

US FISH & WILDLIFE SERVICE--ALASKA



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**U.S. Department of the Interior
Fish and Wildlife Service
NATIONAL WILDLIFE REFUGE SYSTEM
KOYUKUK/NOWITNA REFUGE
COMPLEX**

Galena, Alaska

**DOES NOT
REPLICATE**

ANNUAL NARRATIVE REPORT

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ANNUAL NARRATIVE REPORT

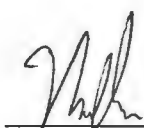
2000

KOYUKUK NWR
NORTHERN UNIT, INNOKO NWR
NOWITNA NWR

KOYUKUK/NOWITNA NATIONAL WILDLIFE REFUGE COMPLEX

Galena, Alaska

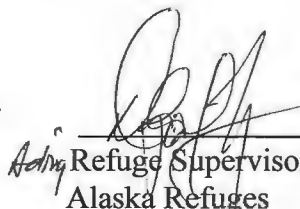
REVIEW AND APPROVALS



Complex Manager

3/10/03

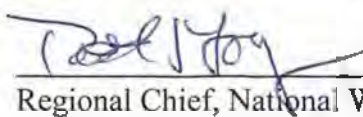
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Acting Refuge Supervisor Northern
Alaska Refuges

05/19/2004

Date



Regional Chief, National Wildlife
Refuge System - Alaska

10/27/06

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ANNUAL NARRATIVE REPORT

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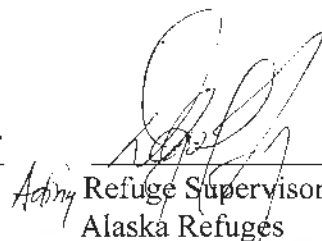
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INTRODUCTION

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;



Koyukuk/Nowitna Refuge Complex



Nogahabara Sand Dunes, Koyukuk NWR

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:



Innoko National Wildlife Refuge in March.

1. To conserve fish and wildlife populations and habitats in their natural diversity including, but not 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.

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:



Nowitna National Wildlife Refuge

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.

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 620 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.

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A. HIGHLIGHTS

- H.8. A drawing moose hunt was implemented within the Koyukuk Controlled Use Area of the Koyukuk Refuge.
- D.6. The Refuge acquired a storage building lease from the United States Air Force - at no charge!
- E.5. Leased shop/cold storage space quadrupled this fiscal year. Wow!

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 weather from October to early April. The winters in the Galena area tend to fluctuate between periods of extreme cold and milder temperatures. Cold spells (usually -20 to -30°F , but sometimes to -40°F to -60°F , or even -70°F) occur during periods of clear skies and no wind between late October and late February. These spells usually last a week or two, sometimes three, and are moderated by intervening milder weather (-20°F to $+20^{\circ}\text{F}$), accompanied by clouds, snow, and light to moderate winds. In interior Alaska the moderating effect of 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 late April-early May, and breakup of the Yukon River ice in 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 . Summers on the refuge Complex are generally cooler, with frequent overcast skies and precipitation, compared to Fairbanks and the eastern Interior. 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.

Temperatures during most of 2000 were near normal, with some exceptions (Fig. B.1): February, November, and December were significantly warmer than normal. Precipitation in 2000 was quite different from normal (Fig. B.2). Precipitation was above normal in five months: January, February, March, July, and September. High September rainfall caused the highest autumn water levels along the Yukon than anyone could remember in quite some time. April, May, June, August, October, and November precipitation were below normal. Despite these differences, total annual precipitation was close to normal--12.94 inches, compared to the long term mean of 12.74 inches. The Yukon River ice at Galena first moved on May 15th, two days later than the long-term mean of May 13th (Table B.1). The Yukon River water flooded into Alexander Lake at Galena for the first time in about six years. Timing of Yukon River freeze-up near Galena was much later than normal (Table B.2). This was likely caused by high river levels which persisted after the heavy rains of September.

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

	Breakup (<u>first ice movement</u>)	Freeze up (<u>ice stoppage</u>)
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
2000	May 15	November 19
Mean	May 13	October 29

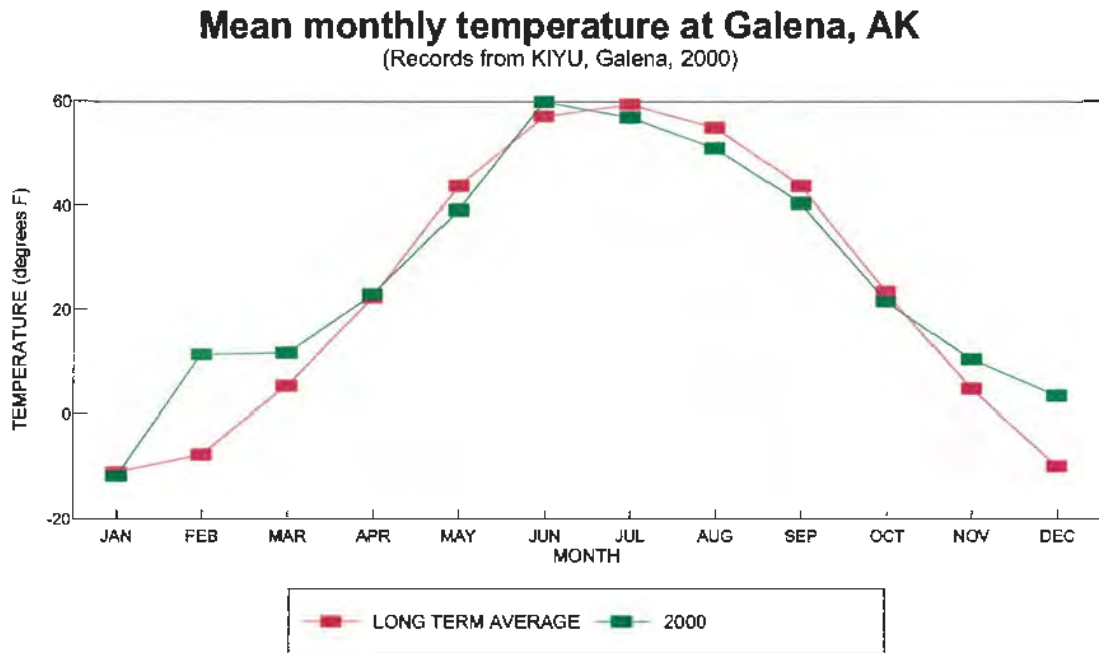


Figure B.1. Mean monthly temperature compared to long term mean at Galena (data courtesy KIYU and National Weather Service).

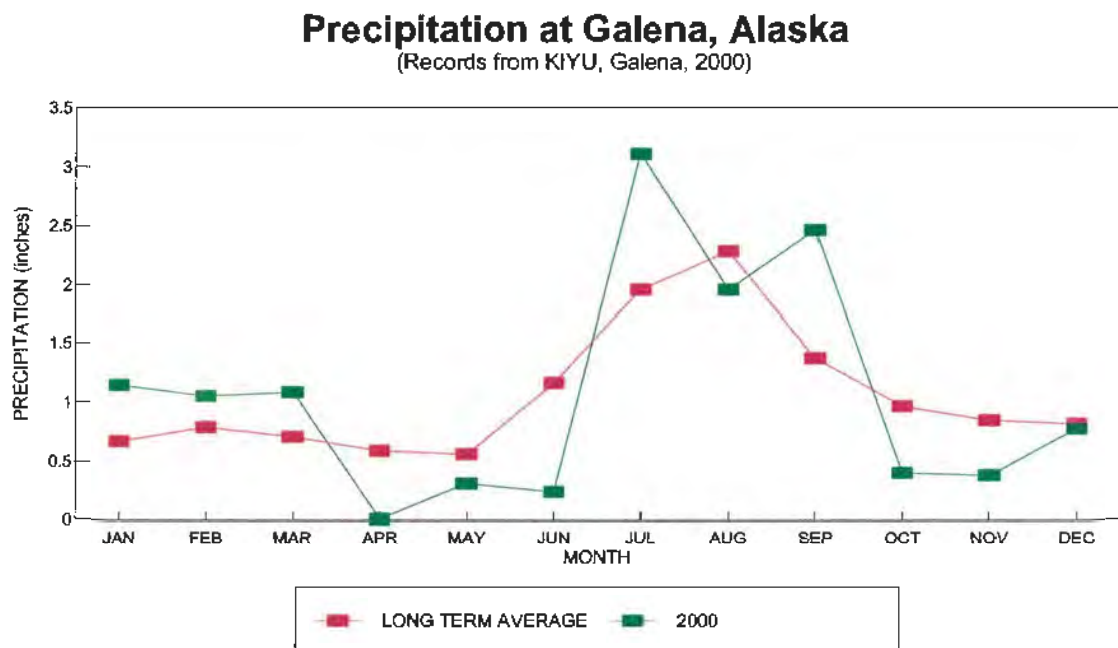


Figure B.2. Mean monthly precipitation compared to long term mean at Galena (data courtesy KIYU and National Weather Service).

D. PLANNING

5. Research and Investigations

The following approved Refuge wildlife studies were active during 2000. 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 moved to the 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. A radio-telemetry study was successfully completed in 1998 and results were summarized for the North American Arctic Goose Conference. An abstract of the paper appears 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. This proposal for \$20,000 was approved and USGS began work in 1999. Craig Ely and Joel Schmutz of USGS-BRD at the Alaska Science Center, Anchorage have been working on a manuscript for publication. An abstract from their draft report appears in Section G.3.

Evaluation of moose browse monitoring methods for development of a long-term habitat assessment procedure for the Koyukuk/Nowitna NWR Complex inventory and monitoring plan. WB Hughes initiated a project to develop a long-term moose habitat monitoring plan for Refuge habitats. Initial field work was conducted in March-April and July-August 2000. A progress report is in preparation, and activities are reported in Section G.8.

Landsat Satellite Mapping Project.

Koyukuk/Nowitna NWR Complex joined forces with Ducks Unlimited, the Bureau of Land Management, the U.S. Air Force, and a consultant (Spatial Solutions, Inc.), to form a multi-agency partnership aimed at producing land cover maps from satellite imagery. Field work for the Northern Unit of the Innoko NWR (731,634 acres) was completed in 1998 and a classified map product was produced in 2000.



Plant collecting on the Nowitna NWR during a break from ground truthing satellite imagery.

Field work for the Nowitna NWR and the U.S. Air Force's Galena Military Operations Area (MOA), a 5 million acre project area, was completed in summer of 2000.

Wildland fire and yellow-cheeked vole populations in Interior Alaska -- an investigation of fire effects in the boreal forest. Earlier studies on the Refuge Complex indicated that the yellow-cheeked vole (*Microtus xanthognathus*) is a major prey item of marten, and that its patchy distribution is influenced by the extent of early post-burn seral stages within the boreal forest (Johnson, W.N., T.F. Paragi and D.D. Katnik. 1995. *The relationship of wildland fire to lynx and marten populations and habitat in interior Alaska*. Final Report, U.S. Fish and Wildlife Service, Galena, Alaska, USA.). During the summers of 1997 and 1998, University of Alaska graduate student Karin Lehmkuhl conducted 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. She defended her master's thesis in spring 2000, and abstracts are included in Section G.10.

Subsistence Waterfowl Harvest Survey: Grayling, Anvik, Shageluk, Holy Cross, McGrath, Takotna, Nikolai. Refuge RIT's Huntington and Farmer assisted Innoko NWR and Division of Migratory Birds staff in conducting a waterfowl harvest survey in the "GASH" (Grayling, Anvik, Shageluk, Holycross) and McGrath area villages. Data forms were forwarded to Migratory Birds for summarization. These data were needed to assist in defining reasonable and sustainable spring waterfowl seasons and bag limits.

6. Other

Koyukuk Refuge served as a technical advisor during a planning process launched by Alaska Department of Fish and Game to deal with the fast-growing popularity of moose hunting on the Koyukuk River. The Koyukuk River Moose Hunter Working Group was formed to address concerns surrounding the popular moose hunt: too many hunters, too many moose harvested, littering, etc.

Moose populations in the core Three Day Slough area have averaged approx. 10.5 moose/square mile from 1985 through 1998 but recent surveys point to a downturn in density and productivity throughout this and other surveyed areas.

This working group was composed of representatives from local subsistence users, urban sportsman groups, guiding, and transporting industries. The group drafted a management plan calling for a drawing permit system for moose hunting inside of the Controlled Use Area of the Koyukuk National Wildlife Refuge. The plan was implemented in Fall, 2000. The hunt/harvest strategy called for a split season for the general moose hunt. Total number of permits issued via drawing was 258, with 20 % going to non-residents. The number of resident hunters hunting under State subsistence regulations was not affected.

The majority of those involved in the process and the affected public were delighted with the outcome. Fewer hunters were afield and overall moose harvest was reduced. Going forward, no changes are anticipated in hunt management as the Fall, 2001 season approaches.

E. ADMINISTRATION



E.1. 2000 Refuge Staff. Back row, Gene Williams, Wayne Strassburg, Sharon Tunnell, Bob Rebarchik, Deborah Webb, Karin Lehmkuhl, Rosie Cassou, Nathan Schwalen, Guy Hughes and Melanie Hans. Front Row, Joanna Roberts, Joe Huhndorf and Hector Hernandez.

1. Personnel

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 (Joe) 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. Converted to Wildlife Biologist, GS-486-11 effective 9/10/00.
6. Joanna L. Roberts, General Biologist, GS-0401-9, EOD 5/3/98, PFT. Transferred to Selawik NWR 11-5-00.
7. Robert A. Rebarchik, Fire Management Officer, GS-401-11, EOD 9/3/95, PFT.
8. Orville H. Huntington, Refuge Information Technician, GS-1001-8, EOD 11/12/95. Conversion from Wildlife Biologist to Career Seasonal technical position effective 8/29/99.
9. Karin L. Lehmkuhl, Park Ranger (Environmental Education/Wilderness Issues), GS-025-9, 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 Resigned effective 9/30/00.
12. Wayne W. Strassburg, Maintenance Worker, WG- 4749-8, EOD 8/16/98, CS Local Hire.
13. Jenny M. Lowe, Wildlife Biologist, GS-486-5, Converted 6/18/00 from SCEP/Student Trainee GS-499-5.
14. Deborah Webb, graduate SCEP/Student Trainee GS-499-5, EOD 5/21/00.

Guy Hughes filled void created by Buddy Johnson's transfer to Tetlin NWR in October of 1998. Joe Huhndorf replaced Colin Brown following Mr. Brown's decision to resign during Fall, 1998.

b. Temporary

14. Robert Farmer, Refuge Information Technician, GS-1001-6, EOD 5/13/98, Local Hire, Intermittent.
15. Melanie Hans, Refuge Clerk, GS-303-5, Excepted Appointment effective 9/26/00 - 11/17/00.

c. Volunteers

Melanie Hans
Hector Hernadez
Tim Osborne
Nathan Schwalen
Randy Shaw

4. Volunteer Program

Melanie Hans. Melanie assisted with a variety projects at the Refuge. She was one of the volunteers primarily working under Wildlife Biologist, Guy Hughes. She assisted with the goose float survey on the Kaiyuh flats, vegetation ground truthing of satellite imagery on the Nowitna NWR, willow mapping on the Nowitna, Koyukuk and Yukon rivers, swan aerial

surveys, and the moose hunter check station. Melanie did GIS work consisting of creating maps, analyzing data and digitizing. A large portion of her office time was spent converting 20 years of moose aerial survey data into a spatial database.

Hector Hernandez. Hector was the third student from Mexico to come and volunteer at the Complex. He assisted with goose banding on the Innoko and Koyukuk refuges. He spent several weeks banding ducks with Migratory Birds near Anchorage. Hector did vegetation ground truthing, willow mapping, swan aerial surveys, and helped with the moose browse project. He organized and input browse data, moose aerial and census data for analysis.

Tim Osborne. The refuge signed up Tim Osborne, a former ADF&G area biologist in Galena, to review the moose browse quantification procedures he used and locate the transect areas that he surveyed in the 1980's. Tim volunteered from March 19-22, 2000. Biologist/Pilot Mike Spindler, Pilot Joe Huhndorf, Biologist Guy Hughes, and Tim visited Three Day Slough to review the transect method, and visit several of the transects. On March 22 Tim and Guy went out by snowmobile to visit several of the local Galena area transects. Guy continued the work later that spring with volunteer Hector Hernandez.

Nathan Schwalen. Nathan aided with many projects over the summer. Nathan helped Park Ranger Karin Lehmkuhl and Wildlife Biologist Jenny Bryant with teaching at the summer science camp. He assisted with the goose float survey, vegetation ground truthing out of Ruby, willow mapping on the Nowitna, Koyukuk, and Yukon rivers, swan aerial surveys, and the moose hunter check station. He worked on entering, proofing and organizing twenty years of moose aerial survey data. Nathan worked with Arcview to create maps, digitize, and analyze *Salix alexensis* patch data collected over the summer.

Randy Shaw. Randy Shaw, a local Ruby resident and falconer, volunteered in July 2000 to help with the Yukon River raptor survey. He also volunteered a day in August to help with swan surveys, and a week in September to help at the Nowitna mouth moose hunter check station. His rapport with local Ruby residents was appreciated during his stint at the check station.

5. Funding

Base operation funds increased in calendar year 2000. Subsistence funding was \$96,000 for 2000 (part of 1261 base). The environmental education and outreach programs received \$9,000 in 2000. There were no MMS-funded projects in 2000. However, a significant MMS project was accomplished in 2000 with FY99 funding. \$173,000 in FY99 money was used to replace the driveway retaining walls at quarters 1-6.

Lease costs for shop/storage space increased from \$13,290./yr. to \$34,704/yr in FY00. The Koyukuk/Nowitna Refuge Complex had previously shared the shop/storage facility with its landlord, Gana-A' Yoo Corp. This arrangement proved untenable and new lease terms were

agreed upon. Warm/cold storage space at this station has nearly quadrupled with exclusive use of the facility!

Beginning in 2000, the federal subsistence fisheries program (1937) provided additional money to base operations funds. An allocation of \$15,000 was received to cover costs associated with travel related to newly acquired responsibilities.

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

<u>Program</u>	<u>FY96</u>	<u>FY97</u>	<u>FY98</u>	<u>FY99</u>	<u>FY00</u>
1231	22,000	12,000			20,000
1261	977,500	938,000	1,054,000	1,113,000	1,255,000
1262	140,000	131,000	33,000	224,000	0
1937					15,000
4960		990	1,400	2,108	3,277
8610	25,000	30,000	35,499	47,232	53,457
9110	105,000				
9120	7,000				
9251		126,000	163,000	128,000	123,000
9252		30,000			
Total	1,276,000	1,267,990	1,286,899	1,513,108	1,469,734

6. Safety

In February 1999, DRM Jim Good retired from the U.S. Fish and Wildlife Service at which time our full-time safety officer position became vacant. Since that time, Refuge Manager Gene Williams has been acting safety officer for the station. The annual field and general safety training courses were held for all staff members including volunteers from May 22 through 26. All required training was provided at this time. Training topics included administration, Refuge FM radio use, bear safety policy and firearms, basic aviation for non-pilot crew members on special use flight operations, boat safety, first aid and CPR. Appropriate field gear was issued to field personnel at this time. Water Craft Instructor Rebarchik held a boat safety session at the new Galena City Pool which students received hands-on training in the use of canoes, throw ropes, PFDs, float coats and Mustang Suits, and other water craft safety gear. WB/Pilot Spindler and Pilot Huhndorf received Emergency Maneuver Pilot Training at CP Aviation in Santa Paula, CA during winter of 2000.

A non-local moose hunter experienced chest pains when hunting with friends in the Koyukuk Controlled-Use Area on September 8th. His friends brought him to the Ella's Cabin ADF&G Check Station where WB Glenn Stout (ADF&G) ascertained that the hunter was having a heart attack and administered aspirin to the hunter. Glenn called his wife in Galena for assistance in alerting EMS using the Refuge FM radio and phone-patch system. Pilot Huhndorf in Maule N120G was en route from Nowitna Check Station to Galena with Jackie

Kephardt, an ADF&G Biologist, and overheard the conversation. The flight was diverted to Ella's. The hunter was successfully evacuated to Galena with the hunter sitting upright in the back seat and Jackie, who was a medic in the US Army, next to him monitoring his condition. The hunter wrote later saying thanks to Glenn and everyone else who helped. He said he has made a full recovery.

Phukan Engineering, Inc. of Anchorage was hired to do a contaminants investigation and remediation of fuel spill at quarters 109-bunkhouse. A leaking heating oil line was discovered under the residence - requiring removal of eleven yards of contaminated soil. This material was bagged and barged out of Galena via the Yukon River! The Region's Engineering Office assumed responsibility for the project cost.

There were no loss time accidents in FY00. Safety committee meetings were held regularly. Staff safety meetings were held sporadically throughout year.

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 on the Koyukuk. The Yukon, Nowitna and Koyukuk rivers 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 along rivers and creeks are well drained and are usually free of permafrost. Deeper bodies of water are also usually underlain by non-permafrost soils. These factors create a steep habitat gradient away from river and creek channels. Riparian vegetation usually includes 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 which vary in width depending on the size of the river. Further from the rivers and sloughs, white spruce stands typically grade into black spruce (*Picea mariana*), which grade into treeless bog and wet sedge habitats. On extremely winding rivers, large oxbows form, often concentric bands of the above-mentioned species in various stages of succession are intermingled with strips of grasses and sedges and open water. 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 Koyukuk Refuge, and in scattered locations on the Nowitna and Kaiyuh

Flats (N. Innoko). Bog vegetation on the Complex consists of various species of cotton-grass (*Eriophorum* spp.), dwarf birch (*Betula nana*, *B. glandulosa*), bog blueberry (*Vaccinium uliginosum*), Labrador tea (*Ledum palustre*), leatherleaf (*Chamaedaphne calyculata*), myrtle (*Myrica gale*), sedges, and mosses, especially sphagnum moss and peat. Other species of bog habitat include bog rosemary (*Andromeda polifolia*), bog cranberry (*Oxycoccus microcarpus*), and sundew (*Drosera anglica*, *D. rotundifolia*). On drier ridges, willow, alders, resin birch (*Betula glandulosa*), black spruce and American larch (*Larix laricina*) are found.

Extent of land cover types was mapped on units of the Complex in the mid-1980's, and estimates were included in the Refuge Comprehensive Plans (1987). Technical information for part of this mapping project was reported in 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.).

Refuge staff joined forces with Ducks Unlimited, the Bureau of Land Management, the U.S. Air Force, and Spatial Solutions, Inc. to form a multi-agency partnership to produce modern land cover maps from high resolution satellite imagery. The goal of this partnership is to map vegetation on over 16 million acres of land in Alaska's Western Interior by the summer of 2002. Included in the project is our entire 7.7 million acre Refuge complex. Field work for the N. Unit of Innoko (731,634 acres) was completed in 1998 and a draft map product was produced in 2000. The field work for a 2.2 million acre portion of western Koyukuk NWR was completed in the summer of 1999. The remaining 2.3 million acres of the Koyukuk is scheduled to be completed in the summer of 2001. A finished product for the Koyukuk NWR is expected in the summer of 2002. Fieldwork to map the Nowitna NWR (and the adjacent U.S. Air Force Galena military operations area totaling 5 million acres) was completed in summer 2000. A final map product for the Nowitna NWR is expected in the spring of 2001.

