

U.S. Department of the Interior
Fish and Wildlife Service
NATIONAL WILDLIFE REFUGE SYSTEM

KOYUKUK/NOWITNA
REFUGE COMPLEX

Galena, Alaska

ANNUAL NARRATIVE REPORT

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US FISH & WILDLIFE SERVICE--ALASKA



ANNUAL NARRATIVE REPORT

1993

KOYUKUK NWR

NORTHERN UNIT, INNOKO NWR

KOYUKUK/NOWITNA NATIONAL WILDLIFE REFUGE COMPLEX



Galena, Alaska

REVIEW AND APPROVALS

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Complex Manager

8/29/94
Date

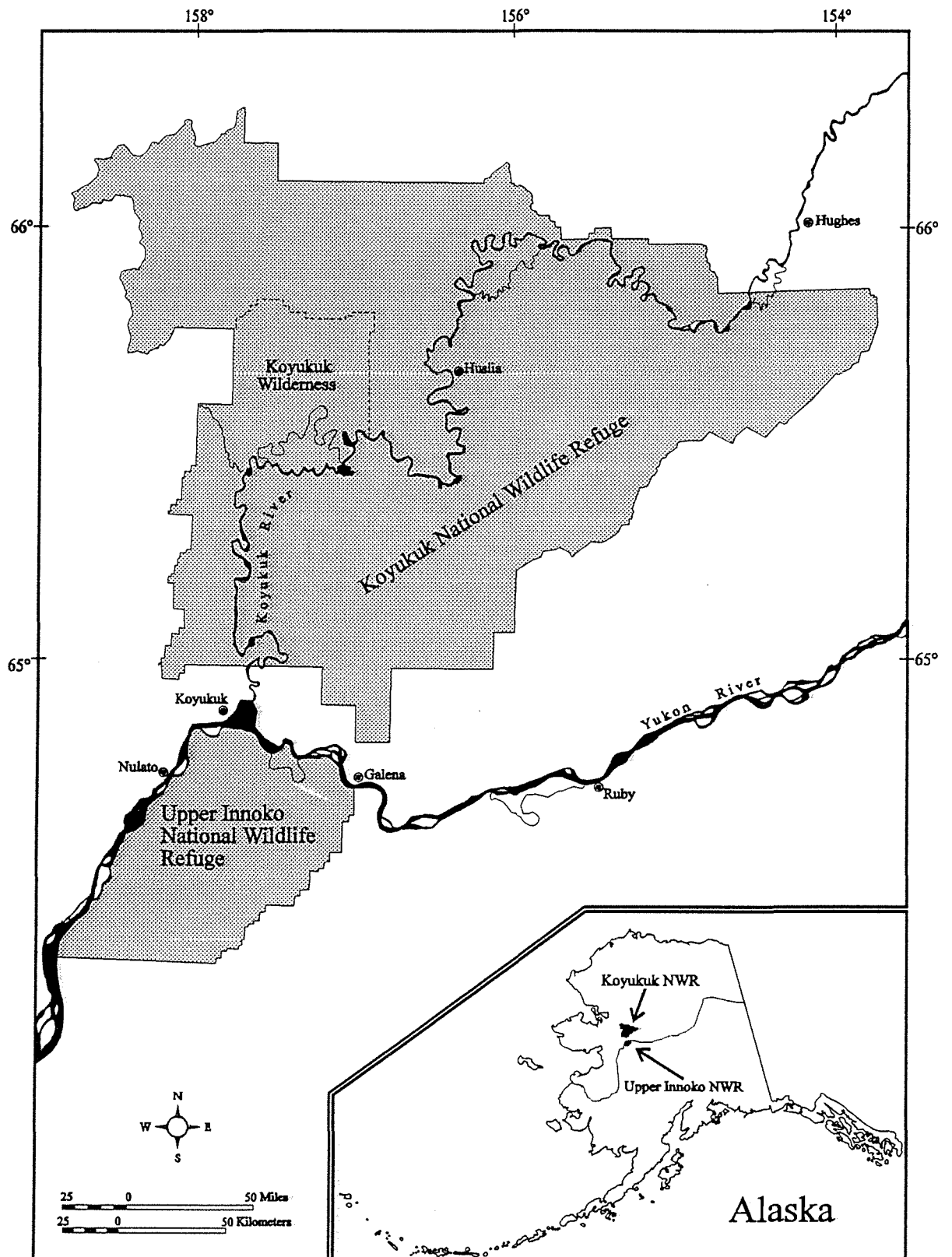
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Koyukuk and Upper Innoko National Wildlife Refuges, Alaska.



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

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

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

1. To conserve fish and wildlife populations and habitats in their natural diversity including, but 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.

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 500 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. A discussion of the base closure is included in Section J.3.

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K. FEEDBACK

A. HIGHLIGHTS

-1993 was a year of normal temperatures but extremes in precipitation. Spring and summer were sunny, warm, and pleasant, with precipitation below normal, but extreme amounts of rain were experienced in September. We experienced the latest freezeup in years.

-Galena Air force Base was reduced from active to caretaker status.

-The partnership with local native corporation Gana-a' Yoo flourished and produced a regional geographic information system and a cooperative land use planning effort.

-An early breakup hinted at good waterfowl production, but extreme flooding on the Koyukuk caused reduced production in the floodplain. Overall, duck and swan production was about average while goose production was below average.

-Our fire management officer Tom Lugtenaar worked on disseminating his idea of a triple ring of protection around structures surrounded by wildfire prone habitats, and applied the idea to several refuge facilities.

-Moose populations were growing in most areas, stable in a few, and declined in one area. The current harvest of <5% per year is sustainable according to our studies.

-The Galena Mountain caribou herd study identified core wintering and calving areas. Genetics work revealed little reindeer ancestry.

-The wolf study indicated populations are stable and that predation on moose is not limiting growth on the Koyukuk but could be approaching a limiting level on the Northern Unit, Innoko Refuge.

-Four fisheries studies were underway on the refuge: salmon stock assessment, salmon genetic stock inventory, Koyukuk tributary resident fish identification, and Northern Unit, Innoko Refuge pike study.

-Results from 1991 contaminant sampling indicated that the same areas harbored fish containing elevated levels of mercury in tissues. Tanana Chiefs Conference did more detailed sampling on the Kaiyuh and found a relation between fish size and mercury concentration.

-Commercial big game guides operated for the first time on the refuge since 1989. Two guides hunted moose in partnership with the villages of Hughes and Huslia.

-Refuge staff conducted the second annual Biological Skills Camp for area high school students, and assisted in teaching a similar Camp at Innoko NWR.

-35 different presentations of a moose population dynamics educational program were made to 622 regional school students. Informal presentations on the same topic were made to adults in three villages.

-We began a monthly educational segment called "Fish and Wildlife Report" on the regional public radio station, KIYU.

-A four day long subsistence only moose season proved difficult to manage and enforce.

-Number of moose hunters and harvest decreased since 1991.

-Village subsistence harvest surveys were completed and the job was taken over by Tanana Chiefs Conference.

-Personnel changes during the year included the transfer of RM David Stearns to Yukon Delta, the transfer of WB Mark Bertram to Yukon Flats and the hiring of his replacement Lisa Saperstein as a 2-year term biologist.

B. CLIMATIC CONDITIONS

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

January of 1993 began with unseasonably warm temperatures up to 37°F that soon plummeted to -48°F by the 21st. Average temperature for the month was 9.8°F, with a total snowfall of 22 inches (Figure B1). The low temperatures for the first four days of February averaged -51°F ending a 21-day cold spell that averaged -43°F. The remainder of the month was unseasonably warm with the high temperature of 32°F on the 17th and the low of -54°F on the 3rd. Snow accumulation exceeded the average annual accumulation of 50 inches with a total of 109 inches by month's end. Temperatures in March were warmer than normal however, precipitation (Figure B2) for the month was lower than normal. April brought warm, dry temperatures with trace amounts of precipitation. Summer made its splash when the Yukon River ice went out at Galena on the 12th. Monthly temperatures ranged from 25°F to 76°F, 5°F warmer than normal. The remaining spoils of winter soon faded in June with an average temperature of 59°F and a high temperature of 83°F. June's weather continued throughout July with similar temperatures and precipitation. Residents of the western Interior enjoyed berry picking and fewer mosquitoes as August brought the first signs of autumn. The warm, dry conditions of summer continued into mid-month. Snow was seen on Galena Mountain on the 16th, and the first frost hit Galena on the 24th. September proved to be a cool, wet, and windy month forcing local residents to hunt moose in the blowing rain with temperatures averaging 41°F. The month was drenched by a total precipitation of 3.7 inches. October was unseasonably warm with total precipitation less than normal.

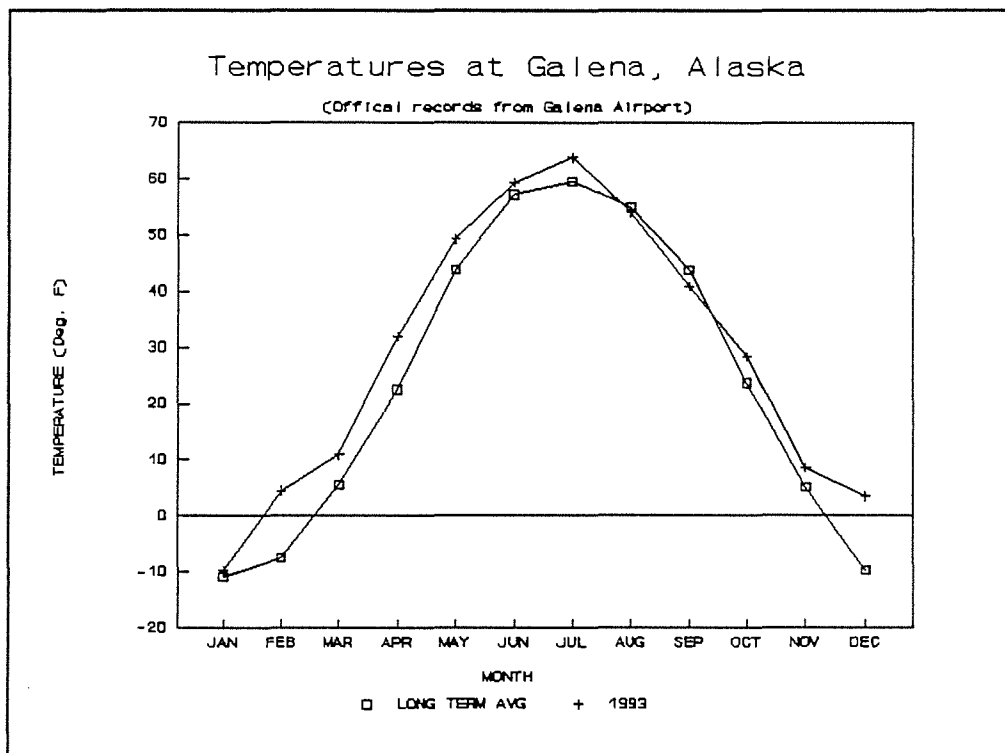


Figure B1. Long term average and observed temperatures in 1993.

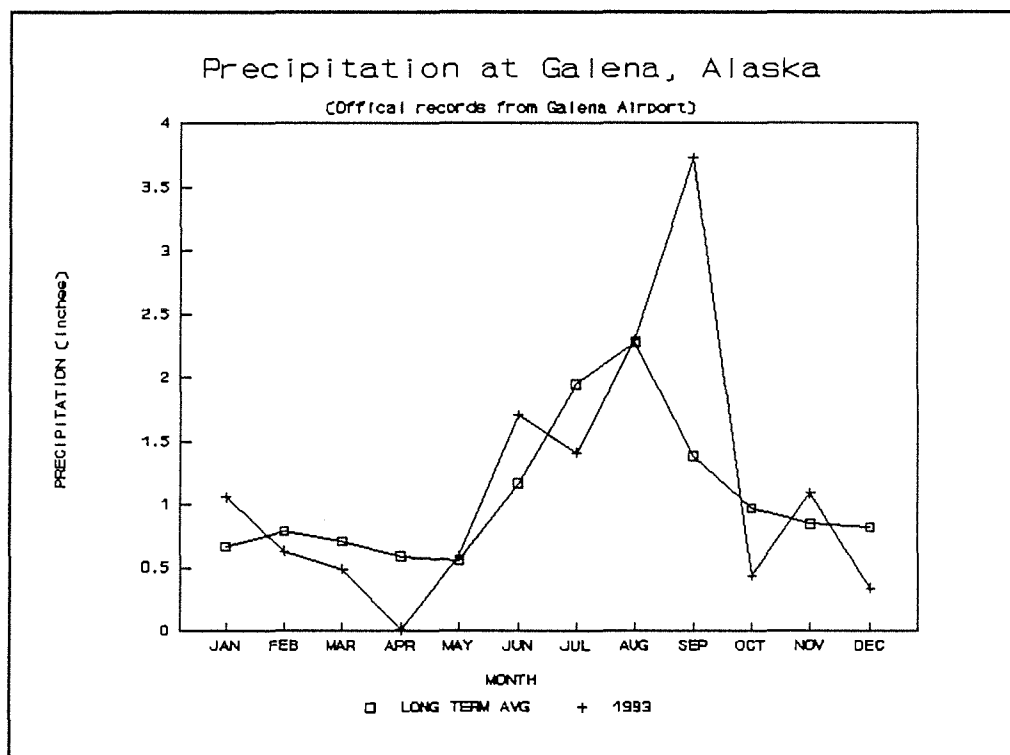


Figure B2. Long term average and observed precipitation in 1993.

The Yukon and its tributaries remained open throughout the month which subsequently delayed the trapping season for area residents. November saw the latest freeze-up to occur in many years when the ice stopped flowing past Galena on the 3rd. Perhaps the late freeze-up and light snowfall were related to the southward and westward shift in winter distribution of Western Arctic Caribou Herd which avoided most of the Koyukuk Refuge except for the northwestern corner. Temperatures for the month were relatively cool however, the average temperature was 3.5°F warmer than normal. December completed the year with unseasonably warm temperatures and below average precipitation.

With the closure of the Galena Air Force Base on the 1st of October, full-time, human climatological monitoring was reduced to inconsistent part-time monitoring. Gaps are filled by an Automated Weather Observation System (AWOS). The AWOS has proved to be somewhat unreliable as elsewhere in Alaska. Maintaining a climatological database for Galena enhances the interpretation of seasonal biological data, therefore we began investigating purchase of a self-contained weather station with data logger.

C. LAND ACQUISITION

1. Fee Title

In 1990 a Land Acquisition Priority System was completed for all refuges in Alaska. As a result of the prioritization system, a land protection plan (LPP) will be developed for the Koyukuk Refuge. As part of this process, a meeting was held with Realty personnel in April to begin planning for the LPP. Although development of land status maps and the first round of village meetings were scheduled to begin late in the year, other commitments in the Realty office forced a delay until 1994.

3. Other

The Service has a Land Bank Agreement per Section 907 of ANILCA with one of the major refuge inholders - Gana 'A Yoo, Ltd., the local native corporation for the villages of Galena, Koyukuk, Nulato, and Kaltag. A total of 437,000 acres of corporation land are included in this agreement. Although minor land withdrawals have been made in the past for activities such as airport expansion at the villages, no withdrawals were made in 1993. Major components of the agreement provide for management of included lands in a manner compatible with the management plan for the Koyukuk NWR and the providing of technical and other assistance to the land owner. Activities related to technical assistance through challenge grant funding are described in Section J.1.

D. PLANNING

1. Master Plan

No significant work was done on updating the Comprehensive Conservation Plan (CCP) during the year. Per guidance supplied with Refuge Operations Needs System (RONS) instructions, the Region agreed that CCP's would be reviewed every 10 years. For the Koyukuk, that means the next major effort toward comprehensive planning will not take place until 1997.

5. Research and Investigations

The following approved refuge wildlife studies were active during 1993. Progress reports are available from the Complex Office or the Regional Office Library. A brief report from each study is included in the appropriate section of the Koyukuk or Nowitna reports.

Seasonal movements home range of three wolf packs on the Koyukuk National Wildlife Refuge.

This project was initiated in Spring 1990. Primary objectives of the study were to determine pack sizes, location, and home range size, seasonal habitat use, and to develop an estimate of wolf/prey ratios in an area of known prey density. The study also included three radio-collared packs on the Nowitna NWR. A progress report was completed in 1992. Twelve more collars were deployed in 1992 and 1993 for continued monitoring of trends in wolf population and predation. A draft progress report was written in 1993. Recent progress is reported in Section G.10.

Investigation of mercury and copper contaminants in fish and wildlife resources on the Koyukuk/Nowitna Refuge Complex.

Begun in 1985, in cooperation with Northern Alaska Ecological Services (NAES), the project objectives were first to screen for the presence of any known heavy metal contaminants in refuge streams that originate in areas with known mining history. The actions of placer mining in uplands surrounding the refuge basins often releases naturally occurring heavy metals; likewise mercury pollution has been associated with refining gold ore. A revised study proposal called for further sampling in 1991 and 1993 with the objectives of re-testing known hot spots and beginning to ascertain whether the heavy metals were naturally occurring or mining-related. Laboratory results from sampling completed in 1991 were made available late in 1993 and an early preview was given us by NAES. No funding

was allocated for the proposed 1993 work. Paul Headlee from the Tanana Chiefs Conference Division of Wildlife and Parks conducted fish and water sampling on the Kaiyuh Flats in summer 1993 and the results are summarized in Section G.11.

Nesting ecology and habitat requirements of white-fronted geese (Anser albifrons).

This study was originally proposed and approved for the Nowitna in 1987. One season of field work occurred in 1987 and a progress report was completed in 1988. The study was then moved to the Koyukuk 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. Progress reports were written in 1992 and 1993 and a revised proposal was submitted for approval in 1993. Results of the 1993 work are reported in Section G.3.



5c, 1c, 5a 1b, 7a, 4c, 6a, 8d, 4a,
2c, 1a, 3a, 10a, 2b, 10c, 8c, 2a, 9c

E. ADMINISTRATION

1. Personnel

a. Permanent

1. F. David Stearns, Refuge Manager, GS-485-12, EOD 6/17/90, Transferred 10/3/93, PFT
2. Michael A. Spindler, Refuge Operations Specialist/Airplane Pilot, GS-485-12, EOD 2/11/90, PFT
3. Paul A. Liedberg, Refuge Operations Specialist/Airplane Pilot, GS-485-12, EOD 2/11/90, PFT
4. Peter G. DeMatteo, Refuge Operations Specialist, GS-485-9, EOD 12/01/91, PFT
5. Colin B. Brown, Airplane Pilot, GS-2181-12, EOD 4/20/84, PFT, Local Hire
6. Thomas K. Lugtenaar, Fire Management Officer, GS-401-9, EOD 1/26/92, PFT
7. Walter N. Johnson, Wildlife Biologist, GS-486-11, EOD 5/21/89, PFT
8. Mark R. Bertram, Wildlife Biologist, GS-486-11, EOD 4/10/88, Transferred 1/10/93, PFT
9. Maudrey M. Honea, Administrative Technician, GS-318-6, EOD 10/7/85, PFT, Local Hire
10. Theresa Burley, Refuge Clerk, GS-303-4, EOD 2/10/91, PFT, Local Hire

b. Term

1. Thomas F. Paragi, Wildlife Biologist, GS-486-9, EOD 6/17/90, FT
2. Lisa B. Saperstein, Wildlife Biologist, GS-486-9, EOD 5/30/93, FT

c. Temporary

1. Bernard Attla, Maintenance Worker, WG-4749-8, EOD 9/23/91, TAPER, FT-Seasonal
2. Heather N. Johnson, Park Ranger, GS-025-7, EOD 7/8/91, FT-Seasonal
3. George M. Wholecheese, Biological Technician, GS-404-5, EOD 6/13/90, Terminated 6/12/93
4. Jenny M. Lowe, Biological Technician, GS-404-5, EOD 6/17/90, Local Hire, Intermittent
5. Pollock Simon Jr., Biological Technician, GS-404-5, EOD 6/2/92, TFT
6. Marlene R. Settle, Biological Technician, GS-404-5, EOD 7/15/93, TFT
7. Misty L. Conrath, Biological Technician, GS-404-5, EOD 6/27/93, TFT
8. Donald D. Katnik, Biological Technician, GS-404-5, EOD 5/2/93, TFT
9. Allen B. McGinty, Biological Technician, GS-404-5, EOD 6/1/93, TFT
10. Claudette Green, Biological Technician, GS-404-5, EOD 6/1/93, TFT

d. Volunteers

1. Jacque Russell
2. Dave Crawford
3. Eric Wimberly
4. Phillip Pilot
5. Steven Attla
6. Isabel Butler
7. David Dirk
8. David Brannon
9. John Sexton
10. Roland Quimby
11. Rodney Houghton
12. Jessica Torvik
13. Victor Wilson

As usual, several major staff changes occurred during the year. Most notable was Refuge Manager Stearns being selected to fill the same position on the Yukon Delta NWR. Dave had been at this station since June of 1990 and departed effective October 3. Dave kept the "wheels turning" and several major accomplishments occurred during his tenure - most notable was completion of an

Operational Plan and Wildlife Inventory Plan for the station, the move into a leased office within the community for better exposure to the public, the addition of maintenance mechanic and subsistence coordinator positions, and initiation of a major wildfire and furbearer study on the Nowitna.

Wildlife Biologist Mark Bertram transferred out of the bush and into the city when he took a similar position with the Yukon Flats NWR headquartered in Fairbanks. He departed effective January 10 and took with him an enthusiasm and dedication to his work that will serve him well throughout his career.

Although we were not allowed to refill Mark's position on a permanent basis, we were finally able to temporarily fill the slot with a term appointment. Lisa Saperstein was hired effective May 30 to provide the bulk of the biological support needed to accomplish work per our wildlife inventory plan. Lisa recently graduated from the University of Alaska - Fairbanks with a Masters in Wildlife Science degree. She did her graduate work on arctic caribou and brings a background in vegetation which will be a very positive addition to the staff.

As good as it is to have Lisa on board, we feel somewhat vulnerable at having lost two permanent biologist positions in just over two years and having them replaced with a single term biologist. We hope this term appointment can be made permanent in the near future.

Maintenance Worker Bernard Attla who had been serving under a temporary appointment since September of 1991 was appointed to a TAPER (Temporary Appointment Pending Establishment of a Register) position NTE 10 months per year on August 8. It is unlikely a register will be developed by OPM in Galena and thus, Barney can be converted to a permanent position in three years. He enjoys almost all the benefits of permanent status within this appointment.

Park Ranger Heather Johnson was recruited to fill her position at a GS-7 level effective March 7. She occupies this position on a seasonal basis not to exceed 10 months per year.

In Fiscal Year 93 this station used 10.08 FTE's. This does not reflect the total staffing of the station because local hire positions do not count against our FTE allowance. Actual staffing in the past five years is depicted below:

	Permanent	Temporary*	
		Full Time	Part Time
FY93	9	11	0
FY92	10	10	0
FY91	10	10	0
FY90	10	9	0
FY89	11	4	0

*Includes Term Appointments

Although total staffing has remained fairly constant we have actually done quite a bit of position shifting. Two of the three PFT biologist positions on board in 1989 have been lost. During that time we have added a maintenance worker and refuge operations specialist for subsistence. Although the need for the new positions was critical, the major loss in our biological horsepower for a station where that is our main program is hard to take.

4. Volunteer Program

Volunteers contributed 1,025 hours to refuge operations this year, primarily in resource support, wildlife studies and maintenance activities. This represents a 56% decrease in total hours contributed in 1992, in part due to the contribution of two cinematographers who donated 31% of 1992 volunteer hours. A total of 115 hours was contributed by volunteers stationed at Galena Air Force Base, a reduction of 69% from 1992. Air Force personnel have contributed 485 hours to our program over the past two years. We appreciated the help from several individuals who had work schedules on base that accommodated refuge office working hours.

Operation costs for the 1993 program totalled \$1,657 and were mainly for transportation and stipend. A total of 40 staff hours was required to administer the 1993 program. For the third summer the Wildfire/Furbearer Project utilized a student volunteer from the University of Washington. Undergraduate Jessica Torvik donated 660, hours assisting the staff with vegetative surveys and small mammal trapping. Volunteers were also involved in goose production surveys and the Nowitna Moose Check Station. The majority of volunteers helped with maintenance projects throughout the year. The greatest benefit of the volunteer program for this station is being able to utilize additional help as needed on a project-by-project basis. The refuge recognized volunteers efforts with appreciation gifts of locally written books, FWS mugs, and a wild game barbecue.

5. Funding

A summary of funding for the past five years follows:

Table E.1. Koyukuk/Nowitna Refuge Complex Funding, 1989-1993

Program	FY89	FY90	FY91	FY92	FY93
1221		30,000			
1230	15,000	5,000	6,000	6,000	1,500
1241		116,000			
1260	927,000				
1261	575,000	708,000	652,000	646,000	648,200
1262	190,000	336,500	295,000	301,000	320,000
1411					10,000
8610	48,600	39,500	40,000	29,300	28,100
9110			61,000	125,000	78,000
9120			81,700	145,000	190,000
Total	1,755,600	1,235,000	1,135,700	1,252,300	1,275,800

Funding in Fiscal Year 1993 remained constant to slightly lower when considering funding sources and inflation. Within the 1261 funds we received \$54,200 in Challenge Grant monies to cooperate with Gana-a' Yoo Ltd. under the land bank agreement to begin land use planning in an area that includes their 437,000 acres and refuge lands and included in the land bank agreement with the Service. All \$10,000 of the 1411 funds were used by Migratory Bird Management to conduct portions of a waterfowl brood survey sightability project on the Koyukuk Refuge. The station expended \$15,600 on four MMS projects during the year. Subsistence funds provided to the station through the 1261 program totaled \$85,000. With the special funding sources, about the only figure that can be used for comparison purposes is the allocation to cover fixed costs. In Fiscal Year 93 this totaled \$791,000 compared to \$722,000 in Fiscal Year 92.

6. Safety

Probably the single most important action the Service can do to improve safety in remote locations such as Galena, is to hold extensive safety training. The Complex held its annual safety orientation training for the entire staff June 1-7. A total of 22 staff members from this station and Gana-a' Yoo Ltd. were involved in this year's training. All regional safety training mandates were met with the help of our staff, WB/P Vivion of the Yukon Flats NWR, Billy Demoski, (Chief of Loudon Village Council-Galena), and U.S. Air Force medic staff. Safety training was conducted in the areas of first aid, CPR, aviation safety, firearms/bear safety,

watercraft safety, hypothermia, survival gear, and the refuge radio system. We used a combination of videos from the Regional Library, slide presentations, hands-on demonstrations, and participatory exercises as well as lectures. Also, during several of our weekly staff meetings, safety hazards in and out of the office were discussed. Pilot Brown also gave a demonstration of our new winter survival vests for the staff.

One staff member suffered minor injuries as a result of slipping on the float of the refuge aircraft, however, no lost-time due to accidents or injury occurred during 1993. Our safety training obviously paid off, this year.



ROS/P Liedberg and RV Dave Brannon practiced pinpointing the "notch" during CPR training.



The cast of characters posed with their "Chris Clean" mouth pieces for CPR graduation.

7. Technical Assistance

FMO Tom Lugtenaar assisted Gana-a' Yoo, Ltd. with planning for a prescribed burn on corporation lands located south of Galena. The prescribed burn is scheduled for 1994.

In July 1993 Pilot Colin Brown provided logistical assistance to biologists Anne Morkill and Randi Jandt of the BLM Kobuk District office. He flew two refuge canoes to the Pah River Flats, where they were used for fire effects studies and duck production surveys. Cooperation continued along the same lines when we shared a chartered Super Cub with them for a week in mid-July at the peak of our aircraft use.

In response to a request by the Village of Huslia, we flew moose surveys at Treat Island which is the area permitted to a commercial moose hunting guide who is working in cooperation with the village. Otherwise we would not have given the area very high priority for survey because it receives little hunting pressure and moose are abundant.

In February Dave Stearns provided assistance to the Western Interior Economic Development Conference held in Galena. He presented two sessions, one on

preventing wildlife/development conflicts and another outlining the technical assistance available for land use planning under existing agreements. The Service also provided two vehicles with drivers to shuttle the many out of town guests from the airport to their lodging and the meeting hall.

8. Other

The staff visited with AM Fuller from Region 2 and ARD Thorson as part of the national functional review team in May. A candid and spirited discussion resulted on a wide variety of topics.

A lease with the State of Alaska at the Huslia airport was initiated to facilitate storage of a small number of fuel barrels on the site. A portable spill container was placed on the site in August.

During the Project Leaders meeting in November 1993, refuge managers were given the option of reducing the size and effort of the monthly activity report to only highlights, if the station would put those efforts into more effective communication and outreach methods. This station did just that, and started monthly public radio information segments in concert with a quarterly newsletter. The first radio program was on the Christmas Bird Count and it aired in December.

After October 1, following the departure of Dave Stearns to Yukon-Delta NWR, Mike Spindler and Paul Liedberg alternated as acting refuge manager. When they were out of the office, Pete Dematteo and Bud Johnson assumed the duties. Lack of a manager at times had a ripple effect and caused delays in the main duties of the acting managers. Not meeting the annual narrative deadline was one of the effects.

F. HABITAT MANAGEMENT

1. General

The most conspicuous characteristic of vegetation on the refuge is the complex interspersed of vegetation types. Differences in vegetation cover are caused by an intensive fire history, sediment deposition during periodic flooding, ice scouring, discontinuous permafrost, and sand dune action.

No active habitat management in terms of improvement or modification occurs on the refuge. The only exception is the option for controlled burning which has not

been conducted but is listed in the Comprehensive Conservation Plan as an approved activity. Management practices associated with mechanical manipulation such as large scale tree crushing and water impoundment/diversions is not authorized by the CCP but "may be considered subject to appropriate plan revision." There are no foreseeable plans for such activities.

A discussion of vegetation types follows in the appropriate category.

2. Wetlands

The rivers in the refuge lowlands are characterized by low gradients meandering courses and heavy spring flooding. Flooding during spring is common, and it is often mid-summer before most of the flood waters subside. The rivers, particularly the Yukon and Koyukuk, carry a heavy silt load at flood stage. Meandering creeks with steep banks are typically slow and shallow. Narrow bands of white spruce line higher banks, while willow and alder thickets are found in lower areas.

Lake and pond wetlands include upland basins, ice-formed lakes on the flats, river flooded lowlands, oxbows and bog lakes. Spring runoff, rain and river flooding recharge lakes. Water depths and shorelines can vary from year to year. Lake depths seldom exceed 15 feet and usually are much shallower. Water temperatures in shallow lakes reach 70°F or more in mid-summer, creating ideal conditions for growth of aquatic plants and invertebrates. Among the aquatic plants, duckweed, horsetail, water milfoil, mare's tail, and smartweed are abundant. One or more of 12 species of pondweed occur in almost all lakes. Bog lakes usually contain water lilies. Several species of graminoids including sedge, bluejoint grass, and foxtail provide cover on exposed shorelines. The forb fleabane grows on recently exposed soils along shorelines.

Shallow seasonally flooded basins (locally are called "grass lakes") are common along the Koyukuk River. They are usually wetlands during spring breakup and flooding, but otherwise are dry meadows with many showing the beginnings of shrub and forest succession. During flooding sedges and occasionally, bluejoint grass will survive as emergent vegetation in water depths exceeding four feet. Shorelines of bog lakes vary in character, but nearly always contain buckbean, wild calla, and various sedge species; cattails are rare.

Waterfowl use is related to the type and density of aquatic and shoreline vegetation present. Preference is given to lakes with abundant submergents such as pondweeds, water milfoil, and horsetail and to wetlands with shoreline vegetation that is moderately dense and interspersed with openings. These

attractive basins are either closed drainage lakes maintained by infrequent flooding and long periods of gradually receding water levels or lakes connected to river systems that are more frequently flooded but also have gradually receding water levels.



A wide zone of horsetail and sedge, usually found on river-connected wetlands, provides favored brood-rearing habitat for dabbling ducks. About 270,000 acres of the refuge is wetland.

3. Forest

Three broad forest vegetation types occur on the refuge.

