trumpeter swans, and tundra swans are found on the refuge in moderate numbers. The greatest concentrations of waterfowl occur during spring and fall migrations on large, shallow floodplain waterbodies, especially connected oxbow lakes that are partially drained.

Weather Conditions and Waterfowl Migration Chronology

Spring breakup on the Yukon was average (May 14 at Galena, water level 109 ft., and no flooding). On April 28, most small tributaries of the Nowitna River were overflowed, and the Nowitna canyon was mostly open and flowing. A few swans were seen along the Nowitna River and near its confluence with the Yukon River. By May 3, most anchor ice along the lower Nowitna had floated. By May 10, the upper Nowitna River was 90% ice-free, open and flowing, however, there were ice jams in the canyon, and there was 40% ice cover along the lower Nowitna River. On the same date snow cover along the upper Nowitna was estimated to be less than 1%, while it was about 40% along the lower Nowitna. A total of 722 swans was observed on the Nowitna NWR on May 10. Birches

on eastern Nowitna were green and the western Nowitna was just starting to green up. Habitat conditions were estimated to be excellent for nesting waterfowl and brood production in 1999, based on conditions that could be observed from aircraft (Nowitna is pretty inaccessible during breakup). Average to excellent conditions were also estimated for 1995, 1996, 1997, and 1998. Poor conditions occurred in 1989, 1992, and 1994 due to significant widespread flooding. In 1994, an ice-jam flood on the Yukon just above Ruby caused record water levels and flooded much of the available waterfowl habitat in the Nowitna floodplain as far up as the Loop.

Ducks

Duck production surveys were conducted on the refuge from 1983 to 1992, and were analyzed by Saperstein (1996) in a report entitled *A summary of ten years of duck production surveys, Nowitna National Wildlife Refuge, Alaska, 1983-1992*. Refuge-wide production estimates reported between 1987-1992 ranged between 4,209 ducklings (90% CI=14.5%) in 1989 and 17,140 ducklings (90% CI=15.9%) in 1988. Confidence intervals around production estimates were much wider following standardization of techniques and refinement of statistical procedures in 1990. Production estimates between 1990-1992 ranged from 4,855 (90% CI=63.4%) in 1991 to 14,270 (90% CI=57.4%) in 1990. The 1990 implementation of standardization and stratification methods that worked for other Alaska refuges to improve precision of estimates did not improve the quality of estimates for Nowitna. Any future duck production surveys on the Nowitna would likely benefit from a serious review of the earlier methods documented by Andy Loranger that were so successful.

The only other indication of trends in duck numbers available for the refuge is the aerial duck breeding pair survey conducted by the Service's Division of Migratory Birds in Juneau. A summary of key duck species estimates for the Tanana-Kuskokwim stratum is presented in their unpublished reports entitled "*Alaska-Yukon waterfowl breeding pair survey...*" for years 1997 and 1998. The Nowitna NWR comprises <10% of the Tanana-Kuskokwim Stratum, and therefore, these data will not be presented here. For 1999 and 1998 trends by species, in a nearby area, see the *Koyukuk* annual narrative, Section G.3.

Geese

River float-trips to assess goose production have been conducted on the refuge since 1985. These data (through 1995) were summarized by BT Lowe and SWB Spindler in Progress Report FY96-01 entitled: *Goose production surveys on Koyukuk and Nowitna National Wildlife Refuges, Alaska, 1983-1995.*

White-fronted goose adult counts have been relatively stable between 1985 and 1998, but declined sharply in 1999. Low points were observed in 1985, 1992-94, 1997, and 1999, and high points in 1991, 1995, 1996, and 1998 (Fig. G.3.1). In 1999, the second lowest number of adults was observed (the lowest was observed in 1994). During the same time,

production of young was more variable, with low points observed in 1992 and 1994, and high points in 1991 and 1995. Nineteen ninety-nine showed the lowest production observed in all surveys, continuing a decline which began in 1998. To improve applicability of the survey and increase the number of geese sampled, refuge staff in 1993 increased the length of the surveyed stretch of river from 61 to 143 miles (Fig G.3.2). With expansion of the survey, the number of geese counted doubled: average adults went from 38 (SD=13) to 80 (SD=46), while average young went from 97 (SD=37) to 190 (SD=74). Mean percent young was equivalent (71 *vs.* 72, SD 6 *vs.* 7) between the shorter and longer samples. Compared to the Koyukuk, counts of white-fronted goose adults and young on the Nowitna have been incredibly stable until the declines observed in 1998 and 1999. Production has also been high and stable, but the recent decline has lowered production to below average for 1998 and 1999.

Canada goose adults have declined steadily on the Nowitna from 1991-97, with slight increases shown during 1985-91, 1998, and again in 1999 (Fig. G.3.3.) No such clear trend in Canada goose numbers was discerned on similar surveys on Koyukuk NWR. Production of Canada goose young on the Nowitna has shown some dramatic fluctuations, with low counts in 1985, 1992, 1993, and 1997, and high counts in 1990 and 1994. In 1999, young observed declined from the high numbers seen in 1998, and are just below average. Due to the declining adult trend, it was difficult to assess effects caused by expansion of the survey length in 1993 from 61 to 143 miles. Average Canada goose adults went from 97 (SD=63) to 65 (SD=25), while average young went from 69 (SD=51) to 95 (SD=45) (Figs. G.3.3 and G.3.4). Mean percent young increased (44 *vs* 58, SD 21 *vs* 15) when the survey length increased.

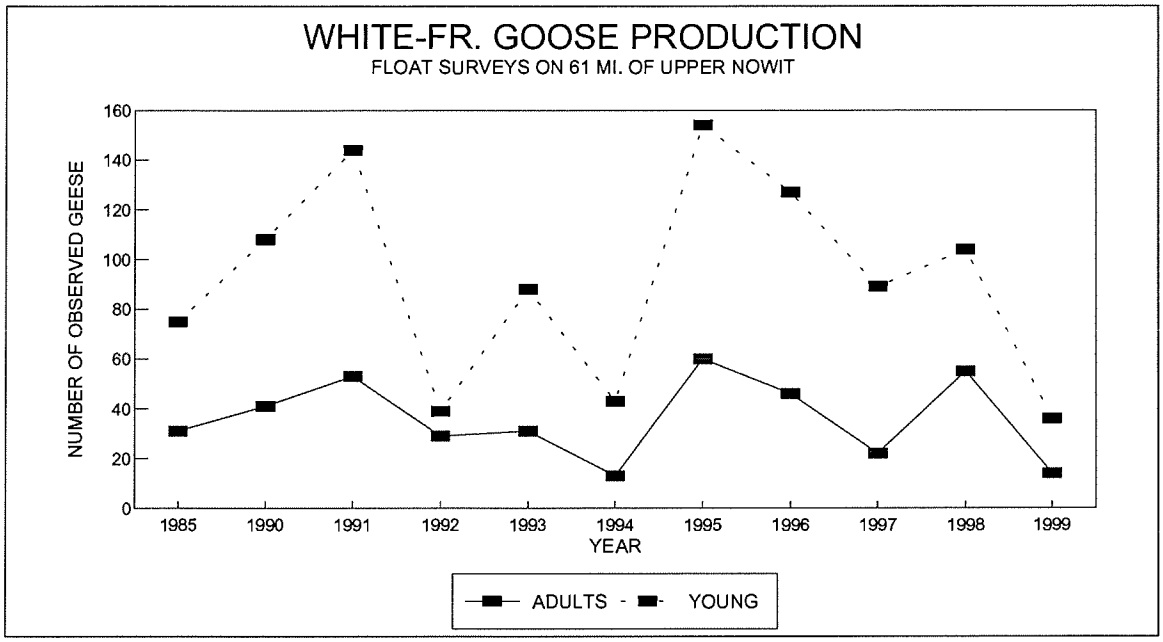


Figure G.3.1. White-fronted goose adults and young observed on float surveys of a 61 mile stretch of the Nowitna River (from upper refuge boundary to upper administrative cabin), Nowitna NWR, Alaska, 1985-1999.