2. Wetlands

The floodplains of the Koyukuk, Nowitna, and Yukon Rivers form a major component of the Refuge Complex. The actions of these meandering rivers have created a high diversity of wetland habitats for fish and wildlife. Each of the main rivers in the Refuge units has distinct hydrological characteristics, which in turn creates differences in floodplain and wetland characteristics. For example, The Nowitna River originates in limestone bedrock in the Kuskokwim Mountains, which contributes carbonates that buffer the acidic qualities of the river and make it more productive than many of its Interior Alaskan counterparts. The Yukon River runs through all units of the Complex, and is the fifth largest river system in North America. The Yukon is silty for most of the summer because of glacial sources in the Alaska Range and Wrangell-St. Elias Mountains. The Koyukuk River originates along the arctic circle in the Brooks Range, and is subject to later snowmelt runoff than the Yukon and Nowitna. In early June, at the height of waterfowl nesting, water levels of the Yukon and Nowitna may be low, while the Koyukuk River may be flooding due to mountain snowmelt

in the arctic and subarctic portions of the Brooks Range. In summer any of these rivers may respond to localized heavy thunderstorms or more extensive late summer weather fronts.

There are about 14,000 lakes and ponds on the Nowitna Refuge, where wetland acreage is estimated at about 30,000. Koyukuk and N. Unit of Innoko NWR (Kaiyuh) have an estimated 15,000 waterbodies and 5,500 miles of rivers and streams. There are an estimated 280,000 acres of wetlands on the Koyukuk and N. Innoko.

Refuge wetlands include upland basins, ice-formed lakes on the flats, river flooded lowlands, oxbows, and bog lakes. Spring runoff, rain, and river flooding recharges lakes. Water depths and shorelines can vary from year to year. Lake depths seldom exceed 15 feet and are usually 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*), buckbean (*Menyanthes trifoliata*), and bladderwort (*Urtricularia macrorhiza*). Shorelines of bog lakes vary in character, but nearly always contain buckbean (*Menyanthes trifoliata*), wild calla (*Calla palustris*), various sedge species (*Carex* spp.), and burreed (*Sparganium hyperboreum*). Several species of graminoids including sedge (*Carex*), bluejoint grass (*Calamagrostis canadensis*), and foxtail (*Hordeum* sp.) provide cover on exposed shorelines. A variety of forbs grow on recently exposed soils along shorelines. Cattail (*Typha latifolia*), is an invasive species on the Refuge, and has recently appeared near Galena.

Shallow seasonally flooded basins (locally called "grass lakes") are common along the Koyukuk, Yukon, and Nowitna Rivers. Grass lakes are usually wetlands during spring breakup and flooding, and in summer become dry meadows, many of which show 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, and marsh cinquefoil (*Potentilla palustris*) dominate in the wetter portions. During flooding, sedges, and occasionally bluejoint grass will survive as emergent vegetation in water depths exceeding four feet.

3. Forest

Forests cover 88% of the Nowitna NWR and 41 % of the Koyukuk/Kaiyuh. Portions of the lower Koyukuk and Nowitna River floodplains, and some islands in the Yukon River, contain especially high quality white spruce timber measuring over 18 inches in diameter and over 100 feet high. Local residents primarily use spruce for house logs and firewood, although small commercial sawmills have operated in Tanana, Ruby and Galena. The Comprehensive Conservation Plans for Refuge units preclude commercial logging. Local interest in

commercial logging operations on islands of the Yukon River has been expressed. Each year, a few permits are issued to local residents for personal harvest of house logs.

Vegetation classes: Many classes of forest vegetation occur on the Complex including closed needleleaf, closed mixed deciduous, open needleleaf, and needleleaf woodland. Each of these forest classes are arbitrary. While there are pure stands dominated by a single tree species, stands typically mix and grade into one another, depending on underlying soil moisture regimes. Mixtures create the opportunity to recognize other subclasses of mixed forest. 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 are particularly well developed on alluvial sites along the major rivers. Closed forests typically have 60% to 100% cover. The dominant tree species is white spruce (*Picea glauca*), which may grow to 80-100 feet tall, forming the largest stature forest found on the Refuge Complex. Understory species include northern toadflax (*Geocaulon lividum*), highbush cranberry (*Viburnum edule*), azalea (*Rhododendron lapponicum*), prickly rose (*Rosa acicularis*), sweetvetch (*Hedysarum alpinum*), and various species of feathermoss. This type comprises about 2% of the Refuge Complex.

Closed deciduous forests occur in well to imperfectly drained sites. White birch, aspen, and balsam poplar dominate the overstory. Other types of broadleaf deciduous forests occur in hills where strips of birch forest line hillside streams, and aspen is present on south-facing sandy hillsides. This subclass reaches its greatest extent on the Nowitna, where it covers 30% of total surface area. Only 3% of the Koyukuk was classified as this type.

Mixed forests have 25-100% cover of deciduous broadleaf trees mixed with evergreen needleleaf trees. Mixed forests are distributed mainly along the major water courses, especially on islands in the Yukon and Koyukuk Rivers, and on relatively dry, south-facing hillsides where drainage is good and permafrost is absent. The forest type consists of moderately tall (50 feet) to tall (80 feet) paper birch (*Betula papyrifera*), aspen (*Populus tremuloides*) and cottonwood, mixed with white-spruce. Common understory species found in mixed deciduous forest include highbush cranberry, currant (*Ribes triste*), bunchberry (*Cornus canadensis*), and prickly rose. This type comprises 6% of the Koyukuk and 4% of the Nowitna Refuge.

Open needleleaf forests have 25-60% tree cover and are found on moderately to poorly-drained soils. This type is composed primarily of black spruce, but often includes larch (*Larix laricina*) and willows. This type is frequently found on north facing slopes and poorly drained lowlands usually underlain by permafrost. Ground cover species in this forest include bog blueberry, Labrador tea, sedges and mosses. In many areas a thick blanket of lichen species entirely covers the ground forming an open needleleaf-lichen association. This type dominates the Nowitna, making up 42% of area. On the Koyukuk it occupies 7% of the area.

Needleleaf woodlands, which are sometimes called "muskeg," have 10 to 25% tree cover, and are found on moderately to poorly drained soils. These woodlands contain low, sparse, tree growth (mainly black spruce, but larch may be present). The ground cover resembles a treeless bog community dominated by shrub species such as Labrador tea, bog rosemary, bog blueberry, low-bush cranberry, bog cranberry, and crowberry (*Empetrum nigrum*). Various graminoid and moss species also may be common including cotton-grass, sedges, and mosses (*Sphagnum* moss and peat). This type makes up 26% of the Koyukuk and 10% of the Nowitna Refuge.

Fire regeneration: Wildland fires are primary agents of disturbance in the boreal forest, initiating successional changes which impact a variety of plant and animal species. Years of fire have produced a mosaic of seral stages within the Refuges, which provides a diversity of wildlife habitats. The general sequence of plant communities that become established after fire is as follows:

<u>Black Spruce Sites</u>		<u>White Spruce Sites</u>	
0-1 years	newly burned	0-1 years	newly burned
1-5 years	moss-herb	1-5 years	moss-herb
5-30 years	tall shrub-sapling	3-30 years	tall shrub-sapling
30-55 years	dense tree	26-45 years	dense tree
56-90 years	mixed hardwood-spruce	46-150 years	hardwood
91-200+ yr	spruce	150-300+ yr	spruce

These plant associations are described above and in section F6.

6. Other habitats

The Complex contains several non-forest shrub, herbaceous, and graminoid (grass-sedge) vegetation cover types. The most significant types are listed below:

Alluvial/lowland tall shrub: This type is dominated by deciduous shrubs ranging from 1.5 to 16 feet in height. It includes 'lowland broadleaf', 'alluvial broadleaf', and 'subalpine broadleaf' communities. Tall shrub communities are found primarily in floodplains, and are dominated by willows (*Salix alaxensis*, *Salix planifolia pulchra*, *Salix arbusculoides*, *Salix bebbiana*), and in some areas, alder (*Alnus incana*, *A. crispa*). Chief understory species include *Vaccinium vitis-idaea*, *Linnaea borealis*, *Calamagrostis canadensis*, and *Equisetum arvense*. The type makes up 4% of Nowitna and 3% of Koyukuk area.

Dwarf shrub-graminoid tussock peatland: This community contains slow-growing dwarf shrubs less than 1.5 feet tall, and frequently occurs on poorly drained organic soils. Mosses and lichens cover the surface. Dominant species include *Ledum decumbens*, *Chamaedaphne calyculata*, *Vaccinium uliginosum*, *V. vitis-idaea*, *Betula glandulosa* (or *B. nana*), *Eriophorum vaginatum*, *Carex bigelowii*, *Rubus chamaemorus*, *Sphagnum* spp., *Dicranum* spp., *Cladina* spp., and *Cetraria* spp. This is the dominant habitat type on the Koyukuk, comprising 27% of surface area, but makes up only 2% of the Nowitna Refuge.

Graminoid tussock-shrub: Plant composition similar to above but dominated by *Eriophorum* tussocks, with lesser amounts of dwarf shrub and herbaceous cover. This type is transitional to arctic and alpine tundra in some areas. It is most common on the Koyukuk, and makes up about 14% of cover there.

Prostrate dwarf shrub tundra characterizes relatively bare alpine communities dominated by low-growing matted dwarf shrubs. The habitat 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*, *Thamnolia subuliformis*, and *Stereocaulon* spp. The type comprises 1% of the Koyukuk and N. Innoko and less than 1% of the Nowitna Refuge.

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*, *Carex 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 2% of the Nowitna and 2% of the Koyukuk is comprised of this class.

Other vegetative types occur in upland areas that surround the wetland floodplain basins that make up the Koyukuk, Kaiyuh, and Nowitna. On the Koyukuk NWR, small mountain ranges occur on the east, west, and north boundaries Refuge. On the N. Unit of Innoko, the Kaiyuh hills occur along the southern boundary. On the Nowitna, hills occur along all four sides of the Refuge. 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. cucullata*, *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. Estimated cover of these alpine and subalpine habitats is 3% on the Koyukuk and 1% on the Nowitna.

9. Fire Management

Fire Management goals and procedures for the Complex are contained within the Alaska Interagency Wildland Fire Management Plan (AIWFMP, 1998). 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 (CCP's) for all three refuges, there were no prescribed fires in 2000. The majority of the fire management program activity is related to managing wildland fires. Lightning is the cause of most wildland fire. The Complex lies within a zone of extremely high early summer lightning strike activity. 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. Fire occurrence during 2000 was somewhat below the 10-year average in Alaska.

FMO Rebarchik continued participation on the Alaska Firefighter Safety and Health committee and on the national FWS team to revise the DI-1202 Individual Fire Report. The new Fire Reporting System (FRS) is due to be available for use for the 2001 fire season. Rebarchik's Interagency fire assignments in 2000 included 10 days as a Division Supervisor assignment on the Chicken fire near Nagadoches, Texas.

Koyukuk/Northern Innoko NWR

In 2000 statewide, wildfires burned about 743,400 acres in 368 wildland fires. There were five wildfires on the Koyukuk Refuge and one on the Northern Unit of the Innoko Refuge during the year. The largest fire was the Natlaratlen River (7120), which totaled 8,541 acres. This burn occurred about twenty miles northwest of Galena, in a modified protection area entirely on Refuge lands. This fire was suppressed to protect critical habitat for the Galena Mountain Caribou herd. The only fire that burned on the Northern Unit of the Innoko Refuge was the Yukon Creek fire (7158), which burned 61,291 acres. Only 1,416 acres of this burn was on refuge lands. The remainder burned south of the refuge, primarily on State of Alaska land. Details for 2000 individual wildfires are shown in Table E.9.1

Wildland Fire Situation Analyses (WFSA) were completed for fires 7120 and 7157. Fire 7120 required a WFSA because of the extended attack situation and the desire to accomplish the suppression action as cost effectively as possible. Fire 7157 burned into a Modified protection zone from Limited protection in the northern most part of the refuge. There was not a need or desire to spend suppression dollars on this fire which did not threaten any valued property. This fire did not require additional suppression action

above the monitoring status it received. Thus, surveillance was the only action taken after the WFSA was completed. The fire was rained out after burning 651 acres.

Table F.9.1. Wildfire Occurrence on the Koyukuk and Northern Unit of the Innoko NWR's, 2000.

<i>Fire Number</i>	<i>Acres Burned</i>	<i>Cause</i>	<i>Option of Protection</i>	<i>Discovery Date</i>	<i>Declared Out</i>
7156(A199)	10.0	Lightning	Limited	06/10/00	06/19/00
7152(A201)	3.0	Lightning	Modified	06/10/00	06/11/00
7166(A200)	20.0	Lightning	Limited	06/10/00	06/18/00
7157(A207)	651.0	Lightning	Limited/ Modified	06/10/00	06/27/00
7120(A292)	8,541.0	Lightning	Modified	06/25/00	07/19/00
7158(A291)	1,416.0	Lightning	Limited	06/25/00	07/19/00

Nowitna NWR

The Nowitna refuge had three wildfires in 2000 (see Table E.9.2 for details). Lightning started all of the fires, and were all in Limited suppression zones. The Bering Creek Fire (A-247) was the largest fire burning about 141,497 acres in late June and July. The Grand Creek fire was also significant because it reached 93,317 acres in size, 53,665 of which burned on the refuge.

Table F.9.2. Wildfire Occurrence on the Nowitna NWR, 2000.

<i>Fire Number</i>	<i>Acres Burned</i>	<i>Cause</i>	<i>Option of Protection</i>	<i>Discovery Date</i>	<i>Declared Out</i>
7121(A247)	141,497.0	Lightning	Lim./Full	06/14/00	09/15/00
7155(A299)	53,665.0	Lightning	Limited	06/27/00	09/15/00
7154(A340)	675.0	Lightning	Limited	07/11/00	09/15/00

Wildland Fire Situation Analyses were completed for fires 7121 and 7155. Both were large fires that started in Limited protection areas of the refuge. Fire 7121, the Bering Creek fire, threatened full protection areas (cabins, allotments, and timber) north of where it started. The WFSA (signed by Doyon, BLM, State of Alaska, AFS, and the FWS)

concluded that suppression action should be taken to protect threatened structures but, the fire would continue to burn unsuppressed where not threatening valued resources. Resources were protected and no structures were lost. The Grand Creek fire burned entirely in Limited protection. One cabin was destroyed that was located on BLM lands east of the Refuge. It was a non-permitted cabin that the BLM was not aware of before the fire started. By policy non-permitted cabins will not receive protection from wildfires.

Activities of FMO Rebarchik were concentrated on the Fire Management Plan , proposed protection level changes, and GIS fuels mapping. A fire suppression zone change proposal was submitted to the Alaska Fire Service (AFS) for the northern portion of the Nowitna refuge east of the Nowitna River. The proposal is a culmination of meetings that were held with affected land owners in the area of the village of Ruby since 1995. The refuge proposal would lower the current protection status for approximately 200,000 acres. Breakdown of affected acreage is: Doyon (38,400), State of Alaska (7,000), and US Fish & Wildlife Service (154,880). Under the proposed, all these lands would change from Full suppression strategy down to Limited suppression strategy. This is a remote area that would allow for resource benefitting fire to take place. Figure F.9.1 shows the proposed area changes. All agencies have agreed to the proposed change except Doyon Ltd. A decision from them is pending and won't come until next year.

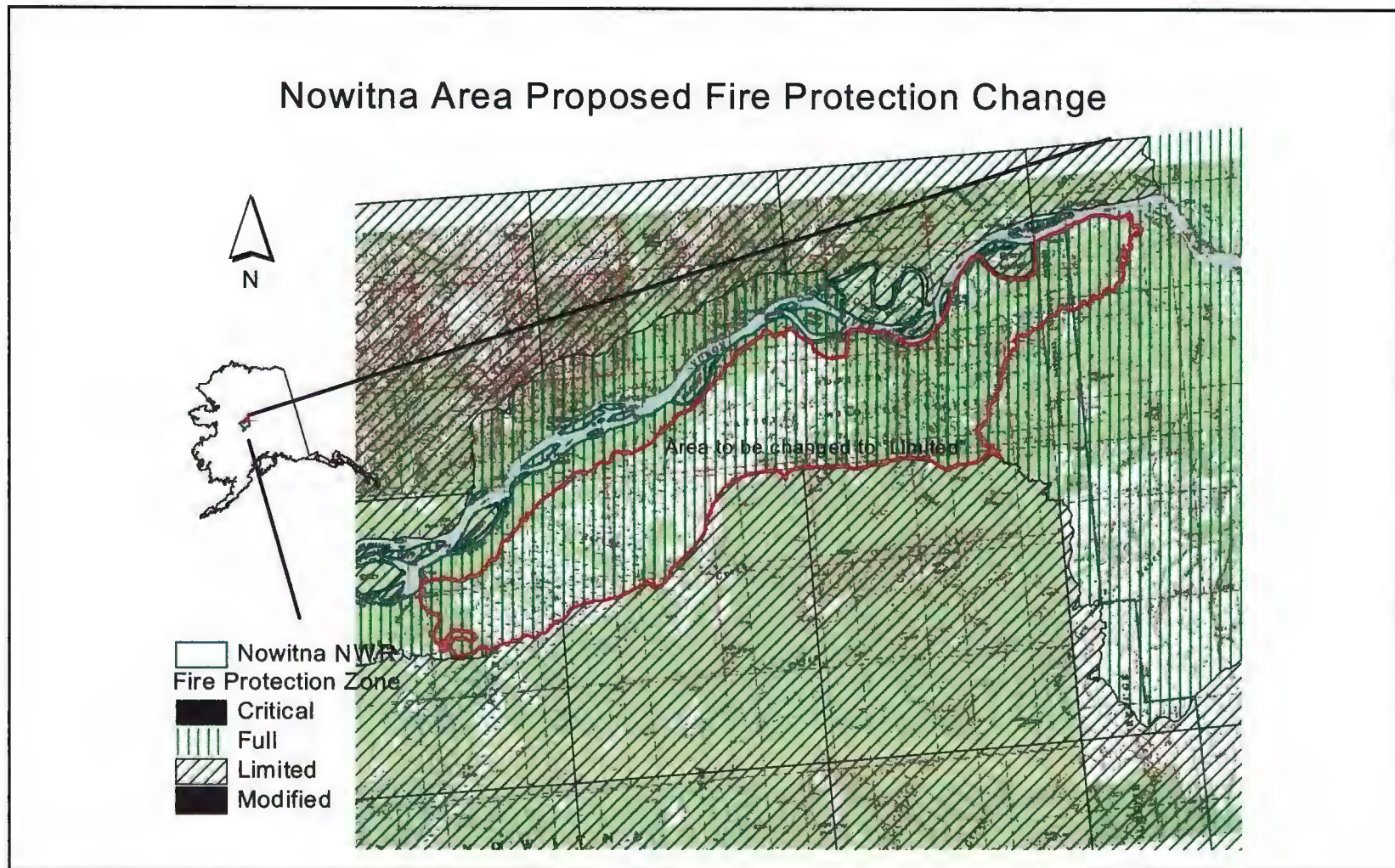


Figure F.9.2. Nowitna area Land Ownership.

The GIS fuels mapping project continued on the Nowitna Refuge during 2000. The Bureau of Land Management (BLM), Ducks Unlimited, and the U. S. Fish & Wildlife Service conducted a cooperative satellite imagery mapping project. The project utilized helicopter ground surveys combined with satellite imagery to produce a vegetation land cover map the Nowitna Refuge and surrounding areas. The ground truth survey will be used to verify satellite imagery interpretation classification to produce a habitat/vegetation/fuels map of the area. The cooperative effort will continue in 2001 to gather the information necessary for the remainder of the Koyukuk and Northern Unit of the Innoko Refuge habitat/vegetation/fuels coverages.

G. WILDLIFE

1. Wildlife Diversity

The Koyukuk/Nowitna National Wildlife Refuge Complex 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 Koyukuk and Northern Innoko NWRs. A Koyukuk NWR bird list was published in 1992 following a decade of active field surveys and local observations by staff living in Galena.

Thirty-seven species of mammals, 147 birds, 20 fishes, and 1 amphibian are known to occur on or near Nowitna NWR. 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. Fish, mammal, and plant lists for both the Koyukuk and Nowitna, published in the Refuge Comprehensive Conservation Plans in 1987 and 1988, need to be updated and revised.

Included among the biodiversity monitoring efforts on the Complex in 2000 were surveys of spring bird migration phenology (collection of arrival dates), the North American Migration Count, breeding bird surveys (Standard BBS, Section G.7), inventory of plant species in habitat mapping efforts, and inventories of wintering birds (Christmas Bird Count, Section G.7).

2. Endangered and/or Threatened Species

The only endangered species, or formerly endangered species to occur on the Complex are the arctic peregrine falcon and American peregrine falcon. The arctic peregrine falcon migrates across the region to its arctic nesting areas. The American peregrine falcon nests on all units of the Complex. The American peregrine falcon was removed from the endangered species list in June 1999. It will be monitored nationally for a five year period

and re-evaluated for permanent removal. The threatened arctic peregrine falcon was delisted in 1994, and its monitoring period is over.

3. Waterfowl

Wetlands within the Koyukuk NWR, Northern Unit of the Innoko NWR (Kaiyuh Flats), and Nowitna NWR support large waterfowl populations. The main breeding duck species include American wigeon, northern pintail, mallard, green-winged teal, northern shoveler, surf scoter, white-winged scoter, common and Barrow's goldeneye, bufflehead, and lesser scaup. Less abundant breeding ducks include red-breasted merganser, greater scaup, canvasback, ring-necked duck, redhead, black scoter, and long-tailed duck (oldsquaw). Arctic, red-throated, and common loons also nest on the Complex, as do horned and red-necked grebes. Canada geese, white-fronted geese, trumpeter swans, and tundra swans occur in moderate numbers. The greatest concentrations of waterfowl occur during spring and fall migrations on large, shallow floodplain waterbodies.

Weather Conditions and Waterfowl Migration Chronology

It is important to monitor arrival chronology and spring breakup conditions because these factors greatly influence waterfowl productivity. In 2000, white-fronted geese arrived in Galena on April 17, a week earlier than the long-term mean arrival date (*see* Section G.7, Table G.7.2). Canada geese arrived on April 30, three days later than average. Mallards arrived in Galena on April 20, five days earlier than average, while pintails arrived on April 26, a day earlier than the long-term mean.

Koyukuk/Kaiyuh: On May 12, most of the Koyukuk NWR had 90-100% snow cover. Only the smaller creeks, like Cottonwood and Holtnakatna Creek, were open and flowing. Small river tributaries, like the Dulbi, had open moats on the sides, but ice was still in place. Only the smallest ponds had open water; medium and large lakes were 100% frozen. By May 19, snow cover had dropped to 20-30%; the lakes were still 80-90% frozen. The Gisasa River was open down to its mouth on the Koyukuk River, but the Koyukuk River ice had not yet moved. On May 23, snow cover was down to 0-5% in the southern Koyukuk NWR, but up to 65% in the north at Billy Hawk Creek. Lakes still had 80-90% ice cover. Ice on the Koyukuk River was jammed near Treat Island, and Bear Mountain causing minor flooding in these areas. On the Kaiyuh Flats on May 24 there was 0-2% snow cover; lakes were 40-60% open, except near the Kaiyuh Hills, where lakes were still 80% frozen. Along the Yukon River there was minor flooding, especially near Kaiyuh Slough and Koyukuk Island. By May 29, most small lakes were ice-free, however medium and large lakes near Hozatka Lake and Dulbi Slough still had 95% cover of rotten ice. The Dulbi River was flooded from its mouth up to 10-mile bluff. The Koyukuk River at Dubin Point was bank-full, but a few high sand bars were still showing. Along Dulbi Slough at the Nayuka R. confluence flooding was observed into the willow zones, but not into the open ericaceous shrub meadows where geese nest. On June 8 Koyukuk River water had backed up into Willow Lake and flooded low places, but the

grass spit separating the north and south lakes was above water. By June 14 the Willow Lake grass spit was flooded, while reports from Huslia and Hughes indicated that the Koyukuk River had crested.