Closed spruce-hardwood forests are found mainly along the major water courses and on warm, dry, south-facing hillsides where drainage is good and permafrost is absent. This type consists of moderately tall (50 feet) to tall (80 feet) stands of white and black spruce, paper birch, aspen and balsam poplar.

Open, low growing spruce forests are found in the northwestern quarter of the refuge and are scattered throughout the central portion. This type is composed primarily of black spruce, but is often associated with paper birch and willows and is locally interspersed with treeless bog. This type frequently is found on north facing slopes and poorly drained lowlands usually underlain by permafrost.

Treeless bogs are the predominant vegetation type in the center of the refuge. The vegetation of these bogs consists of various species of grasses, sedges and mosses, especially sphagnum moss. On drier ridges, willow, alders, resin birches, black spruce and tamarack are found.

9. Fire Management

Fire management goals and procedures for the Complex are contained within two regional interagency fire management plans. The Complex is within the Seward/Koyukuk (1984) and the Kuskokwim/Iliamna Fire Management Planning Units (1983) of the Alaska Interagency Fire Management Plan which designated levels of suppression throughout the planning area.

Although prescribed burning is an approved activity per the comprehensive conservation plans for all three refuges, the majority of the fire management program activity is related to managing wildland fires. The Complex lies within a zone of extremely high lightning strike activity which is the source of most wildfire starts. On an average day during June and July, over 500 lightning strikes can be recorded in the area. With favorable drying conditions, we can expect numerous wildfires from early June until mid-September.

Refuge-specific fire management plans were initiated during the year with a target completion deadline of September, 1994. The existing plans written several years ago required updating for several reasons, one of which includes meeting the new format as described by policy.

The refuge's fire management objective, consistent with the refuge manual and the Alaskan Consolidated Interagency Fire Management Plan, is to protect or enhance habitat and ecosystems for the benefit of fish and wildlife on refuge system lands. To meet that objective, we will continue to manage wildfire to the extent practical in a manner that will restore it as a natural feature in habitat rejuvenation.

The summer of 1993 was not a normal fire year. We had only three wildfires burn 22.5 acres on the Koyukuk/Upper Innoko Refuges. Two of the fires occurred in the full or modified suppression category and smokejumpers were dispatched for suppression action. One fire of seven acres was in a limited category area, was monitored and allowed to burn out naturally. Several fires in the 1,000 acre range did occur just outside the refuge boundaries. Though not within our administrative boundary, these fires did make progress toward meeting an objective of managing on an ecosystem wide basis. Table H.9.1 summarizes wildfire occurrence on the Koyukuk and Upper Innoko NWR's during the year.

Table H.1. Wildfire Occurrence on the Koyukuk and Upper Innoko NWRs, 1993.

Fire Number	Acres Burned	Option of Protection
7311	15.0	FULL
7324	.5	MODIFIED
7319	7.0	LIMITED

Although Alaska, and in particular interior Alaska, offers probably the best opportunity to manage natural wildfire, we are still challenged in this endeavor by numerous tracts of private inholdings - mainly native allotments, but also village and regional corporation lands - interspersed with refuge land. Some of the village and regional corporation lands are gradually being assigned suppression level categories that allow a more natural fire occurrence, however, this is not true for the numerous native allotments. They will most likely continue to receive suppression appropriate to a critical site for as long as there is no cost to the landowner. Our dilemma is how to allow a natural wildfire program on refuge lands to the maximum extent possible, while providing protection in the form of a buffer for private lands in a higher level suppression category.

To alleviate this dilemma, we have begun advocating a program of presuppression around structures that are situated in areas prone to wildfire. FMO Lugtenaar has developed a concept called the Triple Ring of Protection. Using this concept of vegetation thinning and placement of control lines down to mineral soil, structures set in wildland fuels can better withstand low intensity wildfire even without crews on hand to defend the site. The concept involves thinning around the structure so that it can be more easily defended should wildfire be approaching the site. During an extreme wildfire, providing the site is maintained, it is ready for an immediate burnout of light and flashy fuels that will allow neutralization of the approaching wildfire. This presuppression was done on six of our structures. Five of these were residences in Galena and the sixth was our Hog River administrative cabin.

The effectiveness of this concept is limited by the extent of maintenance possible. This is especially a concern for remote cabins visited rarely if ever in the summer when the work could be done. Even if the prework was done, much of its value may deteriorate in a couple of years as trenches fill up with leaves and other flammable material, grasses invade the site, and stumps resprout.

At our five thinned and pruned sites in Galena there was a light sprouting of coppice growth from the stumps of hardwoods that were cut down in the thinning operation last year. It took one person about an hour to clip all the stumps clean of sprouts at each site. We predict that one more early summer cutting of the coppice growth will cause the root systems to expire permanently. The three circular control rings around each site will fill in with leaves each fall but we found that a commercial backpack leaf blower quickly restores the mineral soil control rings back to effectiveness in about a half hour. Ideally these trenches should be filled with mineral soil.

This first generation of the presuppression concept is still in the formulation stages and many questions still need to be answered. There is no question that if the work is done and maintained around remote sites, the sites will be easier to defend by firefighters should wildfire threaten the area. However, there are several problems that stand in the way of ready acceptance by private inholders. The foremost question is, why should the inholder expend anything to do the prework when they are guaranteed full wildfire protection for not only the structure but the entire allotment which may include up to 160 acres? We can put forward an excellent presuppression concept that would ultimately save a large amount of money for the taxpayers, but without any incentive for the landowner it will be difficult to gain acceptance. For now we will fine-tune the concept, work with other agencies for wider adoption, and try to sell the idea among the inholders.

Five AFS smokejumpers out of Fairbanks jumped in on a prescribed burn that was part of the presuppression work on our Hog River administrative cabin. Nine AFS smokejumpers assisted with a prescribed burn at the Innoko administrative cabin which included two remote fuel sites. The Galena Fire Suppression Specialists helped us with three prescribed burns and presuppression on two sites in Galena.

The last of 14 photo points was established on previous burns. Soil core samples were also collected and sent to the U.S. Forest Service, Pacific Northwest Research Station in Seattle, Washington where they will analyze the samples to determine intensity and frequency of past burns.

FMO Lugtenaar was invited by the National Park Service to Denali National Park where he gave a presentation on presuppression concepts and evaluated their headquarters site for potential threats from wildfire.

A before and after sequence of our presuppression work at the Hog River administrative site is shown on the following page.



Before clearing



After clearing



Alaska Fire Service smokejumpers assisted with controlled burning done as part of presuppression at the Hog River administrative cabin.

Two foam wagons were built to give us the capability to safely burn slash from our presuppression projects. They will be left on site to burn off light fuels in the event a large uncontrollable wildfire threatens. The units are equipped with foam pumps, a drip torch, back pack water pumps, beating hand tools, scrapping and cutting handtools and personal protective equipment such as hardhats, gloves, and fire shelters. The wagons were relatively inexpensive to build (\$3,000) and they provide examples for interested private land owners of some of the fire fighting equipment available.

An initial meeting of land managers representing Doyon Limited and Gana-a' Yoo, Limited was held in December to discuss possible changes to fire suppression levels on the Kaiyuh Flats and adjoining lands. Initial agreements were made to reduce the suppression response level if a full round of public and agency involvement supported that decision. The entire Kaiyuh Flats has been in the full suppression category since fire planning began because of the interspersed of private lands.



Two firewagons were built to use for burns conducted around the residences or for wildfire protection.

12. Wilderness and Special Areas

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

In addition to the sand dunes, the Koyukuk Wilderness includes the Three Day Slough area of the Koyukuk River. Three Day Slough contains several large meanders of an old Koyukuk River channel which represent the Complex's best moose habitat with the densest concentration of moose.

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

G. WILDLIFE

1. Wildlife Diversity

The Koyukuk National Wildlife Refuge has a high diversity of habitat types resulting from the combination of flooding, erosion and deposition, wildfire, and topographical variation. Baseline data continues to be collected to determine the status and distribution of bird, fish, and mammal species. Over 140 bird species, 30 mammal species, and 14 fish species occur on refuge lands. A refuge bird list was published in 1992 following a decade of active field surveys and local observations of staff living in Galena. In 1993 one additional mammal species, an uncommon eurasian shrew, *Sorex minutissimus*, was added to the refuge list. Specimens collected from near Galena and on the Nowitna were identified by a Russian scientist visiting the University of Alaska Museum. Excellent documentation of refuge fish species was obtained following a resident fish survey (see Section G.11).

Included among the biodiversity monitoring efforts on the refuge are surveys of spring bird migration phenology, breeding birds (Standard BBS), and wintering birds (Christmas Bird Count). Phenology analyses are used to relate annual differences in temperature, precipitation, timing and duration of flooding, etc., with observed patterns in wildlife populations and productivity. To compare phenology among years, records of annual spring arrival dates for common and conspicuous birds were summarized (Table G1). With the exception of snow buntings, arrival dates for all of the monitored species averaged about a week early in 1993.

Table G1. Spring arrival dates of common birds at Galena, AK., 1982-1993.

Species	MEAN	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Snow bunting	30Ma	17A	6A	7A			17Ma	7A	28Ma	6A		21F	4A
Mallard	26A	4M	27A	29A	30A	30A	27A	25A		19A	20A	18A	20A
Pintail	25A	5M	19A	29A	30A	1M	28A	22A		20A	20A	20A	17A
Canada Goose	27A	7M	6M	29A	29A	28A	29A	22A		20A	19A	26A	20A
Dark-eyed junco	28A	10M	15A	24A	9M	3M	27A	23A		11M	19A	26A	17A
Ruby-cr kinglet	30A	29M	30A	7M		3M	29A	25A		10M		25A	18A
Mew Gull	1M	4M	27A	29A	9M	1M	1M			30A	15M	3M	25A
Am. Robin	1M	8M	1M	29A	9M		30A	26A		2M	24A	6M	23A
Am. tr. sparrow	2M	6M	3M	24A	9M	6M	3M		13M	3M	26A		20A
Common Snipe	6M	12M	6M	6M	11M	6M	30A	29A		10M	29A	11M	1M
Tree Swallow	10M	10M	14M	5M	12M	11M	7M	8M		8M		19M	6M
Olive-s flyca.	25M	29M	17M	28M	3J	2J	1J	12M	12M		2J		15M

Months are indicated by the letters: F=February, Ma=March, A=April, M=May, J=June. Data collected by T. Osborne, ADF&G, Galena, and refuge staff.

2. Endangered and/or Threatened Species

The American peregrine falcon (*Falco peregrinus anatum*) is the only endangered animal species known to occur on the Koyukuk refuge. Delisting has been proposed for the American peregrine; Region 1 is responsible for acting upon the proposal and is currently gathering information. There is also a proposal to delist the threatened arctic peregrine falcon (*Falco peregrinus tundrius*). Alaska Department of Fish and Game (ADF&G) has recommended that the American and arctic peregrine falcons be removed from the state's endangered species list but should be considered "species of special concern." American peregrines nest on the refuge, but arctic peregrines only migrate through en route to nesting areas to the north. A discussion of peregrines observed during the raptor survey is included in Section G.6.

It is unknown if any threatened or endangered plant species occur on the refuge. Disjunct species occur on the Nogahabara Sand Dunes, and some species found there may represent range extensions. Also, inaccessible alpine and subalpine habitats on the refuge have received little botanical survey work to date.

3. Waterfowl

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

Waterfowl inventories on the Koyukuk NWR in 1993 included duck, goose, and swan production surveys. Duck breeding pair counts are conducted annually by the Division of Migratory Birds in Juneau. This was the final year of a study comparing helicopter and ground duck production survey techniques. The study was conducted in cooperation with Kanuti NWR and the Division of Migratory Birds. An analysis of duck brood production data collected since 1983 was begun in an effort to examine the effectiveness of stratification methods and to determine long-term patterns of production in individual plots.

Weather Conditions and Waterfowl Migration Chronology

Waterfowl began arriving in April. Swans arrived on the 13th, the first ducks splashed down in Galena on the 17th, and geese followed close behind on the 19th. Waterfowl were greeted by warm temperatures as April averaged 9.3°F warmer than normal. To the north, water was running over ice on the Dulbi River and open holes were observed on lakes on April 21, although large amounts of snow remained. The Yukon's ice went out at Galena on May 12, and water remained high throughout the remainder of the month. Flooding was still evident on most rivers on the refuge in June as water from melting snow in the Brooks Range continued to swell the Koyukuk River through the end of the month. Lakes, ponds, and sloughs were also flooded, and it was suspected that nesting attempts along the Koyukuk River would be hindered by high water. In contrast, other small drainages on the Koyukuk Refuge and areas along the Yukon River upriver of the Koyukuk River did not flood, and production in these areas is expected to be good.

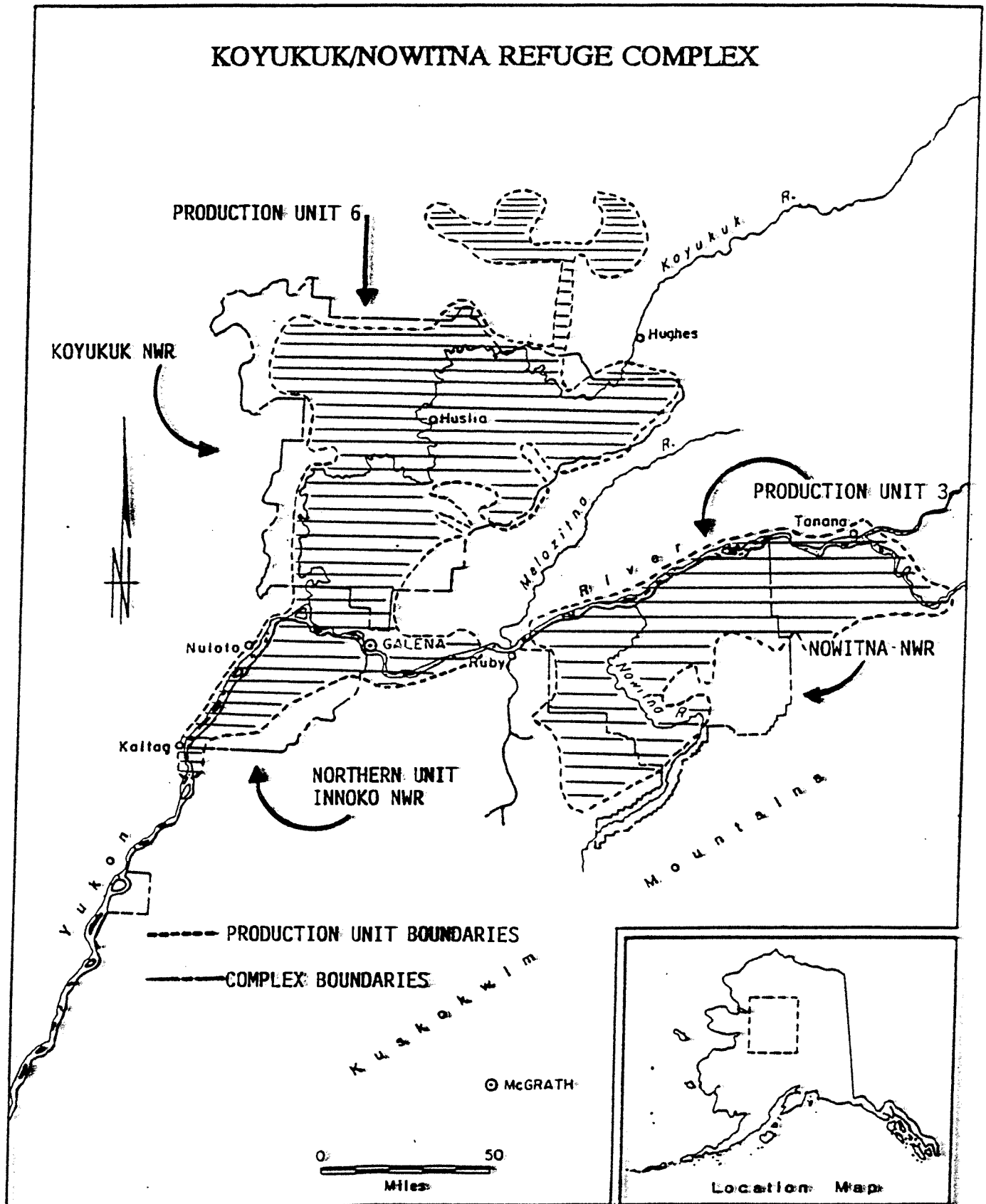
Early arrival of waterfowl was balanced by an early departure. Swans were observed flocking at Willow Lake near Huslia on August 11, and the first flock of white-fronted geese migrating southeast was seen on the 22nd.

Duck Production

Waterfowl brood surveys have been conducted on the Complex since 1983. The refuge has participated with the Division of Migratory Birds in a state-wide waterfowl production survey since 1990. The Koyukuk Refuge and Kaiyuh Flats are part of Koyukuk Production Unit Six, which includes the Kanuti Refuge and BLM lands (Figure G1). Sampling scheme and methods for brood survey methods have varied from year to year, but standardization to the current methods has been maintained since 1990. Using color infra-red (CIR) photos, all 1-mi² sections within the refuge were classified as habitat or non-habitat based on the presence or absence of wetlands. Sample plots considered for selection were all of the 1-mi² sections that were classified as duck habitat. Each plot was then assigned to one of three strata representing expected waterfowl density (low, medium, or high). Expected density in each plot was based on amount of water and presence or absence of bog habitat determined by distance from the nearest river-connected water.

Cessna 185 and PA-18 floatplanes provided access to 27 medium and high density strata plots for ground crews in 1993; these plots were surveyed by canoe, walking, or both. Helicopter surveys were conducted on low density strata plots, all plots surveyed by ground crews, and additional plots in high and medium density strata. A total of 61 plots was surveyed by helicopter in Production Unit 6, and 43 of these occurred on the refuge. Only the helicopter survey data collected from the

Figure G1. Koyukuk Waterfowl Production Unit Six



Koyukuk and Northern Unit of the Innoko Refuge are reported for 1993 in this narrative. Advantages of the helicopter survey over the ground survey are that the helicopter surveyed more plots, and there was little variation in technique or identification skills since the same observer and pilot surveyed each plot. The major disadvantage of the helicopter method was that an unknown number of diver broods were missed because they went underwater in response to the passing helicopter.

A total of 307 duck broods (including 21 broody hens) was observed during the helicopter survey in 1993. This count is similar to 1992 when a total of 293 broods (including 49 broody hens) was counted during the helicopter survey. Seventy-seven percent of the 1993 total was comprised of dabbling broods while diver broods accounted for 16.9%. In addition, 3 Canada goose broods, 16 red-necked grebe broods, and 1 sandhill crane brood were observed. Wigeon broods were the most commonly observed dabbler (116 broods) and scaup were the most commonly observed diver (44 broods). The majority of dabbling ducklings were in age class 1B (32%); 20% and 14% were in classes 1A and 1C, respectively. Class 2A contained 15% of the dabblers, 12% were in class 2B, and no class 3 ducklings were observed. All diver ducklings were in age class 1; 68% were in 1A, 30% were in 1B, and only 2% were in 1C.

An estimated 18,196 dabbling broods, 5,194 diver broods, and 170 surf scoter broods were produced on the refuge in 1993 (Figure G2). The coefficients of variation (CV=variation relative to the means of the sample) for these estimates were 0.32, 0.52, and 0.49, respectively. In addition, it was estimated that 535 broods (CV=0.65) of unidentified duck species occurred on the refuge. Estimated total production was 24,094 broods (CV=0.32). This figure is greater than the 1992 expanded estimate of 15,883 (CV=0.37), possibly because of different flooding patterns between years. In 1992, flooding was extensive along both the Koyukuk and Yukon Rivers while flooding in 1993 was restricted to the Koyukuk River and the Yukon River below the mouth of the Koyukuk. The estimated number of ducklings produced by dabbling species (Table G2, Figure G3) was highest for American wigeon (46,640 ducklings; CV=0.35), followed by green-winged teal (19,460 ducklings; CV=0.34), northern pintail (14,603 ducklings; CV=0.46), and mallard (6,963 ducklings; CV=0.48). Scaup had the highest estimate for divers (30,766 ducklings; CV=0.64) followed by buffleheads (2,450 ducklings; CV=0.59, Table G2, Figure G3).

An estimated 140,056 adult ducks were present during the July brood survey, however, dabbling, diver, and individual species estimates should be interpreted with caution because they were associated with high CV values (Table G2, Figure G4). Unlike 1992, when the CV for diver adults was only 0.31, the CV in 1993 was 0.52.

Total cost for waterfowl production surveys on the Koyukuk and Northern Unit of Innoko Refuge was \$33,000 in 1993. Unfortunately, high quality duck production surveys are expensive. Because of high costs, 1992 was the last year of state-wide production estimates. We decided that refuge-wide estimates for the Koyukuk Refuge and Northern Unit of the Innoko Refuge should be continued in 1993 to allow for completion of the helicopter-ground survey comparison study in 1993. The timing of brood rearing in this part of Alaska did not allow the data to be available by mid-July in time for the Flyway Council meetings where season and bag limit decisions are made. Therefore, because of costs and limited utility of late data, the future direction of annual duck productivity surveys on the refuge is uncertain. In the meantime, at least we have good baseline duck production data for the early 1990's.

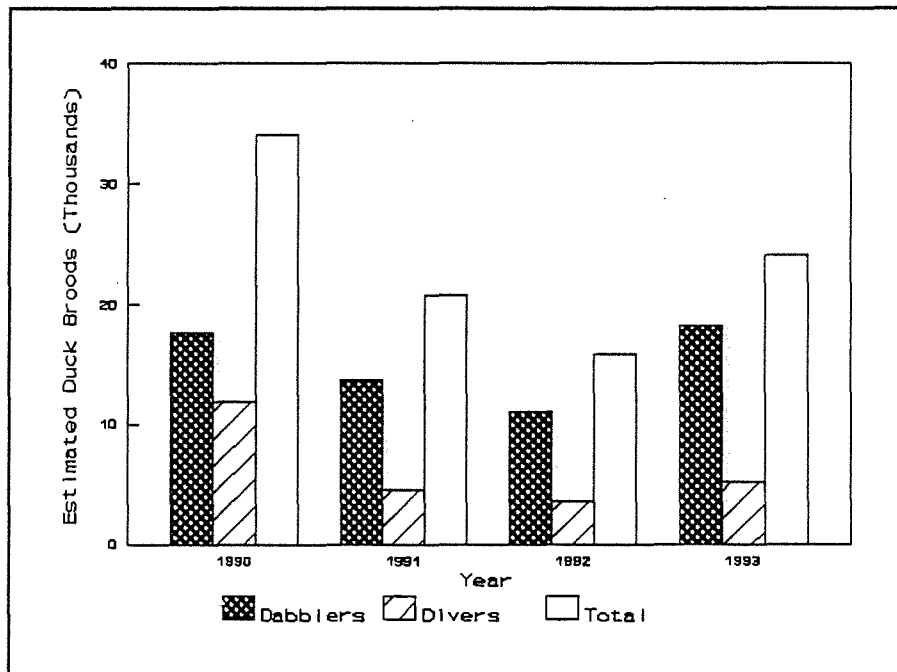


Figure G2. Estimated number of broods produced on the Koyukuk NWR and the Northern Unit of Innoko NWR, Alaska, 1990-1993.

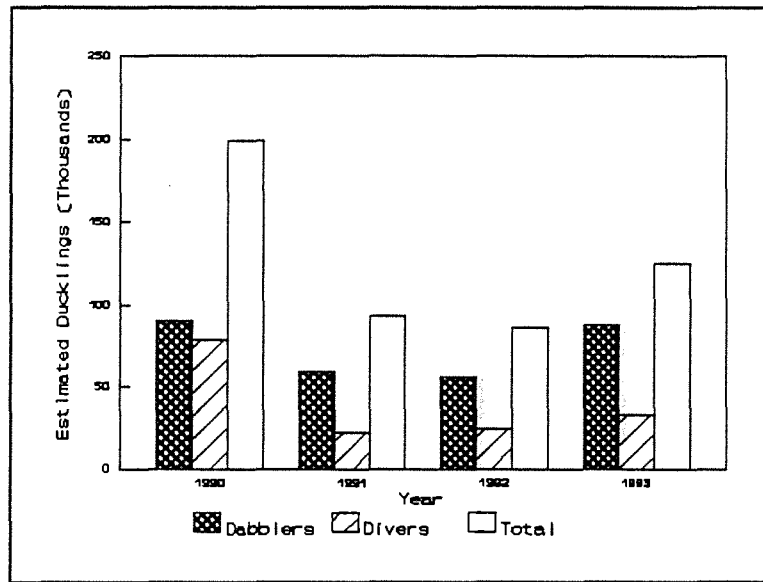


Figure G3. Estimated production of ducklings on the Koyukuk NWR and the Northern Unit of the Innoko NWR, Alaska, 1990-1993.

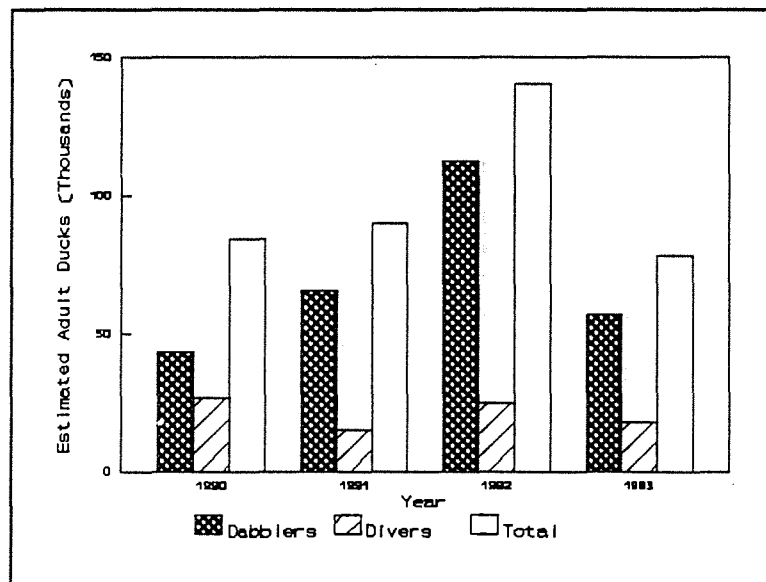


Figure G4. Estimated number of adult ducks on the Koyukuk NWR and Northern Unit of the Innoko NWR, Alaska, 1990-1993.

Table G2. Estimated young ducks and adults based on results of helicopter surveys on the Koyukuk NWR and the Northern Unit of the Innoko NWR (Kaiyuh Flats), Alaska, 1992 and 1993.¹

	Estimated Young		Estimated Adults	
	1993 (CV) ²	1992 (CV)	1993 (CV)	1992 (CV)
Wigeon	46,640 (0.35)	29,278 (0.23)	43,519 (0.58)	91,864 (0.57)
G-W Teal	19,460 (0.34)	16,694 (0.51)	6,652 (0.30)	8,478 (0.33)
N. Pintail	14,603 (0.46)	1,984 (0.34)	3,693 (0.36)	1,333 (0.31)
N. Shoveler	577 (0.70)	71 (1.00)	268 (0.77)	1,985 (0.87)
Mallard	6,963 (0.48)	8,127 (0.57)	2,644 (0.40)	8,731 (0.66)
Dabbler Subtotal	88,243 (0.3)	56,153 (0.32)	56,776 (0.46)	112,391 (0.54)
Canvasback	0	28 (1.00)	14 (1.00)	371 (0.92)
Scaup spp.	30,766 (0.64)	24,003 (0.64)	17,324 (0.50)	24,441 (0.59)
Redhead	0	0	0	0
Ring-necked	0	0	0	0
Goldeneye spp.	0	85 (1.00)	63 (0.81)	14 (1.00)
Bufflehead	2,450 (0.59)	128 (0.73)	582 (0.62)	43 (0.55)
Diver Subtotal	33,216 (0.59)	24,245 (0.64)	17,984 (0.48)	24,870 (0.58)
Oldsquaw	0	0	28 (1.00)	0
W.W. Scoter	0	0	344 (1.00)	0
Surf Scoter	735 (0.54)	2,796 (0.75)	560 (0.52)	2,604 (0.54)
Black Scoter	0	0	871 (0.81)	49 (1.00)
C. Merganser	0	0	14 (1.00)	0
R.B. Merganser	0	0	0	28 (1.00)
Misc. Duck Subtotal	735 (0.54)	2,796 (0.75)	1,818 (0.5)	2,681 (0.52)
Unknown Ducks		3,366 (0.71)	3,668 (0.75)	1,885 (0.91)
Totals	125,561 (0.33)	86,862 (0.40)	78,463 (0.35)	140,056 (0.46)

¹ Estimates are based on expanded area of 4318 square miles.

² CV=Coefficient of variation



Extensive wetlands that surround Willow Lk. and Dulbi Sl. just east of Huslia form the heart of the refuge's waterfowl habitat. Flooding in 1993 was so extensive and severe that waterfowl production in these areas was nearly a complete failure.



Statewide duck production survey techniques were finally standardized in 1990. On the Koyukuk, a combination of canoe and foot surveys was used to survey all waterbodies within a stratified random sample of 1-mi² plots.



Wigeon and scaup are the most abundant duck species on the Koyukuk. In July 1993, total production for all duck species was 125,561 young. A range of 62,648-199,348 was observed between 1988 and the present.



Fieldwork for a 3 year study comparing results of helicopter versus ground methods for duck production surveys was completed in 1993. Preliminary results indicated that except for diving ducks, the helicopter method was more thorough and cost effective.

Goose Production

A progress report entitled Status of white-fronted and Canada geese on Koyukuk NWR, Alaska was drafted in 1993 and completed in 1994. The report provides historic and recent survey results and discusses possible causes of observed declines in the index surveys. A summary of that report follows:

From 1985 to 1988, goose populations on the Koyukuk NWR averaged 3,807 white-fronted geese (range 1,336-6,573) and 1,085 Canada geese (range 170-2,288) as determined from July riparian and August aerial extrapolation surveys. The primary monitoring efforts for geese since 1988 have been riparian float trips to determine trends in production as described in the Wildlife Inventory Plan. In 1993 goose production surveys were conducted June 21-24 in three areas: Dulbi River, Huslia River and Khotol River. These surveys were done in late June when broods guarded by adult flocks traditionally move from upland nesting areas to the rivers, hence greatly increasing their observability. Standardized methods and survey routes as described in the Wildlife Inventory Plan were used to count and record all geese seen according to species and age-class. In June and July 1993, the Dulbi Slough area was completely inundated making surveys impossible. Based on casual observations, we deemed goose production in the area a failure.

The Dulbi River survey showed that a decline in adult and young white-fronted geese continued in 1993 (Figure G5). The total of 112 adults was the lowest ever recorded, and the 46 young was the second lowest production ever recorded. Observations of 39 adult and 56 gosling Canada geese represented slight increases over 1992, which had the lowest recorded numbers.

The Huslia River survey confirmed that the low numbers of white-fronted geese observed in 1992, as compared to observations made in 1976, continued in 1993. Totals of 19 adult and 28 young white-fronted geese were counted in 1993, which represent a 62% and 36% drop, respectively, since 1992, and a 90% drop in adults and young since 1976.

The Khotol River on the Kaiyuh Flats was surveyed for the first time in 1993. Totals of 11 adult and five young white-fronted geese and six adult and three young Canada geese were seen on a survey of a 103 mile stretch of Kaiyuh Slough and the Khotol River in 1993. The survey indicated minimal goose numbers visible along the slough system, although numbers might have been higher in other years or without extensive flooding as occurred on the Kaiyuh in 1992 and 1993.

On the Dulbi River we observed less Canada geese in five of the last six years compared to 1984-1987 (Figure G6). Interestingly, on the nearby Nowitna Refuge Canada geese declined (about 50% after 1990) while white-fronted geese have remained relatively stable. This apparent drop in Canada geese on the Nowitna

does not appear to have been as steady and long-term as the declining trend noted for Canada and white-fronts on the Koyukuk.

In recent years three different areas, Dulbi River, Dulbi Slough, and Huslia River all showed declining patterns of abundance, moreover, long-time residents have told us that geese were more abundant in previous decades compared to recent years. The most obvious and proximate cause of reduced goose abundance on Dulbi River and Dulbi Slough was most likely the extreme flooding in June and July 1992 and 1993. With repeated flooding, reduced production would greatly affect numbers of returning adults in succeeding years. Perhaps the flooding temporarily or permanently displaced the Dulbi geese to other nesting grounds. Flooding alone, however, cannot explain the substantial declines along the Huslia River because not all years since 1976 were flood years, and the topography along the surveyed stretch of the Huslia River is not prone to severe flooding as compared to the Koyukuk and Dulbi areas.