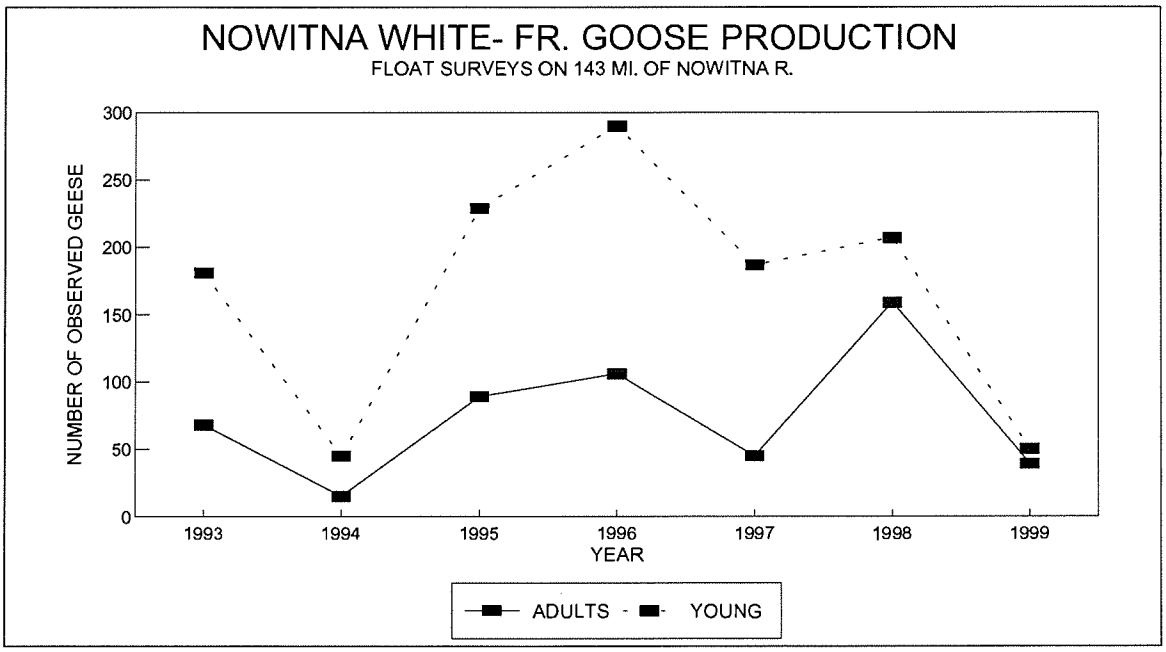


Figure G.3.2. White-fronted goose adult and young observed on float surveys of a 143 mile stretch of the Nowitna River (from upper refuge boundary to lower administrative cabin), Nowitna NWR, Alaska, 1993-1999.

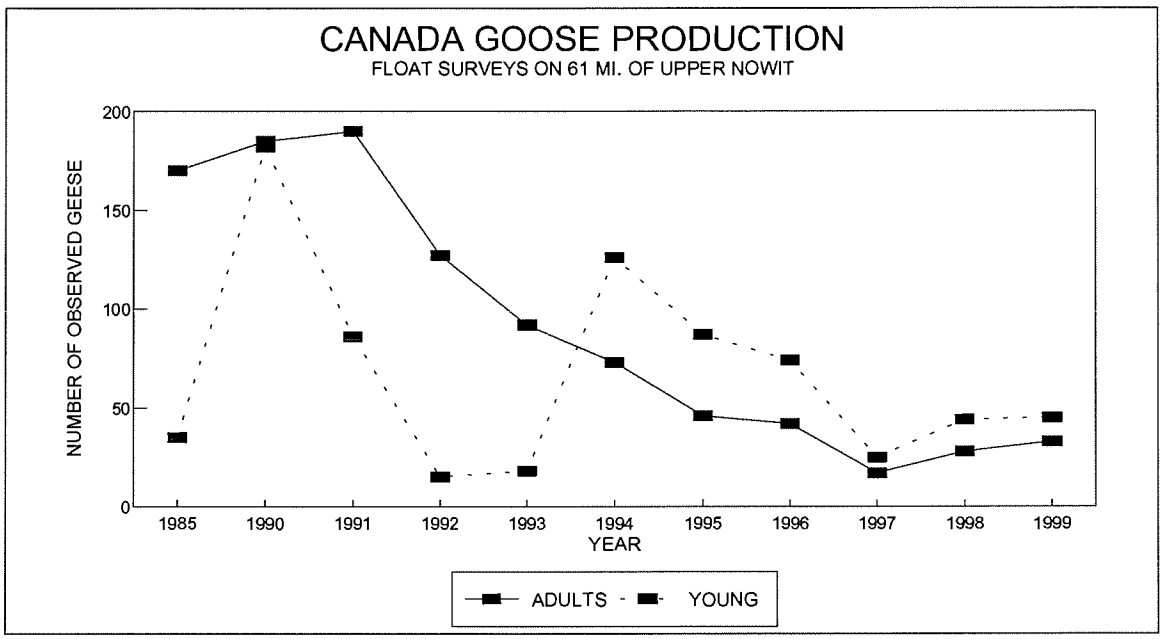


Figure G.3.3. Canada goose adults and young observed on float surveys of a 61 mile stretch of the Nowitna River (from upper refuge boundary to upper administrative cabin), Nowitna NWR, Alaska, 1985-1999.

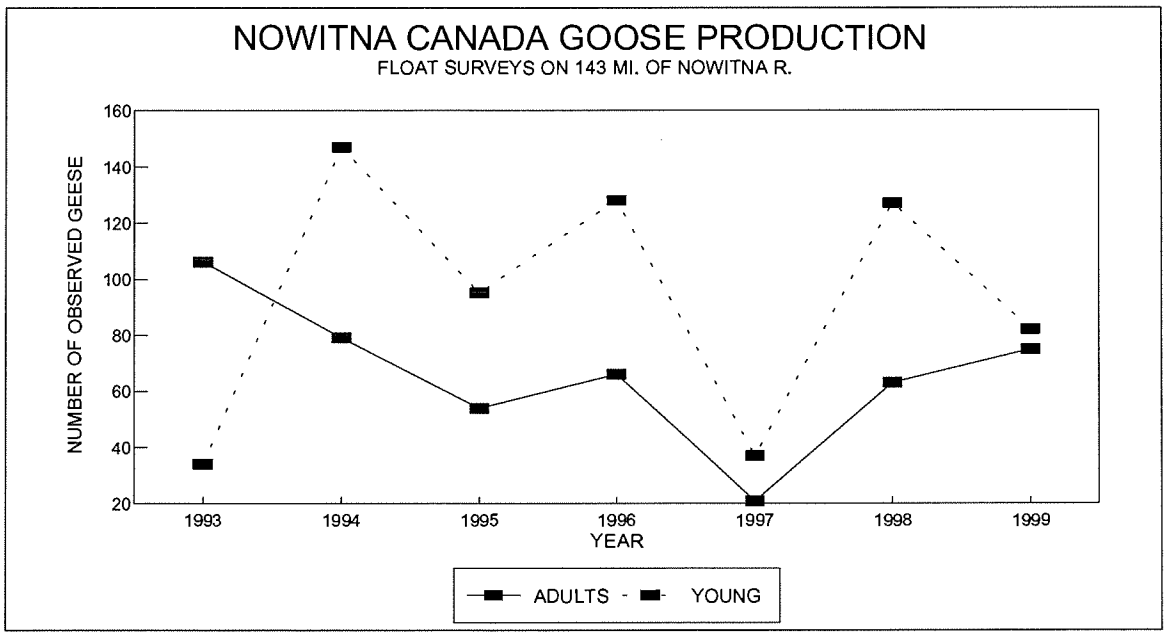


Figure G.3.4. Canada goose adults and young observed on float surveys of a 143 mile stretch of the Nowitna River (from upper refuge boundary to lower administrative cabin), Nowitna NWR, Alaska, 1993-1999.

Swans

Both Trumpeter and Tundra Swans nest on the refuge but species composition has differed by area and year; therefore, late summer aerial production surveys have necessarily grouped the two species simply as "swans." Swans are considered a key indicator species because their production trends tend to correlate well with that of other waterfowl species, swan sightability is high during aerial surveys, and they are sensitive to nest disturbance. For these reasons, swan surveys have been conducted on the Nowitna NWR since 1985, when the staff selected seven 1:63,360 trend maps to monitor swan population and production, according to the wildlife inventory plan.

Complete statewide censuses of Trumpeter Swan summer populations in Alaska were conducted by USFWS in 1968, 1975, 1980, 1985, 1990, and most recently in 1995. In census years, the trend maps are a subset of the census. In the five years between these two most recent censuses, swan estimates on the Nowitna NWR increased 68% from a total of 292 to a total of 492. The estimated annual growth rate of the adult component was 12%. No swan surveys were conducted on the Nowitna in 1996, 1997, or 1999. Surveys were conducted in 1998 in response to drastic declines in goose production on the Koyukuk and we wanted to determine if waterfowl production was similarly affected on the Nowitna. (Note that 1998 goose production was not as negatively affected on the Nowitna as on the Koyukuk in 1998). In 1998 we observed decreases in swan production, flocked birds, and total swans, but noted an increase in paired swans (Fig. G.3.5). Mean brood size in 1998 was 3.4, which was slightly higher than the long term average of 3.2. Breeding effort declined greatly, with only 23% of pairs with broods. A census is scheduled for 2000.