On May 2, SWB/Pilot Spindler and Ranger Lehmkuhl observed about 200 white-fronted geese, 50 swans, and 200 ducks in a few scattered open water spots of the Kaiyuh Flats. On May 19 Pilot Huhndorf and RIT Huntington counted large numbers of waterfowl concentrating in open water areas of the southern Koyukuk NWR between Galena and Huslia, along the Koyukuk and Dulbi Rivers: 1,596 swans; 2,974 geese (including 1,393 identified as white-front, 703 Canada, and 48 snow); 1091 ducks; 87 gulls; and 7 cranes. On May 23 Huhndorf and Huntington made a similar count in concentration areas of the northern Koyukuk NWR from Huslia northwest to Billy Hawk Creek, and northeast almost to Hughes: 599 swans; 930 geese (including 453 identified as white-front, 479 Canada, and 190 snow); 1,305 ducks; 2 cranes; and 2 gulls. On May 24 Pilot Huhndorf, Biologist Hughes, and Ranger Lehmkuhl counted waterfowl in concentration areas of the Kaiyuh Flats: 254 swans; 389 geese; 616 ducks; 159 gulls; and 50 cranes.

Nowitna: On May 12 the upper Nowitna River valley was snow-free, and the river was open and flowing ice-free almost to the mouth. There was about 5% snow cover from the Canyon to the Oxbow Stretch; about 15-20% snow cover from Oxbow Stretch to the Lower Cabin; and 60% snow cover near the Nowitna River mouth. Along the upper Nowitna all small ponds were open, while most of the large lakes in the Oxbow Stretch and below were still 90-100% ice-covered. On the flats along the lower Nowitna River all but the smallest waterbodies were still ice-covered, and ice was jammed up along the lower few miles of the Nowitna River down to its mouth, where Yukon ice was still solid. Grass lakes at the mouth of the Nowi were flooded; there was probably little to no breakup flooding along the upper and middle stretches. On May 24, the entire Nowitna Refuge was snow-free, oxbow lakes near the mouth were flooded by waters backing up from the Yukon River. Pilot Huhndorf, WB Hughes, and BT Webb counted the following birds on an overflight along the Nowitna River corridor: 142 swans; 128 geese (including 68 identified as white-front and 40 as Canada), 929 ducks, and 30 gulls.

Ducks

Ducks on Koyukuk NWR

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 available indication of trends in duck abundance on the Refuge is the aerial duck breeding pair survey conducted by the Service's Division of Migratory Birds in Juneau. In 2000, indices of abundance of most duck species/groups were well above the long-term mean, with the exception of scoters and "others", which were at or just below the long-term average (Table G.3.1). It should be noted that the estimates 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 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 211,700 ducks, May 1984-2000. Similarly, the mean estimated population for Koyukuk NWR was 76,000-137,000, using the percentages given above. These figures corresponded well with and appear to be increasing above 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.

Incidental Observations. Incidental duck observations are recorded during early July annual goose production float surveys conducted on Dulbi River and Dulbi Slough. Data from these surveys are combined and shown as Dulbi Area, Koyukuk NWR (Figure G.3.1). These observations are analyzed strictly as an index of the population and are not used to estimate total population.

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, Alaska.

Species	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	Mean	SD	CV
Mallard	18.8	9.4	17.5	8.8	28.2	20.7	14.9	18.7	12.3	10.2	22	22.3	22.7	24.5	41.6	19	52.7	21.43	11.28	0.53
Wigeon	49.5	19.6	50.9	36.5	49.3	46.5	40.9	39.7	29.4	29.6	41	43.8	38.5	78.6	63.6	36.1	74.1	45.15	15.37	0.34
GWTeal	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	24.6	81	27.00	16.56	0.61
Shoveler	11	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	25.1	18.31	6.92	0.38
Pintail	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	96.1	47.62	39.94	0.84
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	48.1	32.22	10.15	0.31
Scoters	6.1	8.9	10.6	9.3	6.5	5.2	7.5	2.8	6.4	5	3.3	2.5	6.5	7.4	4.5	3.4	6.9	6.05	2.33	0.38
Other	17.3	13.4	24.1	14.8	19.7	14.9	19.7	15.2	8	19.5	13.2	9.8	10.8	8	11.8	8.3	8.1	13.92	4.90	0.35
Totals	344.3	139.5	272.3	205.8	230.2	217.2	185	170.3	139	160.5	169.8	185.6	197.7	198.6	229.9	161.1	392.1	211.70	68.67	0.32

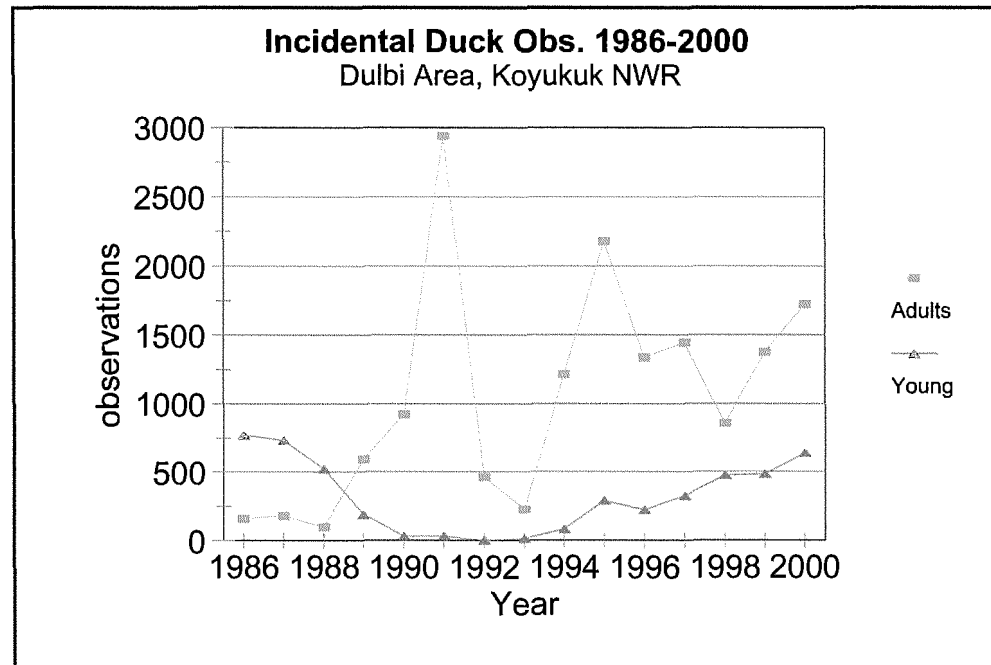


Figure G.3.1. Incidental duck observations recorded during annual goose production float surveys, Dulbi River and Dulbi Slough combined, 1986-2000, Koyukuk NWR, Alaska.

Ducks on Nowitna NWR

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 a 1990 refuge-wide effort to standardize techniques and refine of statistical procedures. 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 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 in 1998 that were more 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 year 2000. The Nowitna NWR comprises <10% of the Tanana-Kuskokwim Stratum, and therefore, these data will not be presented here.

Incidental Observations. Incidental duck observations are recorded during annual goose production float surveys conducted in early July on the Nowitna River. Data from this survey is shown in Figure G.3.2. These observations are analyzed strictly as an index of the population and are not used to estimate of total population.

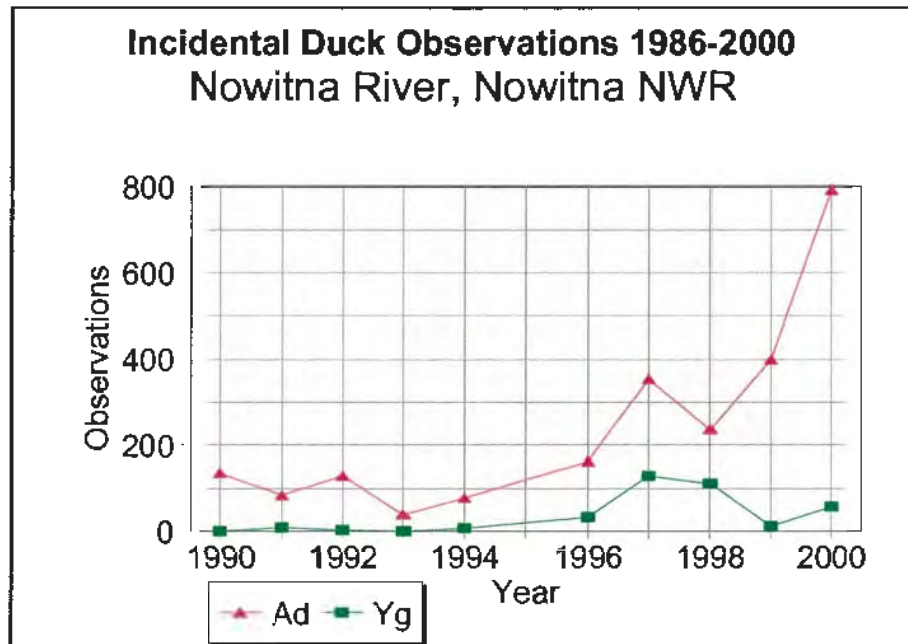


Figure G.3.2. Incidental duck observations recorded during annual goose production float surveys, Nowitna River, 1990-2000, Nowitna NWR, Alaska.

Future Duck Trend Monitoring

In September 2000, a subsample of historical data was analyzed from duck production surveys conducted between 1983-1993 on the Koyukuk/Nowitna Refuge Complex to select possible future trend monitoring plots. J.M. Bryant, 2000. An evaluation of duck trend surveys - Koyukuk and Nowitna Refuge Complex.. U.S. Fish and Wildlife Service, Koyukuk/Nowitna National Wildlife Refuge Complex, Galena, Alaska, USA. Prospective power analysis was performed by WB Bryant on the subsample to determine efficiency with which the proposed trend survey would detect trends of different sizes, and estimate the number of years of data required to reach an acceptable power. Summaries of adult, young, guild, and total observations were performed for each prospective trend plot and further summarized into survey area (i.e Nowitna or Koyukuk/Kaiyuh). Acceptable power estimates (above the target level of power ≥ 0.8) were produced for the Nowitna NWR. Power estimates were below acceptable levels on the Koyukuk/Northern Innoko (Kaiyuh) NWR's. Number of years required to produce an acceptable power to detect a 30% declining trend was 5 years on both the Nowitna and Koyukuk/Kaiyuh NWR's. When combined, the Nowitna, Koyukuk, and Kaiyuh samples produced power estimates

below an acceptable level (0.34 - 0.46), and number of years required to produce an acceptable power to detect a 30% declining trend was 4 years. Because of these results, we are evaluating and reviewing other monitoring methods for possible future application on the Complex.

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. These float surveys were our original method of monitoring goose abundance and productivity.

White-fronted geese. Abundance of adult white-fronted geese on the Koyukuk declined in the 1990's compared to the 1980's (Figure G.3.3). The early 1990's decline in Koyukuk white-front abundance prompted several studies (see below). In 2000 some areas showed an increase in adult white-front abundance (Nowitna, Figure G.3.6), while others have remained stable (Koyukuk, Figure G.3.3), or decreased (Kaiyuh Flats, Figure G.3.5). For all Interior Alaska survey areas pooled together, adult white-front abundance increased in 2000 to a level that was higher than the average of the mid-late 1990's (Figure G.3.8). We are hopeful that this change represents a turnaround from the low abundance observed through the 1990's.

In 2000, float surveys were conducted on four areas specified in the wildlife inventory plan: Dulbi River, Dulbi Slough, Kaiyuh Slough/Khotol River, and Nowitna River. Production of white-fronted geese on the Koyukuk was poor, due to somewhat late breakup and flooding (Figure G.3.3). By comparison, during 1995-97, and 1999, production of white-front young on the Koyukuk was excellent. White-front production in 2000 was good on the Kaiyuh (Figure G.3.3) and excellent on the Nowitna (Figure G.3.6). The overall regional (Koyukuk/Nowitna Complex and Kanuti NWR) mean percent white-front young in the July counts averaged 49% (Figure G.3.8), a level which suggested that production was sufficient for population growth. Mean percent young over the long-term was highest, and most consistent on the Nowitna, at 71%.

Canada geese. In contrast to white-fronts, we have not discerned a long-term trend in abundance of adult Canada geese on the Koyukuk/Nowitna Complex (Figures G.3.4, G.3.7). Adult abundance has varied greatly on the Koyukuk, but less so on the Nowitna. Relative to prior years, surveys in 2000 showed reduced abundance of Canada geese on the Koyukuk, and increased abundance on the Nowitna. Other biologists have reported a high band recovery rate (Rod King, MBM, Fairbanks) and low survival rate (Dr. Mike

Eichholz, University of Alaska) of Canada geese that were banded near Fairbanks in the 1990's. Therefore, abundance and productivity of Canada geese on the Complex should closely monitored in the future.

Production of Canada geese has also shown dramatic fluctuations on the Refuge Complex (Figures G.3.4, G.3.7). In 2000, Canada goose production was good on the Koyukuk and excellent on the Nowitna relative to prior years. Mean percent young was 58 (SD=14) on the Nowitna and 54 on the Koyukuk (SD=10), levels we believe to be sufficient for population growth.

Goose population estimation surveys

In the mid-1990's we recognized that river float surveys were best suited for monitoring production of young and indexing abundance of adult geese. The 1990's decline in white-fronted geese that was first detected by float surveys necessitated more reliable means to estimate the regional population. Therefore, we conducted a study to devise an accurate procedure for estimating goose populations on the Refuge. M.A. Spindler et al. 1998. Evaluation of aerial and float surveys of geese on the Koyukuk National Wildlife Refuge, U.S. Fish and Wildlife Service, Koyukuk/Nowitna National Wildlife Refuge, Galena, Alaska, USA recommended early July aerial surveys on the Koyukuk during the molt. The method was not found to be efficient in the Nowitna, which has lower white-front numbers. Much of this work was funded by the USFWS Division of Migratory Birds.

On Koyukuk NWR the July molting survey showed declining white-front abundance from 1994 through 1998, stability in 1999, and a small increase in 2000 (Figure G.3.9). We believe the small increase in 2000 was the result of good recruitment from high production in 1999, and possibly the results of outreach efforts to affect intensity of subsistence harvest. In 2000 we were successful in implementing this same aerial molt survey on Selawik and Innoko NWR's. Pooled results of the three Refuge surveys provide an estimate of regional population size. (Table G.3.2.). The largest number of white-fronts was observed at Innoko, while the largest number of Canada geese was observed at Selawik. Koyukuk had the fewest adult white-fronts, but the most white-front young. Innoko has been known mainly to be a molting area, while both Koyukuk and Selawik have historically been both breeding and molting areas. In 2001 we hope to include Kanuti NWR in this regional goose survey. Kanuti productivity data from float surveys has been included since 1995 (Figure G.3.8).

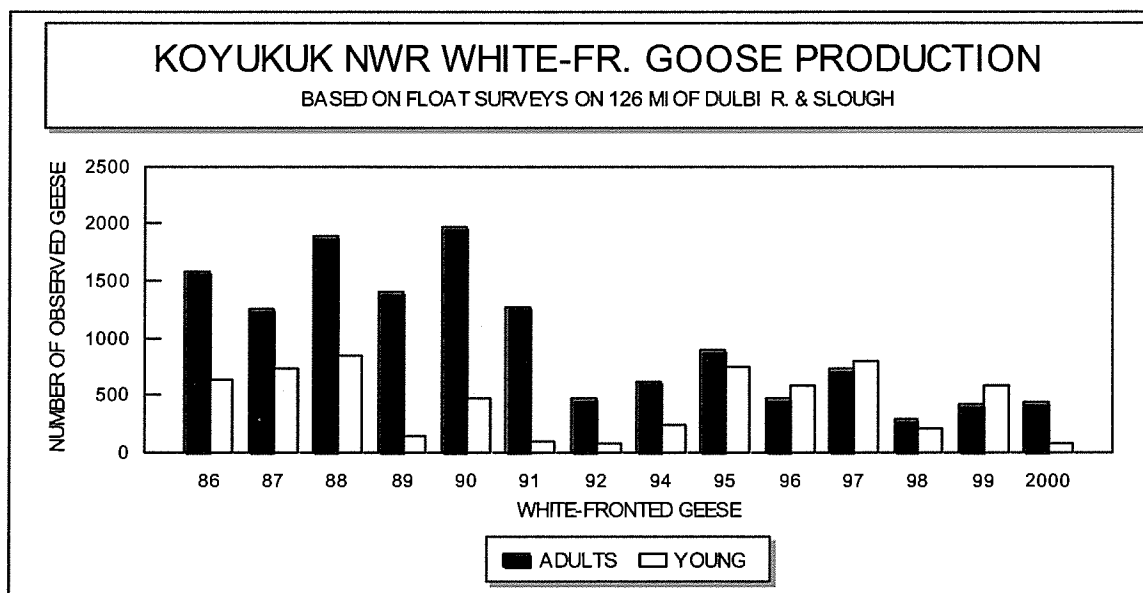


Figure. G.3.3. White-fronted goose adults and young observed on float surveys totaling 126 miles on Dulbi River and Slough, Koyukuk, NWR, Alaska, 1986-2000.

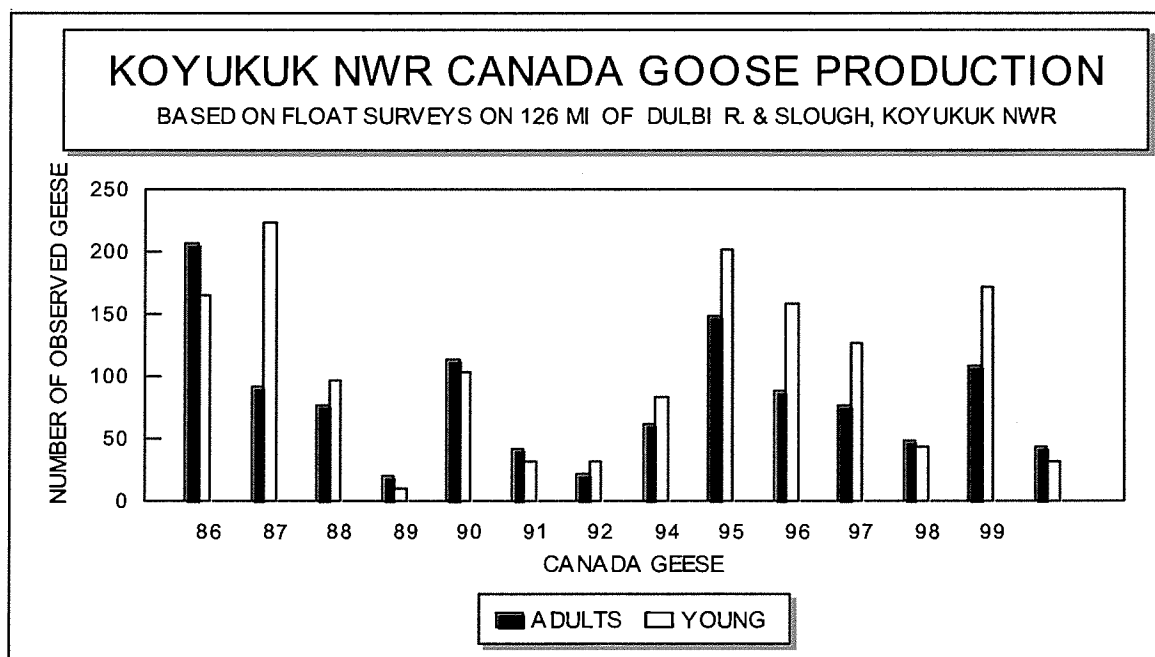


Figure. G.3.4. Results of Canada goose counts on Dulbi River and Dulbi Slough, Koyukuk NWR, Alaska, July 1986-2000.

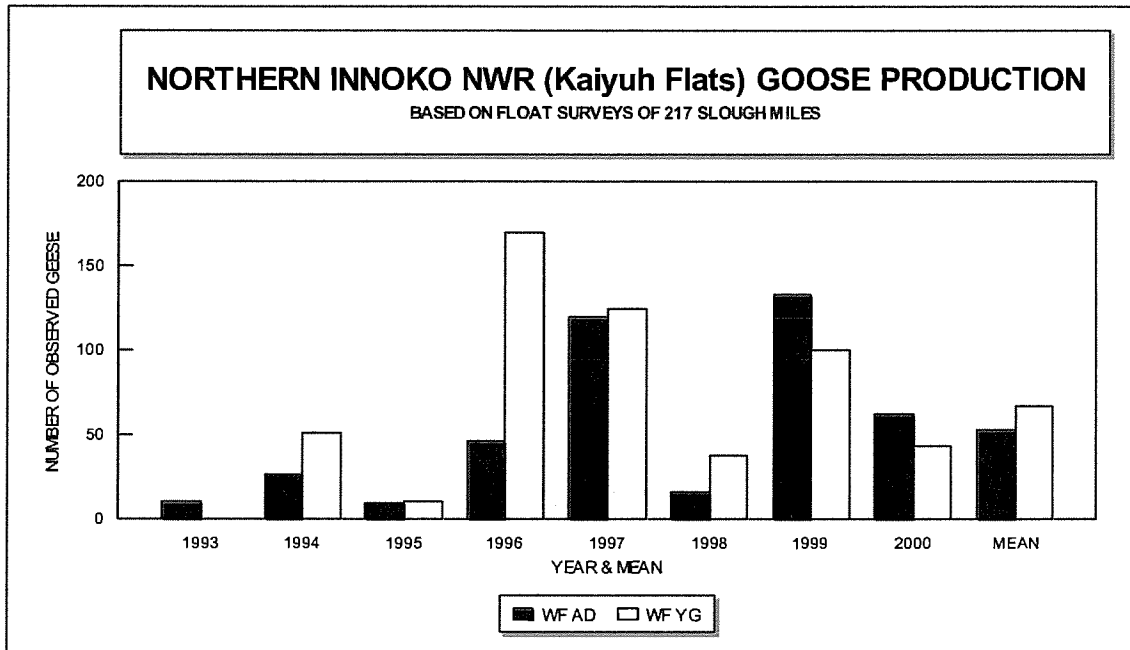


Figure. G.3.5. White-fronted goose adults and young observed on a float survey totaling 217 miles on Kaiyuh Slough and Khotol River, N. Innoko, NWR, Alaska, 1993-2000.

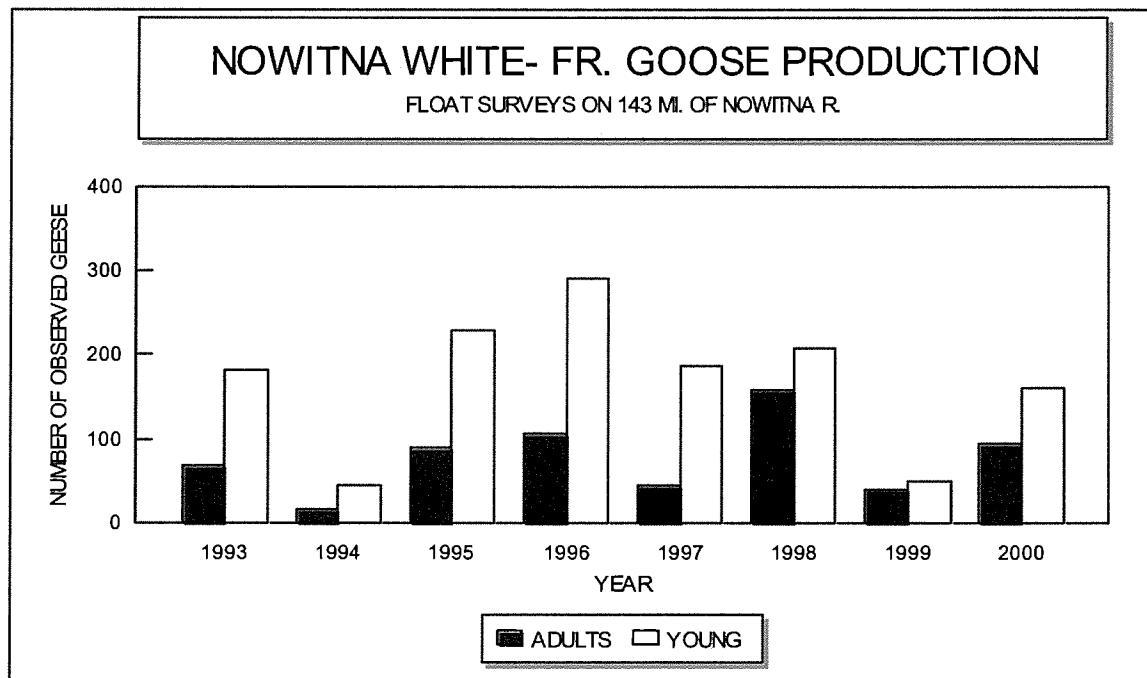


Figure. G.3.6. White-fronted goose adults and young observed on float surveys totaling 143 miles on Nowitna River, Nowitna, NWR, Alaska, 1993-2000.