White-fronted goose numbers may have declined due to increased hunting mortality, both subsistence and sport. Even if harvest has been consistent, the percent of the population taken by hunters may have increased because the numbers of available birds have declined, thus increasing the effect of hunting mortality. Subsistence hunting occurs primarily in the spring upon the birds' arrival. Harvest in the 1980's and 1990's was probably much less than in earlier decades when subsistence activity was dispersed across many spring camps instead of being concentrated around villages. Subsistence harvest is believed to be stable in the Huslia area because of the following estimates of goose harvest: 270 in 1991, 420 in 1992, and 250-300 in 1993. Based on band returns, most of the sport hunting harvest on the Koyukuk white-fronted goose population occurs in Alberta and Saskatchewan in September and October, while most of the Canadian-nesting birds arrive in the same area later. Arrival of the Koyukuk population in the south Canadian prairies earlier relative to other Alaska and Canadian segments could expose it to comparatively greater hunting mortality. Indeed, band returns indicate that a significantly greater proportion of Koyukuk white-fronts are taken in autumn compared to Canadian white-fronts (C. Ely, NBS, pers. comm.). This could be one of the reasons the mid-continent white-front population has been growing while the Koyukuk segment of the population has been declining.

White-fronted goose study

This study was approved in 1987 and initiated on the Nowitna Refuge in 1988. In 1990 the project was moved to the Koyukuk Refuge because of historically more abundant white-fronted geese and concern over recent population trends. The objectives of the study are: 1) to document the breeding biology of white-fronted geese including breeding phenology and nest success; 2) to identify and assess factors affecting nesting success of white-fronted geese on the Complex, including environmental conditions and predation; and 3) to identify the habitat requirements of nesting white-fronted geese on the Complex. Emphasis on the study has increased because of recent surveys suggesting a decline in white-fronted geese on Koyukuk NWR. A revised study proposal was submitted for approval in November 1993.

Because of inadequate funding, this study has been conducted at minimal levels since approval was received in 1987. Nevertheless, attempts were made to identify potential study sites and develop methods of capturing early arriving breeding pairs of white-fronted geese. Capture of such geese is very challenging because of their shyness, limited interest in feeding, and greater interest in selecting nest sites and breeding territories. Bertram (1992) described two extended attempts to capture and mark pre-nesters in late April and early May 1991 and 1992 near Dubin Point in the Koyukuk Refuge. Because of limited success Bertram (1992) recommended use of multiple rocket nets at one or more trap sites and intensive nest searches with trained dogs, as attempted on the Nowitna in 1988. At year's end, capture of post-breeding adult females with brood patches during mid-summer molt was being considered to deploy multi-year radio packages on numbered neck collars. It was hoped the method would provide an adequate sample of marked birds that would return in succeeding years.

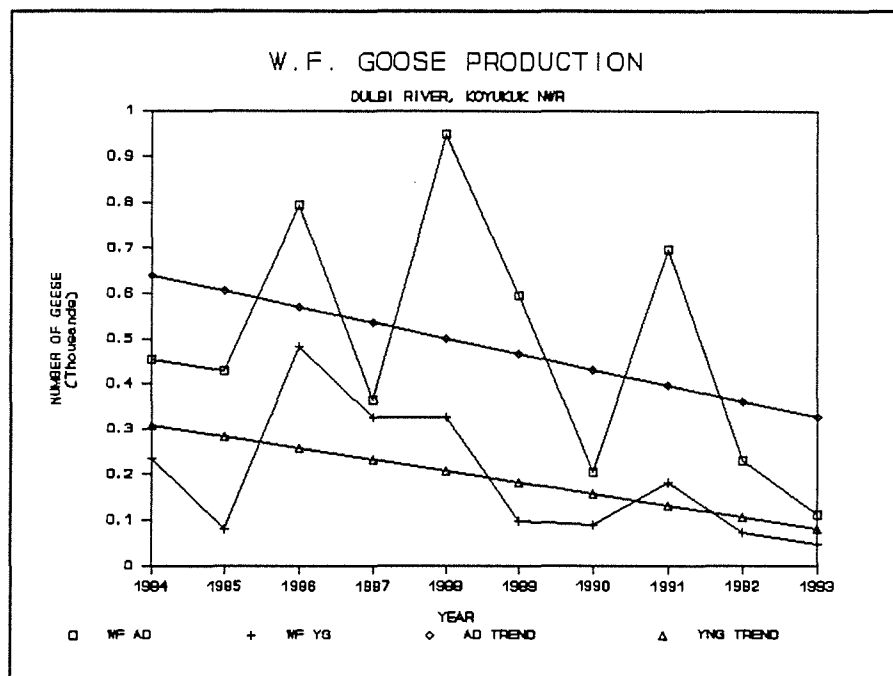


Figure G5. Adult and young white-fronted goose numbers observed during production surveys on the Dulbi River, Koyukuk NWR, Alaska, 1984-1993.

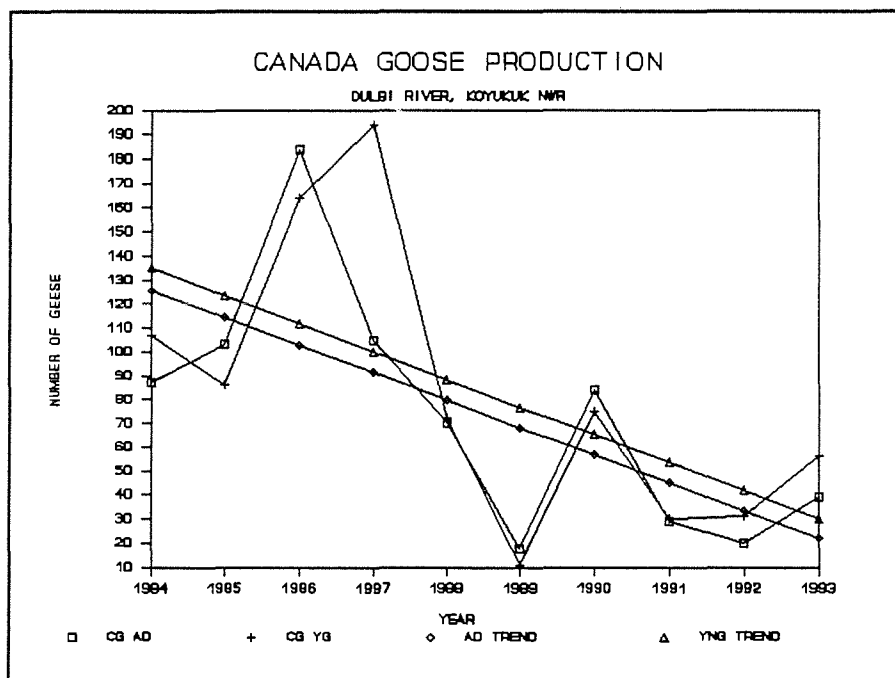


Figure G6. Adult and young Canada goose numbers observed during production surveys on the Dulbi River, Koyukuk NWR, Alaska, 1984-93.

Swan Production

The northern half of Koyukuk NWR is located on the transition between tundra and taiga, and as a result both tundra and trumpeter swans nest on the refuge. During aerial and ground surveys of nest sites in 1988 and 1989, 32% and 48% of nests (n=19, 27), respectively, were found to be those of tundra swans. Prior to these surveys it was thought that a few tundra swans nested here, but it was presumed that a majority of the Koyukuk swans were trumpeters. Discussions of swan populations and trends on the Koyukuk will, therefore, have to be qualified as including substantial numbers of both species until such time as further habitat and distribution studies can be undertaken.

In 1989 six 1:63,360 "trend maps" were selected as trend units to monitor swan population and production. As with other waterfowl on the Koyukuk in 1993, swans showed poor production, with the lowest number of young and average brood size observed since 1985 (Figs. G7 and G8). Number of pairs on the Koyukuk in 1993 approximated the long term average. In 1993 the Kaiyuh Flats showed below average brood size and average production of young, but surprisingly, numbers of pairs continued to remain higher than all other years prior to 1992 (Figs. G9 and G10). The decrease in pair abundance on the Koyukuk coupled with the increase on the Kaiyuh in 1992 and 1993 suggests possible dispersal of paired adults from flooded areas to non-flooded areas.

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. Observations of these species were recorded during duck production ground and helicopter surveys (see section G.3 for stratification and survey methods). In 1993, the 43 plots surveyed by helicopter indicated that red-necked grebes, common loons, and sandhill cranes were the most common marsh and water birds (Table G3).

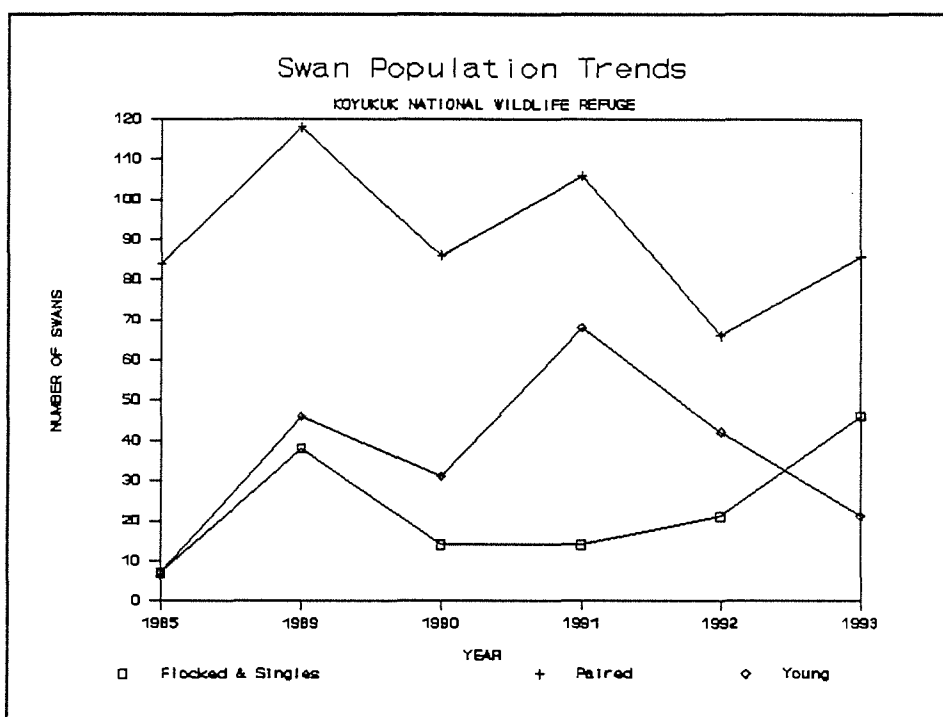


Figure G7. Swan numbers observed on late summer or fall aerial surveys of the Kateel River A2, C1, D1, and D3 trend maps.

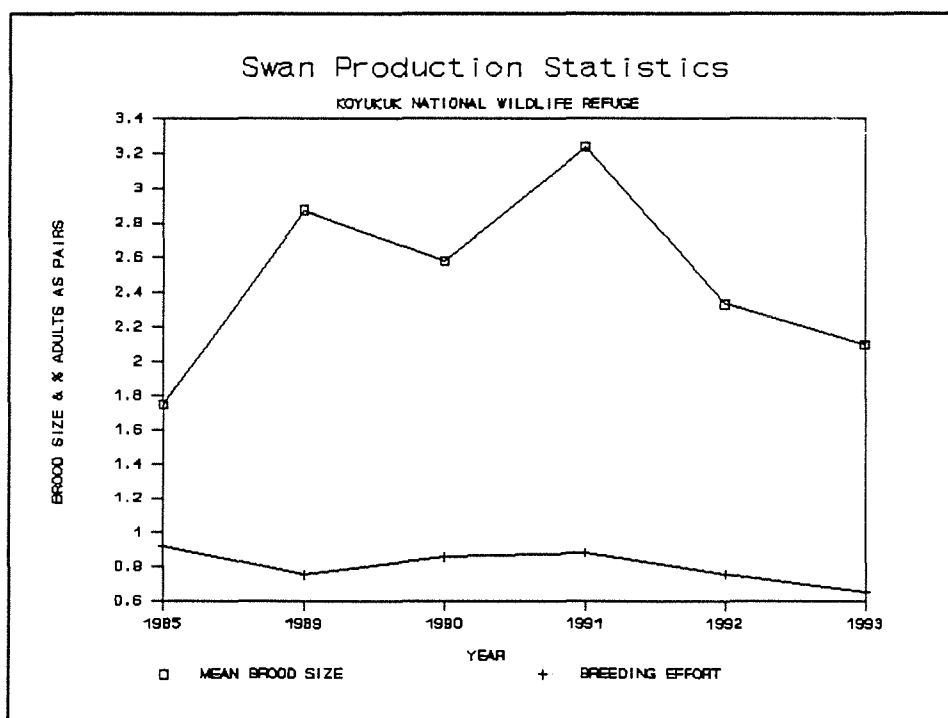


Figure G8. Swan production statistics from late summer or fall surveys of the Kateel River A2, C1, D1, and D3 trend maps.

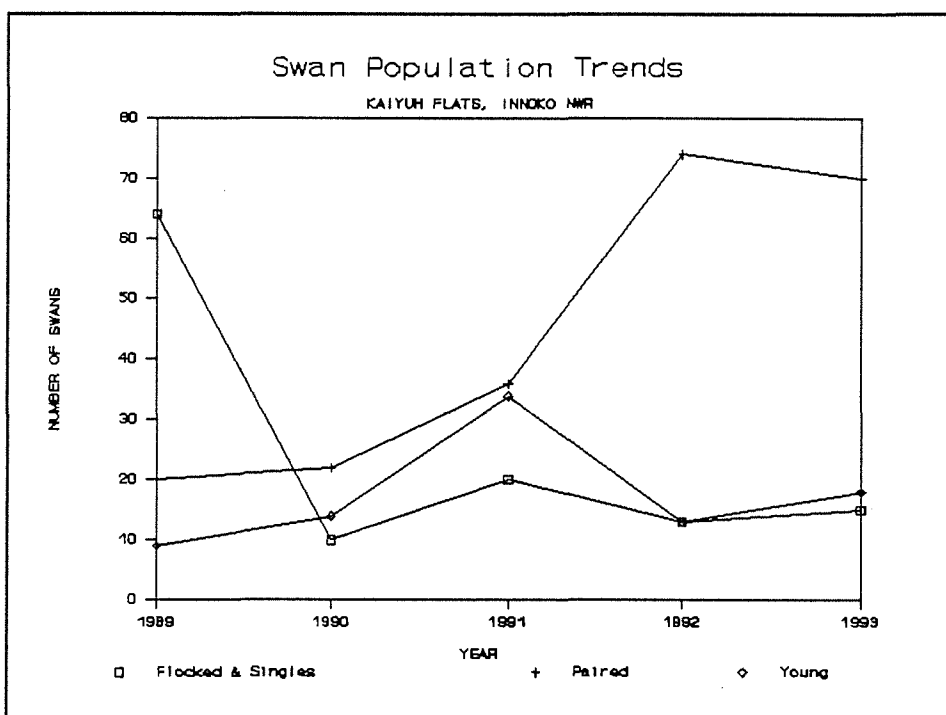


Figure G9. Swan numbers observed during late summer or fall aerial surveys of the Nulato B4 and B5 trend maps.

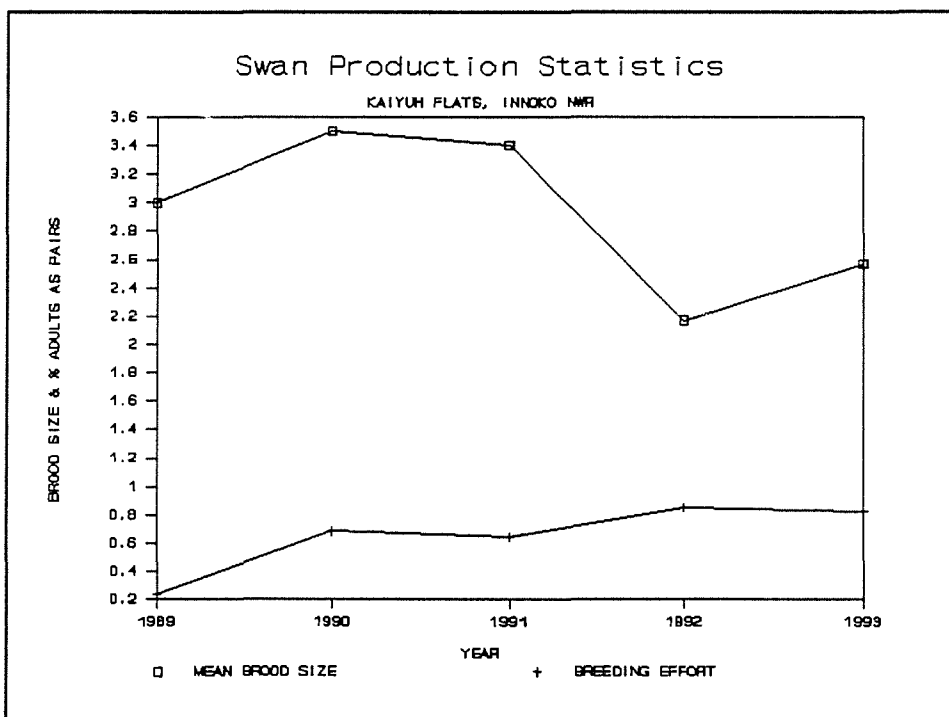


Figure G10. Swan production statistics based on late summer or fall surveys of the Nulato B4 and B5 trend maps.

Table G3. Number of adult and young marsh and water birds observed during duck production surveys conducted by helicopter, Koyukuk NWR and the Northern Unit of the Innoko NWR, July 1993¹.

Species	Adults	Young
Red-necked grebe	83	20
Horned grebe	2	0
Common loon	15	0
Red-throated loon	2	0
Pacific loon	0	0
Sandhill crane	10	1

¹ Number of plots surveyed in each stratum were as follows (see section G.3 for definitions of strata): 21 high density, 12 medium density, and 10 low density.

5. Shorebirds, Gulls, Terns, and Allied Species

The following shorebird species are commonly observed on the refuge: lesser and greater yellowlegs; Arctic tern; glaucous, Bonaparte's, mew, and herring gulls; long-tailed jaeger; semipalmated plover; common snipe; spotted, least, pectoral, and solitary sandpipers; northern phalarope; Hudsonian godwit; and whimbrel. Although no trend data were collected on these species in 1993, observers on duck and goose production surveys were encouraged to record sightings of any shorebirds they identified.

6. Raptors

The refuge supports a diversity of raptor species. Raptors are generally sensitive to disturbance and therefore act as important indicator species. Raptors that nest on the refuge include rough-legged hawks, merlin, sharp-shinned hawks, northern harriers, red-tailed hawks, goshawks, great horned owls, great gray owls, boreal owls, northern hawk owls, American peregrine falcons, and bald eagles.

Raptor surveys were conducted on the Yukon River between the villages of Ruby and Kaltag on 14-18 June 1993. The purpose of this survey is to monitor general trends in the number of raptors utilizing nesting sites along the river. The

USFWS Endangered Species Office conducted the survey from 1979 to 1991 to document peregrine falcon use of bluffs along the Yukon River; the refuge has been responsible for conducting the survey since 1992. Six sites were surveyed between Galena and Ruby. Pairs of peregrine falcons were present in three of these sites, but no nest sites were confirmed. Sixteen sites were surveyed between Galena and Kaltag. Adult peregrines, including seven pairs, were observed at 11 of the 16 sites. Nests were seen at two of these sites, and a territorial adult was observed at a third. One sharp-shinned hawk was also observed.

Although it appears that fewer adult peregrines and nests were observed this year than in 1991, it is difficult to compare this year's survey to those done in the past by more experienced personnel from the Endangered Species Office. Refuge personnel with limited expertise had difficulty recognizing hidden nest sites and locating nesting birds. Previously, experienced rock-climbers sometimes confirmed nest sites, counted young, collected prey and eggshells, and banded some birds. Without climbing experience, observers were limited to studying potential nest sites from a distance, which made it difficult to detect the presence of nestlings. Although information from future surveys may be more limited than those conducted in the past, the surveys will still serve as valuable indices of trends in the population of nesting peregrines on the refuge. This year, most sites were photographed to replace the poor quality photocopies of photos we had in our files. This will enable us to maintain a visual record of bluffs and nest sites and to facilitate the location of previously used nests in the future.



A raptor survey was conducted on the Yukon River from Ruby to Kaltag. Heather Johnson and Allen McGinty used spotting scopes to view inaccessible aeries.

7. Other Migratory Birds

Numbers and species composition of passerine birds fluctuate with the seasons. Frequently seen winter residents in the Galena area include: common and hoary redpolls, common raven, gray jays, black-capped and boreal chickadees, and pine grosbeaks. Wintering birds were monitored during the standardized Christmas Bird Count conducted by refuge and ADF&G staff, as well as local volunteers on December 22 (Table G4). A total of seven species was seen on the count, which is the least observed since 1983. An additional species, a boreal owl, was seen during the count week. The greatest number of species observed was 12 species observed in 1988 and 1991. The count differed from other years by having fewer ravens and redpolls but more gray jays and willow ptarmigan than average. Even though temperatures were mild, the total number of birds counted, 271, was the second lowest ever recorded (Table G4).

Table G4. Results of the Galena Christmas Bird Count, 1982-93.

Species	Year											
	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993
Northern Goshawk	2						1		¹ cw	2	1	
Willow Ptarmigan	cw		cw		cw	5	23	6	44	cw	4	24
Spruce Grouse			2					2				
Ruffed Grouse						3	6	3				
Hawk Owl	1						1					cw
Great Gray Owl			cw	cw	1		1			1		
Great Horned Owl							cw					
Downy Woodpecker			2		1				1	1	1	
Hairy Woodpecker									1	1		
North.3-toed Wood.	1			2	2							
Gray Jay	5	8	21	9	5	8	29	8	6	11	16	24
Common Raven	206	152	121	240	230	276	334	226	225	391	148	103
B.C. Chickadee	5	2	13	11	10	10	30	3		34	17	28
Boreal Chickadee	7	1	20	41	1	9	58	3	8	30	41	28
Siberian Tit			2									
Northern Shrike			cw									
Snow Bunting		cw			20	80						
Pine Grosbeak	1	28	13	7			2	40	cw	6	9	
W.W. Crossbill			50						2		15	
Common Redpoll	65	74	144	101	19	102	45	153	15	244	91	63
Total Birds	293	265	388	411	289	493	530	444	302	721	343	271
Total Species	8	6	10	7	8	8	12	9	9	12	10	8
Participants	4	2	6	5	4	4	5	9	9	15	8	8
Party Hours	14	10.5	22	17	11	10.5	21	23.7	27.7	29	17.5	27.5
Party Miles	94	76	121	69	65.5	48	137	134	86.5	122.5	81.3	119.5
Lowest Temp.	-10	18	18	25	-40	25	20	-35	-42	-52	-3	8

¹ cw=seen during count week



Boreal chickadees are among the 6-12 winter resident species monitored during the Christmas Bird Count. In 1993 the boreal count was higher than usual, but total species and individuals were lower than usual.

Species commonly seen in the summer include alder flycatcher, olive-sided flycatcher, tree swallow, gray jay, robin, Swainson's thrush, gray-cheeked thrush, varied thrush, Bohemian waxwing, yellow warbler, blackpoll warbler, orange-crowned warbler, yellow-rumped warbler, rusty blackbird, savannah sparrow, dark-eyed junco, tree sparrow, white-crowned sparrow, fox sparrow, and Lincoln's sparrow. The refuge assists with national monitoring of songbirds, many of which are neotropical migrants, by conducting two standardized Breeding Bird Survey Routes in taiga habitats near Galena. One route, number 883, follows the Galena road system, while the other, number 284, follows Bear Creek and Nikolai Slough. Both routes have been surveyed since 1985 in cooperation with ADF&G. A third route along the Ruby to Poorman Road is planned for survey in June 1994.

In 1993 total species recorded on the Galena route was 26, down two from 1992. Increases occurred in two neotropical migrants, alder and olive-sided flycatcher, while two other neotropicals declined: gray-cheeked thrush and northern waterthrush. On the Nikolai Slough route, the number of species declined by two, from 44 to 42. In 1993 the olive-sided flycatcher increased while the alder flycatcher decreased. Other notable changes in 1993 were declines in common snipe, varied thrush, northern waterthrush, bank swallows, and fox sparrows. Notable increases in 1993 occurred in only one species-Swainson's thrush.

8. Game Mammals

Moose

Population extrapolation surveys conducted on the Koyukuk and Kaiyuh Flats 1987-1989 estimated the overall refuge moose population at 11,740 moose (+/- 11.4% at the 90% C.I.). In years following these refuge-wide surveys, moose survey efforts have consisted of intensive aerial surveys of standardized trend areas (40-60 mi² in size) where hunting pressure was thought to be greatest, or where other concerns dictated a need for the information. A progress report entitled Moose trend surveys on the Koyukuk and Nowitna National Wildlife Refuges, 1993 was nearing completion at years' end. A summary of that report follows.

Koyukuk. A total of 10 aerial moose trend areas have been surveyed on Koyukuk NWR in the past: Koyukuk River Mouth, Long Stretch, Three Day Slough, Dulbi River Mouth, Dulbi Slough, S. Fork Huslia River, Huslia River Flats, Treat Island, Matthews Slough, and Batza Slough. In 1992 and 1993 five of these areas were surveyed to make comparisons with historical data. To increase accuracy, determinations of trend and percent growth or decline were only based on years in which groups of identical sample units were available for comparison.

All five Koyukuk areas surveyed recently showed growing populations. Three Day Slough continued to have the highest moose density of 13.7 moose/mi², but the growth rate that had averaged 10% per year in the last eight years declined to 2.6% in the last year (Figure G11). Composition ratios for the area indicated less production and recruitment in the last year, but still a good sex ratio of 38 bulls/100 cows. Treat Island, upriver from Huslia, had the next highest density, 5.6 moose/mi², and an average growth rate of 7.7% in the last eight years. The sex ratio was good at 39 bulls/100 cows. Of all five areas, the Huslia River Flats showed the highest growth rate, 11.8% per year in the last decade (Figure G12). Moose density was 4.5 moose/mi², and the sex ratio was excellent at 81 bulls/100 cows. The Dulbi River mouth area showed an annual growth rate of 5.4% in the last decade. Density in 1992 was 3.7 moose/mi², while the sex ratio was normal at 41 bulls/100 cows. Finally, the Koyukuk Mouth area had a 4.5% annual growth rate in the last decade and a density in 1993 of 3.4 moose/mi². The sex ratio of 43 bulls/100 cows was normal.

Kaiyuh. Three moose trend areas have been surveyed on the Northern Unit of Innoko NWR: Kaiyuh Slough, Pilot Mountain Slough, and Squirrel Creek. The latter two were most recently surveyed in 1993 and Kaiyuh Slough was surveyed in 1992. The Kaiyuh Slough trend area, along the Yukon between Nulato and Kaltag, indicated an average annual decline of 3.2% in the last seven years (Figure G13). Density in 1992 was estimated at 1.2 moose/mi², and composition ratios indicated low production but good recruitment. The sex ratio was good at 37

bulls/100 cows. South of Koyukuk, the Squirrel Creek area showed an average population growth rate of 6.5% per year; density in 1993 was 5.2 moose/mi² (Figure G14). The sex ratio of 49 bulls/100 cows was good. Near Galena, the population at Pilot Mountain Slough probably was stable but growth rate and density estimates were not presented due to limited sample area (23-29 mi²). Composition ratios of a larger area in 1993 (not comparable with anything historically) indicated low calf production and recruitment, and a higher exploitation rate, based on the sex ratio of 24 bulls/100 cows.

Three Day Slough moose population identification study. Concerns about increased hunting pressure and high browse utilization prompted the Service and ADF&G to begin this cooperative study in 1984. Twenty-three adult moose (11 bulls and 12 cows) were collared in 1984 and 1986 and monitored through 1988 to determine population identity, movement patterns, seasonal and annual ranges, and habitat use. A final report was completed in 1993 and will be published by ADF&G as a research report. A summary of the report follows.

The majority of adults (83%) and cow/calf pairs (58%) were considered migratory because they moved to summer ranges north and south of the floodplain. These movements averaged 26 and 19 miles (42 and 31 km), respectively. Our study found that moose occurring in the floodplain area during the period September to April can be defined as a population.

In summer, bulls used willow-dominated habitats to a greater extent than cows, while cows used black spruce dominated habitats more frequently than bulls. Both bulls and cows used habitats with a greater willow dominance in the winter as compared to summer. The widespread summer movements and high proportion of migrants in the population implied that moose density at Three Day Slough may be lower in summer than in winter. Migratory behavior may be a response to predators, the need to disperse summer browsing activity to allow the winter range to regrow, or a lack of altitudinal diversity compared to other moose populations that have been intensively studied.

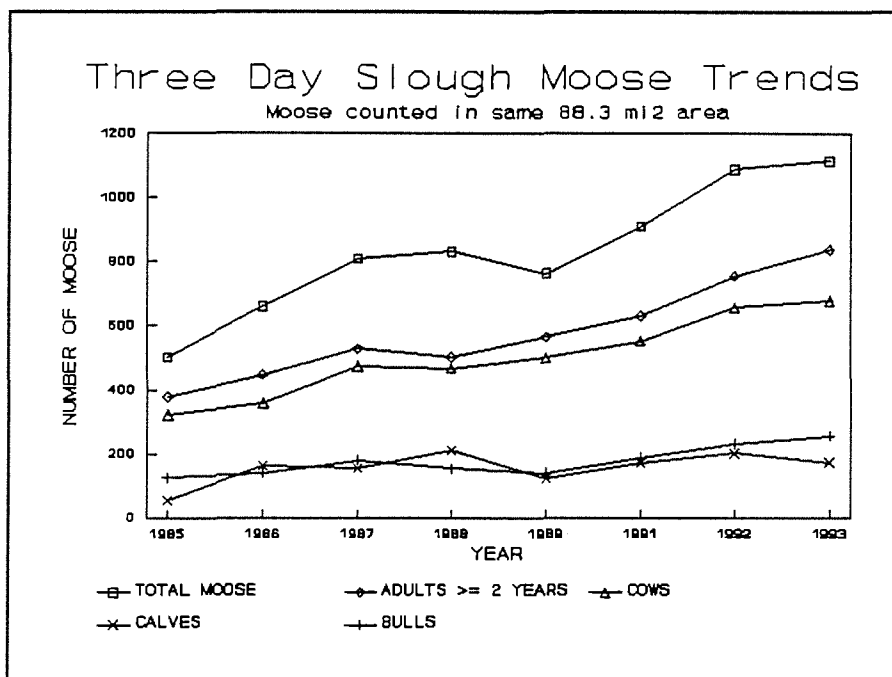


Figure G11. Moose observed during aerial surveys of the Three Day Slough moose trend area, Koyukuk NWR, Alaska, 1985 to 1993 (data courtesy ADF&G, Galena).