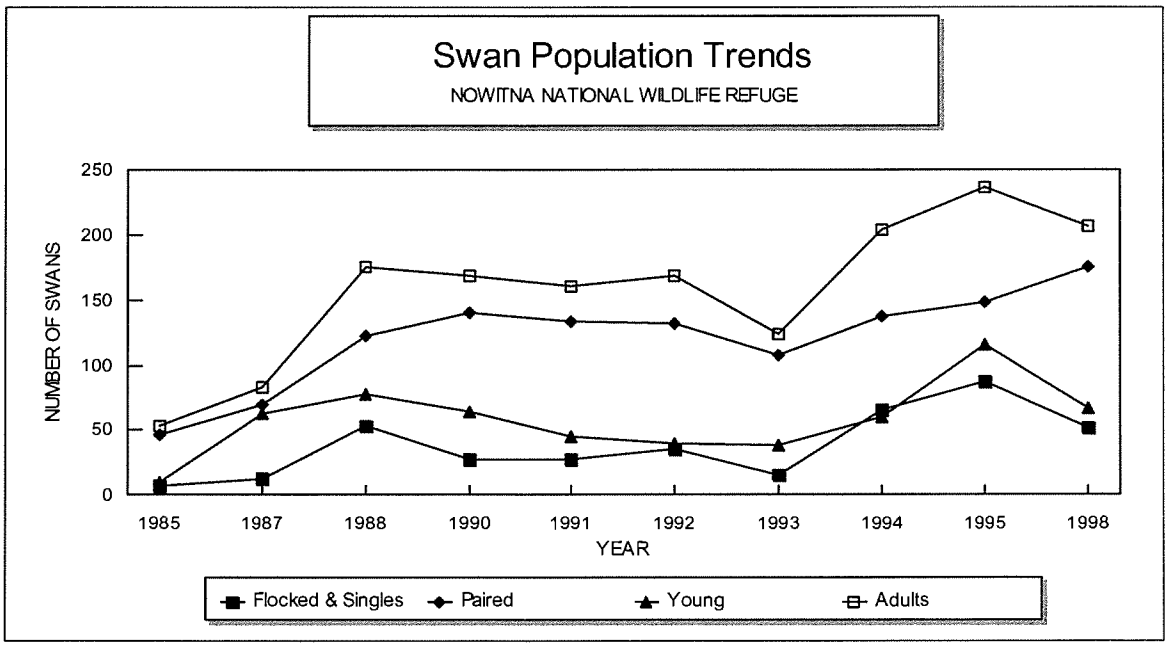


Figure G.3.5. Trends in tundra and trumpeter swans based on aerial surveys of the Ruby B3, C3, C4, D2, D3, D4, and Melozitna A1 maps, Nowitna NWR, August 1985-1998.

4. Marsh and Water Birds

A number of marsh and water birds are commonly observed on the refuge, including: common, Pacific, and red-throated loons, red-necked and horned grebes, and sandhill cranes. Yellow-billed loons are occasionally observed.

5. Shorebirds, Gulls, Terns, and Allied Species

Some of the shorebird species commonly seen on the refuge include the following: common snipe, whimbrel, semipalmated, least, spotted, solitary, and upland sandpipers, lesser yellowlegs, golden and semipalmated plovers, long-billed dowitcher, and northern phalaropes. Mew gulls and arctic terns are common breeders; Bonaparte's and Herring gulls are less common, but regular nesters. No trend surveys are conducted to determine the status and distribution of these species, but observers on goose production surveys were encouraged to record sightings of any *Charadriiform* birds they identified.

6. Raptors

The Complex has nesting populations of rough-legged hawks, merlin, sharp-shinned hawks, ospreys, northern harriers, red-tailed hawks, goshawks, great horned owls, great gray owls, boreal owls, northern hawk owls, American peregrine falcons, and bald eagles. Snowy owl, Swainson's hawk, and gyrfalcon are occasional visitors. Northern hawk owls were seen on a regular basis during the Fire/Furbearer study in the 1985 burn. This burn is in the tall shrub-sapling stage and supports a diverse microtine community. Peregrine falcons and rough-legged hawks nest on river bluffs along the upper Nowitna River and along the Yukon River within the refuge, while the other species tend to be forest nesters.

7. Other Migratory Birds

A Breeding Bird Survey (BBS) route on the Ruby Road near Nowitna NWR was established to monitor Passerine birds in western interior Alaska. There are few places in this mainly roadless region where such a sample can be obtained. The Ruby BBS route follows the Ruby Road, a 50-mile long gravel road that provides access to several mining areas south of Ruby. The route was designed to be run from south to north (toward Ruby) so that the observer could become familiar with the route while on the way to the start, remain overnight, and then run the survey the next day on the way back to Ruby. The survey is conducted following procedures established by the BBS. It begins approximately ½ hour before sunrise (03:17) and requires an elapsed time of four hours, 25 minutes to complete.

Survey conditions in 1999 were warm and still, with clouds of mosquitos. Despite the hordes of insects and one curious black bear, the survey was completed in four hours and 18 minutes on June 10.

Previously, the survey was conducted solely by WB Buddy Johnson (1994-1997) using a four-wheeler. In 1998, the survey was run for the first time using a vehicle (truck) and an assistant, BT Jenny Lowe, who took over the survey in 1999. The use of a vehicle and an assistant was repeated in 1999, and is a vast improvement and hopefully will continue in the future. Volunteer Craig Logsdon assisted BT Lowe (who became BT Bryant after her marriage three days before the survey). The 1999 survey was delayed by one day due to bad weather, but conditions improved and were excellent during the survey.

We recorded observations for 472 individuals of 23 species in 1999, an increase over the long term mean of 331 individuals. Notable increases in the 1999 counts compared to the long-term means were observed for six species: varied thrush, yellow warbler, fox sparrow, white-crowned sparrow, gray jay, and slate-colored junco. One new species was observed this year; 45 individual White-winged Crossbills in 30 stops was recorded. The presence of this previously unrecorded species may be attributed to a large crop of white-spruce cones in 1998. No species decreased significantly from the long-term mean. As we have seen most years, Swainson's thrush were most frequently encountered followed by slate-colored junco (Table G.7.1).

Table G.7.1. Total observations on the Ruby Road Breeding Bird Survey, June 1994-1999.

Species	1994	1995	1996	1997	1998	1999	Mean	SD	CV
Common Snipe	1	0	0	0	1	0	0.33	0.4	1.1
Ruffed Grouse	0	1	0	0	0	1	0.33	0.4	1.1
Olive-sided Flycatcher	0	1	0	0	0	3	0.66	1.1	1.7
Alder Flycatcher	50	37	31	24	34	41	36.2	16.1	0.4
Hammond's Flycatcher	3	1	2	0	0	0	1.0	0.7	0.7
Gray Jay	1	2	1	1	0	12	2.83	4.3	1.5
Common Raven	2	1	7	3	5	4	3.66	2.5	0.7
Ruby-crowned Kinglet	25	37	21	23	38	32	29.3	14.6	0.5
Grey-cheeked Thrush	1	4	4	12	6	6	5.5	4.1	0.7
Swainson's Thrush	92	113	68	95	61	73	83.7	35.2	0.4
American Robin	0	2	5	2	2	5	2.66	1.8	0.7
Varied Thrush	10	17	9	26	17	33	18.6	10.7	0.6
Orange-crowned Warbler	17	10	15	28	26	31	21.2	11.0	0.5
Yellow Warbler	19	10	13	3	12	22	13.2	7.1	0.5
Myrtle Warbler	19	27	22	26	18	30	23.6	9.9	0.4
Blackpoll Warbler	0	4	4	3	0	8	3.16	2.7	0.9
Northern Waterthrush	0	7	4	18	11	11	8.5	5.7	0.7
Wilson's Warbler	1	4	4	1	0	6	2.6	2.3	0.9
Savannah Sparrow	1	0	0	0	2	1	0.5	0.8	1.5
American Tree Sparrow	0	1	0	5	0	2	1.33	1.8	1.3
Fox Sparrow	4	7	2	0	2	15	5.0	5.3	1.1
Lincoln's Sparrow	0	0	3	6	8	4	3.5	2.9	0.8
White-crowned Sparrow	5	13	11	15	11	24	13.2	7.1	0.5
Slate-colored Junco	30	45	29	28	47	63	40.3	19.7	0.5
Common Redpoll	0	10	2	2	1	0	2.5	3.5	1.4
White-winged Crossbill	0	0	0	0	0	45			
SPECIES	17	22	20	19	18	23			
TOTAL	281	354	257	321	302	472	331	69.9	0.2

8. Game Mammals

Moose

Each November refuge staff conduct intensive aerial surveys in standardized trend count areas (TCA's; each 40-80 square miles in size) to evaluate trends in moose density, age and sex composition. TCA's are established where hunting pressure is thought to be high, where moose concentrate during the rut, or where there are other conservation concerns. In 1999, aerial trend surveys were conducted at the Sulatna/Nowitna Confluence and Nowitna River Mouth TCA's on the lower Sulatna and Nowitna River drainages.