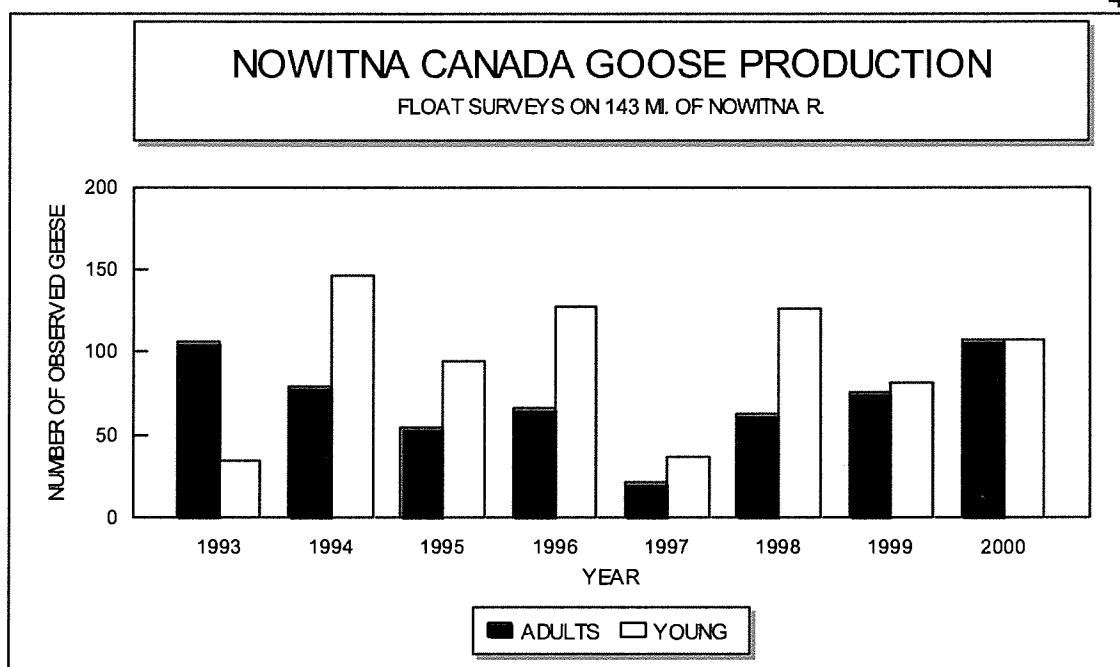


Figure. G.3.7. Canada goose adults and young observed on float surveys totaling 143 miles on Nowitna River, Nowitna, NWR, Alaska, 1993-2000.

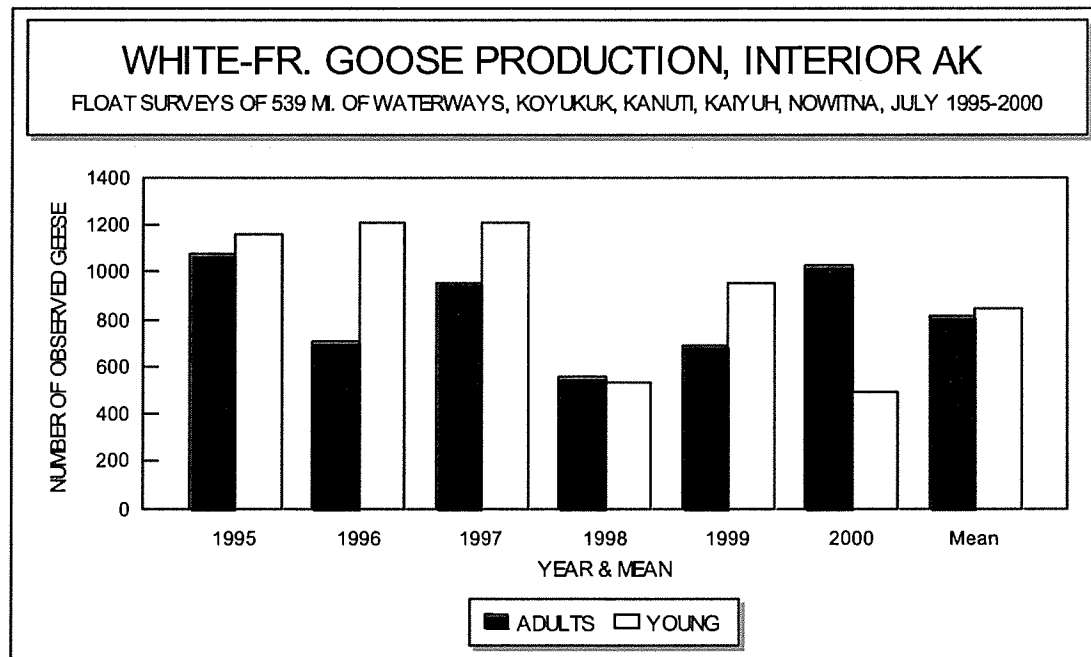


Figure. G.3.8. Recent productivity of boreal forest-nesting white-fronted geese as determined by float surveys along 559 miles of waterways on Kanuti, Koyukuk, Nowitna, and Northern Innoko NWR's, Alaska, 1995-2000. Mean age composition was 49% young.

Table G.3.2. Total white-fronted geese and Canada geese observed during intensive aerial survey of major molting areas in northwest and interior Alaska, July 2000.

White-fronted geese	Adults	Young	Total
Innoko	20684	121	20845
Selawik	2741	129	2870
Koyukuk	908	299	1207
Total White-fronted geese	24333	549	24922
Canada geese	Adults	Young	Total
Innoko	653	28	681
Selawik	5143	112	5255
Koyukuk	49	32	81
Total Canada geese	5845	172	6017

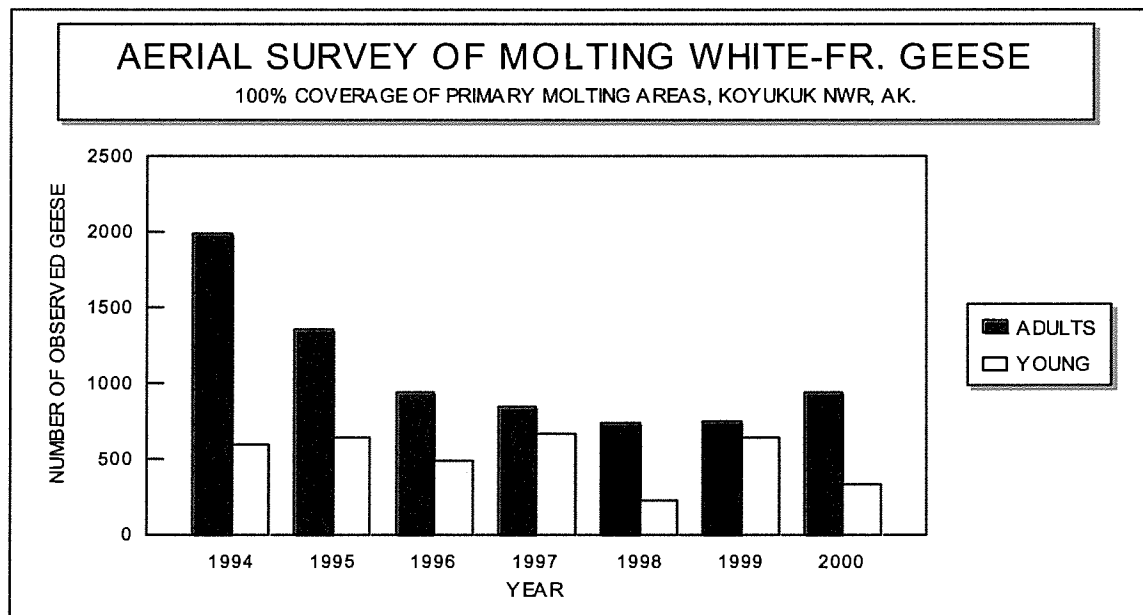


Figure. G.3.9. Estimated abundance of white-fronted goose adults and young during intensive aerial surveys of primary molting areas (Three Day Slough, Dulbi River, and Dulbi Slough), Koyukuk NWR, Alaska, July 1994-99. Sample area was 304 mi² 1995-99, and 197 mi² in 1994.

Other Goose Research

Summer movements of white-fronted geese that nest in the taiga of northwestern interior Alaska. Prior to 1994, we lacked even basic knowledge about seasonal movements and habitat preferences of white-fronted geese on the Refuge. The interior Alaska- nesting white-fronted geese of the mid-continent population, 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. Therefore, in 1994 we began a radio-telemetry study to document nesting and summer movements. During late 2000, SWB/Pilot Spindler and retired Kanuti NWR biologist Patricia Martin prepared a paper for presentation at the 2001 North American Arctic Goose Conference. The abstract from the study appears below:

Lensink (1983) estimated a breeding population of 113,000 White-fronted Geese in the taiga of Northwest and Interior Alaska. Recent estimates, however, indicated a 27% decline in this segment of the mid-continent population. Therefore we studied breeding chronology, nesting and brood-rearing habitat, and potential effects of flooding and predation on nest success. Flightless females (n=72) likely to have bred near their molting area, as indicated by brood-patch, were fitted with VHF radio collars at 2 study areas in northern and western Interior Alaska. Radio-marked geese were located weekly by aircraft during the summers of 1995-98. Of 72 radioed females, 8 were never heard from again and were censored from further analysis. Of the remaining 64 available, 31 (48%) were detected in the study the first year after marking. Thirteen (20%) returned the second year after marking, and three (5%) returned in the third year. In the first year 15 (23%) of these birds nested; in the second year six (9%) nested. Thirteen of the 35 nesting attempts resulted in broods detectable from an airplane. Nine individual geese nested in a subsequent year; two successive nest sites were within 50 m of one another, while the average distance was almost 1 km. Of the 64 radioed females available, 8 (13%) were known to have died of predation on the breeding grounds within two years of marking. Thirty nests were found; a majority (23) were located in forest edges, or in medium-tall shrub expanses near forest patches, while there were a few (7) located in tundra or open meadow habitats. Most (68%) nests were in the riparian floodplain of the Koyukuk River but 31% were in uplands and were not susceptible to flooding. Geese that nested in uplands moved their broods a greater distance (up to 7 km) from the nest to the brood-rearing area. Brood-rearing areas were large (minimum convex polygons ~20 km²).

Nest initiation occurred in mid-May, while hatching occurred the second week of June. Breeding chronology was earlier than other mid-continent white-fronts that nest in arctic tundra. Pre-migratory staging occurred from early to mid-August. Geese marked in the more westerly Koyukuk NWR staged in coastal estuaries after a *northwestward* movement that was opposite to their *southeastward* migration to Canada. Geese marked in the more easterly Kanuti NWR probably migrated directly southeastward; however two were documented staging in riparian habitats along the Yukon River. Fall departure from northwest Alaska was usually complete by the end of August. The comparatively early fall migration of taiga-nesting White-fronted Geese, relative to tundra nesters, may cause early harvest to be directed towards this small component of the overall mid-continent population.

Findings in this study strengthened Lensink's (1987) and Ely & Dzubin's (1994) assertions that white-fronts have high nesting area fidelity. The finding that a majority of nests are within the floodplain, where they are susceptible flooding, may in-part explain the decline of the early 1990's, when there was a string of flood years.

Summer diet composition of white-fronted geese that nest in northwest and interior Alaska. During 2000, former Refuge SCEP technician Delia Person, now a biologist at Yukon Flats NWR, collaborated with SWB Mike Spindler to summarize the results of white-fronted goose diet and habitat studies conducted on the Koyukuk NWR and near Selawik NWR in 1996. An abstract of their paper to the 2001 North American Goose Conference follows:

We documented diets of greater white-fronted geese *Anser albifrons frontalis* in Northwest and Interior Alaska during the 1996 breeding season. This study was part of an investigation of summer movements of radio-marked geese. We hypothesized that one reason geese make a pre-migratory staging movement opposite to their ultimate migration direction could be that nutritional quality of forage was higher at coastal sites compared to interior sites during August. Diet of white-fronted geese was characterized by micro-histological analysis of fecal samples collected June-August on Koyukuk National Wildlife Refuge and in August on the northern Seward Peninsula (fall staging period). We also estimated forage availability and use, and collected plant samples to provide an index of forage quality. Early in the breeding season, when no other vegetation was available, *Equisetum* was the primary component of white-fronted goose diets. In July, *Arctophila*, *Juncus*, *Eleocharis*, and *Carex* graminoid species comprised the majority of the diet at lakeshore sites, while *Equisetum* was the main component in feces at riparian sites. Estuarine graminoids made up a substantial portion of the diet on the northern

Seward Peninsula in August. Berries were not prominent in fecal analysis to the extent we expected based on observations of goose foraging activity in estuarine areas. These results should be interpreted with caution, because differential digestibilities of plant matter may cause micro-histological analyses to either under- or over-estimate the percentages of certain plant species found in the diet. Our preliminary diet analyses in 1996 did not detect differences in forage quality among the coastal and inland study sites. Nevertheless, we determined that coastal estuarine meadows up to 200 km away from the nesting area provided significant nourishment prior to fall migration.

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 (Bill Eldridge, pers. comm.). 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 unknown 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 of geese 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 band 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 fall and spring, 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 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 are collaborating with Canadian Wildlife Service biologists to prepare a scientific paper.

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. The Refuge has contributed to several cooperative studies to better define 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 Mexican Universities in the northern states of Tamaulipas, Nuevo Leon, and Chihuahua).

A Mexican student volunteer program (*see* Section E.4) provided the Service an opportunity to obtain white-fronted goose winter ecology and behavior data from two major wintering areas, Tamaulipas and Durango. These cooperative studies resulted in two poster-papers that were submitted to the 2001 North American Arctic Goose Conference.

Ms. Fabiola Yopez, a 1998 Refuge volunteer and University of Tamaulipas student, spent the winters of 1998-99 and 1999-2000 working on a senior thesis entitled *Winter ecology of the white-fronted goose (Anser albifrons) in Tamaulipas, Mexico*. She was assisted by Alejandro Carreon, her University of Tamaulipas advisor, and by Bill Eldridge, USFWS, Division of Migratory Birds, Anchorage. The Refuge contributed \$2,500 to fund logistics costs and \$2,500 to acquire satellite imagery in support of this project. An abstract to that study follows:

The population of mid-continent white-fronted geese in Mexico has increased in recent years due to expanding agriculture. Up to 200,000

white-fronts may winter in the state of Tamaulipas. There is little information on wintering ecology of white-fronts from these regions. This study was initiated to: 1) determine activity patterns and time budgets 2) determine amount and sources of disturbances 3) assess the amount of available food in agricultural fields. The study was conducted from November, 1998 to March, 2000 on a 3,445 ha private ranch in central Tamaulipas with included a 101 ha artificial impoundment. Classification from Landsat imagery indicated it was comprised of 56% sorghum (*Sorghum bicolor*) fields, 14% natural vegetation and 3% water, and is considered typical of the region. A maximum of 60,000 white-fronted geese were counted and geese were on the site from November to March. Movement patterns consisted of a daybreak departure from the impoundment for feeding with a return by mid-morning depending on temperature. A shorter feeding flight occurred from 1-2 hours prior to dusk. A daily average of two and four hours were spent on these feeding flights in 1998/99 and 1999/2000, respectively. Night feeding rarely occurred. Standard time-budget analysis of 13 classes of activity indicated that feeding (49%) was followed by movement (18%) and resting (14%) in sorghum fields. On the impoundment, movement (45%) was the most common activity followed by resting (19 %) and feeding (14%). During 184 hours there were 20 natural, 31 man-caused and 4 disturbances of unknown origin. Hunters and crop-dusting airplanes were the most common human disturbances, and interspecific social interactions caused the most common natural disturbances. Food availability was determined by random plot sampling of recently harvested sorghum fields. The amount of waste grain was 78 and 162 kg/ha in 1998/99 and 1999/2000, respectively. Differences were attributed to drought conditions in 1998/99 which affected goose use of the site. White-fronts on this study site appear to have an abundant quality food source associated with a sufficient water supply and minimal disturbance in a normal weather year. If this is typical of the region, white-fronts may expend less energy for daily maintenance than on more heavily disturbed areas in the United States. Identifying important impoundments to geese and encouraging proper management would be a useful endeavor in Mexico.

Winter ecology of white-fronted geese in the highlands of Mexico. 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 southern Chihuahua, central Durango, and northern Zacatecas. However, there would be several challenges to surmount. Unlike Tamaulipas, the wetlands in these arid habitats of north-central Mexico are dispersed over a very large area (>1000 km). Access is more difficult and costly, and geese are widely dispersed. In 1999 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 began a Master's Thesis under Dr. Alberto Lafon, at the Univ. of Chihuahua. The Refuge allocated \$7,500 in 1999 and \$12,500 in 2000 for logistical support. To report progress on the study so far, Manuel Ochoa, Alberto LaFon, Rod Drewien, and Mike Spindler submitted the following abstract to the January 2001 North American Arctic Goose Conference:

More than 25,000 white-fronted geese (*Anser albifrons*) were observed in an aerial survey of the northern Mexico highland states from Chihuahua south to Jalisco, December 14-20, 1999. A simultaneous ground count yielded more than 18,000 white-fronts in the three northern states of Chihuahua, Durango, and Zacatecas. The distribution of white-fronted geese was related to the availability of water and food which vary annually. During intensive observations on two study areas in the state of Durango, January-March 2000, we sighted 47 neck-collared white-fronted geese. A vast majority (>90%) of these birds were banded in Northwest and Interior Alaska and are part of the mid-continent population. We did not detect any single factor that had a significant adverse effect on white-fronted geese wintering in the Mexico highlands. However, a decade-long drought has caused a reduction in size and availability of water bodies used by geese for resting. Generally, food production was not greatly reduced due to drought because feeding areas are near larger water bodies that provide irrigation for crops. Irrigation, however, contributes to the reduction in size and availability of water bodies. We observed some inter-wetland movements of collared white-fronts extending 10-18 km and one exceeded 100 km. We did not observe frequent disturbance of white-fronted geese. Probably the most significant disturbance was the activities of hunters, which caused the greatest perturbation of their normal behavior. Snow geese (*Chen caerulescens*) were the greatest competitor of white-fronted geese. Small groups of white-fronts often departed their feeding area when large groups of snow geese also landed to feed.

Working Towards a Goose Management Plan. In late 2000, SWB Spindler, RIT Huntington, and WB Bryant spent a considerable amount of time summarizing the biological and harvest information on geese in the region and the flyways to present to various groups in an effort improve the Service's management of geese in interior Alaska. A document entitled *Towards a management plan that would address declining abundance of white-fronted geese in northwest and interior Alaska* was prepared in November 2000. The document was circulated among interior Alaska Refuges, Regional Office Division of Migratory Birds, and Refuges staff. The issue was discussed at a meeting in the Regional Office in November and December 2000. Refuge staff believed that we had enough scientific documentation to carry the issue forward to the Central

Flyway and the Alaska Migratory Bird Co-management Council (see Section H.20, Subsistence).

Swans

Swan surveys have been conducted on the Refuge Complex since the mid-1980's.. 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. In 1989 the staff selected twelve 1:63,360 trend maps (four on the Koyukuk, two on the Kaiyuh, and seven on the Nowitna) to monitor swan population and production according to the Refuge wildlife inventory plan. Both trumpeter and tundra swans nest on the Refuge. Surveys in 1985 and 1987 indicated that abundance of tundra swans increases as one proceeds north of the Koyukuk River. Late summer aerial production surveys have necessarily grouped the two species simply as "swans."

Aerial surveys are conducted to monitor trends in swan population and production on an annual basis and a state-wide census is conducted to estimate overall population every five years. When the two surveys coincide, as they did in 2000, the trend areas are sampled as a subset of the census. A detailed survey report by WB Bryant entitled *Swan survey summary report 2000 - Koyukuk/Nowitna National Wildlife Refuge Complex*, is available in the Refuge biological files. A brief summary follows:

Koyukuk/Northern Unit of Innoko (Kaiyuh)

The 2000 trend and census showed that swan populations continued to increase on the Koyukuk and Northern Unit of Innoko (Kaiyuh) NWR (Table G.3.3). Census statistics from 2000 (Table G.3.4) show increases in non-breeders, breeders, and breeding effort, but slight decreases in mean brood size, and percent young. Average annual change in population shows that growth has slowed down from that seen between 1990 and 1995, but the population appears stable.

Nowitna

The 2000 trend and census results showed a decline in total swans from the high numbers seen during the 1995 census, but numbers are still higher than the low observed in 1990 (Table G.3.5). The number of adults declined slightly, but the number of young declined sharply and is below the number seen in 1990. The number of breeders (pairs*2) increased showing a good breeding effort, but production (percent young) declined and is the lowest observed (Table G.3.6).

Table G.3.3. Swan Census results, Koyukuk and Northern Unit of Innoko NWR, Alaska 1990-2000.

Year	Singles	Pairs	Broods	Flocked	Adults	Young	Total
1990	43	186	58	45	460	157	617
1995	52	274	95	133	733	273	1006
2000	95	437	128	176	1145	320	1465

Table G.3.4. Swan Census production statistics for Koyukuk and Northern Unit of Innoko, Alaska 1990-2000.

Year	1990	1995	2000
Non-breeders (singles + flocked)	88	185	271
Breeders (pairs * 2)	372	548	874
Mean brood size (young/broods)	2.7	2.9	2.5
Breeding effort (breeders/adults)	0.81	0.75	0.76
Percent young ((young/total)*100)	25%	27%	22%
Avg. annual change in population ((difference/beginning pop / # yrs) *100)	-	13%	9%

Table G.3.5. Swan Census results, Nowitna NWR, Alaska 1990-2000.

Year	Singles	Pairs	Broods	Flocked	Adults	Young	Total
1990	13	89	25	25	216	76	292
1995	10	110	40	118	348	144	492
2000*	24	112	28	9	288	73	361

*the 2000 Nowitna census missed one map (Ruby C-6). This omission is not considered critical because historical swan density has been low (1990 = 1 single, 1995 = 1 pair) on this map.

Table G.3.6. Swan Census production statistics Nowitna, Alaska 1990-2000.

Year	1990	1995	2000
Non-breeders (singles + flocked)	38	128	33
Breeders (pairs * 2)	178	220	224
Mean brood size (young/broods)	3.0	3.6	2.6
Breeding effort (breeders/adults)	0.82	0.63	0.78
Percent young ((young/total)*100)	26 %	29 %	20 %
Avg. annual change in population ((difference/beginning pop/#years)*100)	-	14 %	-5 %

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. 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 Complex: lesser and greater yellowlegs; Arctic tern; glaucous, Bonaparte's, mew, and herring gulls; long-tailed jaeger; 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 southeast 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, including rough-legged hawks, merlin, sharp-shinned hawks, northern harriers, red-tailed hawks, goshawks, great horned owls, great grey owls, boreal owls, northern hawk owls, American peregrine falcons, golden and bald eagles. Raptors are generally sensitive to disturbance and, therefore, act as important indicator species.