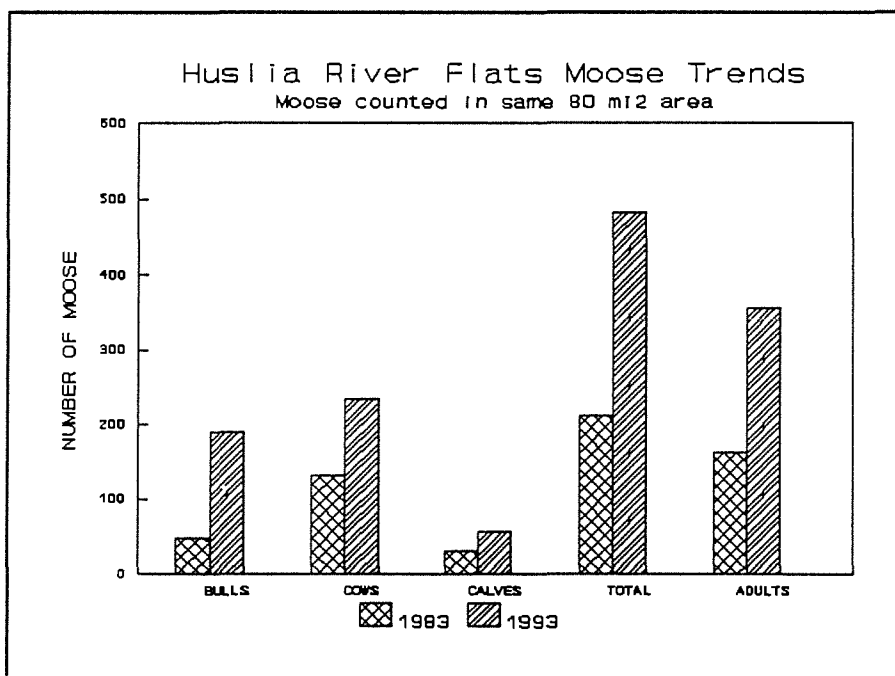


Figure G12. Moose observed during aerial surveys of the Huslia River Flats moose trend area, Koyukuk NWR, Alaska, 1983 and 1993 (1983 data courtesy ADF&G, Galena).

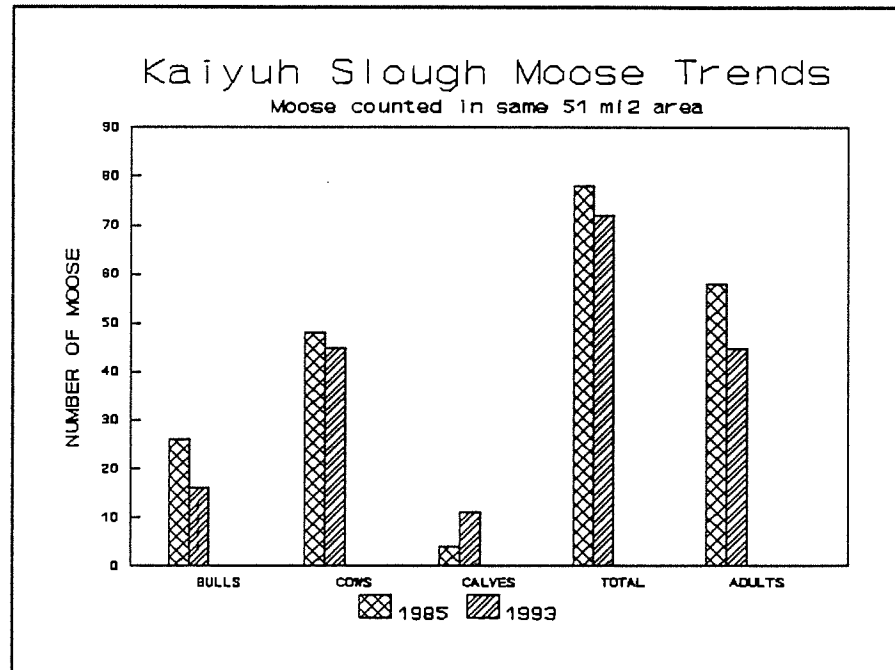


Figure G13. Moose observed during aerial surveys of the Kaiyuh Slough moose trend area, Kaiyuh Flats, N. Unit Innoko NWR, Alaska, 1985 and 1992 (1985 data courtesy, ADF&G).

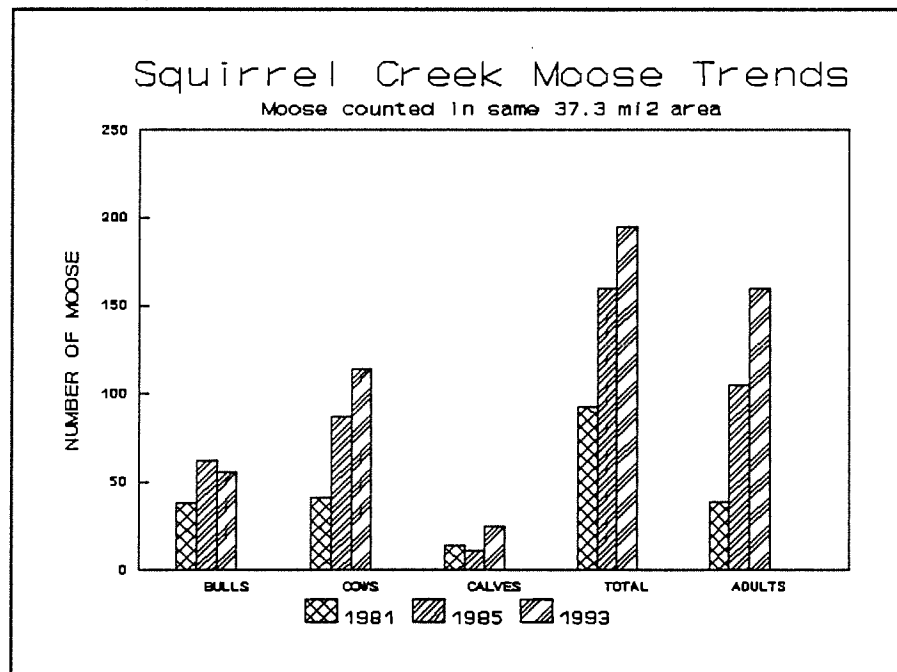


Figure G14. Moose observed during aerial surveys of the Squirrel Creek moose trend area, Kaiyuh Flats, N. Unit Innoko NWR, Alaska, 1981-1993 (1981 and 1985 data courtesy ADF&G, Galena).



According to a 1993 predation and population modelling study, wolves killed 4-8% of the moose on the Koyukuk, while hunters took about 4%. Hunter harvest of up to 5% is sustainable.



An estimated 11,000 moose on the refuge are an important subsistence resource. Aerial population surveys on the Koyukuk showed increases while one area on the Kaiyuh Flats indicated a decline.

Caribou

The ranges of two caribou herds overlap on portions of the refuge. The Galena Mountain Herd (GMH) is a small resident herd of approximately 260 animals that calves in the Kokrines Hills and winters on the flats near Hozatka Lake and in the foothills of Galena Mountain (Figure G15). The Western Arctic Herd (WAH) is a growing herd estimated at a minimum of 415,700 animals. Portions of the WAH winter on northern and western sections of the refuge, but in the winters of 1989-1990, 1990-1991, and 1992-1993 WAH animals wintered southeast of the Koyukuk River and south of the Dulbi River in areas normally occupied only by the GMH. In response to the presence of large numbers of caribou, ADF&G opened a hunting season in Game Management Unit 21D from November 11, 1992 to March 31, 1993 by emergency order. Other than a short fall hunt (August 10-September 30), caribou hunting is closed in Unit 21D to protect the GMH which is not large enough to sustain a significant winter harvest. The WAH did not repeat this migration pattern and few WAH caribou were observed anywhere on the refuge during the winter of 1993-1994. The only area where WAH caribou wintered was north of the Huslia River.

Caribou Study

A cooperative study with ADF&G, the Bureau of Land Management (BLM), and the Alaska Fish and Wildlife Research Center (AFWRC) was initiated in 1992 to monitor the GMH's movements and to determine population size, sex and age structure, age at first reproduction, natality and mortality rates, calving sites, and wintering areas. Blood samples were collected from GMH and WAH animals to compare genetic characteristics between the two herds.

Radio-collared GMH caribou were tracked one to two times each month, although flights were more frequent during calving and post-calving periods and during the winter hunting season. In February to early March 1993, collared GMH animals mingled with the WAH in two main congregations; groups totalling 3,000-5,000 caribou wintered near Hozatka Lake and a larger group of about 15,000 animals was located to the east in the Little Indian River drainage near Huggins Island. Other groups of caribou, ranging in size from a few to 2,000, were observed scattered throughout the area during this period. In April, over 2,000 caribou were observed near Hozatka Lake and between 3,000-5,000, including five collared GMH animals, remained south of Huggins Island. By early May, most of the collared GMH caribou were in the hills east of Galena Mountain and in the Kokrines Hills, while hundreds of WAH caribou were still observed moving northward toward their calving grounds on the North Slope.

The first GMH calves were detected on May 25. Calving was a few days later than usual, a phenomenon reported for other Interior caribou herds and also for

moose. Black and grizzly bears were observed on the calving grounds during telemetry flights and during a trip to the calving area from May 18-24 to document calving behavior and the presence of predators. Caribou began to aggregate on ridges and small snowfields in June. A relocation flight on June 16 reported a total of 194 caribou during the post-calving aggregation period with 18.4 calves per 100 cows. In June, three caribou among GMH caribou collared in April 1992 were found on the North Slope by ADF&G biologists. This confirmed our suspicions that these animals were mistakenly identified as GMH caribou and actually belonged to the WAH. In early August, three collars were collected from mortalities detected on July 30. Although it was impossible to determine cause of death because only bones remained, wolf sign was found at one site and there was evidence of bear activity at another. Collars retrieved from these animals were redeployed on female calves in October.

ADF&G biologists conducted a composition count of the GMH by helicopter on October 12. A total of 259 caribou were observed with a bull:cow ratio of 32:100 and a calf:cow ratio of 25:100. This is an improvement from 1992 when the fall calf:cow ratio was only 7:100. During November and December, relatively shallow snow enabled wintering GMH caribou to remain on lichen-rich ridgetops. The WAH wintering to the southwest, had only a few small groups of about 200 animals move into northern portions of the refuge northwest of Huslia.

Based on measurements taken during collaring in 1992 and 1993, ADF&G biologist Pat Valkenburg noted that GMH caribou were considerably larger than caribou from the WAH and other Interior herds. This observation, and the possibility that the GMH may have originated with a reindeer herding effort in the Kokrines Hills that ended about 1935, prompted a study of GMH genetics. Genetic analyses of blood samples were completed by LGL Alaska Research Associates, Inc. Examinations of mitochondrial DNA genotypes of 9 GMH caribou, 15 WAH caribou, 5 Killbuck Mountain caribou, and 2 reindeer indicate notable differentiation only between caribou and reindeer; GMH caribou did not exhibit the unique genotype found in reindeer samples. Samples from 17 WAH and 13 GMH caribou were analyzed for polymorphisms of the K-casein protein in nuclear DNA. Results suggested the possibility of a significant genetic difference between the two herds, but more samples are necessary for conclusive results. Additional blood samples were collected during the October collaring effort, but have not been analyzed at this time.

The presence of large numbers of WAH caribou on GMH wintering areas in some years has prompted concern about possible degradation of the range. It is hoped that the extent and condition of winter range can be evaluated in 1994.



In October, a composition count of the Galena Mountain Herd yielded a total of 260 animals with a recruitment rate of 25 calves:100 cows and a bull:cow ratio of 32:100 cows.



Winter habitat of the GMH consists of lichen-rich spruce woodlands. Arctic Herd caribou did not winter on the GMH range in 1993-94.

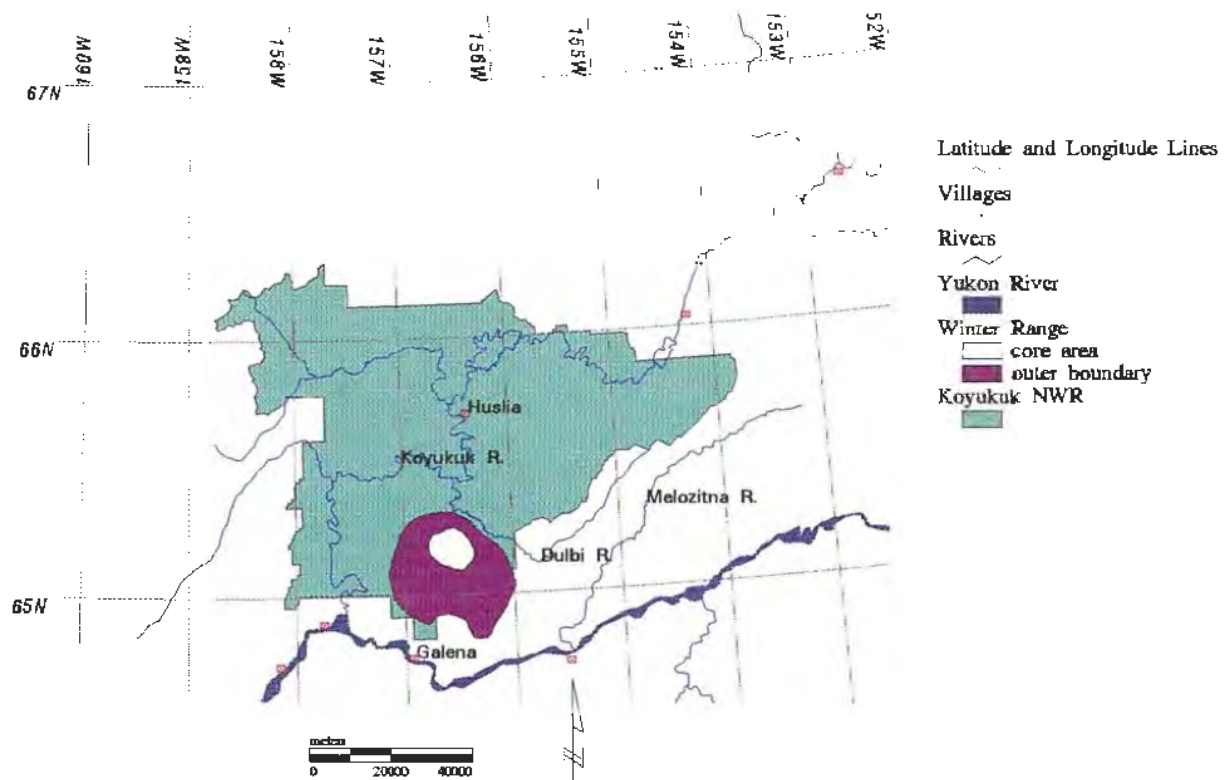


Fig. G15. Location of Galena Mountain Caribou Herd winter range, Alaska



During summer, Galena Mountain Herd caribou calve and aggregate on open ridges in the Kokrines Hills just east of the refuge.



C. Brown landed T. Paragi and P.J. Simon east of Galena Mountain to monitor caribou calving from May 18-24, 1993. Peak calving occurred after the observers departed. They noted many black bears in the area also awaiting the calves.

Bears

Black bears are abundant in lowland forests on the refuge, although accurate numbers are unavailable. Grizzly bears occur primarily in open upland areas, but they are relatively uncommon. A grizzly bear was observed during a duck brood survey in the Kaiyuh Flats, and several grizzlies were sighted off-refuge during caribou telemetry flights in the Kokrines Hills. Residents of Huslia, Hughes and Koyukuk continued to report more grizzlies inhabiting lowland flats near their villages compared to previous years. Salmon runs in the Yukon and its tributaries attract grizzlies during the summer. A moose calf mortality study conducted at Three-Day Slough in 1990 revealed that black bears were the major predator on moose calves, and it is believed that both black and grizzly bears prey upon caribou calves.

9. Marine Mammals

A beluga whale was reported in the Yukon River near Kaltag and Nulato. While missed at Galena, beluga observations were reported further upriver by people from the villages of Tanana and Fort Yukon.

10. Other Resident Wildlife

Furbearers

Beaver. Beaver populations are presently high in much of interior Alaska and beaver are frequently observed on the Complex in summer. Beaver is an important subsistence species for local resource users, although trapping activity has decreased over the years. The fur is used for hats, mitts, and for trim on gloves and mukluks. Beaver meat is prized for its high fat content and is a welcome change from moose in the diet of local residents. From a biological perspective, beaver activity changes wetland regimes which affect fish and waterfowl distribution. Native elders speculate that increased beaver activity has resulted in a greater abundance of pike.

In 1993 beaver cache surveys were conducted between October 15-21 to determine baseline levels of beaver abundance. During the 1991 survey, 85% of the caches in 9 townships on the Koyukuk Refuge were active, and mean density was 0.9 active caches per square mile (SE=0.118). On the Northern Unit of the Innoko Refuge, over 87% of the caches in 6 townships were active, and density was 1.3 active caches per square mile (SE=0.213).

Wolverines

During year end surveys and general flights within GMU 21D, refuge and ADF&G biologists noted more wolverine tracks than elsewhere in Alaska. This appeared to be a recent phenomenon since no other refuge staff does not remembers seeing as much wolverines sign in previous years.

Wolves

Wolves are common 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 Athabascan potlatches. Wolves are the most significant predator to the refuge's major subsistence resources, moose and caribou, therefore population and predation rate information is important to ungulate management decisions. The most recent population estimates for wolves indicate healthy and stable populations (Table G5). Total harvest of wolves on the refuge in 1992 was estimated at 26% of the total population, a level thought to be sustainable over the long-term.

Table G5. Wolf population estimates on the Koyukuk NWR and Kaiyuh Flats, N. Unit Innoko NWR, Alaska, 1992.

Parameter	1992 ^a
Number of Wolves (+/- 80% C.I.)	106 na
Area surveyed (km ²)	12,641
Wolves/1000 km ²	8.3

^a1992 survey included all of Kaiyuh and Galena moose survey subunits for moose/wolf ratio comparisons. Stephenson drainage/ridge survey method was used.

Initiated in 1990, a study entitled Seasonal movements and home range of three wolf packs on the Koyukuk National Wildlife Refuge was continued in 1993. Packs collared in 1990 and 1992 have been monitored monthly to obtain movements, home range, pack size, and predation data. In preparation for a unit-wide census, two additional wolves were collared by ADF&G in Bear Creek in October 1993.

Following is a summary of a draft progress report on predation aspects of the wolf study during 1993. Wolf predation rates were estimated by daily radio telemetry on the Koyukuk NWR during February and March 1993. An estimated 68% of all kills were moose and 29% were caribou. Of 11 kills for which marrow samples could be taken, three had marrow fat values $<20\%$ indicating that the animals were in poor condition, while the remaining eight were thought to be in good condition. Each wolf pack studied on the Koyukuk killed the equivalent of one adult moose every 1.8-13.0 days, with an average of every 11.1 days. Predation rates averaged 0.21 kg prey/kg wolf/day, values that were at the upper end of the range reported in the literature for Alaska and northern Canada. A model of wolf predation at Three Day Slough predicted that wolves would kill 3.5% of the moose available in 1993 if Western Arctic Herd caribou were present and 4.3% if caribou were not present. For the entire Galena subunit of the Koyukuk, where caribou generally do not occur and overall moose density is lower, the predicted wolf kill was 8% of the moose population. These figures differ in many respects to data gathered on the Nowitna in 1991, where wolf kill was estimated at 12% of the moose population (see Nowitna Report, Section G.10).

In recent years wolf predation on moose, although a major source of mortality, probably has not been a significant limiting factor to population growth on the Koyukuk while on the Kaiyuh Flats predation may have approached limitation. The moose/wolf ratio on the Koyukuk was 60.9 moose/wolf, while on the Kaiyuh the ratio was 38 moose/wolf in 1992 (1987 moose data and 1992 wolf data). According to Gasaway et al. (1983) moose/wolf ratios >30 indicate that moose populations are likely to remain stable or increase if other factors are not limiting.



In 1993 when large numbers of Western Arctic Herd caribou were present, 29% of observed wolf kills were caribou while 68% were moose. When caribou are present the proportion of moose in the wolf diet declines.



On the Southern Koyukuk and Kaiyuh Flats the wolf population was stable, at 76-104 wolves, a density of 7.4-10.2 wolves/1000km².

11. Fisheries Resources

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

Because the refuge had no fisheries biologist on staff in 1993, fisheries work on the refuge Complex was coordinated by ROS Pete Dematteo, and most of the work was supervised by David Wiswar of the USFWS Fisheries Resources Office in Fairbanks. The FWS Fishery Resources Office, and Alaska Fish and Wildlife Research Center in Anchorage, ADF&G Sport Fish and Commercial Fish Divisions in Fairbanks, and Tanana Chiefs Conference in Fairbanks also cooperated. There were four major baseline fish studies underway on the refuge

in 1993: (1) Preliminary salmon stock assessment; (2) Salmon genetic stock inventory; (3) Koyukuk tributaries resident fishery investigation; and (4) Kaiyuh Flats pike study. The following are summaries of those studies:

Preliminary salmon stock assessment in the Koyukuk National Wildlife Refuge, 1993

The mainstem Yukon River and other rivers within the drainage are subject to commercial and subsistence fishing. Part of the Yukon River drainage lies within the Koyukuk Refuge. The villages of Kaltag, Nulato, Koyukuk, Galena, Huslia and Hughes depend upon the fish resources of the Koyukuk Refuge for subsistence. Effective management of the Yukon River international salmon stocks is important to ensure the continued success of subsistence and commercial fishing by the local residents. However, effective management cannot occur without adequate data. In order to provide base line information as a first step toward salmon management, the Fairbanks Fishery Resource Office conducted a preliminary salmon stock assessment on the Koyukuk Refuge. After a literature review on salmon distribution and escapement, the primary goal was to determine the presence of salmon in rivers where information was lacking.

Chinook salmon have been documented in the Gisasa, Kateel, Dakli, and Indian Rivers and move into the system from late June to mid-July. Summer runs of chum salmon have been documented in the Gisasa, Kateel, Dakli, Hogatza, Indian, and North Fork Huslia Rivers and Billy Hawk Creek. Summer chum move into the system from late June to mid-July. A fall run of chum and coho salmon migrate into refuge rivers from late August through late-September, however, little is known about these runs.

Annual surveys to determine escapement estimates chinook and chum salmon were conducted on the Gisasa, Kateel, Hogatza, Indian, and Dakli rivers 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. Index stream escapement data (1960 - present) for chinook and summer chum is available for the Gisasa, Dakli, and Hogatza rivers. Based on surveys conducted since 1987 it appears that the Dakli drainage supports higher numbers of summer chum, while the Gisasa River supports higher numbers of chinook.

Escapement estimates for salmon stocks using the Koyukuk Refuge rivers are limited to five tributary streams with multi-year data; these are the Gisasa, Kateel, Hogatza, Indian, and Dakli Rivers. The distribution of chum and coho salmon within the Koyukuk River drainage has not been documented. Escapement estimates over the years have been highly variable, so it is unknown how many salmon are using the drainage for spawning and migration. It is known that

escapement estimates of salmon in the Yukon River drainage have been declining since the early 1980s. It is likely that this decline is also affecting the Koyukuk River drainage.

The Koyukuk Refuge was sampled during July and September to intercept summer and fall chum salmon, chinook salmon, and potentially coho salmon. Sampling between August 8-18 occurred on the North and South Forks of the Huslia River about one kilometer above their confluence with the mainstem. Sampling on the lower Huslia River near the confluence of Billy Hawk Creek was conducted on September 1-7. Both the Huslia River mainstem and Billy Hawk Creek were sampled. Multifilament gill nets were used to capture fish. Two mesh sizes were used during the July sampling period, 21-centimeter to target chinook salmon and 14.9 centimeter to target chum salmon; both nets were 9.1 meters long. In September only the 14.9 centimeter chum mesh was used, and the nets were 18.2 meters long. There were three sampling periods per day and each period lasted three hours. In September, one net was set in the Huslia River mainstem and one net was set in Billy Hawk Creek. All fish captured were identified to species and counted for July sampling period.

Two northern pike were captured in the chum size nets in the North Fork Huslia River. No fish were captured in the king size mesh. In the South Fork Huslia River, fish were captured only in the chum size mesh. The catch was two northern pike and three broad whitefish. During this time, six northern pike, three broad whitefish, and one sheefish were captured in the Huslia River. In Billy Hawk Creek, seven northern pike and two broad whitefish were captured. Heavy rain at the beginning of the month raised the water level significantly. Downed trees, root wads and branches were carried from the banks into the river due to the high water. The gill nets became so fouled with debris that sampling was discontinued after September 7. No salmon were captured during their migration through the Koyukuk Refuge in either July or September. Possible reasons include: (1) the majority of the run had already migrated before sampling began; (2) the run was exceptionally weak region-wide; and (3) Abnormally high water level negatively affected the September sampling effort.

During the resident fish study in mid-August, FRO staff Katie Brenner and Shane Derendoff visited with Lloyd and Amelia DeWilde, who have lived and fished in the area 45 kilometers upriver from the confluence of Billy Hawk Creek and the Huslia River since 1967. The DeWilde's passed on some of their observations made while fishing the area over many years. During the salmon runs they find both chum and sockeye salmon. Lloyd did not mention a fall run of chum, but did mention that much of the summer run was over when sampling took place in early September. He did mention that sockeye come through in the fall. There was some confusion about this because he referred to them as chinook. Since he described them as having red bodies and bright green heads,

they are most likely sockeye. The run is from early August to after freeze-up followed by a lull for a week or two. He described the run as very erratic; most times seeing two or three fish then a few more are seen. The fish are not seen every year, but that doesn't necessarily mean they aren't running.

Further investigations are necessary to determine spawning areas and obtain more accurate escapement estimates. Salmon migrating through the Koyukuk River drainage 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.

Salmon genetic stock inventory

ROS Pete Dematteo assisted Steve Miller of the Anchorage Fishery Resources Office in the collection of tissue samples from 100 summer chum salmon on the Indian River from July 17-19. The samples were quick frozen for addition to the regional baseline salmon genetic inventory. A report summarizing Yukon salmon genetic studies through 1991 included some refuge tributaries. The 1993 samples from Indian River and 1992 samples from the Dakli River will eventually be used to update this report.

Koyukuk tributaries resident fish investigation

Baseline fish investigations were conducted on the Honhosa River, North Fork Huslia River, and Billy Hawk Creek during late July and August. Objectives were to determine species composition and distribution of resident fish (non-adult salmon) by life stage (young of the year, juvenile, and adult) in drainages on the Koyukuk Refuge.

Sample sites in each river were located from USGS 1:250,000 and 1:63,360 topographic maps and were established approximately every 10-15 kilometer and near the mouth of major tributaries. Water width, and water depth were measured while bank-full width, bank slope, and substrate composition were estimated. Fish were captured with baited minnow traps, hook and line, dipnets, variable size mesh gill nets, and a backpack electrofisher. Visual observations of other species were also recorded.

The North Fork Huslia River was travelled by inflatable raft between July 23 and 28. Four sites were sampled in the lower 25 kilometer of the North Fork and one site in the mainstem Huslia River was sampled approximately 1 kilometer below the confluence of the North Fork and the South Fork. The river was slow moving and few, if any, riffles were encountered on the trip. The river bottom consisted of sand and silt with overall channel width of 10 meters and depth less than 1.5 meter. At high water levels the channel was estimated at 30 meters wide and 11



Chum salmon along with resident species are important resources to the local residents.

meters deep. Stream banks were high (10 meters) and steep (approximately 45 degrees). Northern pike, broad whitefish and longnose sucker were captured at the mainstem Huslia River site. Northern pike were captured at three of the four sites on the North Fork, and humpback whitefish were captured at one site on the North Fork. Young of the year longnose sucker were observed at one site on the North Fork. All other fish captured were determined to be adults.

The Honhosa River was surveyed between August 7 and August 13. Ten sites were sampled along 85 kilometers of the river starting at the confluence of the Koyukuk River and Honhosa River. Each site was accessed by helicopter because the water level was too low to allow travel by boat. The river bottom in the lower Honhosa was composed of sand, silt and medium sized gravel and in the upper Honhosa gravel, sand and cobble composed the bottom. Channel width was between 6-12 meters. The Honhosa is faster, narrower and shallower than the North Fork Huslia River. Riffles were present along the river and riffle depths were generally less than 0.2 meters. Pool depths were less than 1.2 meters. Banks were generally low, with a slight grade. The river seemed faster and narrower farther upstream. Adult arctic grayling were captured by angling at several upper sites. Using the backpack electrofisher adult, juvenile and young of the year Arctic grayling, slimy sculpin, burbot, round whitefish, and young of the year longnose sucker were captured. Slimy sculpin were the most widespread fish as they were caught at 8 of the 10 sites.

Billy Hawk Creek (designated as the North Fork on maps drawn prior to 1963) was travelled between August 18 and 25 using an inflatable raft. Six sites were sampled, beginning at the confluence of the Huslia River and ending 45 kilometers upriver at the DeWilde cabin. One site on the mainstem Huslia River was also sampled. Water was high and swift at the time of the survey. Mainstem channel width was 30 meters and water depth was greater than 3 meters. The river bottom consisted mostly of sand and silt. Billy Hawk Creek meanders quite a bit, with many branching sloughs and ox-bows. Northern pike, chum salmon, slimy sculpin, and broad whitefish were captured in Billy Hawk Creek. Burbot, adult and young of the year northern pike, and young of the year longnose sucker were captured in the mainstem Huslia River. According to the DeWilde's, whitefish, northern pike, arctic grayling and longnose sucker are common on Billy Hawk Creek, as well as sockeye and chum salmon during their respective runs.



Humpback whitefish are among the 14 fish species that have been documented on the Koyukuk NWR in the literature and during field studies. Whitefish are harvested in nets set in eddies or under the ice in winter.

Northern Unit of Innoko NWR pike studies

Coordination with ADF&G and Tanana Chiefs Conference continued in an effort to launch a pike study on the Northern Unit of Innoko. In 1991 a small controversy arose when a commercial fishing guide began operating on native lands within the Kaiyuh. Complaints of dead pike were received from local

subsistence users, but the guide insisted that his trophy catch and release fishing was low-impact and that fish were being handled carefully. We felt that because very little was known about pike biology in the area, it would be difficult to determine actual impacts or sustainable harvest. ADF&G Sport Fish Division was interested in pursuing a pike study in the area, so a cooperative study was proposed. Finally, late in 1993, funds in our budget coincided with ADF&G funding for the study. Actual field work was set to begin in August 1994.

Contaminants

Fish, water, and sediments on the refuge were sampled for heavy metals contamination between 1986 and 1988, as part of a cooperative study with the Northern Alaska Ecological Services (NAES) office in Fairbanks. These results were summarized in a 1992 report entitled "Contaminant data for water, sediments, and fish of the Koyukuk National Wildlife Refuge and Northern Unit of Innoko National Wildlife Refuge." Follow-up sampling was performed in summer 1991, the results of which were received at NAES in fall 1993. An early preview of the data was made available by Elaine Snyder-Conn of NAES, however, she cautioned that some of the sediment samples and all of the fish samples had not undergone quality assurance review. The following summary of 1991 data is therefore preliminary and its interpretation is subject to change.

In general, samples showed normal background levels of heavy metals, however, as in the earlier efforts, there were some exceptions:

Clear Creek/Aloha Creek (site 4). Sediment from two replicates had relatively high concentrations of lead, cadmium, and beryllium. One fish had an elevated mercury level.

Caribou Creek (site 6). One Northern Pike muscle tissue had elevated arsenic. Two fish had elevated mercury levels.

Camp Creek Mine, and Lower Camp Creek Lake (sites 13 and 14). Sediment had slightly higher nickel, but still within natural ranges. Chromium was consistently double the concentration of other sites, probably due to a mineral source upstream.

After the 1992 report by the Service on mercury contamination of pike in the Kaiyuh Flats some additional follow-up sampling was done by Tanana Chiefs Conference Water Resources Specialist Paul Headlee in August 1993. The objective of the study was to obtain more information on risks to area villagers who consume large amounts of pike. Water samples and 12 pike were collected at each of four sites: Camp Creek, Bonanza Creek, North/American Creek, and Yukon Creek. The samples were analyzed in a very timely manner by Columbia

Analytical Services, Kelso, Washington (compare their six months to two years by the Service's contractor).

Water samples indicated no detectable mercury or selenium contamination. No detectable selenium occurred in the pike tissue samples but a statistically significant relationship between concentrations of mercury and fish size was noted. The observed levels of mercury were below the human consumption guidelines set by the Minnesota Dept. of Health (no Alaska or national standards have been set), however, Headlee recommended caution for consumption of large amounts of larger sized fish. According to Headlee, if the average size of pike eaten is 32 inches long, the estimated mercury concentration would be 0.730 ppm (wet tissue weight). Guidelines set by the Minnesota Dept. of Health recommend 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.

Published estimates for pike consumption in the three villages closest to the Kaiyuh (Koyukuk, Nulato, and Kaltag) were not available, but ADF&G estimated per capita pike consumption in Galena at 5.2 pounds and in Huslia at 28.8 pounds.