Sulatna/Nowitna Confluence TCA. This TCA is located where much of the moose hunting activity occurs on the refuge, and has been surveyed consistently since 1982. Identical sample units totaling 73.1 mi^2 have been sampled since 1991, enabling good annual data comparisons. Total moose numbers observed in 1999 (106) were lower than the annual average from 1991-98 (186) (Figure G.8.1). In 1998 and 1999, total moose density was estimated at 2.5 and 1.5 moose/mi^2, respectively. The bull:cow ratio decreased from 19 bulls:100 cows in 1998 to 6 bulls:100 cows in 1999, suggesting a high level of exploitation. The yearling bull:cow ratio decreased from 2 yearling bulls:100 cows in 1998 to 1 yearling bull:100 cows in 1999, indicating very poor recruitment. Production was poor as well; the calf:cow ratio decreased from 28 calves:100 cows in 1998 to 23 calves:100 cows in 1999.

Nowitna River Mouth TCA. The Nowitna River Mouth TCA also receives high hunting pressure. This TCA has been surveyed consistently since 1983, with identical sample units totaling 60.4 mi^2 being sampled since 1992. In 1999, total moose numbers were at the lowest level since surveying began in 1983 (Figure G.8.2). In 1998 and 1999, total moose density was estimated at 3.0 and 1.4 moose/mi^2, respectively. The bull:cow ratio decreased from 20 bulls:100 cows in 1998 to 11:bulls:100 cows in 1999, suggesting a high level of exploitation. However, both the yearling:cow ratio (8:100) and the calf:cow ratio (21:100) were higher in 1999 than in 1998, indicating recruitment and production improved.

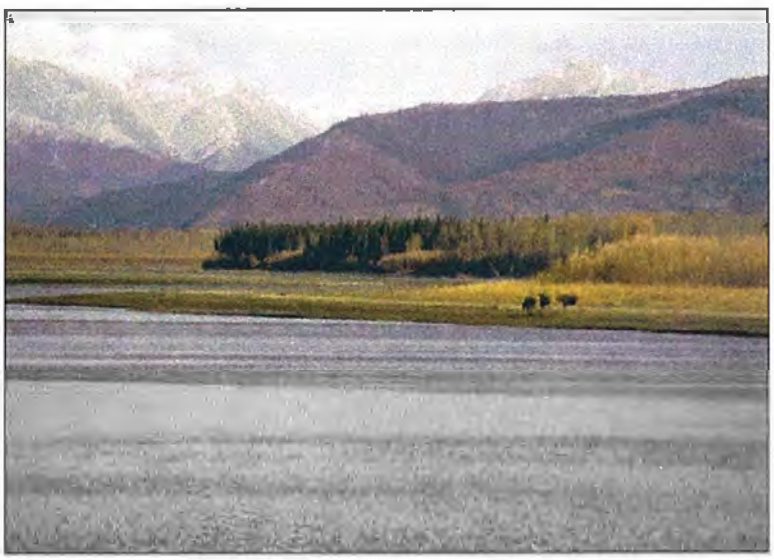
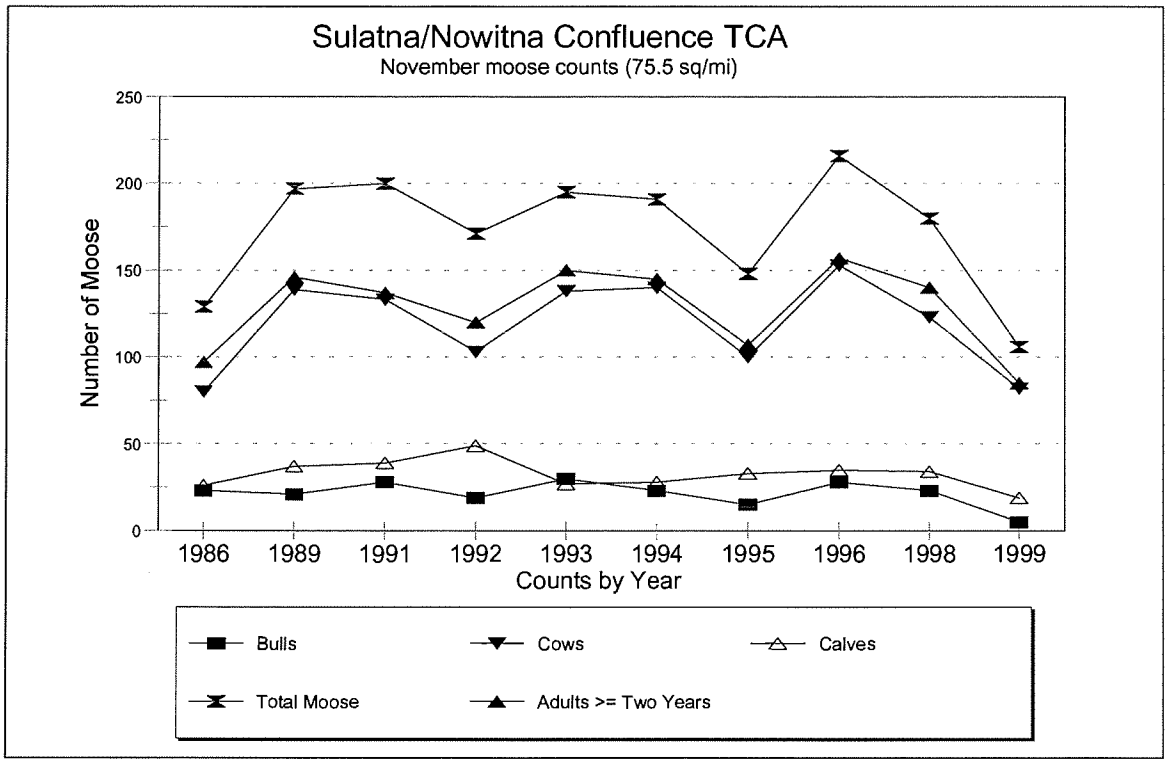
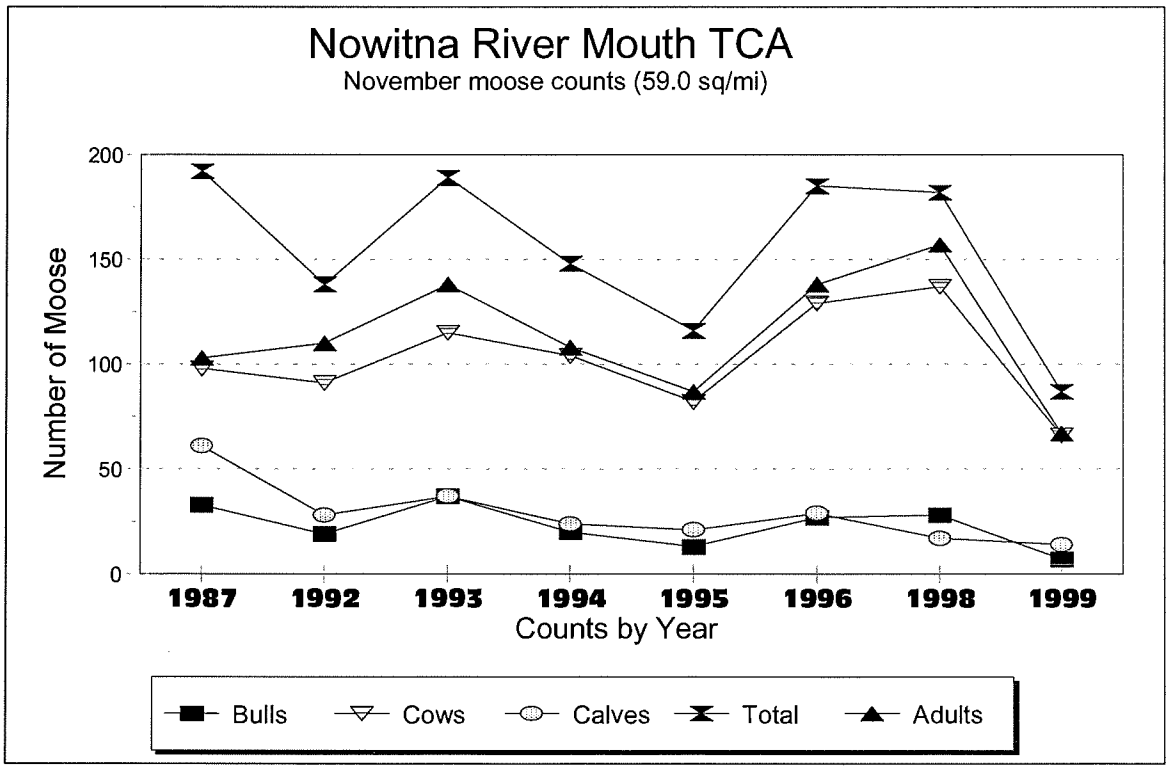