Peregrine Falcon surveys have been conducted periodically on the Yukon River between Ruby and Kaltag, and on the Koyukuk River above Koyukuk village. The USFWS

Endangered Species Office conducted the survey from 1979 to 1991, while the Refuge conducted partial surveys in 1992-1994. A complete survey of peregrine falcon nest sites had not been conducted since 1991. Past surveys were supervised by Peter Bente (ADF&G) who was working with Endangered Species Office, Fairbanks. Bente, now an employee with ADF&G, joined us 2000 to repeat the entire survey. The Refuge benefitted greatly from his extensive knowledge and experience. Bente was able to train Randy Shaw (volunteer, Ruby) and PR Karin Lehmkuhl, to maximize consistency in the survey. Shaw surveyed with Bente between Ruby and Anvik (July 10-15). Lehmkuhl swapped out with Randy at Anvik, and the surveyors continued downriver to Tabernacle, rechecked nest sites in the upriver trip, and traveled up the Koyukuk R. as far as Ella's cabin before returning to Galena (July 15-20).

A 24ft Alweld boat with a 130hp motor (Honda, 4-stroke) was used on the survey. The boat was well suited to survey needs. The boat was easy to maneuver near cliff bases, and got remarkably good gas mileage despite survey conditions requiring frequent idling. Totals of 52 pairs and 12 single peregrines were located at 64 sites, (Table G.6.1). Thirty-one of the pairs were successful, producing an average of 2.14 young per successful pair (1.27 young per pair, total). Bente felt that the population size was "normal" but that production was low (see Table G.6.2 for comparison to 1989 and 1991). The spring of 2000 was cold and there were few mosquitoes early on. This may have impacted songbird populations (overall there were few swallows in 2000). If male peregrines are unable to provide enough food for their mate while she is incubating, she is forced to leave the nest, resulting in egg cooling and mortality. One dead falcon was found at the base of a cliff near Stink Creek (below Kaltag). The carcass was collected to investigate cause of death.

Table G.6.1. Occurrence of single peregrine falcons, pairs, and young on the Lower Yukon River (Ruby to Tabernacle), 2000.

Kilom.	Site	Name	July 10-20, 2000		
			2000 Single	2000 Pair	2000 Young
1072.00	LY-1		0	X	3
1078.80	LY-1.1		0	X	0
1080.40	LY-2	Ruby Rock	0	X	0
1090.00		WPT-002	0	X	2
		WPT-006	0	X	1
1103.7	LY-3	below Emmit Peter's Camp	0	X	2
		Jackson	0	X	0
1110.5	LY-3.1	Yuki-Sandstone Bluff	0	X	0
1112.8	LY-3.2	L. Yuki	0	X	2
		WPT-011	0	X	0
1132.7	LY-3.3	Fish Island	0	X	2
	LY-3.4		0	X	3
		Louden	F	0	0
1194.00	LY-4	Bishop Rock	0	X	0
1205.00	LY-5.1		0	X	3
1207.00	LY-5		M	0	0
1209.00	LY-6		0	X	0
1228.60	LY-6.1	above Gemodedon Island	0	X	3
	LY-6.4	WPT-016	0	X	2
	LY-7+	WPT-017	M	0	0
1240.4	LY-8	WPT-018 (Nulato Airstrip)	M	0	0
1256.2	LY-8.1	below Ninemile River	0	X	3
1260.10	LY-8.2		0	X	0
1261.50	LY-8.3		0	X	0
1266.50	LY-9	above Dwayne Sommer Fishwheel	0	X	0
1269.00	LY-10	above Halfway Island	F	0	0
1271.50	LY10.1	one mile below LY-10.2	0	X	0
1276.30	LY-11	S end Halfway Island	0	X	0
1279.00		WPT-019	0	X	3
1282.50	LY-12	across from center Sevenmile Island	M	0	0
1291.30	LY12.1	2mi above Kaltag	0	X	0
1297.50		WPT-021	0	X	3
1305.50		WPT-022	F	0	0
1309.50	LY-12.2		0	X	0
1323.30		WPT-061	M	0	0
1330.60	LY-14		0	X	3
1331.60	LY-14.8		0	X	2
1339.70	LY-14.2		0	X	0
1345.10	LY-14.7		0	X	0
1363.50	LY-14.3+		0	X	1
1364.50	LY-14.3B		F	0	0
1367.80	LY-14.6		0	X	2
1368.70	LY-15		0	X	1
1373.40	LY-16		0	X	1
1399.00	LY-17		0	X	0
1430.40	LY-18		M	0	0
1435.00	LY-18B		0	X	0
1439.80	LY-18.1		0	X	2

			July 10-20, 2000		
Kilom.	Site	Name	2000 Single	2000 Pair	2000 Young
1441.70	LY-18.2	WPT-041	M	0	0
1451.80	LY-19		0	X	2
1482.30	LY-21		0	X	2
1485.00			0	X	3
1508.50	LY-24		0	X	2
1510.40	LY-25		0	X	0
1512.00	LY-25C		0	X	1
1520.20	LY-26		0	X	2
1542.90	LY-27		0	X	1
1547.90	LY-28		0	X	0
	LY28.1		0	X	3
1577.1	LY29		0	X	0
1609	LY-30		F	0	0
	LY-30/31		0	X	2
1614.6	LY-31	0	X	1	
		Ella's Cabin	0	X	3
TOTAL			12	52	66
Occupied sites = 64			M=7		
Total pairs = 52			F=5		
Successful pairs = 31					
Failed pairs = 21					
Young per total pairs = 1.27					
Young per successful pairs = 2.12					

Table G.6.2. Comparison of peregrine falcon occupancy and nest success in the Lower Yukon Region during three survey years.

Year	1989	1991	2000
Single	9	11	12
Pairs	52	50	52
Young	83	88	66
Occupied Sites	58	62	64
Successful Pairs	35	33*	31
Failed Pairs	17	13	21
Young/Pair	1.6	1.76	1.27
Young/Successful Pair	2.37	2.67	2.12
* plus 4 incubating			



These young peregrine falcons were banded during the 2000 Raptor Survey. (KL)



Cliffs like these along the Yukon River offer nest sites for peregrines. (KL)



Biologist Peter Bente (ADF&G) looks for peregrines and their nest. Also shown is the 24' Alweld which performed well during the survey. (KL)



PR Lehmkuhl perches with young peregrines in the nest. (PB)

7. Other Migratory Birds

Landbird monitoring activities on the Complex through 1996 were summarized in a report by Buddy Johnson entitled "*A summary of landbird inventory and monitoring activities on the Koyukuk/Nowitna Refuge Complex, 1992-1996.*" Reports in this narrative will focus on years subsequent to the 1992-96 report.

Monitoring efforts for passerines in the Galena area during 2000 included surveys of spring bird migration phenology (collection of arrival dates and North American Migration Count), breeding birds (Standard Breeding Bird Survey - BBS), 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 records 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 2000 nine species for which we have long-term data arrived earlier than their long-term mean arrival date, and two species arrived later than the long-term mean.

Table G.7.1. Spring arrival dates of common birds at Galena, Alaska, 2000.

Species	2000	Mean (1982-2000)
Snow bunting	25 Ma	27 Ma
Northern pintail	20 A	25 A
Mallard	26 A	27 A
Canada goose	30 A	27 A
White-fronted goose	17 A	24 A
Slate-colored junco	23 A	27 A
Ruby-crowned. kinglet	29 A	30 A
Mew gull	29 A	30 A
American robin	30 A	30 A
American tree sparrow	29 A	3 M
Common snipe	nd	7 M
Tree swallow	12 M	9 M
Olive-sided flycatcher	19 M	25 M

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

Migration Counts

The refuge began participating in the North American Migration Count (NAMC) in 1992 to provide a "snapshot" of spring migration near Galena. Data are contributed towards a summary of 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 2000 totals of 4,640 individuals of 51 species were recorded in the Galena area (Table G.7.2). The greatest number of species and individuals ever recorded during the Galena NAMC occurred in 2000. Particularly high counts were observed in 2000 for several waterfowl and shorebird species, and lapland longspurs. Another highlight in 2000 was the inclusion of 2,982 sandhill cranes. A majority of these were migrating along the Yukon River headed west across the Bering Strait to nest in eastern Siberia. In prior years, we were not lucky enough to have the NAMC coincide with this spectacular migration, which usually lasts only 2-4 days each spring and fall. Other high counts of sandhill cranes occurred in 1999 (118) and 1997 (165) (Table G.7.2).

Table G.7.2. Summary of North American Migration Count in the Galena area, May 1994-2000.

Species	1994	1995	1996	1997	1998	1999	2000	Mean
Horned grebe	4	0	0	0	0	0	1	0.7
Red-necked grebe	10	2	0	4	0	0	16	4.6
Tundra swan	1	20	1	1	28	7	4	8.9
Trumpeter swan	0	0	0	0	0	9	23	4.6
Swan spp.	0	0	0	0	0	0	46	6.6
White-fronted goose	0	0	3	0	0	6	8	2.4
Canada goose	2	0	1	0	18	7	11	5.6
Green-winged teal	12	2	2	2	1	10	12	5.9
Mallard	13	15	4	2	9	22	53	16.9
Northern pintail	41	0	12	4	175	44	302	82.6
Northern shoveler	5	4	6	4	45	15	76	22.1
Eurasian wigeon	0	0	0	0	1	0	0	0.1
American wigeon	30	48	8	14	48	10	128	40.9
Canvasback	1	1	0	0	2	4	0	1.1
Ring-necked duck	2	0	0	0	0	0	0	0.3
Scaup spp.	13	2	0	0	0	0	14	4.1
Black scoter	0	6	0	0	0	0	0	0.9
Common goldeneye	7	0	5	1	9	0	2	3.4
Bufflehead	0	5	1	5	3	2	2	2.6
Common merganser	0	1	3	0	2	0	0	0.9
Red-br. merganser	0	0	1	0	0	0	0	0.1
Bald eagle	0	0	0	0	0	1	1	0.3
Northern harrier	0	0	0	0	0	3	2	0.7
Harlan's red-tailed hawk	2	0	0	0	0	0	3	0.7
American kestrel	1	0	0	0	0	0	0	0.1
Peregrine falcon	0	0	0	0	1	0	0	0.1
Spruce grouse	0	0	1	0	2	2	0	0.7

Ruffed grouse	0	0	0	0	1	0	1	0.3
Sandhill crane	59	5	8	165	0	118	2892	463.9
American golden plover	0	0	0	0	0	0	25	3.6
Semipalmated plover	0	0	1	0	0	0	0	0.1
Lesser yellowlegs	13	3	1	5	15	0	169	29.4
Solitary sandpiper	17	8	1	1	0	0	38	9.3
Spotted sandpiper	0	0	0	0	0	2	0	0.3
Hudsonian godwit	0	0	0	0	1	0	4	0.7
Whimbrel	0	0	1	0	0	0	27	4.0
Black turnstone	0	0	0	0	0	0	24	3.4
Long-billed dowitcher	0	0	0	0	0	0	4	0.6
Common snipe	13	10	5	10	14	2	17	10.1
Bonaparte's gull	0	0	0	0	1	0	10	1.6
Mew gull	8	3	0	3	3	0	3	2.9
Herring gull	0	0	2	0	2	43	0	6.7
Glaucous gull	0	0	5	0	0	0	2	1.0
Arctic tern	1	0	0	2	0	0	0	0.4
Belted kingfisher	1	0	0	0	0	0	1	0.3
Downy woodpecker	0	0	3	0	0	0	0	0.4
Hairy woodpecker	0	0	0	0	1	0	0	0.1
N. three-toed woodpecker	0	0	0	0	1	0	0	0.1
Northern flicker	0	0	0	0	0	1	0	0.1
Hammond's flycatcher	0	0	0	0	1	0	1	0.3
Tree swallow	12	4	0	1	8	0	7	4.6
Violet-green swallow	8	1	0	5	10	0	2	3.7
Cliff swallow	2	0	0	0	0	0	0	0.3
Gray jay	2	5	2	4	1	6	4	3.4
Common raven	5	2	14	12	5	19	28	12.1
Black-capped chickadee	0	0	0	8	9	21	5	6.1
Boreal chickadee	2	2	3	2	6	1	0	2.3

Ruby-crowned kinglet	18	17	15	20	26	0	1	13.9
Swainson's thrush	0	2	0	0	0	0	0	0.3
American robin	38	15	16	39	25	26	40	28.4
Varied thrush	3	3	0	7	0	0	5	2.6
American pipit	2	0	0	0	0	0	0	0.3
Bohemian waxwing	0	0	0	0	8	0	0	1.1
Orange-crowned warbler	4	6	0	0	0	0	2	1.7
Yellow warbler	0	0	5	0	0	3	0	1.1
Myrtle warbler	29	20	10	28	57	8	18	24.3
Blackpoll warbler	0	2	0	0	0	0	0	0.3
Northern waterthrush	0	0	0	3	0	0	0	0.4
Wilson's warbler	1	0	0	0	3	0	0	0.6
American tree sparrow	0	0	0	0	0	10	39	7.0
Savannah sparrow	17	0	0	7	2	0	9	5.0
Fox sparrow	13	3	0	9	2	0	6	4.7
Lincoln's sparrow	1	0	0	3	2	0	0	0.9
Golden-cr. sparrow	0	0	0	0	0	0	15	2.1
White-cr. sparrow	54	15	2	21	4	0	80	25.1
Slate-colored junco	18	21	21	34	54	12	13	24.7
Lapland longspur	0	0	0	0	0	0	426	60.9
Rusty blackbird	5	3	0	12	10	0	14	6.3
Pine grosbeak	0	0	0	0	0	2	0	0.3
White-winged crossbill	5	0	0	0	0	0	0	0.7
Common redpoll	16	12	0	19	19	14	4	12.0
Hoary redpoll	0	0	0	0	0	1	0	0.1
Total species	43	33	31	33	42	31	51	37.7
Total individuals	510	268	163	457	635	430	4640	1014.7
Birding participants	3	6	5	5	6	6	10	5.9
Parties	3	3	5	5	5	4	6	4.4

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. Three BBS routes were conducted on the Refuge Complex: two at or near Koyukuk NWR and one at or near Nowitna NWR.

Koyukuk NWR

The Galena Road BBS route has been run continuously since 1985. It is the longest-running route on/near Koyukuk NWR (Table G.7.3). It covers 12.5 miles on much of the available road system. 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 other Koyukuk NWR route- Nikolai Slough. The Nikolai Slough survey route is 4-10 miles northwest of Galena and is run by boat, which makes it especially challenging to complete within the allotted time limits. However, the route encompasses some excellent songbird and wetland habitat. It is the most productive route on the Complex in terms of species diversity and abundance (Table G.7.4). Both ADF&G and USFWS Division of Migratory Birds have been particularly interested in the counts of long-distance nontropical migrants (particularly flycatchers) from this route

Galena Road BBS. This survey was conducted on June 13, 2000 by SB/Pilot Mike Spindler. A total of 306 individuals of 36 species was recorded (Table G.7.3). The results in 2000 represented greater than average number of individuals and species richness. The range in number of species observed has been 28-36 in the last four years. Notable increases in the 2000 counts compared to the long-term means, or last year's observations, included fourteen species: red-necked grebe, lesser scaup, common snipe, alder flycatcher, gray jay, common raven, orange-crowned warbler, myrtle warbler, Wilson's warbler, northern waterthrush, slate-colored junco, pine grosbeak, white-winged crossbill, and common redpoll. Six species decreased from the long-term mean, or last year's value: gray-cheeked thrush, Swainson's thrush, varied thrush, yellow warbler, fox sparrow, and white-crowned sparrow.

Nikolai Slough BBS. This survey was conducted on June 12, 2000 by SB Mike Spindler and PR Karin Lehmkuhl. A total of 523 individuals of 51 species was observed in 2000 (Table G.7.4). Total individuals decreased from the long term average, but number of species was above average. Counts above the long-term average were observed for eight species, red-necked grebe, sandhill crane, alder flycatcher, tree swallow, orange-crowned warbler, myrtle warbler, northern water thrush, and slate-colored junco. Counts that were below previous years or below the long-term average were recorded for 17 species: mallard, northern shoveler, American wigeon, common goldeneye, bufflehead, lesser yellowlegs, spotted sandpiper, mew gull, belted kingfisher, common raven, American robin, varied thrush, yellow warbler, fox sparrow, white-crowned sparrow, rusty blackbird, and common redpoll.

Table G.7.3. Results of the Galena Road Breeding Bird Survey. Means are 1985-2000.

Species	1997	1998	1999	2000	Mean	SD	CV
Common loon		1		1	0.1	0.0	0.00
Red-necked grebe		1	1	4	1.1	1.3	1.19
Trumpeter swan		1			0.1	0.0	0.00
White-fronted goose			2		0.1	0.0	0.00
Canada goose			3		0.3	0.5	1.60
Lesser scaup				2	0.1	0.0	0.0
Green-winged teal				1	0.3	0.5	1.89
American wigeon			3		0.6	0.9	1.51
Sandhill crane		1	4	1	1.6	1.0	0.64
Lesser yellowlegs	1		4		3.5	3.1	0.88
Solitary sandpiper	7	3	3	2	2.2	1.9	0.86
Common snipe	5	14	8	15	8.6	4.1	0.48
Herring gull				1	0.4	0.5	1.33
Mew gull	9	3	3		2.4	2.5	1.05
Great horned owl				1	0.3	0.4	1.39
Northern hawk-owl				1	0.1	0.0	0.0
Olive-sided flycatcher	1	4	1	3	2.8	1.9	0.67
Alder flycatcher	17	17	30	40	33.9	11.9	0.35
Tree swallow	25	6	14	5	6.8	5.9	0.88
Violet-green swallow	2	6	2	6	1.8	2.2	1.20
Bank swallow	1				1.1	3.4	3.01
Cliff swallow			1	1	2.4	7.5	3.14
Gray jay	2	3	5	5	1.7	1.6	0.96
Common raven	1	2	14	15	3.6	5.8	1.60
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	6	4.3	3.0	0.71
Gray-cheeked thrush	4	7	1	1	4.3	3.2	0.74
Swainson's thrush	29	41	38	24	31.0	12.7	0.41
American robin	18	21	19	25	18.9	6.7	0.35
Varied thrush	1	5	5	0	4.1	2.6	0.63
Orange-crowned warbler	13	31	12	23	13.4	9.0	0.67
Yellow warbler	30	22	23	15	20.8	11.5	0.55
Myrtle warbler	9	17	22	17	9.1	6.0	0.65
Blackpoll warbler	3	6	9	3	2.8	2.7	0.99
Wilson's warbler		2		2	0.3	0.0	0.00
Northern water thrush	23	22	26	23	14.5	9.6	0.66
Savannah sparrow	3	10	7	7	7.1	2.2	0.31
Fox sparrow	8		3	1	2.6	2.2	0.83
Lincoln's sparrow	8	10	8	5	3.9	3.0	0.77
White-crowned sparrow	8	16	18	9	19.3	6.6	0.34
Slate-colored junco	14	22	21	20	16.6	4.9	0.29
Rusty blackbird		1	7	1	1.5	1.6	1.09
Pine grosbeak				2	0.3	0.7	2.83
White-winged crossbill		4	3	7	2.6	6.9	2.70
Common redpoll	5	5	3	11	8.1	5.5	0.68
SPECIES	28	33	34	36	29.4	3.0	0.10
TOTAL	256	316	331	306	264.4	47.9	0.18

Table G.7.4. Results of the Nikolai Slough Breeding Bird Survey, June 1997-2000, compared to long term (1986-2000) mean, standard deviation (SD) and Coefficient of Variation (CV).

Species	1997	1998	1999	2000	Mean	SD	CV
Red-throated loon				1	0.2	0.0	0.00
Red-necked grebe				3	2.1	1.6	0.75
Trumpeter swan		1	2	1	0.4	0.50	1.17
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	1	4.1	9.0	2.22
Northern pintail			13	1	2.6	3.7	1.42
Northern shoveler			14	2	5.0	7.6	1.52
American wigeon	18	33	34	13	15.1	10.7	0.59
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	1	4.8	3.5	0.74
Bufflehead	2	5		2	2.3	2.2	0.95
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		2	1.0	1.1	1.11
Sandhill crane	3	12	10	10	5.8	3.5	0.61
Lesser yellowlegs	11	13	6	4	10.6	4.6	0.44
Solitary sandpiper	3	5	2	4	4.4	2.5	0.56
Spotted sandpiper	22	21	22	10	14.1	8.7	0.61
Common snipe	57	61	46	40	38.5	12.4	0.32
Bonaparte's gull		1	3		1.3	2.3	1.81
Mew gull	14			2	4.9	6.2	1.25
Herring gull	1	1	5	1	1.4	1.4	1.07
Arctic tern				2	0.5	0.5	0.98
Northern hawk owl				1	0.1	0.0	0.00
Belted kingfisher	3	1	7	1	3.7	2.4	0.64
Three-toed woodpecker	1			1	0.2	0.0	0.00
Northern flicker	1			2	0.9	0.9	1.01
Olive-sided flycatcher	11	16	14	15	12.5	4.5	0.36
Western wood pewee				1	0.01	0.0	0.00
Alder flycatcher	28	27	19	30	20.6	6.4	0.31
Tree swallow	1	12	9	7	4.6	3.5	0.77
Violet-green swallow			6		0.4	0.0	0.00
Bank swallow	14	10	6	43	43.6	36.8	0.84

Table G.7.4, continued. Results of the Nikolai Slough Breeding Bird Survey, June 1997-2000, compared to long term (1986-2000) mean, standard deviation (SD) and Coefficient of Variation (CV).

Species	1997	1998	1999	2000	Mean	SD	CV
Gray jay	21	25	6	9	13.5	6.3	0.46
Common raven	5	4	4	4	4.6	2.4	0.53
Boreal chickadee	2	3	2		2.1	1.3	0.69
Ruby-crowned kinglet	7	11	6	4	5.5	3.0	0.55
Gray-cheeked thrush		6	6	5	6.3	3.9	0.62
Swainson's thrush	74	49	88	61	58.8	21.9	0.37
American robin	22	13	16	21	26.9	19.0	0.70
Varied thrush	21	25	15	9	20.8	11.5	0.55
Bohemian waxwing				1	1.3	1.8	1.42
Orange-crowned warbler	29	42	18	27	16.1	11.3	0.70
Yellow warbler	15	8	9	4	12.9	5.8	0.45
Myrtle warbler	29	43	37	38	25.6	10.6	0.41
Blackpoll warbler	4	3	2	2	2.5	2.7	1.08
Northern waterthrush	61	60	63	64	45.7	17.0	0.37
Wilson's warbler	1	4	2		0.9	1.2	1.43
Fox sparrow	6	12	16	4	10.8	8.1	0.75
Lincoln's sparrow	1	2	2	2	0.6	0.9	1.47
White-crowned sparrow	3	3	4	3	9.1	5.3	0.56
Slate-colored junco	40	40	50	50	40.4	6.9	0.17
Rusty blackbird	10	10	8	6	9.8	3.1	0.33
Pine grosbeak	3	1		3	1.2	1.3	1.11
White-winged crossbill	12		3	3	3.8	5.3	1.39
Common redpoll	44	9	7	10	14.0	12.4	0.89
SPECIES	46	42	45	52	48.5	4.3	0.09
TOTAL	623	649	606	523	557.6	75.7	0.14

Table G.7.5. Results of the Ruby Road Breeding Bird Survey, June 1994-2000.