14. Scientific Collections

Three caribou and two wolves were immobilized on the Koyukuk Refuge by ADF&G and fitted with radio collars. These were refurbished collars deployed to maintain required sample sizes of collared animals in the respective cooperative caribou and wolf studies.

A refuge herbarium was established in 1993. A total of 171 specimens, most of which were collected on the Nowitna in support of habitat map ground truthing, were cataloged into the herbarium in 1993.

One hundred chum salmon were collected for salmon genetic stock inventory.

16. Marking and Banding

The Koyukuk Refuge has had an active banding program for white-fronted geese and northern pintails since 1989. All banding activities have been a cooperative effort with the Division of Migratory Birds. In 1993, an effort was made to band white-fronted geese at two sites on the Dulbi River and two sites near the Koyukuk River from July 12-14. Unfortunately, banding success was lower than expected, 156 six birds received both leg and neck bands and 15 birds received leg

bands only. Low success was attributed to limited abundance, previous flooding, and conditioning of the birds due to previous years banding efforts. A significant problem was that birds were skittish in previously used banding areas. Rather than staying together in the center of the river while being herded, they split up and ran onto shore.



A total of 171 white-fronted geese was captured and banded in 1993. After four years of banding efforts we believe the birds have become educated to our techniques and capture success has declined.

No ducks were banded this year since lakes were still flooded in August when banding usually occurs, and no large congregations of ducks were observed. It was determined that a banding effort would not be cost- or time-effective given the small number of ducks. Low banding success was a problem in all regions of the Pacific Flyway this year, and possible explanations include fewer birds, unusual weather conditions, and timing of banding.



Most recoveries and resightings of white-fronted geese banded and collared on Koyukuk NWR occur in Saskatchewan and Texas.

H. PUBLIC USE

1. General

Public use on the Koyukuk and Northern Unit of the Innoko NWR's almost exclusively takes the form of subsistence or recreational consumptive uses of hunting, fishing, trapping, and gathering (berries and firewood) or other activities associated with these consumptive uses. Of the subsistence and recreational categories, Subsistence by far dominates recreational use with activities ranging from putting meat, fish, and berries on the table to cutting house logs and firewood. Recreational activities include sport fishing and hunting for moose, bear, and wolves. Some recreational floating (canoeing and kayaking) takes place

on the Koyukuk Rive, but most is done closer to the river's headwaters in the Brooks Range above the refuge boundary.

Several activities occurred during the year that point to some changes in the public use arena on the refuge:

- 1) For the first year since 1989 commercial big game guides were operating on the refuge as discussed in detail in Section H.8. This was significant in that both guides worked closely with the villages of Huslia and Hughes - both of which are very traditional subsistence based villages and in the past have been opposed to non-local hunters in the area.
- 2) For the first time to our knowledge, a local Galena establishment began renting boats to non-local moose hunters for travel on the Yukon and Koyukuk Rivers. Although there have always been inquiries by prospective hunters, the service has not been previously available.
- 3) A large part of the recreational northern pike fishing during the summer months has been done by military personnel from the Galena Air Force Base. In addition to fishing, it is estimated that as many as 50 moose hunters associated with the base took to the field each year. Without the base personnel plus the equipment (mainly boats) and lodging facilities available to other qualified military personnel, we can expect some decrease in this resource use. It is unclear at this point what compensating role the custodial status employees at the Base may play or how long they may remain before the Base is completely shut down.
- 4) The new requirement that air taxi operators secure separate special use permits and pay separate \$100 administrative fees for each refuge seems to have discouraged the application for permits unless they had a definite anticipated need. Only one company applied and received an air taxi SUP during the year. This compares with up to four air taxi permits issued previously, although not necessarily quadruple the amount of activity.
- 5) This is the first year user fees were collected for activities conducted via special use permits. The fee collected represents half of what the fees will be when the policy is fully implemented in 1994.

Table H1. Commercial Use Permits Issued in 1993 - Koyukuk/Upper Innoko NWR.

<u>Permittee</u>	<u>Use</u>	<u>Fee Collected</u>
Virgil Umphenour Hunt Alaska	Guided Big Game Hunting	\$100.00 Admin \$450.00 User Fee
Brian Simpson Taiga Hunting	Guided Big Game Hunting	\$100.00 Admin \$200.00 User Fee
Steve Williams Ptarmigan Air	Air Taxi	\$100.00 Admin \$ 16.00 User Fee

As in the past two years, April meetings were held in villages to discuss the Service policy on the harvest of waterfowl during the closed season. This year meetings were held in Tanana, Nulato, Kaltag, and Galena. A special agent from Fairbanks attended the meeting in Tanana. Although these meetings generated a good deal of interest and discussion in 1991 and 1992, we are now reiterating the same policy and meeting attendance has dropped off markedly. In the future these meetings will be used to exchange information on a host of other topics in addition to the subject of waterfowl hunting.

November meetings were held in Galena and Koyukuk to relay information on local moose populations and mortality factors based on a moose populations model developed for the area. Attendance was low and we decided to delay additional meetings until we could consolidate them with other topics.

2. Outdoor Classroom - Students

In conjunction with American Wetlands Month, the refuge staff lead wetland/waterfowl activities for Galena 4/5th and 7/8th grade classes. Each class received a two day program with background information and an activity the first day, followed by a waterfowl identification field trip the second day. The 4/5th grade class focused on local wetlands and the effect of wetland loss on waterfowl.

The 7/8th graders discussed why and how waterfowl regulations are made. This is the second year the staff has worked with the 7/8th grade group and the students' interest level appears to reflect the consistent effort by the teacher and refuge staff.

The second annual Biological Skills Camp was conducted from August 2-6 in Galena. Five students from Kaltag, Huslia, and Galena participated in hands-on activities to develop skills needed to help qualify for a biological technician position with the Service. Students did tissue sampling in pike, collected water samples and recorded sample data for contaminant testing. In a fisheries session students used seines and minnow traps and observe the technique of electrofishing in a local lake. Two local hire refuge biological technicians gave students instruction on duck identification and how waterfowl brood surveys are done, then took students to do a brood survey by canoe on a local lake. Students also learned orienteering skills with a map and compass. Early in the week, students visited local resource agencies to interview personnel on their major duties and the schooling and training requirements for their professional positions. In the students final evaluations, the majority agreed the skills camp should be several days in an overnight camp setting outside of Galena. We are planning for a 3-4 day overnight camp for next year.

Ella B. Verneti School in Koyukuk invited the refuge to participate in their cultural and natural resource camp held in late August. ROS/P Liedberg and Education Specialist Betsy Whitehill from Fairbanks conducted activities with 24 students from "The Role of Fire in Alaska" curricula at a camp site 15 miles up the Koyukuk River. Activities included setting up transects to observe vegetation changes that can result from wildfire and a discussion on wildlife responses.

PR Johnson presented several sessions on fire ecology and fire management to 13 high school students at the Innoko Student Camp in early August. Students conducted vegetation transects in a mature hardwood/conifer forest and in a 20-year burn to compare growing conditions, plant diversity and abundance. The half day field trip through different successional stages emphasized the purpose of fire in the boreal forest ecosystem. Students developed fire protection maps for their local region as part of the fire management session.

In cooperation with Galena City School, the refuge worked with student intern Michelle Strassburg for 12 weeks during the fall semester. Michelle came to the office one day a week for 3 hours to earn ½ credit. She worked with several staff members on moose survey mapping, small mammal dissection, and a radio telemetry flight for caribou. Michelle will use what she has learned about moose surveys in her science fair project on the local distribution of moose populations.

Refuge biologists and educators presented moose population programs to eight village schools in November. A total of 35 programs were given to approximately 622 students in grades K-12. Students were interested in the information on our moose trend surveys, wolf telemetry and moose calf mortality studies since moose, wolf, and bear are key species of interest to them. High quality graphs showing population trends and densities were a definite plus to the programs. Several

adults were present for the school programs, however we hope to pursue informal presentations in the communities this spring.



During a fire ecology session, students of the Innoko Camp conducted vegetation transects in a mature hardwood/conifer forest and in a 20-year burn to compare growing conditions, plant diversity and abundance. (BS)

3. Outdoor Classrooms - Teachers

The refuge's attempt to organize a teacher workshop fell short this year due to teacher conflicts. Several points on organizing teacher workshops were learned: 1) Establish a pre-registration date and minimum number of participants needed; 2) Require a modest pre-registration fee to strengthen commitment to the workshop 3) Check with teachers, not administrators, when establishing a workshop date - they both don't always have the same commitments. Workshop materials will be used in future teacher in-services and teacher notebooks.

Refuge staff assisted with several fire education workshops and helped organize fire education materials during the year. In March, PR Johnson assisted Kanuti and Regional office staff in a teacher workshop held in Bettles. For the Region 7 EE workshop held in Anchorage, she co-presented a workshop on The Role of Fire in Alaska curriculum with Education Coordinator Betsy Whitehill. Johnson also worked with Whitehill to organize materials for the fire education kits that were distributed to refuge personnel.

As part of a cooperative teacher in-service with the local native corporation and Project Learning Tree, 18 teachers visited the refuge office for an introduction to the refuge's information and education program and to preview curricula, references, and videos available in our EE resource library.

5. Interpretive Foot Trails

Merrelaine A. Kangas School in Ruby responded to the refuge's offer to provide technical assistance to schools interested in developing a nature trail. The school applied for a grant from the U.S. Forest Service and received \$7,000 for trail construction, equipment, and development of an activity handbook. Students and community have brushed the trail and a preliminary plan of sites around the trail has been done. Refuge staff have been providing technical assistance to the school throughout trail development and met with teachers in September to discuss the plan and prioritized their ambitious list of projects. A handbook will be developed that will be applicable to other school sites in the district. This fall, Koyukuk School expressed an interest in a trail at their site and may join in a cooperative effort to develop a handbook.

6. Interpretive Exhibits/Demonstrations

In conjunction with National Fishing Week, the refuge developed two information displays and a radio announcement on local fisheries. The displays provided handouts on salmon life history, the benefits of natural spawning, salmon life cycle, and life histories of several other common fish species. For the month of June, the displays were at a local store and the Air Force Recreation Center. The radio announcement explained fisheries projects to be conducted on the Complex for the summer field season.

7. Other Interpretive Programs

The Complex hosted a wildlife film series for three consecutive Saturdays in February at the Galena Base theater for military personnel and the community. Videos on Interior wildlife, bear safety, refuge wolf and caribou collaring programs, waterfowl banding and habitat conservation were shown. Attendance varied and seemed to depend on peoples' activities related to the weather conditions.



The refuge is working with other village schools interested in setting up a nature trail to use outdoor classroom activities. (CB)

An evening seminar on local wildlife studies was given in Galena on May 1. Refuge staff in cooperation with ADF&G and Fairbanks Fisheries Resource Office gave presentations on local moose population studies, the range and population dynamics of local caribou herds and an overview of the Service's work with fisheries. The attendance was lower than anticipated (approximately 25 people) due to a funeral observance the same weekend.



The Role of Fire exhibit in the office foyer was a great addition to our fire education program. (PL)

The refuge awarded a contract to Imig Video in September to edit and produce a video series on the Koyukuk/Nowitna Refuge Complex. The purpose of the series is to present information on the habitats and wildlife resources of the refuges and to relate the traditional values and uses of wildlife resources to refuge management programs. Footage for the video was taken by two volunteer cinematographers during the summer of 1992. The video is intended to be used primarily as an outreach tool by refuge staff to complement school and community programs in the local villages and presentations to non-local groups.

In lieu of doing full monthly activity reports, the staff is diverting their energies to monthly radio reports on refuge wildlife studies. We received favorable comments from local residents and the station manager on our christmas bird count report in December. A number of topics have been selected for the coming year. We feel confident that providing more information to the public on these topics will benefit our future management efforts.



The refuge hosted a seminar in May to present information to the Galena community on local moose and caribou populations and fisheries work done by the Service. (PD)



Refuge staff presented information from moose trend surveys and censuses during informal evening programs in the villages of Koyukuk, Huslia and Galena. (BJ)

8. Hunting

The primary big game species targeted by subsistence and sport hunters on the refuge are moose, caribou, wolves, and black bear. Ducks, geese, sandhill cranes, snowshoe hare, spruce and ruffed grouse, and grizzly bears are also taken. Subsistence surveys done by ADF&G in Huslia, Hughes, Nulato, Ruby, Galena, and Koyukuk over the last several years have provided us with a general estimate of subsistence harvest. More accurate interview-based harvest surveys from several surrounding villages were conducted from mid-1992 through mid-1993 by refuge contracted surveyors. By year's end these surveys were being compiled. A more detailed discussion of the surveys is included in Section H.20.

A large portion of the refuge, including most of the Koyukuk River corridor is contained within a controlled use area established by the Alaska Board of Game. This essentially closes the area "during all open moose hunting seasons to the use of aircraft in any manner for hunting moose, including transportation of moose hunters into or within this area, and the transportation of moose parts to or within this area." The Koyukuk Controlled Use Area likely results in fewer moose being harvested and clearly reduces the interest of commercial hunting guides in the area, however it concentrates the majority of hunters on the refuge to the navigable waterways. The area is within prime moose habitat attracting non-local hunters who travel more than 600 miles round trip by boat. Conflicts between local hunters and non-local hunters do exist. Although often called for by local residents, the state is unable to separate user groups to reduce the conflicts.

Through the Federal Subsistence Board regulation process, the refuge supported a proposal submitted by a local resident that provided for a four day subsistence only moose hunt from September 1-4 within Game Management unit 21D within the Koyukuk NWR within the Koyukuk Controlled Use Area. This season immediately preceded the sport season which ran from the 5th through 25th. What proved to be good in concept proved to be difficult to administer. Little did anyone in the initiation, review, or approval process realize the management complications involved with the season. The underlying problem lies in the fact that we only manage Federal land, e.g. not village or regional corporation lands, not private native allotments, and most importantly, not navigable waterways that are claimed by the State of Alaska. In an area where 100% of access for moose hunting is via navigable waterways and where hunting from a boat is as much a tradition as road hunting in other parts of the country, the federal subsistence regulation proved difficult to manage and enforce. In addition to the navigability problem, we were expected to tell hunters where private land ends and federal land begins. If the assistance we received in doing this and the information we provided to the public is as good as it gets, then it is safe to say that this was an impossible task. We did receive a land status map from the Subsistence office, but on a scale of 1:500,000 it was of limited value.

The result of the entire process was that everyone was confused, about six individuals participated in the hunt, and two moose were harvested.

Complicating our intent when supporting the proposal was the mistaken (possibly) impression that one of our goals in subsistence management ought to be separation of users where we have a conflict. Changed (or possibly clearer) guidance that surfaced throughout this process is that we should only propose changes that deal with resource allocation problems and not simply a separation of user groups. As of year's end we had submitted a proposal to eliminate the special subsistence moose hunt.

During the winter of 1992/93, caribou from the Western Arctic Herd moved into the refuge between Galena and Huslia and mingled with the much smaller Galena Mountain Herd. The ADF&G issued an "emergency opening" that allowed the harvest of two caribou per day. The opening ran from November 11, 1992 through March 31, 1993. An estimated 200 caribou were taken during the opening. As of the end of 1993, no Western Arctic Herd animals had returned to the area and an emergency opening is not likely during the 1993/94 period.

Spring waterfowl hunting during the closed season (after March 10) occurs in all the villages in the area. This historic activity takes place today less because of the basic need for food, but more because of cultural traditions and the desire for a change in diet after a long winter of mainly moose, caribou, and fish. This is the only period when significant waterfowl hunting takes place because the fall season conflicts with the completion of fishing, moose hunting, and other activities related to preparing for winter. In addition, many birds particularly white-fronted geese, are gone at the September 1 opening which provides little hunting opportunity. The ADF&G subsistence division conducted a study of subsistence harvest of migratory birds in the state in the mid to late 1980's. They estimated the six villages in the area of the refuge harvested 3,602 geese and 8,553 ducks. We believe these figures are high. Early in 1994 we will have figures from a first round of refuge conducted village harvest surveys to compare with the previous estimates. The preferred species of choice by area residents is the white-fronted goose. Within entire villages there may only be a handful of hunters who distribute the birds and thus, a sledload of geese (hunting is done with snowmachine) would seldom if ever be considered overharvest or wasteful. We have continued to supply information to the villagers on changes to the Migratory Bird Treaty Act which could legalize this activity.

Commercial big game guided hunting occurred on the refuge this year for the first time since 1989. The new process of allocating guide areas on refuges that began in 1992 resulted in two guides being selected to operate in four of the six refuge units. Units KOY-01 on the Upper Innoko Refuge and KOY-02 which included the extreme southern portion of the Koyukuk were both declined by the original

applicants because of conflicting land status problems, the effect of the controlled use area restrictions on their operations, and other factors. Units KOY-03, 04, and 05, which encompass about 2,000,000 acres was awarded to Hunt Alaska owned by Virgil Umphenour from Fairbanks, Alaska. He guided 10 hunters for a total of 90 days and harvested nine moose, three black bear, two wolves, and one grizzly bear. Unit KOY-06 was awarded to Taiga Hunting owned by Brian Simpson from Eagle, Alaska. He guided four hunters for 40 days and harvested four moose and one black bear.

Both guides developed agreements with the villages of Huslia and Hughes which included hiring residents as assistant guides, contracting with the villages for boats, tents, other equipment, and other assistance as needed with the operation. Through this cooperative arrangement they have provided an income source for the villages, been able to direct the guided hunting away from traditional subsistence use areas, and in general have taken an active approach to land management in the area. This has been a tremendous aid to the refuge in dealing with conflicts between subsistence and sport hunting user groups.

One moose taken by the Hunt Alaska camp was scored as an unofficial Boone and Crocket record for a muzzle loader. It measured 72 1/4 inches and scored 216 4/8, outscoring the standing record by 30 points. An article on the moose is included in the back of this report.

Effort expended to hunt wolves by local residents probably exceeds the effort made to harvest them by trapping. The traditional method of taking wolves has included the use of snowmachines in the late winter when the combination of good snow cover, increasing daylight, and warmer temperatures provide the best conditions. Unfortunately, hunting with snowmachines has the same inherent problem as hunting with an airplane - the difficulty in taking the animal without violating laws regarding harassment. These laws have been largely ignored or misunderstood in the 25 years that snowmachines have become fast enough and reliable enough to use for this purpose, because enforcement of harassment laws has been lax or non-existent. An estimated 46 wolves were harvested (hunting and trapping) from an estimated population of 206 wolves by the six villages in the area of the refuge during the 1991/92 season - the last year in which we analyzed information from a number of sources and which includes both harvest and population estimates. Some wolves are sold for cash but many are used for sewing or given away as gifts and never leave the village. Information on sealing records for wolves is included in Section H.10.

Hunter Check Station

The ADF&G Area Game Biologist has conducted a hunter check station on the Koyukuk River just south of the refuge boundary since 1983. Because the entire

Koyukuk River within the refuge boundary is part of a controlled use area which bars aircraft access for moose hunting, the check station provides a constant source of harvest information for the majority of refuge hunters who gain access from the Yukon River. This includes most residents on the Yukon and virtually all hunters who do not reside in the local area. The check station has been a mandatory stop since 1990.

Weather conditions could be characterized as close to normal for the moose hunting season and did not hinder boat or aircraft traffic as the early freeze-up did in 1992. By the end of the season on September 25 many good days of river travel remained.

Hunters checked 185 moose through the station during September 1993. This harvest was down 11% from 1992 and down 3% from the previous five year average of 179 (Table H2). Numbers of hunters decreased 15% in 1993 compared to 1992. Of the 281 hunters, 115 (41%) were local game management unit (GMU) 21D residents, 132 (47%) were non-local state residents, and 34 (12%) were out of state residents (Table H1).

Table H2. Number of moose hunters by residency class checked through the Koyukuk River Check Station¹. Date courtesy ADF&G, Galena.

Year	Non-Local AK.	Non-Res.	Local Unit Res.	Total Hunters
1983	29	3	132 ²	164
1984	67	9	92 ²	168
1985	74	4	117 ²	195
1986	80	9	140 ²	229
1987	92	21	151	264
1988	121	17	158	299
1989	125	23	154	302
1990	133	36	137	306
1991	189	55	136	380
1992	153	28	149	330
1993	132	34	115	281

¹ checking in and out was not mandatory until 1990 and compliance was lower during the first year, 1983.

² includes every trip made by hunter

Table H3. Harvest by moose hunters and hunter success by residency class checked through the Koyukuk River Check Station¹. Data courtesy ADF&G, Galena.

Year	Non-Local AK.	Non-Res.	Local Unit Res.	Total Harvest
1988	88 (73%)	17 (100%)	73 (46%)	181 (61%)
1989	89 (71%)	14 (61%)	55 (36%)	158 (52%)
1990	105(79%)	30 (83%)	48 (35%)	183 (60%)
1991	121(64%)	38 (69%)	49 (36%)	208 (55%)
1992	96 (63%)	18 (64%)	51 (34%)	165 (51%)
1993	109(82%)	28 (82%)	48 (42%)	185 (66%)

¹ checking in and out was not mandatory until 1990.

9. Fishing

Sport fishery harvests on the Koyukuk and Northern Innoko refuges are expected to decrease with the closure of the Galena Air Force Base on October 1st. Air Force personnel widely enjoyed the sheefish and pike fishing opportunities the local area has to offer prior to the closure.



Arctic grayling can be found in the not very accessible mountain streams of the Koyukuk Refuge.

10. Trapping

Trapping provides an important source of supplemental income for many residents in the villages of Galena, Huslia, Kaltag, Koyukuk, Nulato, and Hughes. The reported harvest of furbearers (sealing records) on the Koyukuk and the Northern Unit of the Innoko is shown in Table H4. These figures provide a conservative or "minimum" estimate of harvest because some skins, especially beaver and wolves, are kept by trappers for personal use. There are no sealing requirements for marten or mink.

Compared to previous years, trapping success, or more likely effort, declined last year for beaver (Table H4). However, more wolves were sealed last year than in recent years. A combination of weather and snow conditions last spring included ideal snowmachine travel and probably contributed to increased hunter effort and success. Also, the conditions appeared to make moose more vulnerable to wolf predation and many local people responded by increasing their efforts to harvest wolves.

Traplines are not registered but are generally passed down from person to person or generation to generation. Thus, claims to certain areas for trapping are usually recognized and respected by other local residents. Beaver trapping is not always done within strictly controlled trapping territories and areas are often shared by several people, perhaps because of the importance of this species as a food item.

Snowmobiles are the primary means of transportation for trapping with some individuals traveling up to 200 miles round trip on the trapline. Most dog teams in Galena are used for recreation although a few trappers still use dogs for transportation on their lines. Some trappers use airplanes for access and a few simply walk their traplines. Martens, the biggest catch, are generally taken using pole sets and/or cubby sets. Beavers are taken with snares through the ice while most wolves are shot or trapped with snares around kill sites.

Table H4. Furbearer harvest on the Koyukuk NWR and Northern Unit of the Innoko NWR (Kaiyuh Flats) during the 1992-93 trapping season.¹

Area	Species				
	Beaver	Lynx	Otter	Wolverine	Wolf
Kaiyuh Flats ²	15	4	0	3	13
Lower Dulbi	0	0	0	0	0
Koyukuk Mouth	27	0	0	0	0
3-Day Slough	0	0	0	0	5
Coffee Can	0	0	0	0	0
Gisasa-Kateel	0	0	0	0	0
Nikolai ²	0	0	3	0	0
Bear Creek ²	0	1	0	0	7
Huslia West ²	2	0	0		9
Huslia East ²	62	2	5	0	20
Totals	106	7	8	3	54

¹Based on sealing records obtained from ADF&G, Area Biologist.

²This area contains several drainages and some fall outside refuge boundaries.

Table H5. Total furbearer harvest on the Koyukuk NWR and Northern Unit of the Innoko NWR (Kaiyuh Flats) 1989-90 through 1992-93.¹

Species	Trapping Season			
	89-90	90-91	91-92	92-93
Beaver	258	272	215	106
Lynx	7	5	17	7
Otter	2	9	11	8
Wolf	13	1	14	54
Wolverine	2	12	4	3
Total	282	299	261	178

¹Minimum number harvested based on sealing records obtained from ADF&G, Area Biologist.

17. Law Enforcement

Law enforcement activities associated with the September moose hunt were minimal this year due to the upcoming transfer of one refuge officer and the continuing field season on a research project for another.

Two hunting guides worked the refuge from September 5-25. Both camps were visited by a refuge officer on one occasion and by the local Alaska Fish and Wildlife Protection (AKF&WP) officer on two other occasions. A warning was issued to one guide by the state for a violation related to documentation of clients.

A FWS Special Agent, in conjunction with the AKF&WP officer, worked the Koyukuk River during the September 1-4 subsistence moose season discussed in detail in section H.8. On the 4th the AKF&WP officer encountered one individual from Huslia who had shot a moose on a gravel bar. A citation was issued. The individual's fine was reduced to doing 100 hours of community service and donating \$100 to the Alaska Wildlife Safeguard fund.

The combination of confusion by local hunters, ill-feelings by the state because of the season, inability by us to manage navigable waters, and inability by us to even tell the public definitely where private land ends and federal land begins resulted in an undesirable situation. The concept is admirable but the implementation to date is difficult.

The AKF&WP officer issued citations to two individuals for flying into the Koyukuk Controlled Use Area to hunt moose. A total of nine counts were filed against the individuals. The case was not settled by year's end.

In March, two individuals from Huslia were encountered hunting wolves by chasing them with snowmachines. By the time a refuge officer arrived on the scene, three wolves had been shot and a fourth one was being pursued and was eventually shot. Because of landing conditions, only one individual was contacted at the site. The information was provided to the AKF&WP officer who seized the wolf hides in Huslia the next day and issued citations. The defendants plead not guilty and delays in a hearing date occurred throughout the year. At year's end the trial was scheduled for March of 1994.

All refuge officers attended the annual refresher training at Marana, Arizona in February and March. Refuge Officer Stearns relinquished his authority when he transferred in October. A background check by OPM was done on Officer Liedberg in October.

18. Cooperating Associations

The Middle Yukon outlet of the Alaska Natural History Association increased its sales by 13% from last years revenue. Now in its third year of operation, the outlet has shown an increase in revenue each year. The best sales items for the year were topographic maps, along with the recent publication Shadows on the Koyukuk written by local community leader Sidney Huntington. The most successful sales event for the outlet, now in its third year, was a local Christmas Bazaar where sales exceeded \$300.00. Free gift wrapping for purchases over \$5.00 was offered as a sales promotion. The outlet will carry over its educational aid money from 1991-93 until a project is identified that will best utilize this funding.

20. Subsistence Management

The Koyukuk and Nowitna Refuges support uses which occur on a checkerboard of Federal, State, Native Corporation, and privately owned lands within refuge boundaries. Subsistence activities conducted on state and native corporation lands, navigable waters, and on certificated native allotments within the Complex, are managed by the ADF&G. Subsistence activities occurring on federal lands and waters are administered by the various agencies depending upon ownership. As a result, user group conflicts between subsistence and non-subsistence moose hunters on the Koyukuk River continued this year. The present arrangement of dual federal-state subsistence management has presented the Complex with many new challenges since 1990.

ROS Pete DeMatteo continued to serve as subsistence coordinator for the Complex. In fiscal year 1993 the Complex received \$67,000 in subsistence funds:

Subsistence coordinator	\$45.0K
Galena Mountain caribou study	\$ 5.0K
Village harvest surveys	<u>\$17.0K</u>
	\$67.0K

Federal Subsistence Board

A four-day fall moose season (September 1-4) for local residents - only was created this year by the Federal Subsistence Board to minimize competition between subsistence and sport hunters during the federal/state September 5-25 seasons. The Federal Board created the season with the intention of increasing subsistence opportunities for local users. Because of navigability issues the hunt was difficult to administer and local participation was limited. As a result, the Complex submitted a proposal to the Federal Board to realign the Federal season with that of the State to eliminate confusion. Comments on proposals for changes in seasons and bag limits were submitted to the board in February.



Local families move to their traditional camps during the summer months.

Federal Advisory Councils

The third year of the Federal program consisted of the establishment of the Federal Subsistence Advisory Councils and the Regional Council Coordinators. The new federal advisory council system consists of ten regional councils. The constituents of the western Interior region are represented in Council Six with nine seats. Included on the Council from our region are Harold Huntington (Chair) of Koyukuk, Franklin Simon, Sr. of Huslia, Kenneth Madros, Sr. of Kaltag, and Sharon Gurtler-Strick of Ruby. The function of the Councils is to convey the needs and opinions of their constituencies to the Federal Subsistence Board and to submit regulation proposals and comments. Council Six got off to a good start at its first meeting in McGrath in September. Council Six operations are overseen by Regional Coordinator David James who is employed by the Federal Office of Subsistence Management. Five coordinators interface between their respective Councils and the Federal Board and the agencies of the departments of Interior and Agricultural. Many challenges face the councils and their coordinators.

Alaska State Local Advisory Committees

State funding for Regional Advisory Committee Coordinators was cut this year and subsequently the Interior Regional Coordinator, Vince Matthews, was dismissed. The Ruby, Middle Yukon, and the Koyukuk River Advisory

Committees continued to meet despite lack of formal funding and coordination by ADF&G and the Board of Game and Fish. To continue local involvement in the regulations process, the Complex continued to work with the Committees regardless of any changes resulting from the cutback. ROS/P Liedberg attended the Koyukuk River Advisory Committee meeting in Allakaket and the Middle Yukon Advisory Committee meeting in Galena in February.

Village Harvest Surveys

Federal subsistence management prompted the need for a harvest database for each village in the complex. While previously published reports for the area were available, they were largely from a social and anthropological perspective. From a biological standpoint, we needed very recent data on the totals of animals and fish harvested by each village. In April 1992, we initiated a one-year census of all households in the villages of Galena, Koyukuk, Nulato, Kaltag, and Huslia. Local surveyors were selected from each village with the help of the respective village councils. The survey included all species of fish, game, harvested plants, and forest resources of the local area from April 15, 1992 through April 14, 1993. Survey intervals were Spring (April 15-May 31), Summer (June 1-August 31), Fall (September 1-October 31), and Winter (November 1-April 14). Data entry was contracted through a private computer service in Galena and was completed late in 1993. The final report will be assembled in 1994 in cooperation with the Office of Subsistence Management, ADF&G, and the Tanana Chiefs Conference (TCC). The job of subsistence harvest surveys was taken over by TCC in 1994 and we are awaiting the results of their first year's survey.

I. EQUIPMENT AND FACILITIES

1. New Construction

Wood stoves purchased in FY 1992 were installed in five of the refuge residences during the year. The stoves operate using a plenum and ductwork to transfer the warm air to the upper living area of the quarters. Although temperatures during October through December were hardly cold enough to use the stoves, the one test stove which was operational during the previous winter proved to heat the entire house down to -40°F. We anticipate a significant savings in heating fuel with the stoves installed.

Rear widow safety guards were constructed and installed on three of the station pickups. The guards were fabricated and installed by Maintenance Worker Attla. Rain gutters were installed in conjunction with a 500 gallon tank on Quarters No. 1 to collect rainwater for general use. Even with the limited rain we receive in Galena, the tank was filled to capacity during much of the summer.

As part of possible "Jobs Bill" funding we were instructed to look for an airport lot suitable for building an aircraft hangar. A good site was available, however the bill did not pass and no construction took place. Galena is high on the list for funding a hangar but with construction funds limited, it may be many years before we see the facility. With three airplanes and winter temperatures that commonly reach -45°F, this is a high priority for us.

3. Major Maintenance

New PVC framed Alaska Windows were purchased for the kitchens on all six of the new residences. By year's end half had been installed. The old wood frame windows suffered from a constant frost problem in the winter which prevented their complete closure.

The final three residences were spray painted (Q-2,4,6). After last year's toil when the first three were painted, a system was worked out that reduced time and effort in completing the job.

The Hog River administrative cabin was scheduled to be releveled during August. However, when the crew arrived to complete this task along with some minor maintenance, they discovered that the entire foundation needs to be reworked. The piling footings were placed on top of the ground rather than down on mineral soil when the cabin was originally built. Settling has taken place requiring all footings to be taken out, dug down to mineral soil, and replaced. This will be done when maximum permafrost thawing has taken place in 1994.