Photo G.8.1. *Three moose make a brief appearance near the mouth of the Nowitna River during hunting season. (JLR)*


Sulatna/Nowitna Confluence TCA
November moose counts (75.5 sq/mi)
Number of Moose
250
200
150
100
50
0
1986
1989
1991
1992
1993
1994
1995
1996
1998
1999
Counts by Year
Bulls
Cows
Calves
Total Moose
Adults >= Two Years


Nowitna River Mouth TCA
November moose counts (59.0 sq/mi)
Number of Moose
200
150
100
50
0
1987
1992
1993
1994
1995
1996
1998
1999
Counts by Year
Bulls
Cows
Calves
Total
Adults

Wolves

Wolves are common to abundant on the refuge and are normally hunted and trapped by locals. Wolf furs are prized for parka ruffs and a wolf pelt is a distinguished gift in local Koyukon Athabascan memorial potlatch ceremonies. Wolves are one of the most significant predators to the refuge's major subsistence resources, moose; therefore, wolf population and predation rate information is important to refuge moose management decisions. The most recent population estimate for wolves on the Nowitna NWR was from a March 1996 aerial survey that indicated a healthy and stable population. The survey estimated 68 wolves in GMU 21B, 55 wolves in the northern portion of Nowitna NWR, and 49 wolves in the 1995 moose census area. Estimated densities within these three areas were 5.4 wolves/1,000 km^2 (SE = 0.8), 9.1 wolves/1,000 km^2 (SE = 1.1), and 14.9 wolves/1,000 km^2 (SE = 2.9), respectively. Comparisons with previous estimates suggest that the refuge wolf population was stable or increased. The moose:wolf ratio was estimated at 18.5 moose:1 wolf within the standardized moose census area in 1996. This ratio was judged to be at a level where wolf predation could be limiting growth of the moose population.

Total harvest of wolves on the refuge is unknown, but is thought to be low and sustainable. RIT Farmer, RIT Huntington, SWB/Pilot Spindler and Dave Anderson of ADF&G Subsistence Division are planning a subsistence wolf harvest survey for the villages of Hughes, Huslia, Koyukuk, Nulato, Kaltag and Galena. Refuge staff are considering adding the village of Ruby to the survey because they rely on the Nowitna NWR for subsistence.

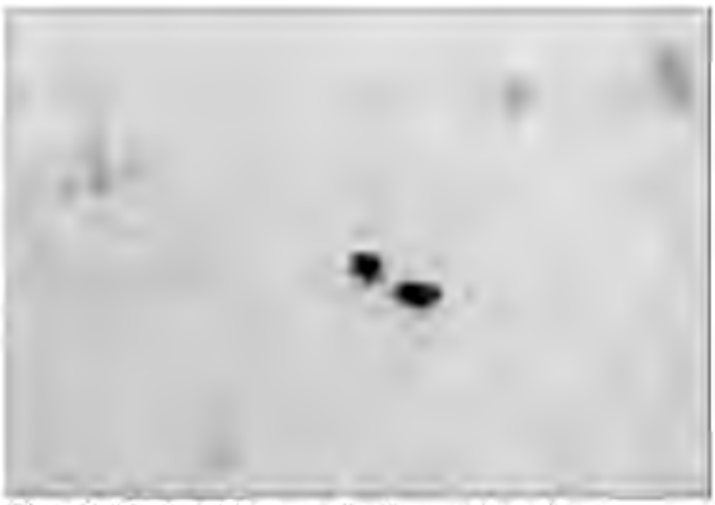


Photo G.8.2. *Total harvest of wolves on the refuge is unknown; USFWS and ADF&G are planning a subsistence wolf harvest survey for several area villages.*

Caribou

Caribou occur in small numbers in the hills both north and south of the Nowitna NWR. The late John Honea of Ruby reported to SWB Spindler in a *Ravens's Story* interview that he saw large numbers (thousands) wintering on the Nowitna in the 40's. These were likely from the Western Arctic Herd when it formerly migrated in large numbers through Anaktuvuk Pass and wintered in the Kanuti and Melozitna areas.

Marten

To obtain long-term information on the demographics of the marten population and harvest intensity on the Nowitna Refuge, we purchased marten skulls from refuge trappers from1987-1998. Tooth sectioning and analysis of cementum annuli and radiographs are used to age individual animals. Trapper questionnaires provide estimates of annual trapping effort. This information has been used to develop a better understanding of the relationship between harvest characteristics (total harvest, sex- and age composition) and the status of the Nowitna marten population. Skulls were not purchased and questionnaires were not collected in 1999.

Detailed analyses of the 1996-97 and 1997-98 marten harvests are available in refuge progress reports by WB Johnson (Report Numbers FY98-06 and FY99-01), entitled *Analysis of marten harvest on the Nowitna National Wildlife Refuge*.

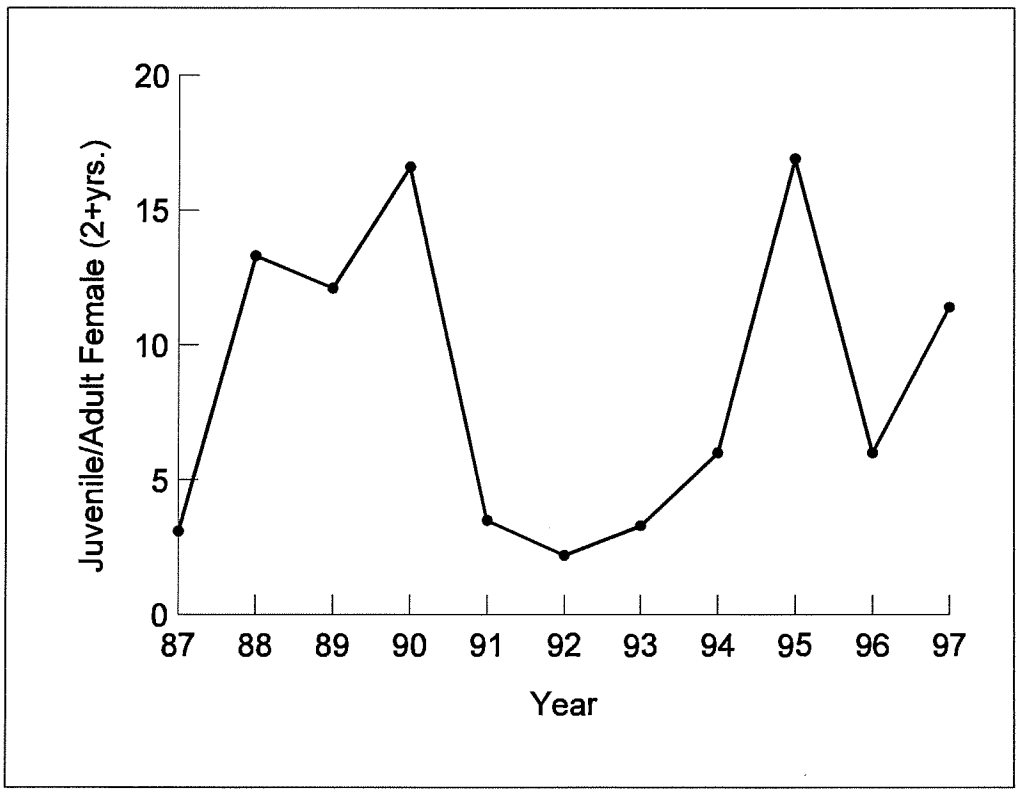


Figure G.8.1. Ratios of juvenile marten to adult females($\geq$ 2 years old) harvested on the Nowitna National Wildlife Refuge, Alaska. 1987-97.

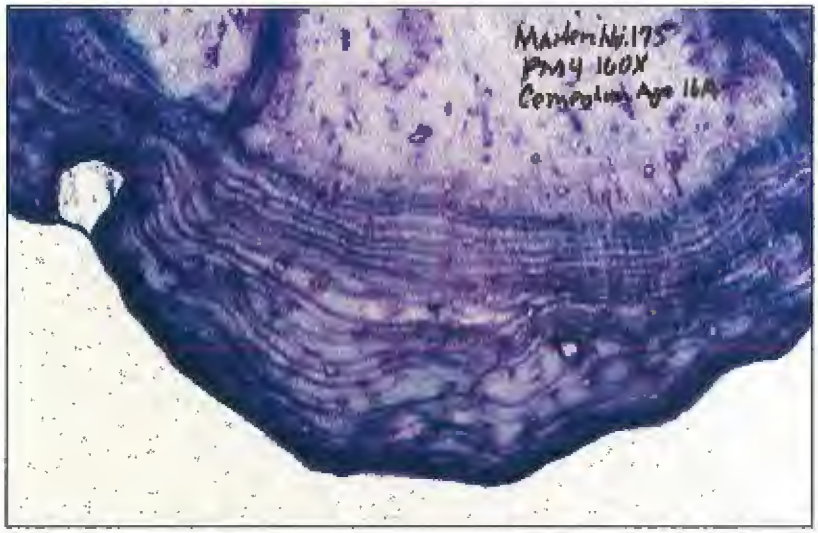


Figure G.8.2. Photo of tooth section from female marten with cementum age of 16. This animal was the oldest of 31,507 marten aged by Matson's Laboratory.