Species	1994	1995	1996	1997	1998	1999	2000	Mean	SD	CV
Common snipe	1	0	0	0	1	0	1	0.43	0.53	1.25
Ruffed grouse	0	1	0	0	0	1	0	0.29	0.49	1.71
Olive-sided flycatcher	0	1	0	0	0	3	0	0.57	1.13	1.98
Alder flycatcher	50	37	31	24	34	41	52	38.4	10.1	0.26
Hammond's flycatcher	3	1	2	0	0	0	0	0.86	1.22	1.42
Gray jay	1	2	1	1	0	12	11	4	5.16	1.29
Common raven	2	1	7	3	5	4	12	4.86	3.72	0.77
Ruby-crowned kinglet	25	37	21	23	38	32	41	31	8.02	0.26
Grey-cheeked thrush	1	4	4	12	6	6	4	5.29	3.4	0.64
Swainson's thrush	92	113	68	95	61	73	56	79.7	20.8	0.26
American robin	0	2	5	2	2	5	0	2.29	2.06	0.9
Varied thrush	10	17	9	26	17	33	20	18.9	8.51	0.45
Orange-cr. warbler	17	10	15	28	26	31	44	24.4	11.5	0.47
Yellow warbler	19	10	13	3	12	22	0	11.3	7.91	0.7
Myrtle warbler	19	27	22	26	18	30	25	23.9	4.38	0.18
Blackpoll warbler	0	4	4	3	0	8	6	3.57	2.94	0.82
Northern waterthrush	0	7	4	18	11	11	14	9.29	6.1	0.66
Wilson's warbler	1	4	4	1	0	6	6	3.14	2.48	0.79
Savannah sparrow	1	0	0	0	2	1	0	0.57	0.79	1.38
Am. tree sparrow	0	1	0	5	0	2	0	1.14	1.86	1.63
Fox sparrow	4	7	2	0	2	15	5	5	4.97	0.99
Lincoln's sparrow	0	0	3	6	8	4	8	4.14	3.39	0.82
White-cr. sparrow	5	13	11	15	11	24	10	12.7	5.85	0.46
Slate-colored junco	30	45	29	28	47	63	47	41.3	12.9	0.31
Common redpoll	0	10	2	2	1	0	6	3	3.7	1.23
White-w. crossbill	0	0	0	0	0	45	8	7.71	17.1	2.22
Bohemian waxwing	0	0	0	0	0	0	1	0.14	0.38	2.65
SPECIES	17	22	20	19	18	23	20	19.9	2.12	0.11
TOTAL	281	354	257	321	302	472	377	338	72	0.21

Ruby Road BBS. Just west of the Refuge boundary is a 40-mile State-maintained gravel road that connects the village of Ruby with a major gold mining district. Since 1994 Refuge staff have conducted a standard Breeding Bird Survey along this road, which represents the only significant length of roadway in western and northern interior Alaska. This affords an opportunity to have a standard BBS route in an area of the state that is poorly represented. The 2000 survey was conducted on June 16 by WB Jenny Bryant and PR Karin Lehmkuhl. A total of 377 individuals of 20 species was recorded, an increase over the long-term mean of 338 individuals. Notable increases in the 2000 counts compared to the long-term means were observed for three species: alder flycatcher, ruby-crowned kinglet, and orange-crowned warbler. One new species was observed this year; 1 individual Bohemian waxwing was recorded. Swainson's thrush and Yellow warbler were the only species to decrease significantly below the long-term mean.

Wintering birds

Resident songbirds were monitored with the standardized Christmas Bird Count conducted by Refuge staff and local volunteers on December 22, 2000. The 2000 count had 296 individuals of 13 species, similar to the previous year (Table G.7.6). 2000 had below-average total individuals but above-average species richness. Participation was average, with 7 people spending 21 person-hours and traveling 104 miles. Weather conditions were mild for mid-December, a minimum temperature of 0°F (average is -8.5°F). The count procedure is usually 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, but the count was similar to the 2000 count. By comparison, 1998 showed the lowest total individual count of any year, along with lower than average participation.

Table G.7.6. Species counts in the 2000 Christmas Bird Count at Galena compared to 1982-2000 means. CW= species present on count week but not counted on count day.

<i>Species</i>	<i>1997</i>	<i>1998</i>	<i>1999</i>	<i>2000</i>	<i>Mean</i>
Northern goshawk		CW		3	0.5
Gyr Falcon	1				0.1
Willow ptarmigan	6	17	45	228	22.5
Spruce grouse	CW	2	4	5	1.0
Ruffed grouse			1		0.7
Grouse spp.					0.1
Northern hawk owl	1		1	1	0.3
Boreal owl					0.0
Great gray owl		CW			0.2
Great horned owl				1	0.1
Downy woodpecker		1	1	1	0.5
Hairy woodpecker	1	2			0.3
Three-toed woodpecker	1				0.8
Gray jay	20	3	12	10	12.6
Common raven	117	23	65	223	189.7
Black-capped chickadee	41	24	83	31	20.3
Siberian tit					0.1
Boreal chickadee	23	5	42	8	19.7
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	1	0.1
Snow bunting				53	8.1
Pine grosbeak	2	1	1	4	6.2
White-winged crossbill	45				6.5
Common redpoll	252	14	36	125	90.3
Hoary redpoll		6	4		1.0
<i>Total Individuals</i>	511	98	296	296	360.6
<i>Total Species</i>	13	11	13	13	9.7
<i>Participants</i>	8	5	11	7	7.1
<i>Party Hours</i>	16.25	13.5	23.7	21.3	19.7
<i>Party Miles</i>	36.5	35	68.4	104	83.4
<i>Low Temperature</i>	-10	11	-10	0	-8.5

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). These TCA's are located along river drainages where most moose hunting occurs and where moose concentrate in late fall and early winter. Moose abundance is generally highest in riparian habitats along the river and lowest away from riparian habitats. Within the river corridors, 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 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 Koyukuk/Kaiyuh 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 on the Koyukuk/Kaiyuh. The most recent census for the northern half of Nowitna (1995) indicated about 1,000 moose. The southern half of Nowitna has not been censused since 1990.

In fall 2000, aerial moose trend count area (TCA) surveys were conducted jointly by the Service and ADF&G on the Nowitna, Koyukuk and N. Unit of Innoko NWR's. Snow cover was lighter than normal in November 1999 and 2000. Low snow cover may have influenced sightability and distribution of moose relative to years of more normal snow cover. Therefore, some density and composition estimates for 1999 and 2000 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 Nowitna and Koyukuk NWRs. Following is a brief summary of moose trend survey data on the Refuge, from north to south, and west to east:

Koyukuk NWR.

The moose population in the Koyukuk NWR and Northern Unit of Innoko NWR portions of GMU 21D was estimated at 11,000 in 1987-89 (Bodkin, J. L., W. N. Johnson, T. O. Osborne, and G. Rost. 1990. *Abundance, distribution, and population structure of moose on the Koyukuk/Nowitna National Wildlife Refuge, 1987-89*. U.S. Fish and Wildlife Service, Koyukuk/Nowitna National Wildlife Refuge, Galena, Alaska, USA). Census work in 1997, combined with trend count surveys, provided a population estimate of 8,500 in the same area (Huntington, O. H. 1999. *Koyukuk/Nowitna National Wildlife Refuge Complex, Lower Koyukuk River and Kaiyuh Flats, 1997 Moose Census, Game*

Management Unit 21D, Alaska. Final Report FY98-08. U.S. Fish and Wildlife Service, Koyukuk/Nowitna National Wildlife Refuge, Galena, Alaska, USA.). The Koyukuk Refuge, formerly included some of the highest moose densities in the state (up to 13 moose/mi²). The overall Refuge, however, appears to have stabilized at a lower level in response to increased harvest and predation in the 1990's.

In November 2000, moose trend count surveys were conducted in three areas of the northern Koyukuk NWR: Huslia River Flats, Treat Island and the Dulbi River Mouth (Table G.8.1). These areas total 200 mi². The November 2000 sex ratio was 20 bulls/100 cows, which was lower than most values reported in these areas in previous years. A ratio of 20/100 is judged adequate for reproduction, however, a goal of 30 bulls/100 cows is better for providing quality hunting opportunities according to the Koyukuk River Moose Management Plan. The number of cows in two of the three component areas increased over recent years, which also contributed to reducing the bull/cow ratio in 2000. Despite an increase in cows, calf productivity from the November 2000 survey was low, at 15 calves/100 cows. The Management Plan indicates a guideline range of 20-30 calves/100 cows to maintain population stability. Refuge and ADF&G biologists are concerned about these levels and will be monitoring productivity closely.

Kaiyuh Flats.

The total moose population on the Northern Unit of Innoko NWR (Kaiyuh Flats) was most recently estimated at about 1,500 in 1997 (Huntington, O. H. 1999. *Koyukuk/Nowitna National Wildlife Refuge Complex, Lower Koyukuk River and Kaiyuh Flats, 1997 Moose Census, Game Management Unit 21D, Alaska.* Final Report FY98-08. U.S. Fish and Wildlife Service, Koyukuk/Nowitna National Wildlife Refuge, Galena, Alaska, USA). In November 2000, trend counts were completed at Kaiyuh Slough and Squirrel Creek (snow cover was insufficient to survey Pilot Mountain Slough) (Table G.8.2). These two areas total 112 mi². The 2000 trend counts showed a slight decrease in total moose abundance from levels in prior years. Composition data in 2000 suggested that calf production was good at Kaiyuh Slough (31 calves/100 cows) and poor at Squirrel Creek (14 calves/100 cows). Recruitment declined in both areas, to 9 yearling bulls/100 cows, levels that were lower than the average of previous years. The sex ratio was healthy in 2000 (47 bulls/100 cows at Squirrel Creek and 41 bulls/100 cows at Kaiyuh Slough), but still represented a decline from the long term average. Incidence of twins declined at Squirrel Creek in 2000 (6 twins/100 cows w/calves and was below the long term average (10 twins/100 cows w/calves), while Kaiyuh Slough saw an increase in incidence of twins (15 twins/100 cows w/calves). Refuge and ADF&G staff are concerned over the trend of declining recruitment.

Nowitna NWR.

The most recent population estimate available for the Nowitna NWR was made in 1995. Totals of 908-1,052 moose were estimated in the lower Nowitna portion of GMU 21B, where most of the moose hunting activity takes place (Huntington, O. H., and M. R.

Bertram. . 1996. *1995 moose census, lower Nowitna River and Sulatna River drainages*. Progress Report FY96-04. U.S. Fish and Wildlife Service, Koyukuk/Nowitna National Wildlife Refuge, Galena, Alaska, USA). In 2000, trend surveys were conducted in two areas, Nowitna River Mouth and Nowitna/Sulatna Confluence, which totaled 135 mi². Surveys have been conducted in these two areas since the mid 1980's. The 2000 data indicated total moose abundance similar to the mean of prior years, suggesting overall population stability. At both the Nowitna Mouth and Nowitna-Sulatna Confluence (Table G.8.3), calf production reached an all-time low in 2000 (7-8 calves/100 cows), and there were no twins observed in either area. Observed recruitment of 4-6 yearling bulls/100 cows was below the long term average, and less than the management goal of 10 yearling bulls/100 cows. Sex ratios of 22 and 30 bulls/100 cows at the Nowitna Mouth and Sulatna confluence, respectively, were at levels sufficient for good reproduction and hunter success. However, Refuge and ADF&G staff remain concerned about productivity and high predation on the population.

Table G.8.1. Moose Trend Count Area Data, Koyukuk NW GMU 21(D) and 24 near Huslia, Alas., Nov. 2000.

Trend Count Area	Total Bulls	Total Cows	Total Calves	Total Moose	Total Adults	Total Yearling	Bull/100 cows (mean)	Calv/100 cows (mean)	Yearl. Bulls/100 cows (mean)	M & L bulls / 100 cows	Total twins	Cows w/Calves	Survey Area (sq.mi.)	Moose/sq.mi.	Adults/sq.mi
<u>Husli R. Flats</u>	60	170	29	259	225	5	35	17	3	32	2	28	80.2	3.23	2.81
<u>Treat Island</u>	53	334	43	430	375	12	16	13	4	12	2	41	67.1	6.41	5.59
<u>Dulbi R. Mouth</u>	37	234	36	307	257	14	16	15	6	10	2	34	52.4	5.86	4.90
<u>Total</u>	150	738	108	996	857	31	20	15	4	16	6	102	199.7	4.99	4.29

Table G.8.2. Moose Trend Count Area Data, Kaiyuh GMU 21(D), Alas., Nov. 2000.

Trend Count Area	Total Bulls	Total Cows	Total Calves	Total Moose	Total Adults	Total Yearlings	Bull/100 cows (mean)	Calv/100 cows (mean)	Yearl. Bulls/100 cows (mean)	M & L bulls / 100 cows (mean)	Total twins	Cows w/Calves	Survey Area (sq.mi.)	Moose/sq.mi.	Adults/sq.mi.
<u>Kaiyuh Slough</u>	30	74	23	127	97	7	41	31	9	31	3	20	63.4	2.00	1.53
<u>Squirrel Creek</u>	65	139	19	223	192	12	47	14	9	38	1	18	48.6	4.59	3.95
<u>Total</u>	95	213	42	350	289	19	45	20	18	36	4	38	112	3.13	2.58

Table G.8.3. Moose Trend Count Area Data, Nowitna NWR, GMU 21(B), Alas., Nov. 2000.

Trend Count Area	Total Bulls	Total Cows	Total Calves	Total Moose	Total Adults	Total Yearlings	Bull/100 cows (mean)	Calv/100 cows (mean)	Yearl. Bulls/100 cows (mean)	M & L bulls / 100 cows (mean)	Total twins	Cows w/Calves	Survey Area (sq.mi.)	Moose/sq.mi.	Adults/sq.mi
<u>Nowitna River Mouth</u>	29	130	11	170	154	5	22	8	4	18	0	11	59.0	2.88	2.61
<u>Novi/Sulatna Confluence</u>	40	135	10	185	167	8	30	7	6	24	0	10	75.5	2.45	2.21
<u>Total</u>	69	265	21	355	321	13	26	8	5	21	0	21	135	2.63	2.38

Moose Browse Study

High moose densities in the late 1980's and early 1990's 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 (1): 149-155). The 1998 study indicated that high quality browse in the Three-day Slough area may be able to sustain high moose densities. Kielland and Osborne concluded that browse was not over-exploited at the time because moose bite diameter utilization was below the threshold level of decreased digestibility. In March 2000, WB Hughes and Vol. Hector Hernandez re-sampled some of the 1980's browse transects as well as several other sites within the Complex. An excerpt of a draft report entitled: *Evaluation of moose browse monitoring methods for development of long-term inventory plan, Koyukuk/Nowitna National Wildlife Refuge Complex, Alaska* appears below:

Recent interior Alaskan studies and modeling efforts on feltleaf willow (*Salix alaxensis*) nutrient content and availability to moose have provided an important framework on how biologists can interpret feltleaf willow moose-forage relationships (Keilland and Osborne 1998). If average browse diameters change in response to forage availability, then managers may use this information to understand whether habitat conditions or predator prey interactions are more important in determination of moose densities in hunting units and managed areas. In this regard, a study was initiated to examine the variability in average bite diameter of feltleaf willow browsed on the Koyukuk, Nowitna, and Yukon Rivers in an attempt to assess forage availability in a variety of areas in the refuge complex. In addition, the same areas sampled on the Koyukuk River in 1994 by Keilland and Osborne were sampled in 2000 to see if the average bite diameter was changing through time.

Browse surveys were conducted in each of three interior Alaska refuges comprising the Koyukuk/Nowitna National Wildlife Refuge Complex during April 2000. A 30 km stretch along the Koyukuk River between the upper and lower mouth of Three Day Slough (65° 27' N, 157° 11' W, elevation 40m), a 50 km stretch along the Nowitna River (64° 49' N, 154° 10' W), and a 30 km stretch along the Yukon River (64° 47' N, 157° 11' W) were studied in the Koyukuk, Nowitna, and Northern Unit of the Innoko National Wildlife Refuges, respectively. The sampling sites were located in 5-15 year old stands of feltleaf willow that were 1.5–4.5m tall. In each study area, at least four stands of feltleaf willow were sampled (Table 1). In each stand (n=20) approximately 100 randomly selected branches were measured at the base of the current annual growth (CAG) and at the diameter at the point of bite (DPB). In 13 stands individual plants were

randomly selected and all the branches on each individual were counted and measured as either browsed or not browsed.

We determined that bite diameters did not significantly change between stands throughout the study area or through time. This limits the utility of measuring bite diameters as a method of monitoring moose browsing on the refuge. However, the browsing intensity or percent use of branches in each stand did vary considerably between stands and over time. Thus, % use and the size (CAG) of browsed and unused twigs appears to be the best way to monitor browse availability on the refuges, and a streamlined method should be developed and incorporated into an inventory plan.

Historical Moose Aerial Survey Spatial Database

WB Hughes and volunteers Melanie Hans, Hector Hernandez, and Nathan Schwalen worked diligently on the creation of a spatial database of historical moose survey observations. All historical moose observations were digitized from 1:63,360 quad maps into an Arcview Geographic Information System (GIS). The related attribute data were archived from paper data sheets into database (.dbf) files created from Excel spreadsheets. Electronic spatial data for 16 years (1983, 1986-2000) now exists for the Nowitna Refuge trend count areas located in the State of Alaska's Game Management Unit (GMU) 21B. The spatial database for GMU 21D and 24 are nearly complete, but verification of the data is not finished. Completion of the project was slated for the summer of 2001.

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. Less frequently some WAH caribou have wintered south of the Koyukuk River. 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.

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. Observations suggested 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 River, and the south side of Purcell Mountains.

Bear

Black bears and Interior Alaska grizzly bear inhabit all units of the Refuge Complex. 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. 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 traditional 'Bear Party' where all the men go to hunt, cook, eat fresh bear meat, play games and tell stories.

All harvested grizzly bears must 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. Bears are considered a significant predator of moose, and may be contributing to recent declines in moose abundance and productivity.

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 in recent years. Estimates of wolf density on the portion of Koyukuk NWR within GMU 21D were estimated at 8.7 wolves/1000 km² in March 1994, and 13.7/1,000 km² in March 2000. Wolf survey activities in 2000 included a March aerial track count and abundance survey in cooperation with ADF&G. The following summary of the March 30-April 1 2000 wolf survey was taken mainly from a trip report prepared by Glenn Stout, ADF&G area biologist:

Snow conditions were excellent, and allowed for the implementation of the SUPE Wolf Population Survey Method. We received at least 10-12 inches of new snow between the 21st and 27th of March, followed by clear weather during the survey. Old tracks that had accumulated during the winter were filled in and obliterated by the new storm, which gave us high reliability in spotting tracks less than three days old. Concerns over large numbers of caribou confusing tracking were not realized because the Western Arctic Herd appeared to have been located well north of the survey area during late winter. Most of the caribou stayed on the wind swept slopes of the Purcell Mountains and Zane Hills.

The survey area was generally bounded by the Continental Divide to the north and west, the GMU 24 boundary to the south, and the village of Hughes to the east. The area overlaps with some of the survey block completed in 1999 in the Huslia River Drainage. The overlap gave us some good information about pack home-ranges, and I believe we were able to develop a fairly complete picture of the minimum number of wolves that are on the Koyukuk National Wildlife Refuge. The 2000 survey encompassed 4,175 mi² (10,816 km²) and was divided into four blocks that each survey team was directed to cover. The survey was conducted using four planes; the first was a Maule piloted by Mike Spindler (USFWS), second was a Scout flown by Scott Gibbens (Quicksilver Air), third was a Maule flown by Colin Brown (Yukon Eagle Air), and fourth was a Cub flown by Joe Huhndorf (USFWS). Observers were Orville Huntington (USFWS), Karin Lehmkuhl (USFWS), Brett Gibbens (FWP), and myself. This was Joe's first wolf survey as a pilot and Karin's first as an observer. Combined, the four planes logged 75.5 hours (0.42 min/km²) on this survey. We had visual confirmation of 71 individual wolves that we are confident were not double counted. We identified 19 packs, 15 of which we had visual observations of at least one member from the pack. We had additional track observations of 4 packs with a total of 45 wolves that were distinguishable from all other packs, for a minimum of 116 wolves (Table G.10.1). Pack size ranged from 1 to 14, with a mean of 6.1 wolves (median = 6.0). Density of wolves, as estimated by SUPEPOP, is 13.7/1,000 km² for the 10,816 km² (4,175 mi²) survey area. By comparison, the management objective in the 1997 Wolf Management Report is for a density of 8 wolves/1,000 km². In March 1999, the wolf density in the northern portion of 21D was estimated to be 12.4 wolves/1,000 km². That estimate was considered a minimum count, however, because we didn't have the conditions for a SUPE survey. If we could have done the SUPE Survey last year, I think our estimate would have been higher, considering moose densities are higher in that area. Therefore, I believe the results are comparable.

An additional point worth noting is that several of the packs recorded in the minimum overall count are known to have more wolves. Specifically, the following packs were observed with additional wolves; Lower Kateel Pack (12 wolves-11/99), Colville Bend Pack (18 wolves-11/99), Lower Dulbi Pack (12 wolves-3/00), Natlaratlen Pack (8 wolves-2/00). It is difficult to say what the pre-winter densities are compared to when we did our surveys, but when it comes to trying to estimate yearlong moose mortality attributable to wolves I can imagine a substantial increase in our post-winter estimate would be necessary. For the area surveyed, I estimate there are approximately 6,500 ($\pm 1,000$) moose which would give us a ratio of approximately 1 wolf:24 moose.

Table G.10.1. Results of March 30-April 1 2000 aerial wolf survey covering a 10,192 km² area of northern half of Koyukuk NWR (data courtesy ADF&G).

Pack Location	Visuals	Tracks	Total
Billy Hawk Pack ¹	1	4	5
Tom Cook Hill Pack	6		6
Old Town Pack	12		12
Happy Slough Pack	2		2
Nuna Slough Pack	2		2
Eleven-mile Pack	2		2
Round Mtn. Wolf	1		1
Treat Island Pack	7		7
Winthrop Point Pack	10		10
Dakli R. Pack	2	3	5
Five-mile Lake Wolf	1		1
Huggin's Island Wolf	1		1
Pingo Pack	9		9
Willow Lake Pack		6	6
Nayuka R. Pack	14		14
Nulitna R. Pack		12	12
Middle Huslia R. Pack	1	7	8
North Fork Pack		5	5
Upper Billy Hawk Pack		8	8
Total	71	45	116
Mean	-	-	6.1
Median	-	-	6.0
Density (wolves/1000 km ²)	-	-	10.7
SUPE Estimated Total (90% C.I.)		147.8 (±32.2)	
SUPE Estimated Density		13.7	
SUPE Estimated Pack Size (90% C.I.)		6.9 (±0.79)	

¹ This pack is suspected to be a non-resident pack following Western Arctic caribou.

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 from 1987-1998. 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. Due to declining furbearer harvest, skulls have not been purchased and questionnaires were not collected after 1998. 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*.

Beaver

Beaver populations in much of Interior Alaska were high in the early 1990's. In the mid to late 1990's fur prices dropped and trapping effort has decreased significantly throughout the Interior. As a result, many local people have reported an increase in beaver populations. Beaver are an important resource to the local people, supplying food, clothing, and income.

When time and money permit, beaver cache surveys are flown in October to determine obtain an index to beaver abundance. In 2000, surveys were conducted on the Koyukuk NWR on October 3rd and 4th. On the Koyukuk Refuge, 68% of the beaver caches observed in nine townships were active (Table G.10.2). Although the percent active caches has decreased from 87% observed in 1991, density of active caches has increased from 0.9 active caches per square mile in 1991 to 1.1 active caches per square mile in 2000. Beaver were most recently surveyed on the Kaiyuh Flats in 1999 and on the Nowitna NWR in 2001. Results of the those surveys may be found in the annual narrative reports of those years.