4. Equipment Utilization and Replacement

A new Ford F350 Crew Cab was received to replace an aged Dodge pickup. A boat was added to the fleet with the purchase of a 20' Allweld boat with a 60 HP Mariner motor.

One small lot sale was held during the year where used windows, wood stoves, a wall tent, and other miscellaneous items were sold. This is the fourth small lot sale in the last three years and we are getting much of our excess equipment cleaned up.

5. Communications Systems

Reliable radio communications are essential to conducting safe and efficient field work in the remote parts of the refuges. Due to the size of the complex, a fairly

complicated radio system has evolved. The first remote facilities were installed in 1988, but reliable communications were not attained until 1992, when several required improvements in mountain-top equipment became a reality.

The Complex is serviced by a network of mountain-top VHF-FM radio repeaters that provide coverage in most of the areas we work. The main hub of the radio network is located on Totson Mt., 35 miles south-southwest of Galena. The Totson site receives VHF signals from the field directly on local channel 1, or indirectly through two repeaters on the Koyukuk (Roundabout Mt., channel 2 and Purcell Mt., channel 3) and one repeater on the Nowitna (Peak 2321, channel 5). In addition, the Totson site has a repeater (channel 4) that allows portable-to-portable communication without relaying through the office. Communications between the office and the field, and repeater control are established through a UHF link from the base console in the office to Totson Mt. A telephone interconnect is available for communications after office hours.

Improvements made between 1991 and 1993 that finally made the system reliable included: self-contained fiberglass radio/antenna shelters, internal sheltered antennas, ni-cad batteries, and new repeater equipment made by Daniels Corp. In 1993 the Roundabout site was tested with a portable repeater and found to be ideally located to eliminate gaps in the radio coverage on the northeastern Koyukuk Refuge. Also in 1993, equipment was purchased to make the Roundabout site a permanent installation in 1994. Also planned in 1994 is the testing of a Kokrines Hills site with the portable repeater to eliminate gaps in the Nowitna radio coverage. Backup communications to the complicated VHF/UHF system are provided by a pair of portable HF single sideband radios that can be set up at field camps.

6. Computer Systems

Nearly every permanent, professional, administrative, and technical staff member has their individual computer workstation, however, there is one shared work station. The complex has a total of ten desktop PC-compatible workstations, and four laptop/notebook PC-compatible computers, for a total of 14. The laptops have proved excellent in meeting short-term and portable computing needs, from retrieving remote weather station data to late night report writing at home. Most desktops are connected to a peripheral sharing device called Logical Connection that was installed to allow the sharing of two laser printers.

Computer highlights in 1993 included the development of a geographic information system (GIS) that is shared with the Lands Dept. of Gana-a' Yoo, Ltd. (GYL), a cooperator on land bank and challenge cost share agreements (See sections C.3 and J.1). The GIS is tied together into a network aimed at producing

and sharing maps used for management of wildlife, fish, and land resources, as well as fire management. The network uses Windows for Workgroups, and ties together four computers in the complex office with two computers, a Summagraphics E-size digitizer and a HP color plotter in the GYL office.

Provision was made for future expansion to include more connections in the refuge and GYL office as well as the local ADF&G area biologist. The network and GIS have already paid off in our ability of perform spatial analyses, make presentation quality map and graph products, and build cooperation through use of shared information databases.

Also in the last year we refined methods for analyzing wildlife home ranges. ARCVIEW and Corel Draw software, combined with UTM-MAP (ADF&G custom software) allow us to make maps of animal territories and movements from telemetry studies. Other software in use includes MSDOS 6.0, Wordperfect 5.1, Lotus 123, FoxPro, dbase III, dbase IV, CC Mail, Procomm, Bitcomm, Harvard Graphics, Systat, SPSS-PC, PC Tools, Pro-Cite, and Windows. Four of our PC's are capable of running Windows software.

7. Energy Conservation

Wood-burning stoves were added to five quarters in 1993 (see Section I.1). Energy conservation remains a major need in the planned rehab of the duplex. The entire building needs to be re-insulated.

8. Other (Aircraft)

The complex uses three aircraft, one Cessna 185 (N714KH), and two Piper Super Cubs (N4343 and N13833), to conduct most field operations. All three aircraft are on floats during the summer and on skis during the winter. Wheels are used only for a few weeks during transitions between seasons. The three airplanes were flown a total of 878 hours during the 1993 calendar year. This was done without accident, and represents this station's tenth year without an aviation accident or incident.

The three aircraft are essential to accomplish field operations over the entire complex because most of the flying occurs in seasonal peaks (summer waterfowl and furbearer work) and winter surveys with narrow phenological and weather windows (moose, wolf and caribou surveys, furbearer track surveys, etc.). Three pilots work on the staff, two dual-function GS-485 Refuge Operations Specialists (Liedberg and Spindler) and one full time GS-2181 pilot (Brown). The three pilots on staff and three aircraft provide the flexibility to schedule several types of

work, or similar comparative work in several areas of the complex, and accomplish it despite the unpredictable weather and limited daylight of the subarctic winter.

Aircraft are "owned" and maintained by the Office of Aircraft Services who bill the Service for hourly flight time and daily availability rates. In FY 1993 the total flying bill for our three aircraft was \$94,532. An additional \$25,056 was spent on helicopter charters and \$2,315 on aircraft charters. Maintenance was greatly improved over previous years by our use of Northland Aviation, the OAS Contract maintenance facility in Fairbanks. Three local mechanics, William Dayton, Shaun Shoultys, and Rich Burley, aided us by making repairs after unanticipated breakdowns and performing gear changes. Unfortunately, at year's end, only one mechanic remained in Galena. The local mechanics and the commercial shop in Fairbanks have significantly reduced the delays and costs associated with aircraft maintenance. Expensive trips to the OAS hangar in Anchorage have been reduced to the one mandatory annual inspection.

In May, we vacated a leased hangar owned by Gana-a' Yoo Limited, the local Native corporation. We could not make effective use of the hangar for routine storage during periods of frequent aircraft use because the hangar doors were so difficult to open and close that three to four persons were needed for the task. While the hangar was very useful for aircraft maintenance and storage during the mid-winter inactive period, daily flight activities were much easier the old way - with wing covers and preheating. The landlord resisted making effective improvements in the door situation, therefore we terminated the lease.

The first day our aircraft are installed on floats has ranged from an early date of May 10 (1988) to a late date of June 1 (1992 and 1993). The last day of float operations has ranged from an early date of September 18 (1987) to a late date of October 8 (1988). In 1993 we were off floats on September 28.

J. OTHER ITEMS

1. Cooperative Programs

In 1992 Gana-a' Yoo, Ltd. (GYL) requested cooperation and technical assistance to guide land use decisions on Corporation Land Bank holdings within and around the Koyukuk and Northern Unit of Innoko NWR (see Section C.3). It is of mutual interest to both the Service and GYL to cooperate so that their adjacent lands are managed in a way that is compatible and complementary and that minimizes conflict and degradation of habitat. The corporation's goal is to provide shareholders with a land base that continues to meet their subsistence needs and optimally can provide commercial uses at a profit while maintaining the land's biodiversity and productivity. GYL would like to develop some land-based

economic activities to improve their profitability and improve local employment opportunities. Proposed economic developments include commercial timber harvesting, guided recreational wildlife observation tours, guided and outfitted hunting, fishing, and dog sled trips, and cabin/camp site permits. Additionally the corporation would like to conduct habitat enhancements, particularly prescribed burning, to improve moose populations and berry production for subsistence and commercial leasing opportunities.

In fiscal year 1994 the Service signed a challenge cost share agreement with GYL to formalize the requested cooperation. In developing a cooperative land use planning process, the Service and GYL shared a great need for efficient access to land status, natural resource, and public use data. As a result, we devised a shared Geographic Information System (GIS) that assembled computer accessible maps of land status, sensitive wildlife, endangered species, and public use patterns. The GIS is connected into a network that is used by the staffs of both organizations (see Section I.6). Both land-managing organizations now share easy access to the same high quality information upon which land use planning and management decisions can be based.

Benefits to the refuge and Gana-a' Yoo include:

- 1) Ability to cooperatively manage Land Bank and adjoining federal, state, and private lands as one ecosystem.
- 2) Ability to produce a cooperative land use plan that will have as a goal the maintenance of existing biodiversity in the nearly pristine ecosystem, protect subsistence and endangered wildlife species but allow wise beneficial uses of these resources.
- 3) Guide economic development activities so that wildlife and fish habitats are protected and enhanced rather than degraded.

Proposed activities in the next fiscal year will focus on:

- 1) Continue additions to the GIS database with maps of vegetation, swan breeding areas, caribou and wolf use areas, fish spawning areas, fire history, state and federally permitted guide use areas, and public subsistence use areas;
- 2) Ground truth and accuracy assessment of the vegetation map;
- 3) Experimental prescribed burn for moose and berry production on Gana-a' Yoo lands.
- 4) Publish a popular land use/guide leaflet to help avoid conflicts among land users (especially between subsistence and sport hunters).
- 5) Continue cooperative land use planning by drafting common goals and objectives.

3. Items of Interest

In March the staff along with Ecological Services in Fairbanks reviewed an EIS prepared by the Air Force which included a Military Training route (MTR) over the Upper Innoko NWR. Our comments included a request to move the route to the east which would avoid the refuge and the majority of residents using the area. In response to this and other organizations comments, the Air Force dropped this leg of the MTR completely.

The Galena AFB was officially placed in custodial status effective October 1 with all troops removed and the base deactivated as a support base for two F15 aircraft. The base had been in existence since the outbreak of the Korean conflict and in recent years two F15's and about 325 troops were assigned to the base. The base was home to the 5072nd command Support Squadron of the Pacific Air Forces Command. The main role in recent years had been to intercept Soviet aircraft that threatened to penetrate United States airspace.

The refuge staff and families received a number of privileges from the Base, and, in varying degrees, they will be missed. The small Base Exchange and the Club (restaurant and bar) were probably the most utilized. Facilities, like a bowling alley, library, theater, and gym facilities, were also available. The refuge received support from base personnel in both official and unofficial capacities. A number of base personnel served as volunteers over the past several years as they contributed hundreds of hours of service. On several occasions medical personnel assisted with CPR and first aid training for the staff. Most of our gasoline was purchased from the base utilizing defense contracts that were significantly less expensive than in downtown Galena. The base provided good meals and lodging accommodations for anyone visiting Galena on official travel status. The base closure leaves Galena without a commercial eating facility and only one Bed and Breakfast for lodging. While we have lost some amenities that were actually luxuries to a bush community, we have to assume that some of those will be provided by the village now that the subsidized service is no longer available. More important considerations may be things like reduced air service, higher barge transportation rates, or loss of good fire and crash rescue services now that the Air Force has pulled out.

4. Credits

ROS/P Liedberg was responsible for writing sections C, D.1-4, E.1 and 5, F.1-3 and 12, H.1,8, and 17, I.1-4, and J.1-4. He was also the section editor for sections C, D, E, and H. and compiled the report. ROS/P Spindler was responsible for writing sections A, D.5 and 6, E.7 and 8, G.1, I.5-8, parts of G.3, G.8, G.10, G.11, and I.5-8 and was the section editor for sections B, F, and G. He also assisted

with editing the report. Katie Brenner wrote most of section G.11. ROS Pete DeMatteo was responsible for writing sections B, E.6, and H.9 and served as the section editor for sections I and J. WB Lisa Saperstein wrote sections G.2, 4-7, and parts of G.8, 10, and 16. Sections H.10 and parts of G.10 were written by WB's Buddy Johnson and Tom Paragi. PR Heather Johnson wrote sections E.2-4, H.2-7 and 18. She also assisted with the photo compilation and duplication, and proofed the final report. RC Theresa Burley did all the final word processing and coordinated assembly of the report.

K. FEEDBACK

As we reflect on the past year it seems most appropriate to recognize that the refuge would not have accomplished nearly as much were it not for the hard work of a diverse and talented team of field personnel who were given a tremendous amount of support by the Regional Office. While it would be easy to point out that deficiencies in staff and funding do exist, a visit to another corner of the world tells us loud and clear that we are lucky to have the funds and staff available to at least do an adequate job monitoring and protecting the resources entrusted to us. Indeed some difficulties do exist, but they pale in light of the knowledge that we are really well off compared to many other conservation efforts in this country and other parts of the world.

Finally, the entire staff would like to recognize the accomplishments of our former manager, Dave Stearns, who had the experience, vision, and leadership to make some major improvements in our program and our facilities.

ANNUAL NARRATIVE REPORT

1993

NOWITNA NWR

KOYUKUK/NOWITNA NATIONAL WILDLIFE REFUGE COMPLEX

Galena, Alaska

REVIEW AND APPROVALS

Complex Manager

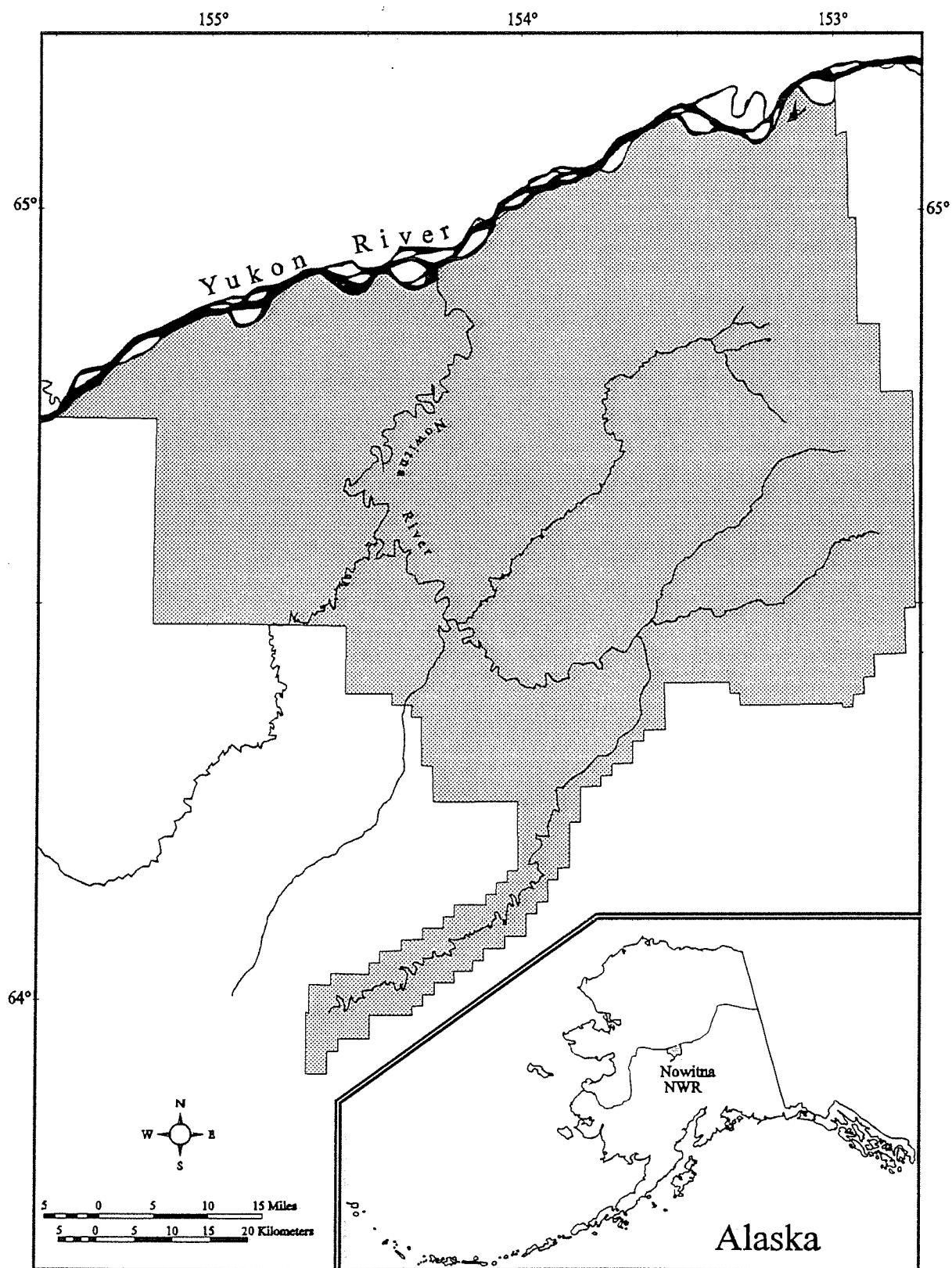
Date

Associate Manager

Date

Regional Office Approval

Date



Nowitna National Wildlife Refuge, Alaska.

INTRODUCTION

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

1. To conserve fish and wildlife populations and habitats in their natural diversity including, but not limited to, trumpeter swans, white-fronted geese, canvasbacks and other waterfowl and migratory birds, moose, caribou, marten, wolverine and other furbearers, salmon, sheefish, and northern pike;
2. To fulfill international treaty obligations of the United States with respect to fish and wildlife and their habitats;
3. To provide the opportunity for continued subsistence uses by local residents; and
4. To ensure water quality and necessary quantity within the refuge.

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

Access to the refuge is possible by airplane, boat, snowmachine, foot, or dog sled. The Complex's aircraft, two Super Cubs and a Cessna 185, as well as three river boats and several snowmobiles provide transportation. The refuge headquarters is located in Galena, a village of approximately 500 people. See the Koyukuk report for a description of Galena. In 1989, the Nowitna Refuge was fused into a complex with the Koyukuk NWR and the Northern Unit of the Innoko NWR. Items common to all refuges are presented in detail under the Koyukuk report.

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K. FEEDBACK

A. HIGHLIGHTS

- This year was another quiet one for wildfires. Only three fires totaling 198 acres were reported.
- Old hunting camps along the Nowitna River were cleaned up by a local resident.
- A rare species of shrew, *Sorex minutissimus*, was caught on the refuge. The species is known to occur in Siberia but is considered rare as well.
- Duck production surveys which had been conducted for the past 10 years were not done in 1993 because of budget constraints.
- Most trend areas surveyed for moose continue to show increases; however, two areas declined recently. We are concerned about low bull/cow ratios along the Nowitna River.
- Beaver cache surveys were conducted for the first time on the refuge.
- Wolf densities on the refuge were estimated at 6.7/1,000 km² based on a wolf telemetry study draft progress report completed during the year.
- Another full year of work continued on the wildfire/furbearer study taking place on the refuge. As part of this project three papers were presented at the Northern Furbearer Conference in Whitehorse, Yukon Territory.
- As part of the fire/furbearer study a vegetation land cover map was developed for the central part of the refuge.
- Results of 1991 heavy metals contaminant sampling studies done on the refuge were received in the fall. Elevated levels of mercury and cadmium in large fish seem to be the rule.
- Moose harvest as recorded on the Nowitna River hunter check station was only 2% below the five year high but hunter numbers were down 12% from the five year average. Water levels on the Nowitna River fluctuated 12 to 15 feet during the season.
- Two ivory "mining" cases were brought to completion in federal court during the year.
- The lower administrative cabin on the Nowitna River was rehabilitated during the year with MMS funding.

B. CLIMATIC CONDITIONS

Refer to the Koyukuk section of this report.

D. PLANNING

2. Management Plan

Refer to the Koyukuk section of this report.

5. Research and Investigations

The following are summaries of approved Refuge studies:

The relationship of wildfire to lynx and marten populations and habitat in Interior Alaska (Project No. 75620-90-01).

The purpose of this project is to examine the response of marten, lynx, and small mammals to differing stages of habitat succession following wildfire. This four year project was initiated in August 1990. The overall project has developed into three subprojects specifically addressing 1) marten, 2) lynx, and 3) small mammal prey species. Although the furbearer field research has focused on the Nowitna NWR, major consideration has been given to larger regional databases, e.g. small mammals, fire history, fur sales records, and interviews with trappers. The project leader is WB Buddy Johnson, who was assisted by WB Tom Paragi, BT Don Katnik, BT Misty Conrath, and occasionally by BT P.J. Simon. The work has been coordinated with other Alaska Refuges, notably Tetlin and Kanuti, as well as NPS, ADF&G, USFS and UAF. For results during 1993, see Section G10.

Seasonal movements and range of three wolf packs on the Koyukuk National Wildlife Refuge (Project No. 75615-85-01).

This project was amended to include the Nowitna NWR, and field work was initiated in spring 1990. Primary objectives of the study were to determine pack sizes, location, home ranges, predation rates, seasonal habitat use, and to develop an estimate of wolf/prey ratios in an area of known prey density. Results from 1993 can be found in the Koyukuk and Nowitna reports, Section G10.

Investigation of mercury and copper concentrations in fish and wildlife resources on the Koyukuk/Nowitna Refuge Complex.

This ongoing study was initiated on the Complex in 1985. Periodic sampling is being conducted on the Koyukuk, Nowitna, and Northern Unit of the Innoko Refuges. The objectives of the study are to quantify the level and distribution of elevated mercury concentrations, compare heavy metal concentrations between watersheds with placer mining and those known to be free of previous mining activity, and determine the level of contaminants in wildlife resources that use known contaminated watersheds. Activities in 1993 included receipt and archiving of data from the 1991 sampling effort. Results of a preliminary review of the data are presented in Section G 11.

E. ADMINISTRATION

1. Personnel

Refer to the Koyukuk section of this report.

2. Youth Programs

Refer to the Koyukuk section of this report.

4. Volunteer Program

Refer to the Koyukuk section of this report.

5. Funding

Refer to the Koyukuk section of this report.

6. Safety

Refer to the Koyukuk section of this report.

7. Technical Assistance

Refer to the Koyukuk section of this report.

8. Other

Refer to the Koyukuk section of this report.

F. HABITAT MANAGEMENT

1. General

Habitat types on the Nowitna NWR are characteristic of interior Alaska but an unusual feature of the refuge, compared to most other Alaska refuges, is that 88% of its lands are forested. The lower Nowitna drainage has some especially high quality white spruce measuring over 18 inches in diameter and over 100 feet high. Approximately 36% of the refuge is dominated by black spruce whereas an estimated 2% is dominated by white spruce. The primary use of spruce by local residents is for house logs and firewood, although small commercial sawmills have operated in Tanana, Ruby, and Galena. The majority of the highest quality timber on the refuge grows along the Nowitna River. The Comprehensive Conservation Plan for the refuge precludes commercial timbering. Local interest in commercial logging operations on islands of the Yukon River has been expressed.

2. Wetlands

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

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

Placer mining for gold and other minerals, which was stimulated by the lifting of federal restrictions on gold prices in the early 1970s, has gone through a

resurgence since that time. A number of placer mines operate within the Nowitna River drainage to the west of the refuge. This mining technique is a source of aquatic and riparian habitat destruction and potential downstream impacts are a concern.

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



The Nowitna NWR contains an estimated 30,000 acres of wetlands, most of which are associated with the Yukon and Nowitna River floodplains.



Wetlands in the river floodplains that have abundant submergents, such as pondweed, water lily, and bur reed, are often the most productive for ducks, especially if connected to the river system.

3. Forests

The Nowitna's vegetation forms part of the circumpolar northern coniferous forest. On the Refuge, forests dominate at elevations below treeline. Open stands of black spruce are common in low-relief terrain. White spruce, occasionally growing with white birch and aspen, can be found in the better-drained and warmer sites. White birch and aspen may dominate following a disturbance such as fire; however, some stands are considered to be mature or climax in certain habitats.

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

The five forest subclasses are described below.

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

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

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

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

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

6. Other Habitats

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

A vegetation class of scrub was described in the mapping process which includes over 4% of the refuge surface area. Sites in this vegetation class are composed predominantly of deciduous shrubs ranging from 1.5 to 16 feet in height. Three subclasses occur within the scrub type and include lowland broadleaf, alluvial broadleaf, and subalpine broadleaf. Dominant species within these subclasses

include feltleaf, diamondleaf, green and river alder, and Beauverd spirea. Chief understory species include meadow horsetail, lingonberry, twinflower, nagoon berry, club moss, and bluejoint.

The dwarf scrub class is also called tundra and contains slow-growing dwarf shrubs less than 1.5 feet tall, chiefly in the heath and crowberry families. One subclasses includes dwarf scrub-graminoid tussock peatland which is located on poorly drained organic soils. Mosses and lichens cover the surface and blueberry, Labrador tea, and glandular birch dominate many areas. The second subclass is prostrate dwarf shrub tundra and refers to relatively bare alpine communities. It is dominated by matted dwarf shrubs and is also rich in lichens. The dwarf scrub class accounts for 1.9% of the Refuge surface area.

A herbaceous vegetation class is dominated by herbaceous plants and includes grasses, sedges, and flowering plants. The primary subclass is graminoid bog, marsh, and meadow. Graminoid bog has a mossy surface underlain by peat which is often saturated with water. Graminoids such as russet cottongrass, shore sedge, and creeping sedge grow through the moss. Graminoid meadow is relatively dry and dominated by bluejoint grass. They are often associated with old river meander scars. Graminoid marsh primarily occurs at the margins of lakes and ponds. The most important graminoids are water sedge, beaked sedge, and bluejoint grass. This class occurs along the margins of most wetlands on the refuge. Approximately 1.8% of the Refuge is comprised of this class.

A scarcely vegetated areas class includes subclasses of scarcely vegetated floodplain and scarcely vegetated scree. In this class plants are scattered or absent and bare mineral soil or rock dominates. The scarcely vegetated floodplain subclass includes river alluvium areas recently colonized by balsam poplar, fireweed, river beauty, soapberry, bearberry, milk vetch, sweet vetch, and several grasses. Less than 0.2% of the Refuge is comprised of this class.

9. Fire Management

This year was another quiet one for wildfire activity. Three fires burned a total of 198 acres on the Refuge. Fire management objectives for the Refuge are similar to that employed on the Koyukuk Refuge and reference is made to that section of the narrative for more details.

Table H1. Wildfire occurrence on the Nowitna NWR, 1993.

<u>Fire number</u>	<u>Acres burned</u>	<u>Option of protection</u>
7309	35	FULL
7320	3	LIMITED
7342	160	LIMITED

Ninety-one thousand, two hundred acres of land in the northeastern corner of the Refuge were changed from a full to limited level of wildfire suppression response during the year. Most of the full suppression acreage on the refuge is so designated to provide a higher level of protection for adjoining private lands. We worked with Doyon Regional Corporation to reduce the response level on their adjoining lands and were then able to reduce the subject acreage on Refuge lands.

12. Wilderness and Special Areas

The Nowitna River within the Nowitna NWR was designated a Wild River by ANILCA per provisions of the Wild and Scenic Rivers Act. The main river channel is 283 miles long, of which 223 miles are within the refuge. The watershed of the Nowitna River is 7,244 square miles of which only 31% lies within the boundaries of the Refuge. Except for nine trapper cabins and two refuge administrative cabins along the river, there are no improvements within the corridor. Two State of Alaska R.S.2477 Rights-Of-Way (ROW) are recorded within the boundaries of the Nowitna Refuge. One of these (No. 219) encroaches on the Wild River corridor in several places and could present management problems should the state choose to exercise use of the ROW.

For the past 30 years hunting parties from Fairbanks and other areas have traveled by boat down the Tanana and Yukon Rivers and up the Nowitna River to hunt moose. The legacy has been a plethora of old campsites with abandoned barrels, stoves, meat caches, boats, etc. Regulations define abandoned property as anything left over one year which precludes us from requiring every item from every camp to be removed each year. However, this year we made our second major effort to clean up some of these items. In June we contracted with a year-round resident who lives on the river above the Refuge to clean up part of the river. In about four days he loaded a 24' boat with 3' outriggers on each side, five feet high with debris from the river. Everything was cached at the mouth of the river and Yutana Barge Lines backhauled it to Nenana and disposed of it free of charge. This does not constitute a total cleanup however, and we will continue this project next year. Our cleanup efforts have been combined with many campsite visits and reminders to hunters to leave clean camps.



Nine trapping cabins are located in the Nowitna Wild River corridor. PAL



Hunting camps dating back 20 years and more have found it convenient to cache and trash equipment along the Nowitna River. PAL

G. WILDLIFE

1. Wildlife Diversity

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

2. Endangered and/or Threatened Species

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

A rare species of shrew, *Sorex minutissimus*, was caught on the Refuge this summer. This species is known to occur in Siberia, but is considered rare there as well. Weighing only about 1.5 g, *S. minutissimus* is small even by shrew standards. It is unknown if any threatened or endangered plant species occur on the Refuge.

3. Waterfowl

Wetlands within the Nowitna and Yukon River floodplains support moderate numbers of waterfowl. Principal duck species that breed on the Refuge include American wigeon, northern pintail, mallard, green-winged teal, white-winged scoter, common and Barrow's goldeneye, and lesser scaup. Other breeding ducks include northern shoveler, red-breasted merganser, greater scaup, canvasback, ring-necked duck, redhead, surf scoter, oldsquaw, harlequin duck, and bufflehead. Arctic, red-throated, and common loons, as well as horned and red-necked grebes also nest on the Refuge. Canada geese, white-fronted geese, and trumpeter swans use the Refuge in moderate numbers. The greatest concentrations of waterfowl occur along the rivers during the spring and fall migrations. Duck production surveys, conducted annually from 1983 to 1992, were not conducted in 1993 because of budget constraints. A complete analysis of historical duck production data from 10 years of duck brood surveys was initiated to make recommendations

for future duck survey work. Goose and swan production surveys were conducted on the Nowitna NWR in 1993.

Weather Conditions and Waterfowl Migration Chronology

Weather and migration data were incomplete on the Nowitna Refuge because staff members visited the refuge intermittently and visits were rare in the spring of 1993. On April 7, open water was seen on the upper Nowitna River. Grizzly bear tracks and beaver were observed, but there were no waterfowl observations. In general, breakup occurs on the Nowitna River two weeks before the ice goes out on the Yukon River at Galena; breakup at Galena was on May 12 this year. During beaver cache surveys on October 4, lakes were about 95% frozen and some ice was flowing in the Little Mud River. Four swans were observed during this flight. Water was still flowing on October 19 and 50 geese were observed on the upper Nowitna River, an extremely late date for geese.

Duck Production

Duck brood production surveys were not conducted on the Nowitna Refuge in 1993 due to financial constraints, and large-scale production surveys are not likely to be conducted on the Complex in the future. In August, a study was initiated to summarize and examine data collected during duck brood production surveys from 1983 to 1992. The main objective of this study was to determine if mean duck density differed among strata as expected. Numerous methods for analyzing performance of waterbodies over time were considered, but variation in methods among years prevented direct comparisons of productivity. Prior to 1990, individual lakes were surveyed. Following standardization of methods in 1990, lakes, sloughs, and river segments within 1-mi² plots were surveyed. Techniques for stratifying lakes also varied among years but were standardized in 1990 when all possible 1-mi² plots were classified as high, medium, or poor production based on the amount of wetlands and presence of bog habitat in each plot.

For the 1983-1992 review study, lakes surveyed five or more years were selected as a subsample and analyzed to determine consistency of duck productivity, species richness, and frequency of occurrence of different duck species in individual lakes and within strata over time. Incompatibility of data between sampling periods (pre- and post-standardization), high variability within lakes among years, and a small sample size for lakes surveyed five or more years precluded the application of most statistical procedures. Preliminary data indicate high variability among years in the density of ducklings in individual lakes. Cluster analyses of dabblers and diver density failed to group lakes in discernable patterns. Species richness and frequency of occurrence of duck species varied among lakes. These factors, along with the level of brood production, should be considered when evaluating the importance of particular lakes to waterfowl ecology.

Goose Production

Peak numbers of 1,177 white-fronted and 634 Canada geese were documented in late April and early May 1988, respectively, during aerial surveys of the entire Nowitna River corridor within the Refuge. Visibility of geese diminishes rapidly in May as nesting commences, so estimates of breeding population necessarily have been educated guesses based on peak numbers seen prior to nesting. Since 1985 we have used a simple, reliable, and economical goose production trend survey technique. The production survey consists of a standardized river float trip made during late June or early July in which all geese observed are recorded according to species and age-class. Most of the upper river is floated, except a motor is used to pass goose flocks that have been counted. The motor is used more on the mid-section to navigate long straight stretches against wind or in slack water. These trips also afford opportunities to document other refuge wildlife, especially shorebirds, raptors, and passerine neotropical migrants.