Small Mammals

We studied the abundance, biomass, and species diversity of small mammals among three stages of post-fire succession on the Nowitna NWR from 1991 to 1999. This effort was initiated as part of a larger project examining the relationship of wildland fire to furbearers, primarily marten and lynx. The larger effort was completed in 1995 but we continued to trap at these sites to document the response of microtines to fire over time.

We used two snaptraps and a pitfall trap, set for three 24-hour periods at each of 100 stations in 100 x 100 m grids. Three grids (replicates) were located in each of the following seral stages: a 1985 burn in the tall shrub-sapling stage; a 1966 burn in the dense tree stage; and a mature black spruce forest >100 years since fire. Trapping occurred in late August-early September when most rodents are at peak abundance.

Over the course of the study we captured 5,457 animals representing 12 species over approximately 71,100 trapnights (TN). Preliminary analysis shows that the ubiquitous red-backed vole (*Clethrionomys rutilus)* was most abundant in the 1985 burn forest ($\bar{x}$ = 3.8/100TN), followed closely by the mature forest ($\bar{x}$ = 3.5/100TN), and least abundant in the 1966 burn forest ($\bar{x}$ = 2.4/100TN,).

Red-backed voles irrupted in all three seres in 1992 following extemely low densities the previous year (Figure G.10.3). They subsequently declined to very low densities on the mature forest and 1966 burn in 1994 and we anticipated another irruption in 1995 in these seres. However, numbers have remained very low in the 1966 burn and although rebounding in the mature forest, they never reached the levels seen in 1992. Interestingly,

red-backed vole abundance has remained very stable in the more recent 1985 burn with very little deviation relative to the other seres. We suspect that the more productive and contiguous tall-shrub habitat provides a more stable environment. Moreover, vole diversity is much higher here and the abundance of alternate prey such as yellow-cheeked vole (*Microtus xanthognathus*) may dampen the annual effects of predation.

Because of the unique habitat relationships yellow-cheeked voles have with early seres, we initiated a cooperative effort with Dr. Eric Rexstad at University of Alaska Fairbanks. Graduate student Karin Lehmkuhl began live-trapping yellow-cheeked voles on several grids in 1997 in recent burns on both Koyukuk and Nowitna NWRs. We report results from her effort in Section G.10 in the Koyukuk report.

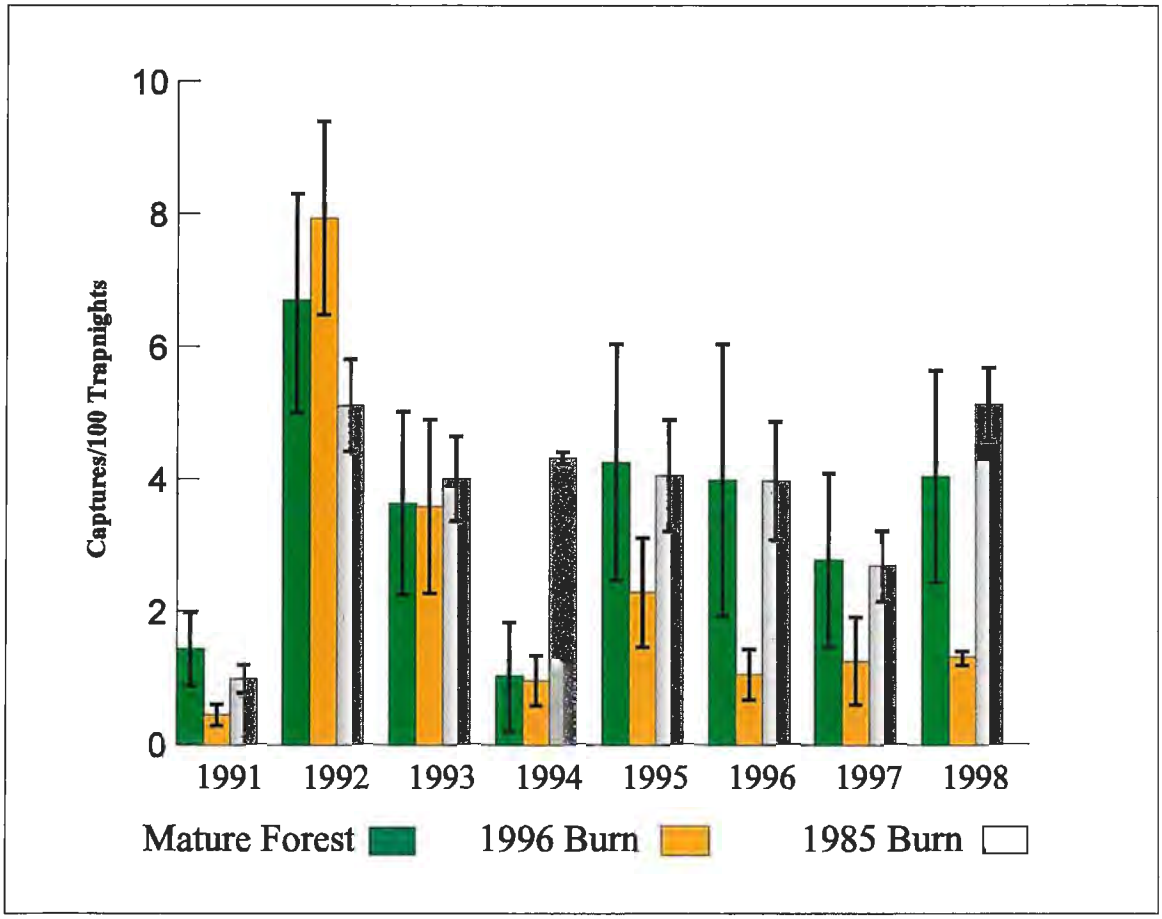


Figure G.10.3. Relative abundance (captures/100 trapnights) of red-backed voles (*Clethronomys rutilus*) in 3 post-fire seres (mature forest, tall-shrub sapling - 1985 burn, dense tree - 1966 burn) on the Nowitna National Wildlife Refuge, Alaska.

Beaver

Photo G.8.2. *Increased beaver activity may be due to lower trapping pressure and has resulted in increased abundance of Northern pike.*

Beaver populations are presently high in much of interior Alaska and beaver are frequently observed on the Nowitna NWR in summer. Beaver is an important subsistence species for local resource users, although current trapping levels are lower than they were historically. The fur is used for hats, mitts, and for trim on gloves and mukluks. Beaver meat is prized for its high fat content and is a welcome change from moose in the diet of local residents. From a biological perspective, beaver activity has an impact on wetland regimes and therefore on fish, wildlife, and waterfowl distribution. Native elders and local trappers suspect that the increase in beaver activity may be due to lower trapping pressure and has resulted in increased abundance of pike. Beaver populations are not monitored annually on the Nowitna NWR, however, baseline surveys of fall caches were conducted in 1993.

9. Marine Mammals - *Nothing to report.*

10. Other Resident Wildlife - *Nothing to report.*

11. Fisheries Resources

The published ranges of 20 fish species fall within the Nowitna drainage, and 14 species have been documented in previous field work. Of these, chinook, chum, and coho salmon, whitefish, burbot, and northern pike are the most important species in subsistence fisheries near the refuge. Additionally, pike and sheefish are important in the area sport fishery. Because the refuge is not staffed with a fisheries biologist, field work on the refuge has mostly been accomplished by the Service's Fisheries Resources Office and the Northern Alaska Ecological Services offices in Fairbanks.

Salmon

Estimates of salmon escapement in the Nowitna Refuge have never been made. The relative strength of each species run is also unknown. It is known that escapement estimates of salmon in the Yukon River drainage have been declining since the early

1980's. This decline has been most evident in summer chum salmon. People from the villages of Ruby and Tanana depend, in part, upon the fishery resources of the Nowitna Refuge for subsistence. In 1993 the Fairbanks Fishery Resource Office conducted a preliminary salmon stock assessment on the Nowitna Refuge, and a progress report was completed in 1994 by D.W. Wiswar: *Salmon surveys on the Koyukuk and Nowitna NWR's, Alaska, 1993* (Fisheries Resources Office, USFWS, Fairbanks, AK.). The brief one-season study concluded that further investigations are necessary to determine spawning areas and make escapement estimates. Salmon migrating up the Nowitna River could be inserted with radio telemetry transmitters to aid in identifying spawning areas. Escapement estimates could be made using enumeration techniques, such as a weir, counting tower, or carcass counts.