Table G.10.2. Beaver cache survey results on Koyukuk NWR 1991-2000.

	1991		2000	
Trend Unit ¹	active	in-active	active	in-active
1	48	9	48	22
2	36	12	39	19
3	23	2	31	17
4	53	2	72	21
5	24	4	18	12
6	38	7	45	20
7	30	7	25	12
8	24	1	56	30
9	15	0	17	10
Total	291	44	351	163
Total caches	335		514	
%active	87		68	

¹Trend units are selected townships defined by grid coordinates on the USGS Kateel River Quad map

Small Mammals

Small mammal species composition and trends in abundance were a focus of monitoring work on the Nowitna NWR, in conjunction with the fire-furbearer study (Johnson, Paragi and Katnik 1995). A summary of small mammal trends, 1991-1998, was presented in the 1998 Nowitna Annual Narrative report.

A main conclusion of the fire-furbearer study was that yellow-cheeked voles (*Microtus xanthognathus*) are an important prey species of marten, and that the abundance of both were influenced positively by post-fire succession. In 1997 PR Karin Lehmkuhl began an intensive study of yellow-cheeked voles on the Koyukuk and Nowitna Refuges as part of a Master's degree at the University of Alaska Fairbanks under Dr. Eric Rexstad. In 2000 Karin completed her Master's thesis. Abstracts from the thesis follow:

Population dynamics and ecology of yellow-cheeked voles (Microtus xanthognathus) in early post-fire seres of interior Alaska (M.S. Thesis, 2000, Univ. of Alaska Fairbanks).

Yellow-cheeked voles occupy early successional habitats in boreal regions, but specific factors influencing the species' distribution and population dynamics are not well known. Yellow-cheeked voles were studied in three early post-fire habitats in interior Alaska to relate population parameters to

habitat characteristics. Voles were live-trapped during June, July, and August of 1997 and 1998, and habitat components were measured within trapping grids. Capture data were analyzed using the robust design to estimate vole abundance, density, survival, and recruitment. Yellow-cheeked voles were most abundant in the floodplain white spruce, where survival was stable and recruitment was high. The white spruce habitat had the greatest cover of preferred forage species, while grasses, large diameter logs and snags provided escape cover. Observed differences in habitat quality may be related to unique successional processes in black and white spruce communities.

*Assessment of habitat quality in yellow-cheeked vole (*Microtus xanthognathus*) populations using the robust design.*

Populations of yellow-cheeked voles (*Microtus xanthognathus*) were studied in 3 early post-fire habitats in interior Alaska: floodplain black spruce, floodplain white spruce, and upland black spruce. Voles were live-trapped on 0.25 ha grids during June, July and August of 1997 and 1998. Capture data were analyzed using the robust design to identify population parameters related to habitat quality. Yellow-cheeked vole abundance was significantly higher in floodplain white spruce than in other sampled habitats in both years. Density in this regenerating habitat was higher than densities previously recorded for the species. Survival was similar among habitats, but showed periodic lows in black spruce habitats. *In situ* reproduction contributed highly to recruitment in June-July, while immigration contributed more in July-August. Highest abundances were related to elevated levels of immigration. Both immigration and reproductive recruitment were highest in the white spruce habitat. Population parameters indicated that the floodplain white spruce was higher quality habitat than the black spruce areas studied.

*Habitat and population ecology of *Microtus xanthognathus* in early post-fire seres of interior Alaska.*

Populations of yellow-cheeked voles (*Microtus xanthognathus*) were studied in 3 early post-fire habitats on the Koyukuk and Nowitna National Wildlife Refuges (NWR), Alaska: floodplain black spruce, floodplain white spruce, and upland black spruce. Voles were live-trapped during summer 1997 and 1998. Analysis of mark-recapture data (Chapter 1) indicated that the floodplain white spruce was higher quality habitat for yellow-cheeked voles. Habitat components, vole weights, and diets at live-trapping grids were measured to identify characteristics related to yellow-cheeked vole populations. *Equisetum* spp. contributed most to summer diets, and *Vaccinium* spp. berries were also important. Relative to previous studies, more large (>145 g) adult voles and heavier young were encountered, particularly in floodplain habitats (FBS, FWS). Cover of

grasses and forbs was greatest in the floodplain white spruce, while black spruce sites had greater shrub development. Soils were warmer on burned sites than in adjacent unburned forest, and depths to frozen soil were greater. Snags and logs were larger in the white spruce habitat, and provided voles with burrow sites and protected travel corridors.”

11. Fisheries Resources

Of the 20 fish species with published ranges that include Refuge Complex waters, 15 have been documented by field investigations in the last two decades. Major fish resources on the Complex 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, from the early 1980's to the mid-1990's, 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 Complex (Koyukuk and Nowitna NWRs Fisheries Management Plans). In the late 1990's strength of both the chum and chinook runs declined dramatically (see Salmon, below).

Salmon

The main stem of the Yukon River and other rivers within the drainage have historically sustained high levels of commercial and subsistence fishing. Part of the Yukon River drainage lies within the Nowitna, Koyukuk and Northern Innoko NWRs. The villages of Kaltag, Nulato, Koyukuk, Galena, Huslia, Hughes, Ruby and Tanana depend upon the fish resources of the Refuge Complex. 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. Prior to 1994 escapement estimates for salmon stocks using the Koyukuk Refuge rivers were available from five tributary streams that had multi-year aerial survey data: Gisasa, Kateel, Hogatza, Indian, and Dakli Rivers. The distribution of chum and coho salmon within the Koyukuk River drainage has not been thoroughly 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.

Gisasa River Weir. In 1994 FRO 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 (9,920) since the weir has been operated.

The 2000 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, 2000*. U.S. Fish and Wildlife Service, Fishery Resources Office, Fishery Data Series Number 2000-1. The abstract from the report follows:

From June 28 to August 7, 2000 a resistance board weir was operated on the Gisasa River, a tributary to the Koyukuk River in west-central Alaska. This was the seventh year of operating the weir at this site. A total of 2,089 chinook salmon *Oncorhynchus tshawytscha* and 11,410 summer chum salmon *O. keta* passed through the weir. The most abundant resident species was the longnose sucker *Catostomus catostomus* (N=43). Chinook salmon escapement was low but fell within the range of weir counts from 1994 to 1999. Between July 14 and 22, 61% of the chinook salmon passed through the weir. Females made up 30% of the chinook salmon. The chinook salmon sex ratio has ranged from 17 to 42% female since the project began in 1994. Age groups 1.3 and 1.4 accounted for 52 and 38% of the run, respectively. Chum salmon escapement was only 16% of the average weir counts from previous years. The sex ratio of the chum salmon sampled was about even. Age 0.4 chum salmon made up 62% of the run.

Clear Creek. 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 20, 1997. In 1998 there were no comparable data available. In 1999 a total of 11,838 was counted between July 5 and 20.

In 2000 responsibility for the project was transferred from Tanana Chief's to the Bureau of Land Management. Carl Kretsinger, in their Fairbanks office, supervised the Clear Creek counting tower in 2000. The tower was operated from June 24 through July 25. He reported:

The first chum past the tower was on 30 June. The estimated chum escapement past the tower was 19,376 fish for the season. The tower this year was located approximately 1/2 mile upstream from the mouth and we estimated that between 100-150 additional fish were spawning below the

tower. The escapement in 2000 was 80% below the 1995-1997 average of 98,146 fish (data from 1998 and 1999 were not considered due to poor counting conditions). Last year chum escapement into Clear Creek accounted for 4.6% of the summer chum passing the Pilot Station sonar which is similar to what we have seen in past years. During the project 532 fish were sampled for age, length and sex. Of the fish sampled for A-L-S info, 473 were aged, for an 11.1% unageable rate. Age classes represented were as follows: age (0.3) 20.7%; age (0.4) 77.4%; and age (0.5) 1.9%. The sex ratio was 56% male and 44% female.

Nowitna NWR

Estimates of salmon escapement in the Nowitna Refuge have never been made, although spawning salmon have been observed. The relative strength of each species run is also unknown. In 1993 the Fairbanks Fisheries Resources 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

N. Unit Innoko NWR

A small controversy arose in 1991 when a commercial fishing guide began operating on Native lands on the Kaiyuh Flats. Complaints of dead pike were received from local subsistence users; however, the guide insisted that his trophy catch and release fishing practices were low-impact and that fish were being handled carefully. The Complex in cooperation with the Fairbanks FRO felt that because very little was known about local pike biology it would be difficult to determine actual impacts or sustainable harvest. The ADF&G Division of Sport Fisheries was interested in pursuing a pike study in the area, so a cooperative project was proposed. From 1994 to 1996 the Service and ADF&G conducted a pike telemetry study on the Kaiyuh Flats, which resulted in a final ADF&G report (number 96-64) entitled *Seasonal migrations of northern pike in the Kaiyuh flats, Innoko National Wildlife Refuge, Alaska* by T. T. Taube and B. R. Lubinski. The abstract to the report follows:

From July 1994 through July 1996, the Department of Fish and Game, Division of Sport Fish, and the US Fish and Wildlife Service (USFWS), conducted a joint study to identify overwintering areas and estimate length and age compositions of the Kaiyuh Flats northern pike population. During July 9-29, 1994, 50 large (>750 mm FL) northern pike were

implanted with radiotelemetry transmitters and 962 northern pike were sampled for length and age. From June 12-22, 1995, the USFWS sampled an additional 840 northern pike for length and age. Northern pike were captured using trap nets, hook and line, and gill nets. Ages of northern pike sampled in 1994 ranged from 2-14 years. Mean length of all pike sampled in 1994 was 666 mm. Ages of northern pike sampled in 1995 ranged from 1-17 years. Mean length of all northern pike sampled in 1995 was 618 mm. During winter 1994-95, 45 (90%) of the 50 radio-tagged fish were found to have survived and retained their transmitters and were located within three distinct overwintering areas (2 lake channel habitats and 1 channel habitat). Sixteen (52%) of 31 fish tracked through winter of 1995-96 were found to have survived and retained their transmitters into summer 1996, with an additional 6 fish perishing or expelling their tags within their overwintering area. Of the 22 fish confirmed to have survived and retained their transmitters during winter 1995-96, 16 (73%) returned to their 1994-95 overwintering area, suggesting a strong fidelity to winter areas for those fish. Northern pike left the overwintering areas for spawning areas beginning in early May and did not concentrate in any specific spawning areas.

Nowitna River. In response to increased guided sport fishing on the Nowitna, in 1997 the Alaska Dept. of Fish and Game, Sport Fisheries Division (Fairbanks), conducted 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 probably 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. Titles and abstracts of two reports resulting from this study are provided below:

Burr, J. 1998. Effects of post-capture handling on mortality in northern pike. Alaska Department of Fish and Game, Fishery Data Series No. 98-34, Anchorage.

Northern pike captured with hook and line gear were subjected to one of two handling regimes to assess the effect of varied catch and release practices on the short term (48 h) mortality of this species. Handling regimes were selected to reflect known angler practices. Northern pike were captured in hoop nets to provide a control for the experiment. After 48 h the only observed mortality was for fish caught in hoop net gear (0.04, SE=0.04).

Burr, J. and S.M. Roach. 2000. Abundances, compositions, and CPUE of Northern Pike within selected sloughs of the Nowitna River, 1997. Alaska Department of Fish and Game, Fishery Data Series, Anchorage.

Abundances, compositions, and catch per unit effort (CPUE) of northern pike *Esox lucius* within Johnson, Titus, and Pat Moore sloughs of the Nowitna River were described using mark-recapture techniques. Variability in abundance and composition of northern pike among these small areas were examined to determine if future population assessment could be simplified by sampling small areas with a minimum of effort as an index of the larger area. Estimated abundances ranged from 20 fish (SE = 5) in Pat Moore Slough in August to 1,247 fish (SE = 375) in Titus Slough in August. Estimated densities ranged from 1.6 fish per hectare (SE = 0.4) in Pat Moore Slough in August to 39.9 fish per hectare (SE = 15.1) in Johnson Slough in June. Density of northern pike varied by slough and month. The average length of northern pike sampled ranged from 606 mm FL (S.D. = 140) in July from Johnson Slough to 744 mm FL (S.D. = 148) in June from Pat Moore Slough. The minimum age sampled was age-2 and the maximum age-15. There were significant differences between length distributions of northern pike sampled by slough ($T_{akn} = 4.85$; $P < 0.01$), month ($T_{akn} = 4.55$; $P < 0.01$), and gear ($T_{akn} = 2.09$; $P = 0.04$). CPUE with gill nets ranged from 2.51 northern pike per hour in June from Titus Slough to 0.09 per hour in July from Pat Moore Slough. CPUE with hoop traps ranged from 0.28 northern pike per hour in June from Titus Slough to 0.02 per hour in July from Titus Slough. CPUE with hook and line ranged from 2.30 northern pike per hour in June from Johnson Slough to 0.00 per hour in August from Titus Slough. There was no obvious correlation between CPUE and abundance. This study does not support the hypothesis that investigators can take a quick look at a small area within the lower Nowitna River to assess the health of the northern pike population in general.

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 in 1991 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*. They found that 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.

Some pike sampled on the Kaiyuh Flats in 1993 by Paul Headlee of TCC had elevated tissue mercury levels. The observed levels were below the human consumption guidelines set by the Minnesota Dept. of Health (no Alaska or National standards exist), however, Headlee recommended caution for consumption of large amounts of larger sized fish. There was a statistically significant relation between fish size and mercury level. According to Headlee, if the average size of a pike eaten is 32 inches long, the estimated mercury concentration would be 0.73 ppm (wet tissue weight). The Minnesota guidelines recommended that the amount of fish muscle tissue from fish of that size class "that could be consumed over a year long period without any adverse effect" would be approximately 23 pounds. ADF&G estimated annual per capita pike consumption in Galena and Huslia at 5.2 and 28.8 lbs., respectively. Details can be obtained in Headlee's final report entitled: *Mercury and selenium concentrations on fish tissue and surface waters of the northern unit of the Innoko National Wildlife Refuge (Kaiyuh Flats), west-central Alaska, 1993.*

16. Marking and Banding

Banding efforts on the Refuge Complex have generally been related to three main efforts: geese, ducks, and songbirds (MAPS project). In 2000, the only banding which occurred was goose banding.

Geese. Totals of 1,138 white-fronted geese and 67 Canada geese were banded by Refuges and Migratory Birds staff on Selawik and Innoko NWRs as part of the regional goose study. A total of 1,205 geese were banded. No geese were banded on the Koyukuk NWR because no flocks of sufficient size were located in accessible areas.

Ducks. No ducks were banded on the Complex in 2000.

Songbirds. No songbirds were banded on the Complex in 2000.

H. Public Use

2. Outdoor Classroom - Students

In May PR Karin Lehmkuhl and WB Mike Spindler presented information on white-fronted goose populations to students at Galena Elementary, Nulato, and Huslia. Presentations were made to 15 class groups (over 200 students). Activities focused on goose identification, habitat, migration, and population dynamics. The interior population

has been declining over the past 10 years (see section G.3) and outreach efforts in the coming years will be vital to its conservation.

Presenters from the Denali Foundation led a Snow Science workshop for students at the Project Education Charter School in Galena March 28-30. PR Lehmkuhl assisted in the three day workshop which included snow chemistry, crystal formation, the water cycle, and glaciers. Students dug snow pits, learned how to build a quinzee (snow cave), learned to make snowshoe bindings, and how to track glacier movements using aerial photos.

In July PR Lehmkuhl traveled to Twin Bears Camp at Chena River State Recreation Area (Fairbanks) to participate in the Earth Quest Science Camp. From July 26 to August 02 nine rural Alaskan high school students were involved in hands-on projects designed to expose them to careers in natural resources. The projects included chum-salmon research, songbird banding, invertebrate investigations, and forest ecology. PR Lehmkuhl helped the students with a small mammal live-trapping study. The camp also included a float trip on the Chena River, and overnight backpack, and many discussions around the campfire with campers, staff, and two village elders who joined us. Earth Quest Science Camp is a cooperative effort between USFWS, Tannana Chiefs Conference and several other partners. This was the fifth Science Camp.



Nine eager rural high school students plus energetic staff participated in Earth Quest Science Camp this year. The camp exposes students to careers in natural resources. (KL)

A Science Camp was held in Galena August 7-18 in cooperation with Galena City School. Leaders for the two week camp were PR Lehmkuhl, WB Bryant, Debbie Koontz, and Hershel Walker. Students (1st-8th grade) met for 2 hours each day at the Galena Old Hall for wildlife activities, games, songs, and field trips. Topics included water pollution, aquatic insects, plants, fish, waterfowl, forests, birds, and mammals. Each day students worked on a wildlife mural, and on the final day we held an open house that was well attended by parents and teachers. The camp was a huge success and we hope to be able to



Science Camp, fish printing (KL)



Science Camp, wildlife activities (KL)



Science Camp, wildlife mural display during open house (KL)

continue it in the future!

3. Outdoor Classroom - Teachers

A new full-color booklet of refuge teaching resources (curricula, books, teaching kits, etc.) was created and copies were distributed to teachers in Galena and area schools. The quality of our outreach products was greatly enhanced by the addition of a new color printer and a higher capacity computer to our host of computers and equipment.

6. Interpretive Exhibits/Demonstrations

Text panels and land ownership maps were updated for the hunter information kiosk that is placed at the boat landing during September. We received several new waterfowl mounts from Jack Moermond. Jack and his wife were volunteers at the Refuge several years ago, and he has provided us with a variety of beautiful duck and goose mounts. We have used the mounts for display and in education, and brought a white-fronted goose that he mounted with us on our village visits this spring.

7. Other Interpretive Programs

Plant identification and use workshops were held in Ruby (June 17) and Galena (June 24). The workshops were well attended, and interest was expressed in having the workshops again next year.

8. Hunting

Koyukuk/Northern Innoko NWR

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. In 2000, Biological Science Technician Deborah Webb completed a report that summarized two years of subsistence waterfowl harvest surveys in seven regional communities: *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 household 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 recently in western Alaska (primarily Yukon River delta, Bering straights and Northwest Alaska regions). In addition, harvest estimates in this study are much lower than estimates from surveys conducted in the Koyukon region in the early 1990's. 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.

In 2000 due to other priorities, the refuge staff was only able to conduct a reduced waterfowl harvest surveying effort compared to the past three years. Refuge Information Technicians conducted goose harvest surveys in the three villages of Nulato, Galena and Huslia. A total of 386 greater white-fronted geese and 371 Canada geese were reported harvested.

Also in 2000, refuge staff conducted an extensive outreach effort in area villages concerning the decline of greater white-fronted geese in our area. Refuge staff were present at the Alaska Migratory Bird Co-Management planning meeting in Anchorage, October 30 and November 1. RIT Huntington met with staff from TCC and other Native organizations throughout the year discussing this issue.

Steel Shot Clinics. In August, Refuge staff assisted staff from ADF&G in conducting steel shot clinics in Huslia and Nulato. In both villages, the clinics entailed an evening classroom session followed the next day with an outdoor shooting session. About 16 people in each village participated in the evening classroom session. At the outdoor shooting session, about 40 people in each village participated. The clinics were well received. However, in both villages residents requested that another clinic be held at a time of the year when so many village residents are not away from their village on fire fighting details.

Moose. Since 1983, ADF&G has conducted a hunter check station at Ella'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 via the Koyukuk River. 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 2000 moose harvest season were again very warm for the duration of the season. The warm weather, in combination with variable water conditions (better conditions during the first part of the season) affected the distribution of both moose and hunters in the Controlled Use Area. Most of the popular Three-Day Slough area was accessible for the first two weeks of the season with the lower end open for most of the season. Hunting effort was also concentrated in other localized areas of the drainage. Meat was checked thoroughly by staff at the check station in 2000. 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 and in 2000 Refuge Volunteer Nathan Schwalen spent one week at the check station. The Refuge gained considerable insight into hunting conditions on the Koyukuk, and will strongly support future requests for assistance.

A total of 510 permits was issued for the combined subsistence and general drawing hunts in the Koyukuk Controlled Use Area in 2000 (415 at check station, 85 in Huslia and 11 in Hughes). Numbers of registered hunters in 2000 decreased by 221 hunters or 30% compared to 1999 numbers (731). The reduction in the number of hunters registered was a result of changes in regulations proposed by the Koyukuk Moose Hunters Working group and approved by the Board of Game at their Spring 2000 meeting. The volume of hunters and resultant congestion that occurred on the lower Koyukuk River in the fall 1999 hunting season exceeded everyone's expectations. The working group used the number of hunters and moose harvested in 1998 in the lower Koyukuk River area as a baseline for the maximum number of hunters and moose harvested in any future years. These numbers were surpassed in 1999 prompting the changes that reduced the numbers in 2000. The biggest change in regulation was instituting a drawing hunt to replace the RM830 general registration hunt. In 2000, a total of 355 RM832 subsistence permits were issued while only 258 drawing permits were made available. Of the 258 hunters who drew permits, 155 hunters hunted with them and 103 hunters did not hunt or use their permits.

Hunters harvested 278 moose (266 bulls, 11 cows and 1 unknown) in the lower Koyukuk drainage during the 2000 registration/drawing hunts. The 2000 harvest was a significant decrease from the 1999 record harvest and slightly above the ten year average of 270 (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 reduce or cease all cow harvest in the unit until productivity and recruitment increase.

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 estimated at about average in 2000 with good water conditions allowing for easy access throughout the area.

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
2000-01	246	44	220	510
Mean	228	69	155	452

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 Station¹. 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%)
2000-01	180 (73%)	26 (59%)	72 (33%)	278 (54%)

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.

Nowitna NWR

The single largest public use of Nowitna NWR is the fall moose hunt. Most of the moose hunting pressure observed on the northern portion of the Nowitna NWR occurs on the Nowitna River from the canyon area downstream to the river's mouth. The majority of

moose hunters using the Refuge are from Fairbanks and other non-local Alaska locations. Most of the local hunters using the lower Nowitna River drainage are residents of Ruby, Tanana and Galena.

The refuge staff and ADF&G have operated a hunter check station at the Nowitna River mouth on the northern border of the refuge since 1988. The majority of the Nowitna River is within the refuge boundary, and 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 has almost always been a voluntary stop, although in 1997 it was a mandatory stop for a registration hunt. The mandatory State registration hunt was discontinued in 1998 because of increased costs and relatively stable trends in moose hunter numbers/harvest.

In September 2000, 157 hunters checked in 45 moose at the check station. The harvest was similar to the last several years and close to the 13 year mean of 46. The 157 hunters checked in is an increase over the last several years and a large increase over the 13 year mean of 117. Of the 157 total hunters, 115 were state residents not from the local area, 14 were local residents and 28 were from out of state.

Table H.8.1. Number of moose hunters by residency class checked through the Nowitna River Check Station.¹

Regulatory Year	Non-local AK. Residents	Non-Residents	Local Rural Residents	Total Hunters
1988-89	137	8	33	170
1989-90	123	12	31	166
1990-91	93	14	23	130
1991-92	116	17	21	155
1992-93	91	10	24	125
1993-94	93	21	19	133
1994-95	104	13	16	134
1995-96	107	9	16	132
1996-97	90	20	19	129
1997-98	78	7	16	101
1998-99	84	22	17	113
1999-2000	117	14	24	155
2000-01	115	28	11	154
Mean	104	16	21	138

¹ Checking in at the Nowitna River mouth check station only mandatory in 1997.

Table H.8.2. Harvest by moose hunters and harvest rate by residency class checked through the Nowitna River Mouth Check Station¹.