In 1993 goose production surveys along the Nowitna River corridor were continued according to the wildlife inventory plan. The upper stretch (from 2 mi. below the upper refuge boundary to the upper administrative cabin) was floated by motorized canoe June 21-24 followed by the middle stretch (from upper to lower cabin) on June 24-25.

Totals of 92 adult and 18 young Canada geese and 31 adult and 88 young white-fronted geese were counted on the upper stretch. These figures represent a continued decline in adult Canada abundance and low production of young since 1992 (Figure G1). Numbers of adult white-front's were similar to previous years, but number of young produced increased over 1992. On the middle Nowitna stretch numbers of Canada geese have declined since 1988 while numbers of adult white-front's were stable (Figure G2). Total geese counted on the middle stretch included 37 adult and 93 young white-fronted geese and 14 adult and 16 young Canada geese in 1993. As is typical for rivers in our region, Canada geese were more abundant in upper reaches of the river while white-front's were more common in lower portions of the river corridor.

Recent declines in Canada goose adult abundance were most likely related to two successive years of extreme flooding in the Nowitna corridor combined with a very short nesting season in 1992. Plans call for continued monitoring to determine if the trend continues and is related to factors other than flooding.

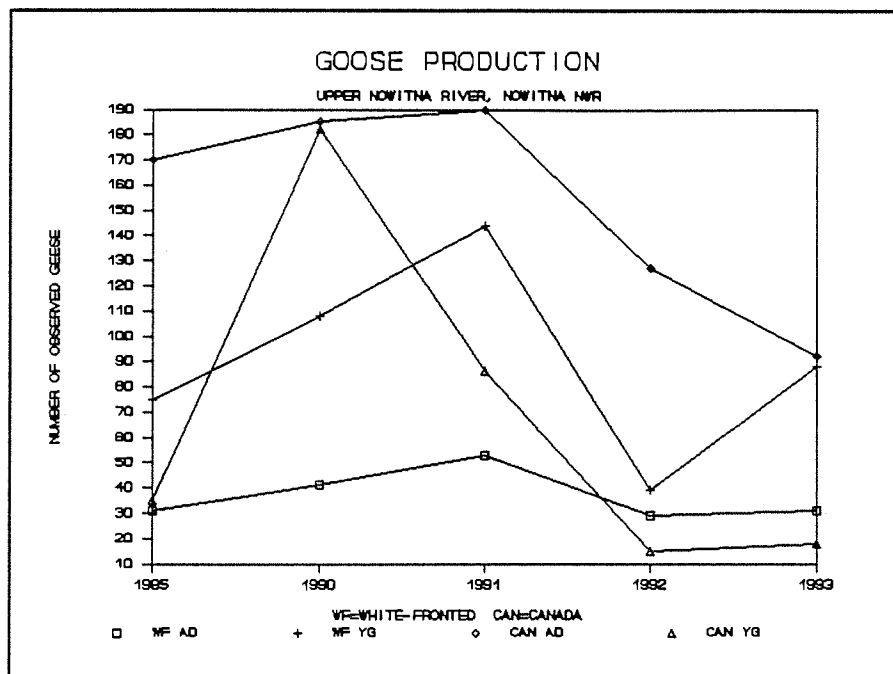


Figure G1. Results of goose production surveys on a 61-mile stretch of the upper Nowitna River, Nowitna NWR, Alaska, 1985-93.

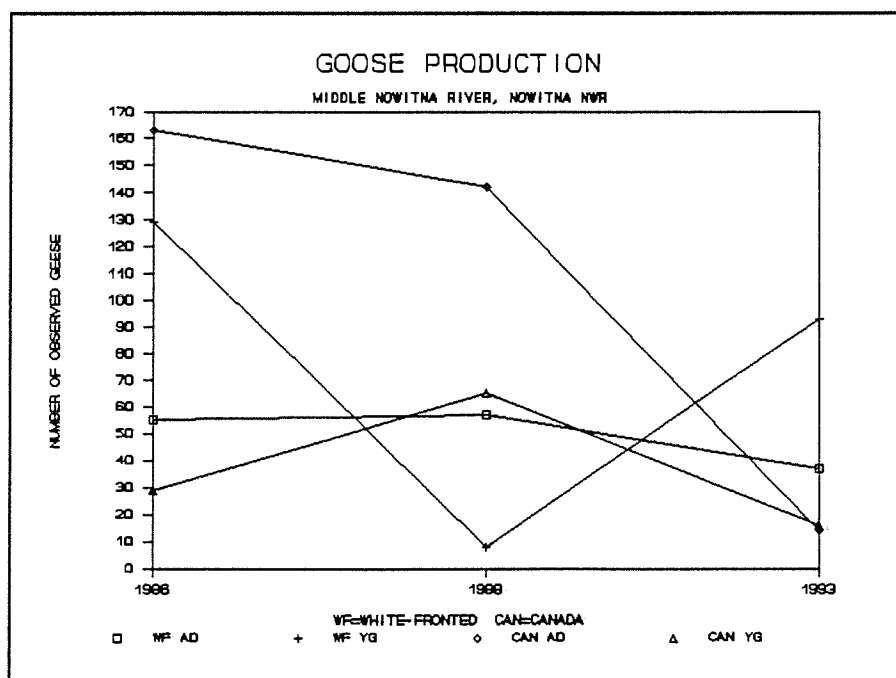


Figure G2. Results of goose production surveys on an 82-mile stretch of the middle Nowitna River, Nowitna NWR, Alaska, 1986-93.

Swan Production

On the Nowitna, the majority of swans identified were trumpeter swans, although tundra swans also occur infrequently. The last complete swan census on the Nowitna was in 1990 when totals of 292 adults and 76 young were counted. Since then a selection of six "trend maps" has been surveyed to monitor trends in swan population and production. Abundance is sampled annually according to the wildlife inventory plan because swans serve as an excellent indicator species due to their susceptibility to disturbance and high sightability (and low error) in aerial surveys. A decline in overall swan numbers and in numbers of cygnets has continued since 1991. The number of paired swans increased from 1985 to 1990 and has gradually declined since. The number of non-breeders (flocked and singles) declined to the lowest level observed since 1985 and 1987 (Figure G3). Mean brood size was 3.2, which was typical of historical values except for a dramatic peak in 1991 and a marked decline in 1992 (Figure G4). The large fluctuations in production appear to be typical and related to spring breakup phenology and extent of spring flooding. Trends in adult numbers are less well defined and will require more annual surveys to better define baseline levels. Production and mean brood size were significantly greater on the Nowitna as compared to the Koyukuk in 1993. We suspect that the extent of spring breakup flooding on the Nowitna and Yukon River within Nowitna NWR was less than the extreme of the previous year but greater than in the late 1980's and early 1990's.

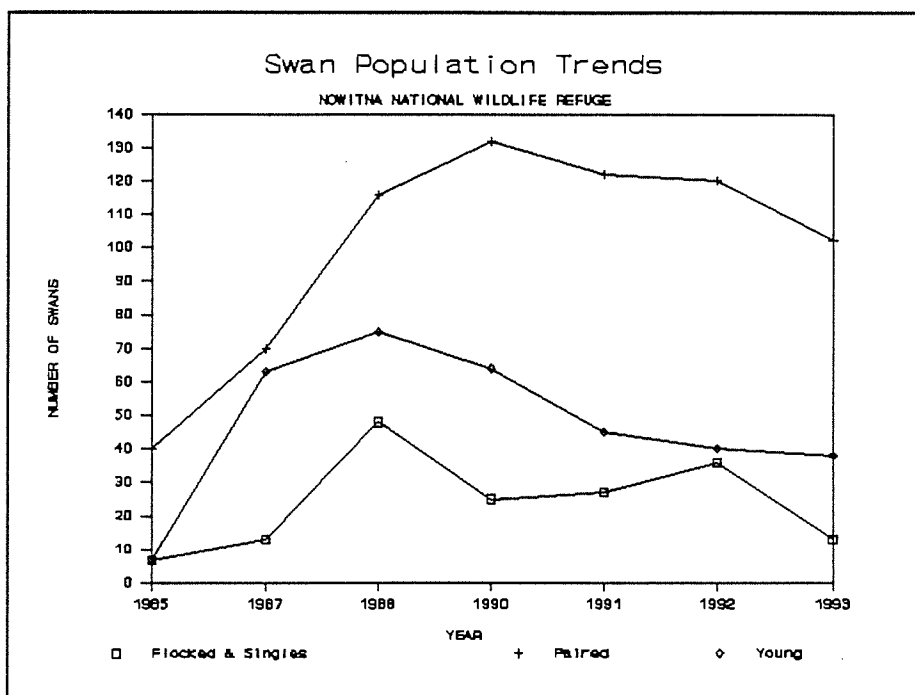


Figure G3. Swan numbers observed during late summer or fall aerial surveys of the Ruby C3, C4, D2, D3, D4, and Melozitna A1 and A2 trend maps.

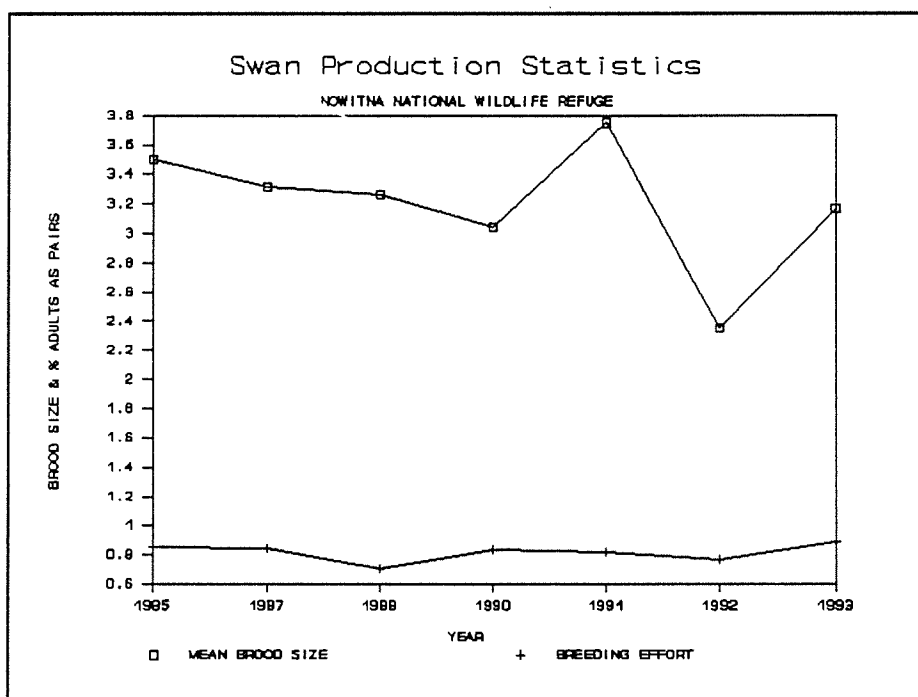


Figure G4. Swan production statistics based on late summer or fall surveys of the Ruby C3, C4, D2, D3, D4, and Melozitna A1 and A2 trend maps.



Waterfowl production surveys were conducted on the refuge from 1983-1992. Estimates of production ranged from 4,855 to 17,140 young.



Pintail, wigeon, mallard, and scaup were the most abundant adult ducks seen on brood surveys. Estimates were highly variable, but the minimum number of summering adult ducks is believed to be about 5,000.

4. Marsh and Water Birds

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

5. Shorebirds, Gulls, Terns and Allied Species

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



Numerous species of shorebirds, such as this Arctic tern, occur on the Refuge in summer. Little data are available on numbers or distribution, however.

6. Raptors

The Complex has nesting populations of rough-legged hawks, merlin, sharp-shinned hawks, ospreys, northern harriers, red-tailed hawks, goshawks, great horned owls, great gray owls, boreal owls, northern hawk owls, American peregrine falcons, and bald eagles. Snowy owls, Swainson's hawks, and gyrfalcons are occasional visitors. A portion of the 1993 Yukon River raptor survey downriver from Ruby is near the Refuge and is reported along with the remainder of the survey in the Koyukuk report, section G 6. A raptor survey has been conducted periodically at the Palisades, but was not conducted in 1993 due to time constraints. These bluffs will be checked in future surveys.



Boreal owls were frequently heard and seen near Round Lake during the Fire/Furbearer study. Observations were most common in March, but occurred throughout the year.

7. Other Migratory Birds

A standard Breeding Bird Survey was in the planning stages for the Ruby-Poorman Road, which is just west of the Nowitna. The route is scheduled to be surveyed in June 1994.

8. Game Mammals

Moose

Population extrapolation surveys conducted on 2,700 mi² of the western Nowitna, including much of the Sulatna River drainage, indicated a declining population: 1,793 moose (+/-14%) in November 1990, compared to 2,309 moose (+/-23%) in 1980. A subset of the above sample area surveyed in 1986, the lower Nowitna River corridor, indicated 1,262 (+/- 18%). The above information, when separated out for the lower Nowitna River corridor only where most of the moose hunting activity occurs, indicated a 7.4% average annual decline from 1980 to 1986 and an 8% average annual increase from 1986 to 1990.

Since 1990, moose inventory work consisted of trend surveys in areas where moose hunting activity was the greatest. On the Nowitna NWR and its immediate surroundings seven moose trend areas have been surveyed: Deep Creek, Nowitna Mouth, Sulatna/Nowitna confluence, Mason Slough, Our Creek, Little Mud/Nowitna confluence and Ruby Road/Long/Poorman. In 1993 all but the latter two trend areas were surveyed.

In the Sulatna/Nowitna Confluence area the overall growth rate in the adult segment of the population averaged 7.7% per year since 1986 (Figure G5). In 1993 the density was 2.7 moose/mi². Composition ratios indicated poorer than average calf production and average yearling recruitment in 1993. The bull/cow ratio has generally declined in the last six years, but improved slightly to 22 bulls/100 cows in 1993. At the Nowitna Mouth the adult population also grew at an average rate of 7.7% since 1987 (Figure G6). Total moose density in 1993 was estimated at 3.3 moose/mi² in 1993. At the Nowitna Mouth the calf production was good in 1993, contrary to the poor calf production observed on the adjacent Sulatna/Nowitna confluence trend area. The yearling bull ratio at the Nowitna Mouth in 1993 showed average levels following very poor recruitment indicated in 1992. The bull/cow ratio at the Nowitna Mouth showed improvement with 30 bulls/100 cows in 1993 compared to 20 bulls/100 cows in 1992.

At Deep Creek, along the south side of the Yukon River above Ruby, numbers of adults grew at an average annual rate of 3%. This increase was due largely to an increase in numbers of cows, because bulls were less in 1993 than in 1982. Total

moose density was estimated at 1.3 moose/mi² in 1993. Calf production in the Deep Creek area has declined steadily since peaking in 1988, however, in 1993 the yearling ratio was the highest observed of the three lower Nowitna areas. The sex ratio in 1993 was 45 bulls/100 cows, the highest observed among all three lower Nowitna areas. These higher yearling and bull/cow ratios, in coincident with relatively low calf production in recent years, likely reflect lower hunting mortality at Deep Creek compared to the more accessible Nowitna Mouth and Sulatna/Nowitna confluence areas.

At Mason Slough, located along the Yukon River 45 miles down river from Tanana, the adult population declined an average of 2.5% per year during the last decade (Figure G7). Density in the three units surveyed in 1983 was 0.54 moose/mi² compared to 0.42 moose/mi² in 1993. Calf production was good in 1993, but less than 1983. The yearling ratio of 18 yearling bulls/100 cows was much better than the zero yearling bulls observed in 1983. The bull/cow ratio was good at 36, compared to 25 a decade earlier. Another Nowitna area to show a decline in the last decade was Our Creek, located at the most upriver extent of the Nowitna panhandle. The adult population declined at an average rate of 6% per year from 1980 to 1993. The decline occurred in all components-bulls, cows, and calves (Figure G8). Moose density in the four sample units surveyed in 1993 was 0.37 moose/mi². Calf production and yearling recruitment was good in 1993, while the sex ratio was poor at 13 bulls/100 cows.



In 1990 refuge moose numbers were estimated at 1,542-2,044, with an average density of 0.59 moose/mi². Since 1990, all trend sample areas have increased except Our Ck. and Mason Slough.

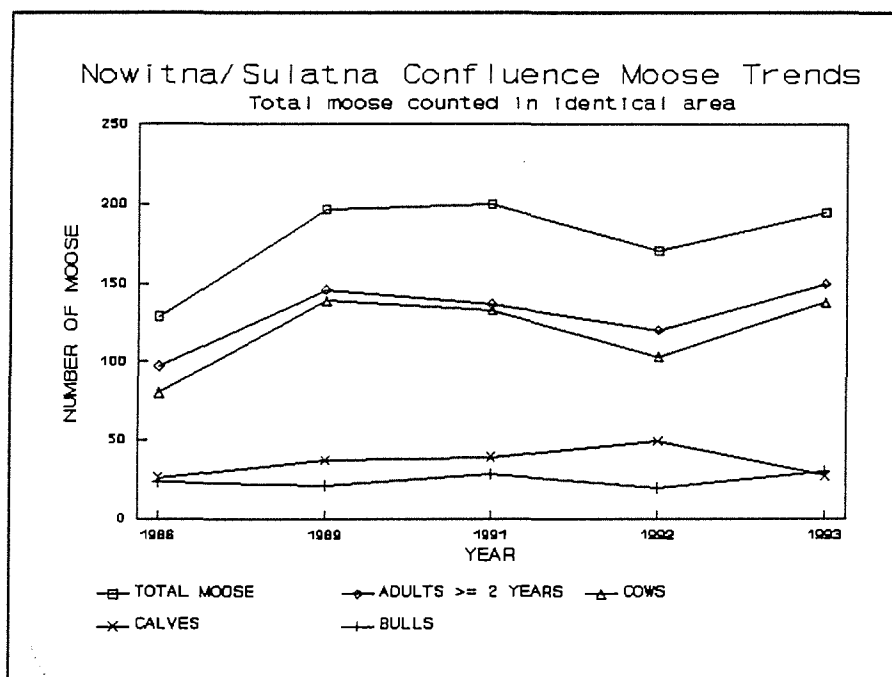


Figure G5. Moose counted during aerial trend surveys, Sulatna/Nowitna confluence, Nowitna NWR, Alaska, 1986-1993 (years in which identical units were surveyed).

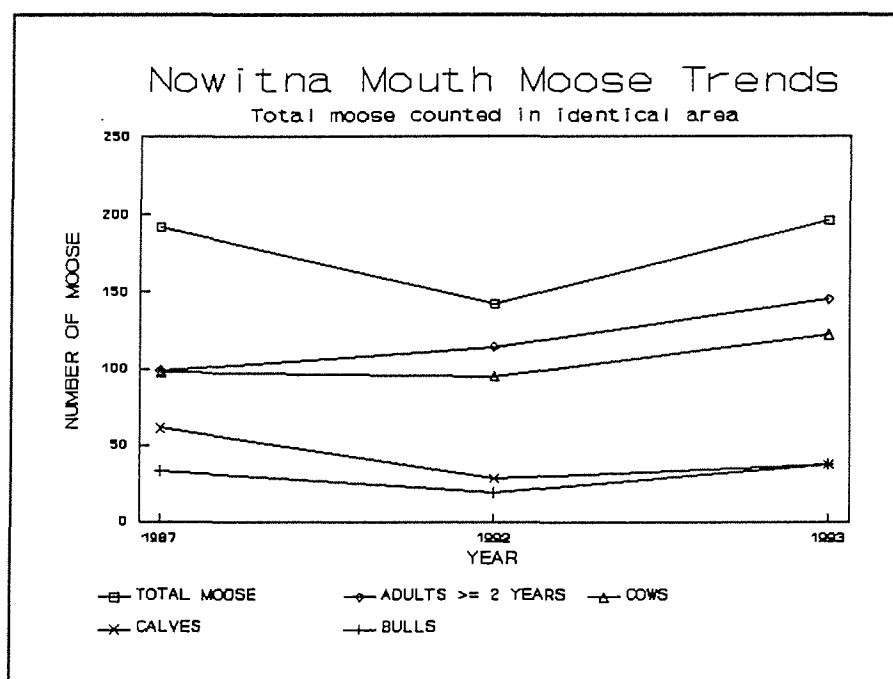


Figure G6. Moose counted during aerial trend surveys, Nowitna River Mouth moose trend area, 1987, 1992, and 1993 (years in which identical units were surveyed).

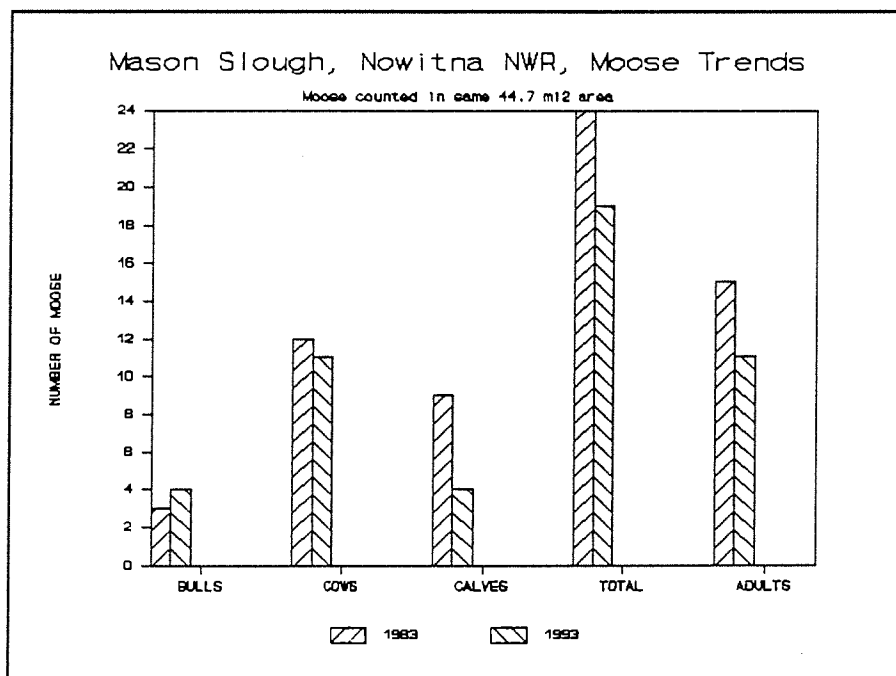


Figure G7. Moose observed during aerial surveys of the Mason Slough moose trend area, Nowitna NWR, Alaska, 1983 and 1993 (1983 data courtesy ADF&G).

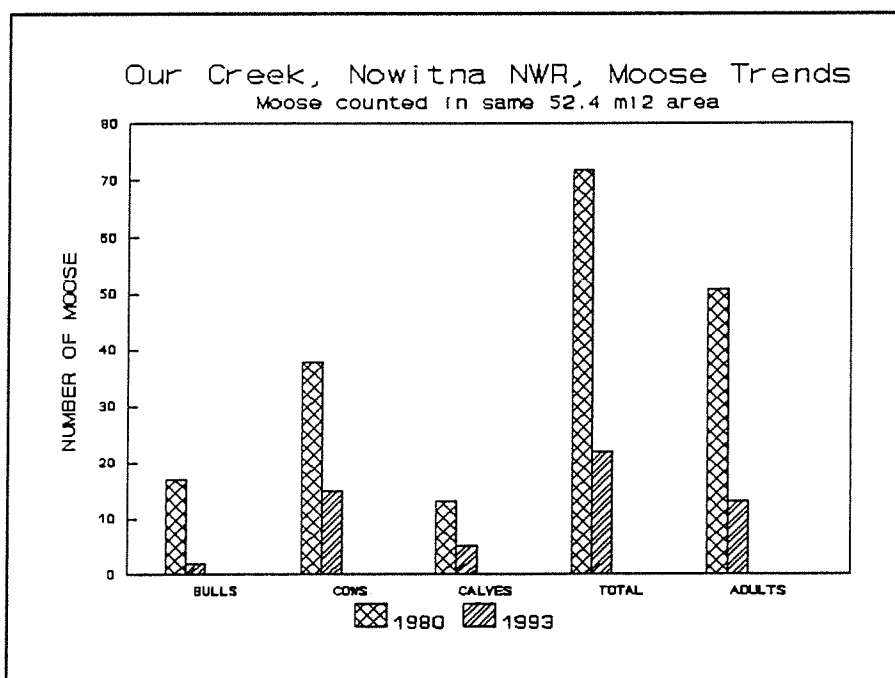


Figure G8. Moose observed during aerial surveys of the Our Creek moose trend area, Nowitna NWR, Alaska, 1980 and 1993 (1980 data courtesy ADF&G)

Caribou

Caribou occur occasionally on the Nowitna NWR in two areas. In February 1994 an estimated 20-40 caribou were seen near the upper Nowitna panhandle, just east of the Sulukna River. These were probably from the Sunshine Mountains herd. Caribou of the Galena Mountain herd are frequently seen on the north bank of the Yukon river, just north of the refuge boundary. Occasionally a few of these caribou wander to the south onto the refuge.

Bears

Black bear densities on the refuge are believed to be high, although accurate numbers are unavailable. They are commonly encountered along rivers and in lowland areas. During a moose calf mortality study conducted along the lower Nowitna River in 1988-89, black bears were the major predator on moose calves. Black bears are usually harvested in spring and summer by local residents, especially when the bears venture into fish camps. The majority of the harvest, however, occurs in September and is incidental to moose hunting.

Grizzly bears occur throughout the refuge but are less numerous than black bears. Highest densities occur in the foothills of the Kuskokwim Mountains in the southern portion of the refuge and in the Kokrines Hills at the northern border.

10. Other Resident Wildlife Fire/Furbearer Project

Furbearers

Twelve species of furbearers regularly occur on the Nowitna NWR: marten, mink, beaver, lynx, otter, red fox, wolverine, muskrat, red squirrel, shorttail weasel, coyote and wolf. All species are harvested by refuge trappers, however marten and beaver are by far the most economically important. Arctic ground squirrels and least weasels, species trapped in other parts of Alaska, are present on the Refuge but are not harvested by local trappers.

Beaver

A beaver cache survey was conducted for the first time on the Nowitna Refuge in 1993. The purpose of the survey was to collect baseline data on the relative abundance of beaver in drainages receiving high to moderate levels of trapping. In the future, these data will provide a general index to population trends and may be necessary for responsible beaver harvest management. Eleven township units (each 36 mi²) were surveyed aerially by Supercub airplane between September 25 and October 6 (Figure G9). Locations of beaver lodges were

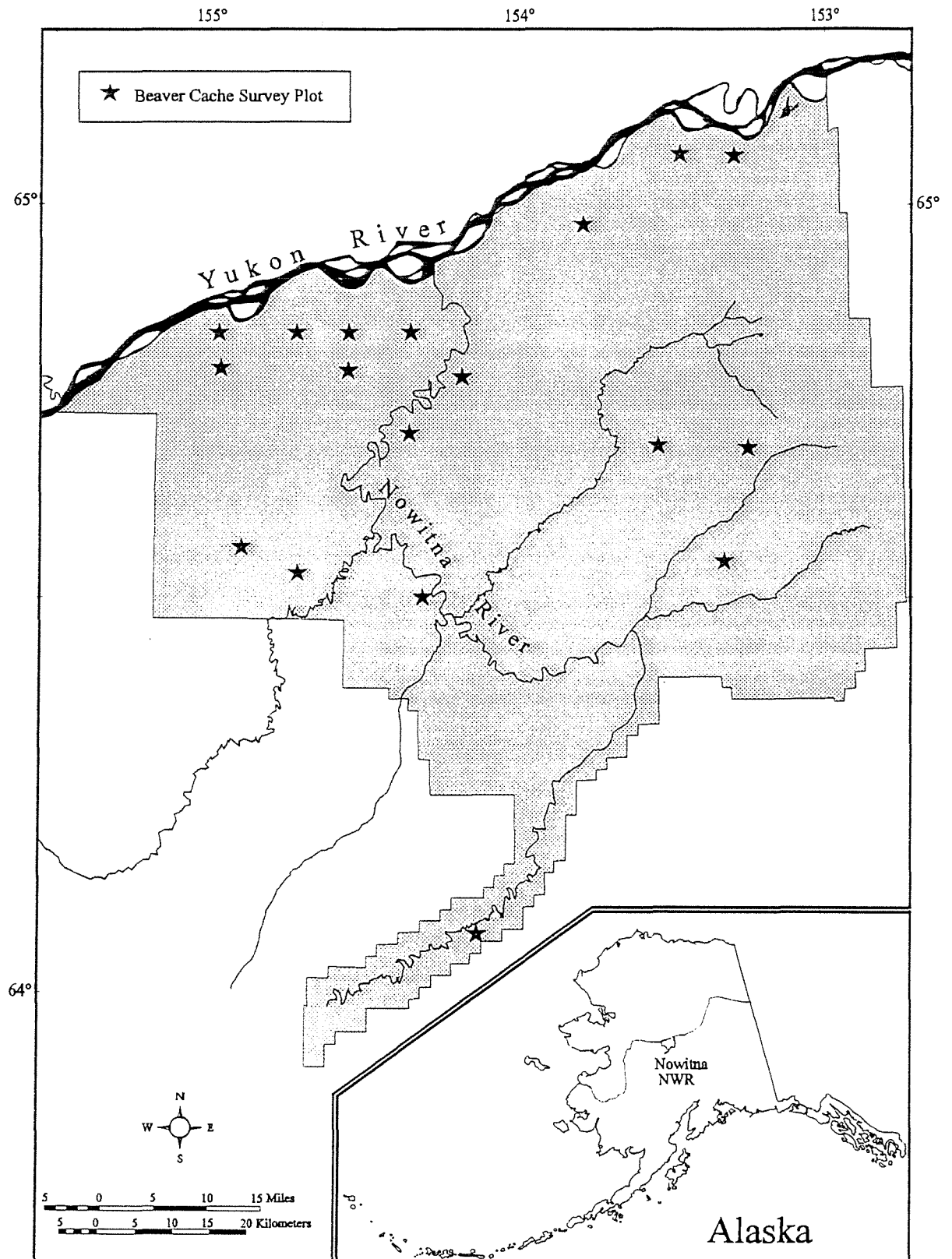


Fig. G9. Location of beaver cache survey plots, Nowitna NWR, Alaska, 1993.

mapped and each lodge was recorded as being active or inactive (Table G1). The mean densities of active and inactive lodges were 0.649 lodges/mi² (SE=0.14) and 0.250 lodges/mi² (SE=0.06), respectively. One reason for variability in numbers of lodges among sample units may be that in units containing steeper terrain than others, beaver activity was restricted to small drainages in the absence of other wetlands.

Table G1. Beaver lodge numbers and density (lodges/mi²) observed during aerial cache surveys on the Nowitna National Wildlife Refuge, Alaska, Fall 1993.

Sample Unit	Number of lodges:		Density of lodges:	
	Active	Inactive	Active	Inactive
1	17	3	0.472	0.083
2	1	10	0.028	0.278
3	12	9	0.333	0.250
4	49	9	1.361	0.250
5	45	8	1.250	0.222
6	39	5	1.083	0.139
7	3	1	0.083	0.028
8	15	8	0.417	0.222
9	35	30	0.972	0.833
10	19	7	0.528	0.194
13	22	9	0.611	0.250
Mean	23.36	9.00	0.649	0.250
SE	4.94	1.81	0.137	0.063

Wolves

A radio telemetry study on the refuge was completed in 1992. A draft progress report on the status of the project was completed in 1993. Wolf densities on the Refuge in 1991 were estimated at 6.7 wolves/1,000 km², the lowest on the Complex. An estimated 90 wolves from 11 packs inhabit the Refuge and adjacent areas. In March 1991 the moose/wolf ratio was estimated at 46:1. Refer to Koyukuk Section G10. for more information regarding the wolf telemetry project.



A beaver cache survey was conducted on the Nowitna NWR for the first time in 1993. The average density of active caches was 0.65/mi².

Wolverine

Relatively little is known about the status of the Refuge wolverine population. They are occasionally harvested by Refuge trappers but are rarely seen.

Lynx, Mink, Red Fox, and River Otter

The population status of these furbearer species have not been determined on the refuge. Population fluctuations are known to occur in accordance with fluctuations in prey species populations, primarily microtine rodents and/or snowshoe hare. All are occasionally harvested by trappers.