Pike

In response to increased guided sport fishing, in 1996 the Alaska Dept. of Fish and Game, Sport Fisheries Division (Fairbanks), began a baseline study on pike abundance and age structure along the lower Nowitna River. According to John Burr, the Principle Investigator, preliminary findings of the study showed that pike were abundant and that age structure had not yet been affected by the sport harvest. He said that the Division would return to the Nowitna in about five years to assess any changes if sport fishing continues to increase. A final report is not yet available.

Contaminants

A technical report entitled *Contaminant baseline data for water, sediments, and fish of the Nowitna National Wildlife Refuge, 1985-1988* was completed in August 1992 by Northern Alaska Ecological Services (NAES) in Fairbanks, with cooperation of refuge staff. Further study based on sampling in1991 was analyzed in a 1996 report by K. Mueller, E. Snyder-Conn, and M. Bertram entitled *Water quality and metal and metalloid contaminants in sediments and fish of Koyukuk, Nowitna, and the Northern Unit of Innoko National Wildlife Refuges, Alaska, 1991.*

Concentrations of beryllium, cadmium, copper, lead, manganese, and nickel were lowest in sediment samples from the Nowitna. Copper concentrations exceeded 25 mg/kg at all Northern Innoko and Koyukuk sites, and at two of four sites on Nowitna. Nickel concentrations exceeded 31 mg/kg at all sites except Sulukna River and Sulukna adjacent pond, which exceeded 28 mg/kg. Mercury was detected in each fish regardless of location, except for the one Alaska blackfish collected. Mean concentrations of mercury in muscle samples were from 3.3 to 8.6 times greater than the mean background concentrations reported by other investigators. The report demonstrated that considerably more baseline work needs to be done to identify the sources of contamination and to have a solid baseline should any threats occur in waters upstream from the refuges.

12. **Wildlife Propagation and Stocking** - *Nothing to report.*

13. **Surplus Animal Disposal** - *Nothing to report.*

14. **Scientific Collections** - *Nothing to report..*

15. **Animal Control** - *Nothing to report.*

16. **Marking and Banding** - *See section G.16 of the Koyukuk report.*

17. **Disease Prevention and Control** - *Nothing to report.*

H. PUBLIC USE

1. **General** - *Nothing to report.*

2. **Outdoor Classrooms - Students** - *See Section H.2 of the Koyukuk report.*

3. **Outdoor Classrooms - Teachers** - *See Section H.3 of the Koyukuk report.*

4. **Interpretive Foot Trails** - *Nothing to report.*

5. **Interpretive Tour Routes** - *Nothing to report.*

6. **Interpretive Exhibits/Demonstrations** - *See Section H.6 of the Koyukuk report.*

7. **Other Interpretive Programs** - *Nothing to report.*

8. **Hunting**

The fall moose hunt continues to increase in popularity, accounting for the majority of public use activity on the Nowitna NWR. In 1999, refuge staff (GB Joanna Roberts, BT Deborah Webb, DRM Jim Good and GB Guy Hughes) operated a voluntary moose hunter check station at the Nowitna River Mouth with the assistance of Alaska Department of Fish and Game (ADF&G) personnel and refuge volunteers. The majority of the Nowitna River is within the refuge boundary; therefore, the check station provides a consistent source of harvest information for the majority of refuge hunters who gain access to the refuge from the Yukon River. The check station was opened for business September 2 and remained open until September 27.

A total of 155 hunters harvested 45 moose in the fall 1999 hunt (Table H.8.1). Twenty-four hunters were from local villages, 57 from Fairbanks, 60 from other areas in Alaska, and 14 were non-residents. In 1999, the number of local hunters, hunters from Fairbanks and non-resident hunters remained similar to numbers in recent years. However, the

number of non-local residents from other parts of the state, primarily Anchorage, Wasilla and the Kenai peninsula, increased this year, more than doubling 1997 and 1998 numbers. Some of this increase was spill-over from the Koyukuk River; a number of these hunters reported they usually hunt the Koyukuk, but had elected to try their luck on the Nowitna this year to avoid crowding. Others reported they'd already been on the Koyukuk but that unseasonably warm weather made hunting conditions very poor. Several groups of hunters from the Kenai peninsula also reported that there was severe moose winter-kill on the peninsula last year, which had caused them to look elsewhere for good hunting opportunity.

The weather was also unseasonably warm on the Nowitna throughout the majority of the hunting season. This may have had a negative impact on overall hunter success, which was at the lowest level since 1996 (Figure H.8.1). Hunters observed many cows and calves throughout the season, but heard and saw few bulls until the end of the month, when the weather got cooler. Success by local and non-resident hunters remained consistent with that of previous years, while success by Fairbanks residents decreased for the second year in a row (Figure H.8.2).

Check station staff also asked hunters to report bear observations and harvest this year. No bears were harvested, but hunters observed 5 grizzlies and 8 black bears (including 1 cub). No wolves were harvested. Most hunters reported that both bear and wolf tracks were abundant throughout the Nowitna drainage.

During fall waterfowl harvest surveys, BT Deborah Webb also asked Ruby residents to report summer and fall spruce grouse harvests. A total of 54 households were interviewed, with 18 households reporting a total harvest of 248 spruce grouse.

Table H.8.1. Residency (N), harvest (n), and success (r%) of moose hunters stopping at the Nowitna River mouth hunter check station.

YEAR	LOCAL VILLAGES			FAIRBANKS			OTHER RESIDENTS			NON-RESIDENTS			UNKNOWN			TOTAL			TOTAL NON-LOCAL		
	N	n	r%	N	n	r%	N	n	r%	N	n	r%	N	n	r%	N	n	r%	N	n	r%
1988	33	9	27%	103	35	34%	25	7	28%	8	5	62%	9	0	0%	170	56	31%	145	47	32%
1989	31	6	19%	94	29	31%	23	9	39%	12	6	50%	6	0	0%	166	50	29%	135	44	33%
1990	23	7	30%	67	32	38%	26	12	46%	14	4	29%	0	0	0%	130	54	42%	107	48	45%
1991	21	9	43%	72	24	33%	44	11	25%	17	2	12%	0	0	0%	154	46	30%	133	37	28%
1992	24	3	12%	38	19	50%	53	10	19%	10	2	20%	0	0	0%	125	34	27%	101	31	31%
1993	19	7	37%	58	26	45%	35	19	54%	21	1	5%	0	0	0%	133	53	40%	114	46	40%
1994	16	6	37%	63	27	43%	41	16	39%	13	5	38%	0	0	0%	134	54	40%	117	48	41%
1995	16	3	19%	63	24	38%	44	9	20%	9	2	22%	0	0	0%	132	38	29%	116	35	30%
1996	19	2	11%	54	21	39%	36	12	33%	20	2	10%	0	0	0%	129	36	28%	110	35	32%
1997	16	1	6%	57	29	51%	21	8	38%	7	3	43%	0	0	0%	101	41	41%	85	40	47%
1998	17	4	24%	57	26	46%	27	17	63%	22	3	14%	0	0	0%	113	50	44%	96	46	48%
1999	24	3	13%	57	21	37%	60	17	28%	14	4	29%	0	0	0%	155	45	29%	131	42	32%
Mean	22	5	23%	65	26	40%	36	12	36%	14	3	28%	1	0	0%	137	46	34%	116	42	37%