Regulatory Year	Non-Local AK. Residents ²	Non-Residents ²	Local Rural Residents ²	Total Moose Harvest ²
1988-89	42 (31%)	5 (63%)	9 (27%)	56 (33%)
1989-90	38 (31%)	6 (50%)	6 (19%)	50 (30%)
1990-91	44 (47%)	4 (29%)	7 (30%)	54 (42%)
1991-92	35 (30%)	2 (12%)	9 (43%)	46 (30%)
1992-93	29 (32%)	2 (20%)	3 (13%)	34 (27%)
1993-94	45 (48%)	1 (5%)	7 (37%)	53 (40%)
1994-95	43 (41%)	5 (38%)	6 (38%)	54 (40%)
1995-96	33 (31%)	5 (38%)	3 (19%)	38 (29%)
1996-97	33 (37%)	2 (10%)	2 (11%)	36 (28%)
1997-98	37 (47%)	3 (43%)	1 (6%)	41 (41%)
1998-99	43 (51%)	3 (14%)	4 (24%)	50 (44%)
1999-2000	38 (32%)	4 (29%)	3 (13%)	45 (29%)
2000-01	39 (34%)	6 (21%)	2 (18%)	47 (31%)

¹ Checking in and out of Nowitna River mouth check station was not mandatory, except 1997.

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

NA - Not Available

9. Fishing

Most fishing within the boundaries of the units takes place as a subsistence activity. Most fish are harvested using gill nets either as a set net or a drift net. Most gill nets are placed in river eddies where fish rest. Some eddies are traditional fishing spots respected and recognized by local residents. Locally recognized fishing rights to these eddies is passed down through family ties, and remains in the immediate or extended family.

The 2000 fishing season was one of the worst on record. All seven refuge area villages were included in the declaration of the Yukon River drainage as a disaster area due to the low salmon runs. The 2000 Yukon River returns of chinook, summer and fall chum salmon were all at new record low levels. For chinook salmon, this was the 3rd year in a row of poor returns and for summer and fall chum it was the 4th year in a row of poor returns. This was the worst fall chum return ever recorded. Subsistence harvest restrictions that were put in place in mid-July to protect summer chum and king salmon remained in place into August to also protect fall chum. Available fishing hours were further reduced in mid-August as fall chum run strength failed to materialize and on August 23rd all subsistence fall chum fishing was closed as the projected run size fell below the drainage-wide spawning goal of 350,000 fish.

Fishing restrictions were initially put in place on the Yukon River starting on July 12, when ADF&G announced that they would not have any additional commercial fishing periods in the lower river. As of that date, the catch per unit effort at the Emmonak test fish was below the 10 year average and the run was being assessed as being worse than the disastrous 1998 run. On July 18, a news release by the Alaska Department of Fish and Game announced the establishment of subsistence fishing restrictions throughout the drainage. On July 19, the Federal Subsistence Board announced identical restrictions on Federal waters. This included Districts 4 and 5a which includes the refuge. Restrictions were as follows:

In District 4, subsistence salmon fishing will be open for two (2) 24-hour periods per week from 6:00 p.m. each Tuesday until 6:00 p.m. each Wednesday and 6:00 p.m. each Friday until 6:00 p.m. each Saturday.

In District 5, subsistence salmon fishing will be open for one (1) 24-hour period per week from 9:00 p.m. each Saturday until 9:00 p.m. each Sunday, and two (2) 12-hour periods per week from 9:00 p.m. each Tuesday until 9:00 a.m. each Wednesday and from 9:00 p.m. each Thursday until 9:00 a.m. each Friday.

However, subsistence fishing for whitefish and other non-salmon species with gillnets of 4 inches or less stretch mesh continued to be allowed seven days a week throughout the Yukon River drainage including the Koyukuk River. Also on July 18, a joint news release asked subsistence fishers throughout the drainage to minimize the harvest of chinook and summer chum to conserve these stocks. The restrictions remained in place for the remainder of the chinook and summer chum salmon run.

The fall chum salmon run got off to a very poor start with the summer subsistence fishing restrictions carrying over to the fall chum run. No commercial fall chum salmon openings occurred anywhere on the river. On August 11, a joint news release by the Alaska Department of Fish and Game and the Federal Subsistence Board announced further subsistence salmon restrictions for districts 4 - 6. On August 21 a joint news release was issued that announced, "In an effort to conserve fall chum salmon, effective 6:00 p.m. Wednesday, August 23, the entire Alaskan portion of the Yukon River drainage will be closed to subsistence salmon fishing until further notice." On September 11, a joint news release was issued announcing that subsistence fishing will be open seven days per week in tributaries of the Yukon River drainage in Districts 1, 2, 3 and portions of subdistrict 4-A, but fishing in the mainstem of the Yukon will remain closed. The relaxing of the subsistence closure did not apply to districts upstream of 4-A including subdistricts 4B and 4C and 5A. On September 14, a joint news release was issued announcing incremental openings of the subsistence salmon fishing for the entire Yukon drainage and allowed for normal seven days per week subsistence fishing. The 4 inch mesh restriction was also lifted.

1999 marked the beginning of Federal subsistence fishery management in Alaska. In 1995, Federal courts ruled in the Katie John decision that the Federal subsistence management program in order to comply with Title VIII of ANILCA must be extended to include navigable waters in which the federal government has reserved rights. The effect of the extended jurisdiction would be federal management of subsistence fisheries in navigable waters associated with federal conservation system units such as national wildlife refuges. A series of annual congressional moratoria had prohibited implementation of the Katie John ruling until 1999.

On January 8, 1999, a final rule, "Subsistence Management Regulations for Public Lands in Alaska, subparts A, B, C, and D, Redefinition to include Waters Subject to Subsistence Priority", was published in the Federal Register. The Final Rule was not to go into effect until October 1, 1999, in accordance with language contained in the Omnibus Appropriations Bill for fiscal year 1999, in order to give the Alaska Legislature an opportunity to bring the Alaska Constitution into alignment with Title VIII of ANILCA. As part of the Appropriations Bill, one million dollars was to be appropriated on June 1, 1999 and 10 million on October 1, 1999 to either the State or the Federal subsistence program to manage Federal subsistence fishery. If the State had started a process to come into compliance with Title VIII of ANILCA the money would have been appropriated to them, but the legislature did not act and the Federal subsistence program received the money. A planning process to prepare for Federal subsistence fishery management began in the late 1999 and extended through spring of 2000. The Refuge had very little involvement in these initial planning efforts. Most of the work has been done by the Office of Subsistence Management in coordination with ADF&G, Native organizations and Fisheries Resources Offices.

Visits to fish camps to monitor subsistence fish harvest was accomplished by the Refuge Information Technician and volunteers.

From mid-July to early August 2000, RIT Huntington assisted by several volunteers traveled the Yukon River from Kaltag to the mouth of the Nowitna River and from the mouth of the Koyukuk River up approximately 25 river miles above Huslia to stop and visit with folks at their fish camps. They saw a total of 35 fish camps during their travels of which 13 were active. They were able to talk to people at 11 of the 13 active fish camps. Most people reported that the run was short. Fish were of good quality early in the run, but as the run progressed more fish were of poor quality and diseased fish were observed. Most of the people reported that they were able to catch enough fish to meet most of their subsistence needs. River-wide the final harvest for chinook salmon only reached 8,518 with an incidental catch of 6,624 summer chum. This was the lowest commercial harvest for both kings and summer chums ever recorded since statistics were first collected in 1918 (YRDFA 2000).

10. Trapping

Trapping on the Koyukuk, N. Unit of Innoko and Nowitna NWR's provides a source of supplemental income for some residents in the villages of Ruby, Tanana, Galena, Huslia, Kaltag, Nulato, Koyukuk and Hughes. Also important to village residents is the opportunity to trap and teach their trapping techniques to youth as part of their customary and traditional practice. Recently, trapping activity on the refuges has decreased, but there are still a few families that rely mostly on trapping for their livelihood.

Trapline territories are not registered, but are generally passed down through families from generation to generation. Thus, claims to certain areas for trapping are usually recognized and respected by local residents. The traplines are usually associated with a cabin or camp of some sort. Occasionally traplines and accompanying cabins and equipment are sold to newcomers. Beaver trapping, however, is not always done within strictly controlled trapping territories. Areas are often shared by several people, perhaps because of the importance of beaver as a survival food.

Snowmobiles are the primary means of transportation for trapping. Some individuals travel up to 200 miles round-trip on the trapline. Most dog teams in the Galena area are used for recreation or racing; however, some dog teams are used for trapping near Ruby and on the Nowitna. Some trappers use airplanes for access, and a few simply walk their traplines. Marten, the biggest catch, are generally taken using pole sets and/or cubby sets. Beaver are taken with traps or snares through the ice, and most wolves are shot, trapped or snared around kill sites.

17. Law Enforcement

Special agents from within Alaska provided for patrols and checks of fishermen during subsistence seasons and closures on the Yukon River during the ice free period.

Refuge Officer Joanna Roberts was detailed to Kodiak National Wildlife Refuge for two weeks in June to assist with sport fishing enforcement. Kodiak Refuge returned the favor

by providing Refuge Officer Mike Getman for the latter 10 days of the September moose season to conduct hunter checks on Nowitna Refuge.

Koyukuk/Nowitna Refuges hosted two Special Agents from the lower 48. The agents based their operation out of the lower patrol cabin of the Nowitna Refuge during the first half of the moose season. It was anticipated that the Nowitna would experience a significant influx of hunters given that a drawing hunt had been implemented on the lower Koyukuk River. Hunter numbers and overall harvest remained unchanged.

During the 1998 and 1999 hunting seasons, the Koyukuk/Nowitna Refuges hosted two lower 48 Special Agents who were assigned to work on the Koyukuk River. Moose hunting on the Koyukuk was growing in popularity and demanded increased law enforcement presence. Congestion, illegal guides/transporters, and overall harvest were quickly becoming significant issues. During the Fall, 2000 season, a drawing/permit system was put into effect. In fall 2000, law enforcement on the Koyukuk River was handled exclusively by Alaska State Troopers.

Lack of compliance with the steel shot requirement for waterfowl hunting remains this station's biggest challenge. Our approach is proactive. The Refuge hosted steel shot clinics in two villages in August. The Refuge has plans to train one of its employees as a steel shot instructor in order to provide clinics and impromptu training in the eight villages within or near Refuge boundaries.

Refuge law enforcement officers and special agents did not write any citations during this calendar year. An investigation was opened on a suspected illegal guide.

18. Cooperating Associations

Our small branch of the Alaska Natural History Association (ANHA) continued to provide books of regional interest, maps, refuge t-shirts and other items for sale. e developed two new sale items using the refuge logo. Our new refuge mug (carefully chosen so that "men would like it") has been popular especially among visiting hunters, and is a good boost for our image. We also added a large tote bag with the refuge logo on one side and a Jim Morris design on the other. This is a popular item in Galena, where the use of plastic grocery bags has been banned and use of personal shopping bags is encouraged. Sales increased this year, due in part to new items for sale and involvement in community activities. Association funds were used to print a booklet that describes environmental education materials available at our refuge office. The booklet was distributed to schools in 7 area villages.

20. Subsistence Management

The Federal government has managed subsistence hunting and trapping of resident wildlife on federal lands in Alaska since 1990. In October, 1999, this management authority was expanded to include subsistence fisheries within or adjacent to federal lands

- per direction from 9th Circuit Court . Title VIII of the Alaska National Interest Lands Conservation Act (ANILCA) of 1980 dictates that federal agencies provide for a rural subsistence priority on federal lands.

Implementation of this mandate is not without difficulty. Alaska Dept. of Fish and Game operates on a parallel course with a separate set of regulations. The state of Alaska does not recognize the "rural" priority mandated by the federal government.

Much effort is expended attempting to align federal/State seasons/methods and means of harvest/ bag limits.

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 with 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 corporation lands, navigable waters, and certified Native allotments within the Complex, subsistence and other recreation consumptive use of *wildlife* are managed by ADF&G. ADF&G also manages sport and commercial fisheries on these 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 through most of 2000. In early November, she transferred to Selawik NWR. In fiscal year 2000, the Complex received \$ 15,000 in subsistence funds used for subsistence harvest surveys, subsistence wildlife surveys, and for travel to meetings, seminars and villages.

Federal Advisory Council

The Western Interior Regional Advsiory Council (WIRAC) represent 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 2000 were Chairman Ronald Sam, Alatna; Vice-Chair Ray Collins, McGrath; Secretary Jack Reakoff, Wiseman; Carl Morgan, Aniak; Angela Demientieff, Holy Cross; Benedict Jones, Koyukuk; Henry Deacon, Grayling; Michael Stickman, Nulato; and Samson Henry, Allakaket. The Council held two regular meetings in 2000. The spring meeting was a joint meeting with the Eastern Interior Regional Advisory Council and was held in Fairbanks, February 22 - 25, and attended by RM Williams, GB Roberts and RIT Huntington. GB Roberts reported on the results from the fall 1999 moose trend count

surveys. The fall meeting was held in Nulato, October 4 - 5, and attended by RIT Huntington.

The primary issues and concerns addressed at the spring 2000 meeting concerning our three refuge units centered again on the increasing hunting pressure on the Koyukuk River and the State's cooperative moose management planning effort. ADF&G planner Randy Rogers reported on the draft management plan developed by the working group and noted that the plan would be presented to the Board of Game.

The following proposals concerning the three refuge units were discussed:

Proposal 2 - align the beaver trapping season in Unit 24 (Nov. 1 - Apr. 30) with the State season of Nov. 1 - June 10. The Council recommended approval.

Proposal 42 - Unit 21(D) change the brown bear season from one bear every 4 regulatory years to one bear every regulatory year. The Council recommended approval.

Proposal 46 - Unit 21(D) to change the 10 day winter moose season from Feb. 1 - Feb. 10 to Feb. 5 - Feb. 14. The proposal was amended to allow a 10 day winter season to be announced by the Refuge Manager and ADF&G. The Council recommended approval.

Proposal 47 - submitted by the Refuge, Unit 21(D) moose, proposed to make the taking of antlerless moose legal only during the Feb. 1 - Feb 10 season. The proposal was originally tabled by the council and rejected.

Proposal 48 - submitted by the Refuge, Unit 24 moose that portion within the Koyukuk Controlled Use Area, proposed to make the taking of antlerless moose legal only during the Dec. 1 - Dec. 10 and March 1 - March 10 season. Council recommended approval.

Proposal 50 and 51 - Both proposals were to align the coyote hunting season in Unit 21 (proposal 50) and Unit 24 (proposal 51) with the State by increasing the bag limit to 10 coyotes.

The primary issues and concerns expressed by council members at the 2000 Fall meeting in Nulato included the increasing number of hunters throughout the entire western interior region, poor salmon runs, increases in numbers of clients by guide/outfitters and air-taxis, and increasing number of wolves and what to do about them. Many council members commented on their appreciation of increased law enforcement efforts in some of the areas and they hope the extra effort will continue.

Subsistence fisheries was a primary focus of the meeting with seven fishery proposals addressed by the council. Only one proposal affected the refuge areas. It was a proposal stating that King Salmon shall be used primarily for human consumption which is the normal practice for villages in our area. The proposal was modified and passed by the council.

Two representatives of the Koyukuk River Task Force, legal counsel Mike Walleri and Darrel Vent, Second Chief of Huslia, were present to discuss their position on moose management in the Koyukuk River area. They gave the council a heads up on three proposals they are considering to submit to the Federal Subsistence Board this next cycle:

1. Reduce the moose harvest rate to five percent in the Koyukuk Controlled Use Area.
2. Close all federal lands to non subsistence hunters in Unit 24 outside the Koyukuk Controlled Use Area.
3. Close the Kanuti Controlled Use Area to all except subsistence users.

First Chief of Huslia, Jack Wholecheese discussed a proposal he will be submitting to establish a federal controlled use area encompassing the Huslia and Dakli river drainages. Randy Rogers with ADF&G updated the council on activities of the Koyukuk River Moose Hunters' Working Group. Glenn Stout with ADF&G and Brett Gibbens with Fish & Wildlife Protection gave a summary of the fall moose season in the Koyukuk Controlled Use Area.

Koyukuk River Moose Hunters' Working Group

In May of 1999, the Alaska Department of Fish & Game organized the Koyukuk River Moose Hunters' Working Group 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 Federal land management agencies including Koyukuk/Nowitna NWR have participated in the planning process as technical advisors by providing harvest and population survey data and other biological information. A draft management plan was developed by the working group in 2000 and presented to both the Board of Game and Federal Subsistence Board. Both boards endorsed the planning process. The draft plan remained open for public comment through the fall 2000 hunting season.

RIT Huntington attended the working group meeting on December 8 in Fairbanks. ADF&G area biologist Glenn Stout presented two recommendations to the working group, (1) to reduce the number of drawing permits issued and (2) and eliminate the fall cow season. The working group did not support either recommendation.

State Fish and Game Local Advisory Committees

The Middle Yukon, Koyukuk River and Ruby local Fish and Game Advisory Committees encompass the area covered by the three refuge units. Refuge staff continued to work with the Committees and attempted to attend meetings whenever possible. RIT Huntington attended the Middle Yukon Committee meeting in Nulato on October 3.

I. EQUIPMENT AND FACILITIES

2. Rehabilitation

The Refuge Complex acquired a 2-bedroom residence from the Federal Aviation Administration on 8/31/00. The structure had received little use in recent years and was a maintenance headache for an agency not based in Galena.

Phukan Consulting, Inc. of Anchorage was hired to conduct a survey of the FAA residence as a precursor to its acquisition. The survey identified a long list of problems in need of remedy. Much of this need has been accomplished by force account. The facility will be ready for use during the 2001 field season.

3. Major Maintenance

Driveway retaining walls were replaced at government quarters 1-6. Original construction included use of untreated spruce timbers. Replacement materials utilized steel pilings and treated timbers. Contractor was Kangas Construction, Inc. of Ruby, AK. Project cost was \$173,000.

Carpet was replaced in quarters #2 and #5 at \$5,270.00 each. In addition, each of these residences was painted throughout in anticipation of new residents. Electric ranges and clothes washers were replaced in quarters 1-6. Refrigerators were replaced in quarters 5 and 108A.



Retaining wall before replacement at government quarters.

4. Equipment Utilization and Replacement

The Refuge Complex replaced a road weary 1990 Chevrolet crew cab truck. Delivery of replacement vehicle, a 2000 Chevrolet crew cab 4x4 arrived in March, 2001. Cost with delivery: \$25,000.

A 21-foot Alweld boat with canvas/vinyl cabin was ordered from the Boat Shop, Fairbanks, AK. The watercraft was purchased with subsistence fisheries (1937) funds: \$15,660.00. A outboard motor was ordered separately- Honda 4-cycle 75hp \$4,573. The watercraft will facilitate visits to villages and fish camps along the Yukon and Koyukuk Rivers.

5. Communications Systems and Weather Stations

This was the fifth year that the Bureau of Land Management (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, eight mobile units (in vehicles and boats), five repeaters, four Remote Automated Weather Station (RAWS) sites, and our

base station radios 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, 2001 will bring a trouble free fully operational radio system.

The satellite phone purchased in 1997 was used sparingly this year. Although, it seems to work it does not get much use because of its bulk and difficulty to operate. Alternatives like the Iridium system are being explored for replacement and back up for our current radio system.

6. Computer and Network System

Every permanent professional, administrative, and technical staff member has either a laptop or desktop computer to work with. There are fourteen desktop work stations and six laptop computers in use by refuge staff by the end of 2000. Our current Local Area Network (LAN) is set up using TCP-IP protocols to the Regional Office by a 56K direct line that was installed in January, 2000. Hedy Saccone and Andy Mooney from the Regional Office IRM section installed Lotus Notes and a new Router in March, enabling all staff to have email and internet access over the network. The 56K direct line and improved productivity throughout the office by providing greatly improved internet access. Four desktop, one laptop, and two dot matrix printers were excess or destroyed in March. Our computer's run using Windows95 and Windows98 operating systems, except the GIS and Router which utilize NT systems. One new color printer, a Xerox Phaser 850, a 20GB tape backup device, and a scanner were added to the network in 2000. Three new Pentium Windows desktop computers along with a new NT computer (our Notes Router computer) were purchased to replace older workstations.

8. Other

In January, the United State Air Force permitted to the Koyukuk/Nowitna Refuge Complex exclusive use of Building 1842 on the Galena Air Station. Our use of this facility for storage and minor equipment maintenance is without charge to the Grantee. This permit became a reality after years of dialogue with local Air Force representatives - and more recent communication with the office of Chief of Refuges and Air Force liaison attached to the Dept. Of Interior in Washington, D.C. The facility provides for secure storage of boats, snowmobiles, canoes, and lumber.

Aircraft

The Complex used three aircraft in 2000: 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 734 hours in 2000 (Table I.8.1). This was done

without incident, which represents this station's 17th year without an aviation accident or incident.

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; and (2) 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.

Two pilots worked on the staff in 2000: One dual-function GS-486 Wildlife Biologist (Spindler) and one full time permanent GS-2181 Pilot (Huhndorf). 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 with Yukon Eagle Aviation Charters for 42 hours. Availability of his charter aircraft is especially useful 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 2000 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 of our aircraft was complicated and expensive because of Galena's remoteness and distance to commercial or OAS maintenance facilities.

Table I.8.1. Summary of flight hours by Refuge pilots in government aircraft at Koyukuk/Nowitna NWR Complex, 1990-2000.

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				432
1998	252	249				501
1999	98 ^a	50 ^b		163	80	391
2000	318	43 ^b		416		777

^aTotal hours lower than usual due to broken leg

^bCharter hours with Yukon Eagle Air Service

Watercraft Incidents and Use

There were nine incidents during (no fewer than) 26 boat trips captained by 11 operators. These trips represented a total of 107 boat days on the river system during the summer of 2000. The following table shows the watercraft incidents that required some repair or maintenance. Many of these repairs were required because of operations on the Yukon or Koyukuk Rivers which have numerous hidden sand bars and sometimes have floating or water-logged debris that pose a hazard to navigation.

Table I.8.2. Summary of watercraft incidents and required repairs for 2000.

Watercraft Incident Report for 2000

<u>Approximate Date</u>	<u>Operator/passenger</u>	<u>Boat/Motor</u>	<u>Damage/ Repairs</u>
June 1-4	Hughes, & crew	24' Bertha/ 150 Mercury	Kicker motor would not start from previous season use/ Kicker replaced
June 4-10	Huntington, Farmer, Sam	20'Selawik/120 Evinrude	Bent drive shaft, damaged skag/ Replaced Lower Unit
June 12	Spindler, Lehmkuhl, Webb	20' Alweld/75 Honda	Propeller blade broken/ Replaced propeller
June 14-20	Hughes, & crew	24' Alweld/130 Honda	Kicker motor mount bent from last season/ Kicker bracket repaired Hull ding while trailering/Trailer rollers replaced
June 26	Hughes & crew	24' Alweld/130 Honda	Kicker motor mount bent/ kicker removed
June 28-	Lehmkuhl, Webb	16' Grumman/ 3Johnson	Water/dirt in fuel/ cleaned carburetor & fuel can, replaced spark plug
July 10-20	Shaw, Lehmkuhl	24' Alweld/ 130 Honda	Skag damaged/ No action yet (lower unit housing may require repair.
July 17-20	Huntington, Hughes & crew	24'Bertha / 150 Mercury	Skag broken , Propeller dinged/propeller filed
July 22-24	Huntington	20' Selawik/ 120 Evinrude	Skag broken, propeller dinged/ Skag repaired, propeller filed

J. OTHER ITEMS**1. Cooperative Programs**

In August, Koyukuk/Nowitna Refuges sponsored two steel shot clinics put on by Alaska Dept. of Fish and Game personnel in villages of Nulato and Huslia.

2. Credits**K. FEEDBACK**