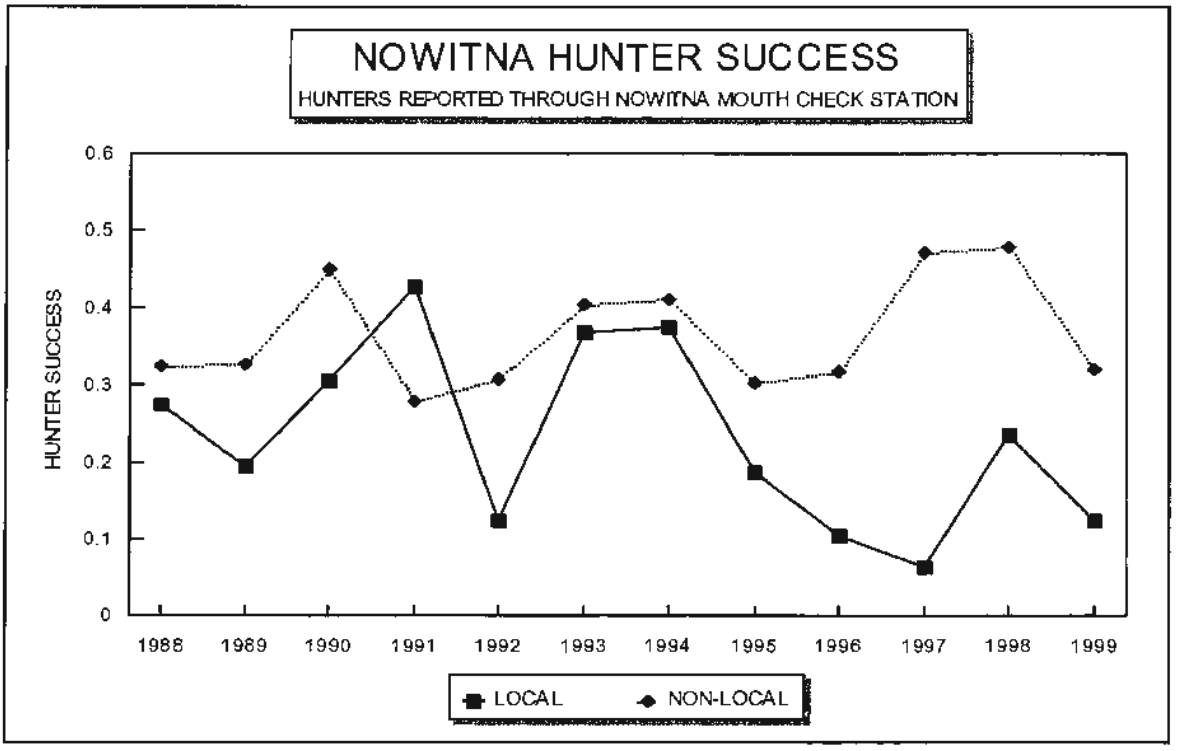


Figure H.8.1. Trends in moose hunter success according to residency, based on reports taken at the Nowitna River mouth hunter check station, Nowitna NWR, Alaska. 1988-99.

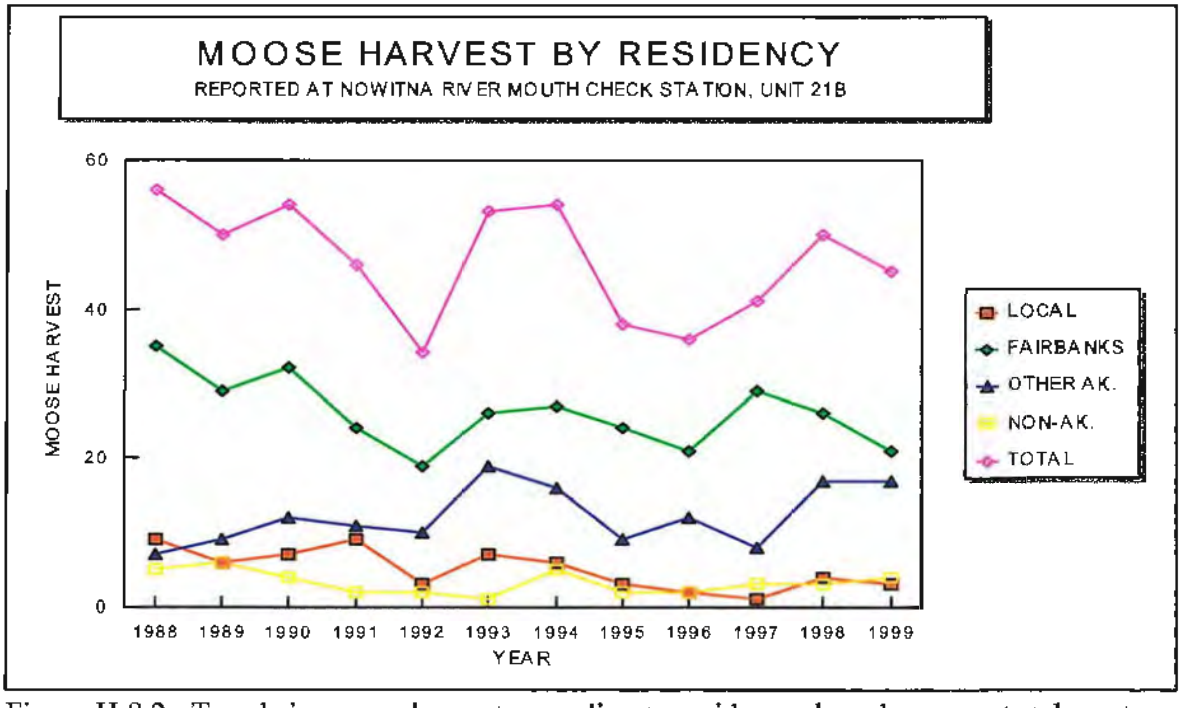


Figure H.8.2. Trends in moose harvest according to residency, based on reports taken at the Nowitna River mouth hunter check station, Nowitna NWR, Alaska, 1988-99.

9. Fishing

Sport fishing provides many hours of challenge on the Nowitna River and its tributaries. Successful fishers catch northern pike, sheefish, and in clearer waters, grayling. Summer pike fishing is popular, and many large sheefish are taken in the fall.

Northern pike and sheefish are the most popular resident fish species for recreational fishing on the refuge. Fishing pressure in prior years has been light, and is done primarily by floaters and guided fly-in anglers who arrived June through August by float-equipped aircraft. Harvest pressure has increased in recent years due to commercial guide/outfitter services operating boats or floatplanes on the Nowitna under special use permit. Don Duncan, who has guided trophy pike fishermen on the refuge for a number of years, reported that the 1998 fishing season was extremely poor for his clients. He reported very few "trophy" catches.

A survey was initiated in 1996 to assess biological effects of fishing pressure on the refuge (see Section G.11). Use of the Nowitna River by floaters is very light. Put-in and take-out points are not conducive to refuge contact with floaters, and often go undetected. There is concern that the number of boats traveling down the Yukon and fishing the lower Nowitna has increased. Angling that occurs in September in conjunction with moose hunting probably equals the total harvest for June through August.

10. Trapping

In the past, trapping was an important public use activity on the refuge that provided supplemental income for many residents in the villages of Ruby and Tanana. Recently, trapping activity on the refuge has decreased, but there are still a few families that rely mostly on trapping for their livelihood. Alaskan traplines are not registered, but are generally passed down from generation to generation within a family. They are usually associated with a cabin or camp of some sort. Occasionally traplines and accompanying cabins and equipment are sold to newcomers.

At least one Nowitna trapper has used an airplane to access remote lakes and trap their periphery. On the Nowitna, most trappers use snowmobiles for transportation; however, some use dog teams, and at least one hardy trapper walks (snowshoes) his entire line. Martens are generally taken using pole and cubby sets. Beavers are taken with snares through the ice and most wolves are shot or trapped with snares placed around moose or caribou kills.

11. Wildlife Observation - *Nothing to report.*

12. Other Wildlife Oriented Recreation - *Nothing to report.*

13. Camping - *Nothing to report.*

14. **Picknicking** - *Nothing to report.*

15. **Off-Road Vehicling** - *Nothing to report.*

16. **Other Non-Wildlife Oriented Recreation** - *Nothing to report.*

17. **Law Enforcement**

Refuge Officer Good conducted two aerial surveillance flights during the course of the hunting season. Eight hunter camps between the south boundary of the refuge and the start of the "canyon" were visited. These moose hunters had all been flown in by air taxi operators.

18. **Cooperating Associations** - *See section H.18 of the Koyukuk report.*

19. **Concessions** - *Nothing to report.*

20. **Subsistence Management**

In 1997 and 1998, there were no significant game management issues on the Nowitna NWR. However, in 1999 the number of hunters recorded at the Nowitna check station was 37% higher than that recorded in 1998, and was at the highest level since 1989 (see Table H.8.1). Conversely, the hunter success rate was 34% lower in 1999 than in 1998. Due to new state and federal regulations that may restrict hunting on the Koyukuk NWR in future years, hunter numbers may continue to increase on the Nowitna NWR. Because of this, we anticipate that subsistence concerns will increase considerably as well. A full discussion of management developments on the Koyukuk NWR is included in that portion of the narrative.

I. EQUIPMENT AND FACILITIES

1. **New Construction** - *Nothing to report.*

2. **Rehabilitation** - *See section I.2 of the Koyukuk report.*

3. **Major Maintenance** - *Nothing to report.*

4. **Equipment Utilization and Replacement** - *See section I.4 of the Koyukuk report.*

5. **Communications Systems** - *See section I.5 of the Koyukuk report.*

6. **Computer Systems** - *See section I.6 of the Koyukuk report.*

7. **Energy Conservation** - *Nothing to report.*

8. **Other (Aircraft)** - *See section I.8 of the Koyukuk report.*

J. OTHER ITEMS

1. **Cooperative Programs** - *Nothing to report.*

2. **Other Economic Uses** - *Nothing to report.*

3. **Items of Interest** - *Nothing to report.*

4. **Credits**

DRM Jim Good prepared section H.17.
SWB Mike Spindler prepared sections G.3, 7 and 8 (part).
FMO Bob Rebarchik prepared section F.9 and digitized photos.
GB Joanna Roberts prepared sections H.8 and 20.
PR Karin Lehmkuhl prepared section G.8 (part) and digitized photos.
RC Sharon Tunnell prepared section A, compiled and edited the final report.

K. FEEDBACK