Fire Furbearer Project

After experiencing an unusually long and active fire season in 1988, rural residents of interior Alaska voiced concern over fire management policies that provide only limited fire suppression in some remote areas. Two of the primary concerns of the resource users most affected by these policies were (1) the immediate loss of trapping cabins and personal property, and (2) the immediate and long-term effects of fire on furbearer populations, particularly marten and lynx.

In response to this issue, a comprehensive project examining the relationships between wildfire and furbearer populations in interior Alaska was begun in 1991. Several complementary studies and tasks have been initiated to obtain baseline ecological data on marten and lynx habitat relationships, seasonal distribution, population parameters, and prey/forage relationships. The primary objectives of the project were designed to meet both research and educational goals. An annotated bibliography on wildfire and furbearers in the boreal forest with emphasis on marten and lynx was prepared to help focus and define the study designs of field projects and assess the feasibility of formulating habitat models for the Interior. An area on the Nowitna Refuge, where three structurally-definable seral stages are close together, was chosen as the primary study site. Here a "new" burn in the moss-herb stage (1985, ca. 140 km²), an "old" burn in the tall shrub-sapling stage (1966, ca. 210 km²), and a mature black spruce forest are located adjacent to one another (Fig G10). Several complementary studies involving furbearers (primarily marten) and small mammals are presently underway at this site. The following is the abstract from the 1993 progress report.

A habitat map was made using data obtained from a Landsat Thematic Mapper image, field reconnaissance, and photo interpretation. Ground data were collected within a 16 km² core area in each seral stage that were used as training blocks for image analysis and photo interpretation. Thirteen cover classes were distinguished and tentatively described for the study area.

Track abundance (tracks/days after snowfall/km) of martens continued to be greatest in the 1985 burn and least in the 1966 burn. Habitat selection was estimated based on track counts stratified by topographic habitats in March of 1992 and 1993. Upland forest was more highly preferred by martens than drainages in the mature forest in both years. In the 1985 burn, ridges were most preferred and lowland forests least preferred during 1992, whereas ridges were less preferred than upland and lowland forests during 1993. In the 1966 burn, ridges were most preferred during 1992 and upland forest was most preferred during 1993.

Quality of post-fire seres as marten habitat was inferred from the proportion of relocations by seral stage and movements across sere boundaries for radio-collared martens with respect to age, sex, residency, and fate. Juvenile and transient martens composed the majority of captures in the 1985 burn. Female and transient martens were relocated more often in the 1985 burn than male and non-transient martens. Non-transient martens crossed between post-fire seres more often than did transient martens. All 5 trapping mortalities, 4 of 7 natural mortalities, and 10 of 23 censures (e.g. had unknown fates) occurred to martens initially captured in the 1985 burn. Overall, 7 of 9 juveniles (2 censored or had unknown fates) were confirmed mortalities, whereas 4 of 32 yearlings and adults (21 censored) were confirmed mortalities.

Four of 8 juveniles captured in September and monitored through January (all with ≤ 9 relocations) dispersed from the seral stage of their capture.

Habitat quality of post-fire seres was also inferred from frequency of investigations along marten trails. Based on analysis of 38.5 km of backtracking data, we believe that the 1966 burn provided the lowest quality habitat for martens. The percentage of backtracking distance that was investigation and the number of pause points per km seemed highest in the mature forest and lowest in the 1966 burn. The distance between investigations ranged from 0.076 km in the 1985 burn to 0.163 km in the 1966 burn. The number of marten track crossings per km of marten trail appeared to be highest in the 1985 burn and lowest in the 1966 burn. Subnivean access, nosing/digging, and circling occurred predominately in the 1985 burn. We found 12 kill or scavenge sites (6 in the 1985 burn, 1 in the 1966 burn, and 5 in the mature forest).

Lynx tracks have been found almost exclusively in the 1966 burn; they showed a higher preference for ridges and upland flats over drainages in 1992, and in 1993 the highest preference was for ridges and the lowest for drainage habitat. Track counts for snowshoe hares seemed similar among seral stages. For both years snowshoe hares also had their highest preference for ridges and lowest preference for drainages in the 1966 burn. Drainages were the least preferred habitat for hares in the mature forest also.

Berries and mushrooms as potential food sources for marten were quantified in 1992 and 1993. The pattern of mountain cranberries (*Vaccinium vitis-idaea*) being most abundant in mature forest during late August and early September was similar to 1992. Blueberries (*Vaccinium uliginosum*) were most prevalent in the 1966 burn again but seemed less prevalent in the mature forest compared to last year, resulting in the 1985 burn having more blueberries than the mature forest. The relative abundance of gilled mushrooms was not different among seres in 1993 despite significant differences among mushrooms in 1992 (boletes and gilled combined: 1966 burn > mature forest > 1985 burn). Boletes were most common in the mature forest.

A questionnaire was mailed to 111 trappers throughout interior Alaska in January 1993 to obtain a broader perspective of furbearer-habitat relationships among regions and post-fire seres. Sixty-five trappers responded (59%), with polarized responses to fire (good vs. bad) accounting for 68% of opinions and differing among regions.

Field work on a companion small mammal study begun in July 1991 continued during the reporting period. Small mammal abundance and annual trends were estimated using removal trapping over 3 trapnights on grids in all 3 seres and on transects across the mature forest-1985 burn-ecotone. Similar to previous years,

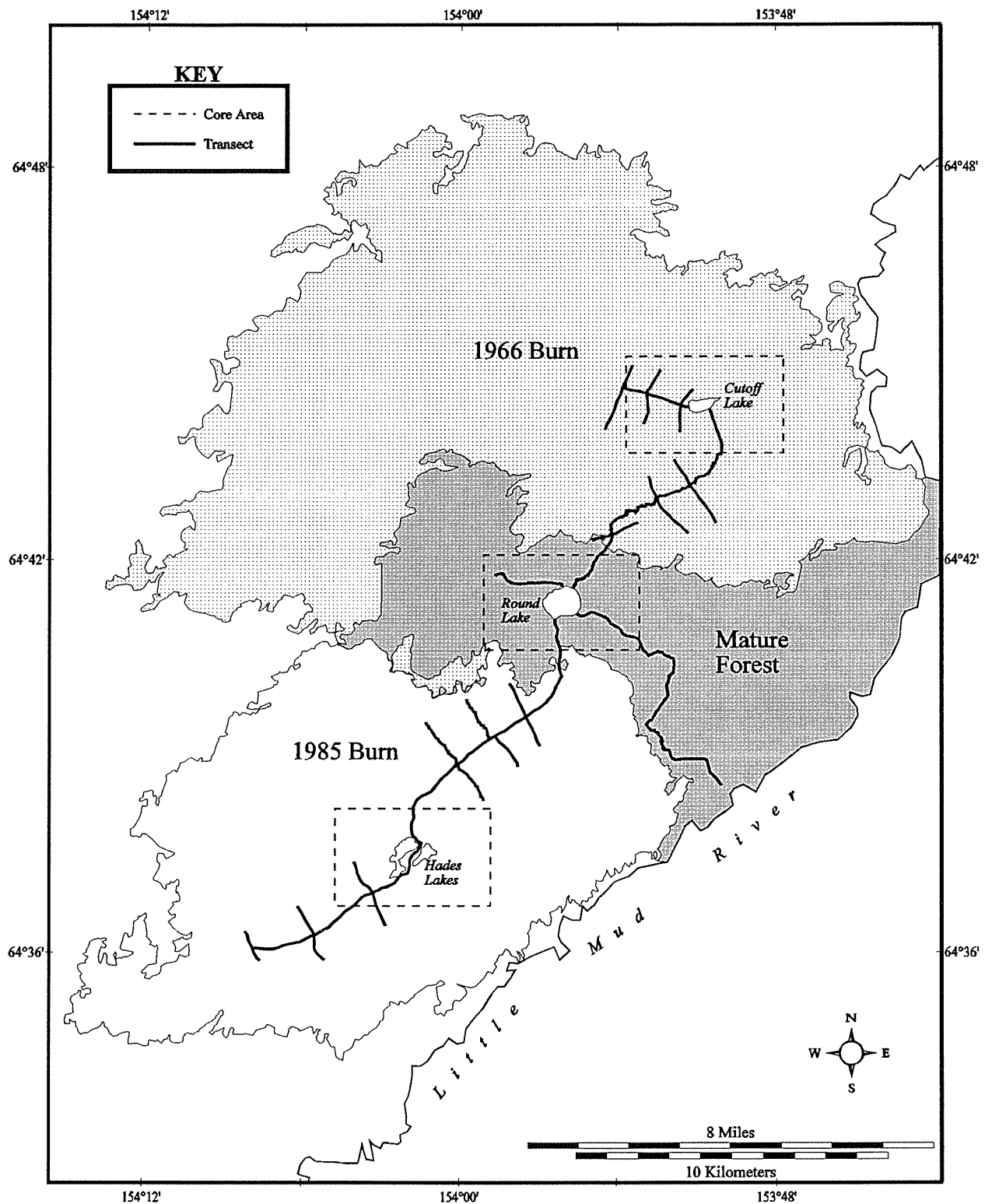


Figure G10. Location of three post-fire seral stages (mature forest, 1966 burn, 1985 burn) on the Nowitna NWR chosen for study in the Fire/Furbearer Project.

Clethrionomys rutilus was found in all grids on all seral stages in 1993 and composed 73% of all microtines captured. In contrast to 1992, when the *C. rutilus* population irrupted, the number of *C. rutilus* captured decreased on all grids in 1993. Captures of *Sorex cinereus* increased by 136% in the mature forest, 98% in the 1966 burn, and 243% in the 1985 burn. Total small mammal biomass in 1993 ranged from 2,213 g in the 1966 burn to 3,179 g in the 1985 burn. *C. rutilus* made the greatest contribution to total biomass, ranging from 63% in the 1985 burn to 82% in the mature forest. Small mammal diversity was similar among all seral stages in 1993 but microtine diversity was greater in the 1985 burn. The two most abundant microtine species, *C. rutilus* and *Microtus xanthognathus*, continued to segregate along transects across the forest edge in 1993, with the former found mostly in the mature forest and the latter in the 1985 burn.

Progress is also reported on our contribution to 2 cooperative efforts. First, we are using a common sampling protocol to assess small mammal abundance and distribution among 4 post-fire seral stages at 3 sites across interior Alaska (with U.S. National Park Service (NPS), Kanuti National Wildlife Refuge, and the University of Alaska Museum). Capture rates of small mammals ranged among seres and sites from 1 to 13.6 animals per 100 trapnights, with *C. rutilus* occurring on all grids at all sites. Small mammal biomass ranged from 174 to 3,354 g/ha. Second, along with ADF&G and NPS we are developing and testing track-count procedures to monitor trends in the relative abundance of martens, lynx, and snowshoe hares at 3 sites in the Interior. Our contribution focused on estimating the variability of track deposition and retention measured along ground transects relative to time since snowfall, seral stage, snow conditions, and temperature.

Marten

To obtain long-term information on the demographics of the marten population and the level of harvest intensity, the Nowitna Refuge began purchasing marten skulls from Refuge trappers in 1987. Tooth sectioning and analysis of cementum annuli and radiographs are being used to age animals. Trapper questionnaires are providing estimates of annual trapping effort. This information will be used in concert with the ongoing Fire/Furbearer Project 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.

Trapline data. Harvest by individual trappers is referenced by trapper number in Tables G2 and G3. Two of the four trappers who returned the annual questionnaire indicated that their trapping effort was minimal in 1992-93, in part because of deep snowfall early in the season. Moreover, several trappers decided not to trap, so the total effort on the Refuge was likely much less than in previous years. The harvest collection is voluntary and includes most of the harvest, but it is only a sample of the total harvest on the Nowitna Refuge. Since 1984, 3-7

trappers have operated on or near the Refuge, with four individuals accounting for 76% of the harvest during 1984-91. Only two of those four trappers have operated or contributed carcasses since 1990-91, which may partly explain the decline in catch per trapper. Based on conversations with Refuge trappers, trapping effort also has been reduced during the last few years because of the declining price paid for marten pelts and in some years because of poor winter conditions for travelling (too much or too little snow).

During the last three trapping seasons, we have distributed trapline calendars in an attempt to gauge trapping effort. All trappers have expressed concern that these calendars may not accurately represent effort because of factors that affect whether traps are operational (drifting, etc.). These calendars can also be cumbersome to complete for large numbers of sets or multiple lines and consequently very few trappers bothered completing them. We have decided to stop sending trapline calendars out unless a more accurate means can be devised.

Age-sex distribution. During the 1992-93 trapping season, we purchased 151 marten carcasses at \$3.00 each from trappers on or near the Refuge. The proportion of juveniles in the harvest (42%) was within the range of previous seasons since carcass collections began in 1984-85 (Table G2). The sex ratio of 1.4 males per female was also similar to previous seasons. However, the number of juveniles per adult (female) age 2 years or older was the lowest observed since we began collecting age data in 1987. The harvest ratios in recent years of reduced trapping effort may show a localized effect (specific traplines) rather than a Refuge-wide effect.

Harvest pressure has likely decreased during recent years, but the pregnancy rate and litter size of the Nowitna martens are relatively low compared to elsewhere in North America (see section on Reproductive Indices). The reproductive potential for yearling females was relatively low in 1991-92, which may be part of the reason for low numbers of juveniles per adult female in the 1992-93 harvest. Our reproductive data only go back to 1990-91, so we do not know whether reproduction is lower now than in previous years. A lower production of young in recent years, for whatever biological reason, also may be contributing to the low ratio of juveniles to adult females in the harvest.

The juvenile to adult female index is the most sensitive indicator of overharvest because it is based on a new crop of young each year. Sex ratio in any one year is a more cumulative or additive index that represents several years of past harvest on the different age and sex classes. Based on the data in Table G2, the level or "intensity" of harvest seems high for most trappers on their traplines, despite the apparent drop in trapping effort in recent years. We have suggested to trappers who have the option of letting part of their trapline "rest" while trapping another part may wish to do so during the 1993-94 trapping season. The marten carcasses

we collect from the 1993-94 season should tell us whether this strategy of letting part of the trapline "rest" will produce harvest indices that indicate a less intense harvest.

Reproductive indices. The reproductive organs of female martens were examined to obtain estimates of litter size by three different methods. First, we looked for "corpora lutea" (CL) in the ovaries, which is a measure of how many eggs were ovulated during the breeding season. Second, we counted "blastocysts" (BC), which are the fertilized eggs that form after breeding and are found in the uterus. Third, we looked for "placental scars" (PS), which are dark spots on the uterus where young had been attached during pregnancy the previous year. The ovaries were sent to Matson's laboratory in Montana for preparation and analysis.

We obtained counts of both egg scars and developing young from six females that were 6-12 years old. The average number of egg scars was 2.2 per female (67% pregnant), and the average number of developing young was 1.0 per female (also 67% pregnancy rate). This suggests that the four females who produced eggs had at least one egg that was fertilized (thus were pregnant), but not all the eggs produced were fertilized (so there was a decline in litter size).

The reproductive tracts from 27 other females were too small to flush well with a syringe, so their egg scar counts were added to the six females above for a separate analysis (Table G3). Marten populations in North America often have pregnancy rates of 90% or more, but in 1992-93 the Nowitna martens had relatively low pregnancy rates of 59% (yearlings and older) and 69% (2 years and older). Only 17% of yearling females were pregnant (Table G3). We have read about such low yearling reproduction in only two marten populations (in which prey had declined) and in a population of Russian sables. The low pregnancy rate for yearlings, and the fact that 2-year-old females were 40% of the reproductive segment of the population, is another reason for the apparently low number of juveniles in the harvest.

Table G2. Total number and age-sex ratios of martens harvested by five trappers during the 1992-93 trapping season, Nowitna NWR, Alaska.

Ratios in harvests						
Trapper Number	Total Marten	Males/female (all ages)	Males/female (both > 1.5 yrs)	Juveniles per female > 2.5 yr.	Juveniles per female > 1.5 yr.	% Juveniles
01	11	1.8	-	-	-	55
05	15	1.1	1.2	1.3	0.8	27
08	29	1.1	1.2	0.3	0.3	10
10	28	2.5	2.5	3.5	3.5	50
15	68	1.3	1.1	3.6	2.4	53
Total	151	1.4	1.4	2.2	1.8	42

Table G3. Age distribution of martens harvested by five trappers during the 1992-93 trapping season, Nowitna NWR, Alaska.

Marten Age Class (years)													
Trapper Number	0	1	2	3	4	6	7	9	10	11	12	13	Total
Male martens													
01	2	3	1	1	0	0	0	0	0	0	0	0	7
05	2	1	3	0	1	0	0	0	1	0	0	0	8
08	1	2	7	3	2	0	0	0	0	0	0	0	15
10	10	0	3	3	3	0	0	0	0	0	0	1	20
15	21	5	3	2	4	0	1	1	1	0	0	0	38
Total	36	11	17	9	10	0	1	1	2	0	0	1	88
Female martens													
01	4	0	0	0	0	0	0	0	0	0	0	0	4
05	2	2	3	0	0	0	0	0	0	0	0	0	7
08	2	0	5	3	2	1	1	0	0	0	0	0	14
10	4	0	2	1	0	0	1	0	0	0	0	0	8
15	15	5	1	2	1	0	0	1	3	1	1	0	30
Total	27	7	11	6	3	1	2	1	3	1	1	0	63
Both Sexes	63	18	28	15	13	1	3	2	5	1	1	1	151

Table G4. Average number of egg scars (corpora lutea) counted in the reproductive tracts of female martens harvested during the 1992-93 trapping season on the Nowitna NWR, Alaska.

Age (yrs)	Sample size	Range	Average	% pregnant
0	1	-	0	0
1	6	0-3	0.5	17
2	14	0-5	2.6	79
3	5	0-3	1.8	60
4	5	0-5	2.2	60
7	1	-	4.0	100
10	1	-	0	0



M. Conrath sets a small mammal trap in the 1966 Burn at the Fire/Furbearer study site. Small mammals are a major food source for furbearers. HNJ



Yellow-cheeked voles were abundant in the 1985 Burn, and were an important food source for martens using the recent burn. CQ



Forest regeneration and woody debris in the 1966 Burn. The Fire/Furbearer study found that coarse woody debris remaining after a burn was used as cover by furbearers. HNJ



An entrance to a resting site used by a marten in the 1985 burn. Studies of marten movements through snow tracking during winter were a major part of the Fire/Furbearer study. TFP



Fall colors at Round Lake, the base camp of the Fire/Furbearer study, in the east-central part of Nowitna NWR. 1993 was the third year of the four-year Fire/Furbearer study. HNJ

11. Fisheries Resources

The published ranges of 20 fish species fall within the Nowitna drainage, and 14 species have been documented in previous field work. Of these, chinook, chum, and coho salmon, whitefish, burbot, and northern pike are the most important species in subsistence fisheries near the Refuge. Additionally, pike and sheefish are important in the area sport fishery. Because the Refuge is not staffed with a fisheries biologist, field work has mostly been accomplished by the Service's Fisheries Assistance Office and the Northern Alaska Ecological Services offices in Fairbanks. There were two fishery efforts underway in 1993: salmon stock assessment and a contaminants study.

Preliminary salmon stock assessment, 1993

Estimates of salmon escapement in the Nowitna Refuge have never been made. The relative strength of each species run is also unknown. It is known that escapement estimates of salmon in the Yukon River drainage have been declining since the early 1980's. This decline has been most evident in summer chum salmon.

The mainstem Yukon River and many tributary rivers within the drainage are subject to commercial and/or subsistence fishing. Part of the Yukon River drainage lies within the Nowitna Refuge. People from the villages of Ruby and Tanana depend, in part, upon the fishery resources of the Nowitna Refuge for subsistence. Effective management of the Yukon River salmon stocks is important to ensure the continued success of subsistence fishing by the local residents. However, effective management cannot occur without adequate data. As a first step toward obtaining some baseline salmon information, Dave Wiswar of the Fairbanks Fishery Resource Office conducted a preliminary salmon stock assessment on the Nowitna Refuge. Following a review of literature on salmon distribution and escapement, the primary goal was to determine the presence of salmon in rivers where information was lacking.

The Nowitna River was sampled during July and September in order to intersect both the summer and fall chum salmon run. The sample site was approximately 15 kilometers below the confluence of the Sulatna River and the Nowitna River. No major tributaries occur below this site on the Nowitna River, therefore salmon runs in the Nowitna drainage would not go undetected. Multifilament gill nets were used to capture fish. Two mesh sizes were used during the July sampling period, 21 centimeter to target chinook salmon and 14.9 centimeter to target chum salmon. In September only the 14.9 centimeter chum net was used. Both nets were 30.5 meters long. There were three sampling periods per day and each period lasted three hours.

The July sampling period took place between June 29 and July 18. During this time 11 chinook salmon, 55 northern pike, 64 broad whitefish and 31 sheefish were captured with the chum size mesh. One chinook salmon, four northern pike, and six broad whitefish were captured with the king size mesh. Chinook salmon were captured between July 2-12. Of the 12 chinook salmon captured, sex was determined for nine of them. There were five females and four males.

Throughout July the river was prone to fluctuations in the water level and at one point an alternate site had to be chosen because of low water.

The September sampling period was scheduled to take place from September 1 to September 15. Heavy rain at the beginning of the month raised the water level about 3 meters. Downed trees, root wads and branches were carried from the banks into the river due to the high water. The gill nets became so fouled by this debris that sampling was effective only on September 3 and 4. After this time sampling was discontinued. During those two days two chum salmon (male and female), one female coho salmon, 11 northern pike, and two sheefish were captured.

No literature was found to document chinook salmon (kings) captured in the Nowitna Refuge. However, Frank Walter and his family were travelling up the Nowitna River to their homestead above the refuge boundary when they stopped to visit at the lower Nowitna cabin. He said he and his neighbors have always known there are kings in the drainage and catch them every year. Chum and coho salmon have been documented previously. Summer chum, which are expected to move into the Nowitna River from late June to mid-July, had earlier been found near the confluence of the Big Mud River and the Nowitna River. Fall chum move into the Nowitna River starting in late August and have been captured near the mouth of the Sulukna River. Coho salmon have been captured in the upper Nowitna River near Our Creek in early fall.

The low number of individuals of all species captured may be due to a number of reasons. The start of the July sampling period was too late, and the September sampling period was early. The Nowitna River was higher than what is considered normal for both the June-July and September sample periods. Sampling gear was inadequate to cover a large enough area of the river. This year was known to have a very weak run of chums throughout the Yukon River drainage and results on the Nowitna were likely influenced. Finally, the number of chinook, chum and coho salmon using the Nowitna drainage is small.

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.

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. This initial study reported significantly higher turbidity, iron, and manganese in waters of the Sulatna River as compared to several sites on the Nowitna River. The Titna River showed high iron. Mercury concentrations in sediments were high in all sites except for one (California Creek). Fish tissue concentrations of mercury were highest in northern pike from the unmined Sulukna River, and exceeded the FDA action level. Northern pike from the mouth of the Nowitna River also contained elevated mercury levels, but did not exceed the FDA action limit. The source of mercury in the Nowitna Refuge fish is uncertain but is most likely derived from natural sources rather than placer mining activity.

Results of the 1991 heavy metals contaminant sampling studies on the Nowitna were received at NAES in the fall of 1993. An early preview of the data was made available by Elaine Snyder-Conn of NAES, however, she cautioned that some of the sediment samples and all of the fish samples had not undergone quality assurance review. The following summary of 1991 data is therefore preliminary and the interpretation is subject to change.

Middle Sulatna River (site 2). One chum salmon had elevated cadmium in its kidney and liver, which matched some 1988 observations from the same site.

Sulatna River Oxbow lake (site 6). One fish had an elevated mercury level.

Sulukna River Mouth (site 4). Three fish from this site had elevated mercury levels, exceeding the FDA action level.

Given the above, the cautions regarding human consumption of large amounts of large sized fish made by Paul Headlee of Tanana Chiefs Conference seem appropriate. See Section G 11 of the Koyukuk report for more details.

14. Scientific Collection

As part of the fire/furbearer study on the Nowitna, abundance of small mammals was indexed using snap-traps or conical pitfall traps during August and September 1993. Totals of each species collected include: 480 red-backed vole; 152 yellow-

cheeked vole; 27 other *Microtus*; and 486 shrews (*Sorex*). A majority of the specimens were submitted to the collection at the University of Alaska Museum.

H. PUBLIC USE

1. General

Refer to the Koyukuk section of this report.

2. Outdoor Classrooms - Students

Refer to the Koyukuk section of this report.

3. Outdoor Classrooms - Teachers

Refer to the Koyukuk section of this report.

4. Interpretive Foot Trails

Refer to the Koyukuk section of this report.

6. Interpretive Exhibits/Demonstrations

Refer to the Koyukuk section of this report.

7. Other Interpretive Programs

Refer to the Koyukuk section of this report.

8. Hunting

Over the years, subsistence and recreational hunting has comprised a substantial portion of the public use on the Nowitna Refuge. The area is popular for Fairbanks residents who access the refuge primarily by boat, but also by plane. The primary big game species targeted by subsistence and sport hunters are moose and black bear. Ducks, geese, sandhill cranes, hare, grouse, and grizzly bears are also taken.

Two air taxi operators were issued permits to transport hunters into the Refuge in 1993. Ptarmigan Air transported four hunters who harvested two moose and Willow Air Service transported nine hunters who took six moose.

The Nowitna River Hunter Check Station was in place again for the September 5-25 moose season. This voluntary check station was staffed by refuge personnel and a volunteer.

Unlike last year's early freeze-up and cold weather throughout the year, 1993 brought more normal temperatures but a good deal of rain caused water levels to fluctuate dramatically throughout the season. On two different occasions the river level rose from 12 to 15 feet above normal. This obliterated all gravel bars and sent some hunters elsewhere. Those who were persistent recorded a success rate that has only been exceeded once in the past five years.

The total of 133 hunters that registered at the check station was up by eight from last year but down by 18 (12%) from the five year average. There was a significant increase in non-resident hunters but with only one moose taken their 5% success rate was the lowest of any group. The number of moose taken (53) was near the five year high and hunter success of 40% was exceeded only in 1990, and then by only 2%. Check station data for the years 1988 through 1993 is presented in Tables H1 and H2.

Table H1. Nowitna River moose hunter check station data 1988-93. Data represent only those hunters stopping at the mouth of the Nowitna River, and does not include fly-in hunters or those hunting only the sloughs of the Yukon River.

	Harvest	Total Hunters	Success rate	Parties
1988	56	178	31.1%	66
1989	48	168	29.0%	74
1990	54	130	42.0%	46
1991	46	154	30.0%	56
1992	34	125	27.2%	43
1993	53	133	39.8%	43

Table H2. Residency (N), harvest (n), and success (S%) of moose hunters stopping at the Nowitna NWR hunter check station 1988-93.

	<u>Local Villages</u>			<u>Fairbanks</u>			<u>Other Residents</u>			<u>Non-resident</u>			<u>Unknown</u>			<u>Total</u>		
	N	n	S%	N	n	S%	N	n	S%	N	n	S%	N	n	S%	N	n	S%
1988	33	9	27%	103	40	39%	14	5	36%	11	5	46%	9	0	0%	178	56	31%
1989	31	6	19%	94	29	31%	23	9	39%	12	6	50%	6	0	0%	168	48	29%
1990	23	7	30%	67	32	48%	26	12	46%	14	4	29%	0	0	0%	130	54	42%
1991	21	9	43%	72	24	33%	44	11	25%	17	2	12%	0	0	0%	154	46	30%
1992	24	3	12%	38	19	50%	53	10	19%	10	2	20%	0	0	0%	125	34	27%
1993	19	7	37%	59	26	45%	35	19	54%	21	1	5%	0	0	0%	133	53	40%

9. Fishing

Northern pike and sheefish are the most popular resident fish species for recreational fishing on the refuge. Fishing pressure is light from June through August, and is done primarily by floaters and guided fly-in anglers who arrived by float-equipped aircraft. No formal surveys are conducted to assess fishing pressure. Use of the Nowitna River by floaters is very light. Pike fishing that occurs in September in conjunction with moose hunting, probably equals the total harvest for June through August.



Visitors enjoy the opportunities the Nowitna has to offer.

10. Trapping

Trapping continues to be one of the major public use activities on the refuge and provides a source of supplemental income for several residents in the villages of Ruby and Tanana. The reported harvest of those furbearers required to be sealed is shown in Table H3. While these figures may be somewhat inflated because they include some areas adjacent to the refuge, sealing records are generally considered conservative estimates of harvest as some fur, especially beaver, is often kept for personal use and not sealed. There are no sealing requirements for marten or mink. The reported harvest of beavers appears to have declined since the 87-88 season (Table H4) due in part to declining pelt prices.

Traplines in Alaska are not registered but are generally passed down from generation to generation within a family and are usually associated with a cabin or camp of some sort. Occasionally traplines and accompanying cabins and equipment are sold to outsiders or newcomers. At least one trapper on the Nowitna uses an airplane to reach remote lakes and then traps their periphery. Most trappers use snowmobiles for transportation, a few occasionally use dog teams, and at least one hardy trapper walks (snowshoes) his entire line. Martens are generally taken using pole sets and/or cubby sets. Beavers are taken with snares through the ice and most wolves are shot or trapped with snares placed around moose or caribou kills.

Table H3. Furbearer harvest on the Nowitna NWR during the 1992-93 trapping season.¹

Area	Species				
	Beaver	Lynx	Otter	Wolverine	Wolf
Deep Creek ²	9	0	0	0	1
Lower Nowitna	2	0	1	0	0
Grand Creek	0	0	0	0	0
Pilot Creek	0	0	0	0	0
Lost R.-Sulukna	0	1	0	0	1
Sulatna/ Monzonite	0	0	0	0	0
Sulatna-Poorman	0	0	0	0	0
Lost River	0	0	0	0	0
Titna ²	31	6	0	0	0
Susulatna ²	0	0	0	0	0
Palisades ²	1	3	0	1	0
Big Mud	0	0	0	0	0
Big Creek	0	0	0	0	0
Little Mud	0	0	1	0	0
Total	43	10	2	1	2

¹Based on sealing records obtained from Tim Osborne, Area Biologist, ADF&G.

²Part of this area falls outside the refuge boundary.

Marten is the most economically important species in the Nowitna region and most trappers focus their efforts on this species. Studies are presently underway examining several aspects of marten ecology and refuge trappers have been very cooperative in these efforts. (see Section G.1)

Table H4. Total furbearer harvest on the Nowitna NWR from 1989-90 - 1992-93.¹

Species	Trapping Season						
	86-87	87-88	88-89	89-90	90-91	91-92	92-93
Beaver	176	141	45	36	57	5	43
Lynx	4	6	25	6	6	27	10
Otter	4	12	7	0	2	1	2
Wolf	14	15	0	1	19	15	2
Wolverine	2	1	0	1	5	7	1
Total	200	175	77	44	89	55	58

¹Minimum number harvested based on sealing records obtained from Tim Osborne, Area Biologist ADF&G.

17. Law Enforcement

One refuge officer again conducted LE during the September moose season based out of the hunter check station on the Nowitna River. One violation was investigated and forwarded to the AKF&WP officer for prosecution. One non-resident was cited for taking a 45" moose in a 50" minimum area and was fined \$300 in state court. The moose was forfeited.

A FWS special agent worked the Nowitna River with a refuge officer for five days during the moose season.

Two ivory "mining" cases were finally closed during the year when defendants paid fines of \$500 and \$250 on the two respective cases. Both cases related to the taking of mastodon ivory and miscellaneous bones from the area on the Nowitna Refuge known as the Palisades or Boneyard. Because possession of this ivory, and

in many places digging it up and collecting it, are all legal, we are required to prove that the collection took place from refuge lands. In one case the seized items (two tusks) were appraised at \$15,000 so the risk of a fine totaling \$500 is little incentive toward deterring the crime. The items do not fall within the realm of the Antiquities Act.



Two LE cases involving mastodon ivory "mining" were brought to a close during the year. The items shown here would be valued at approximately \$1,000.00. TE

18. Cooperating Associations

Refer to the Koyukuk section of this report.

I. EQUIPMENT AND FACILITIES

2. Rehabilitation

MMS funds were received (\$15,000) to rehab the lower administrative cabin on the Nowitna River. The structure was purchased in the mid-1980s from an individual who did not have a valid permit nor was qualified to receive one. The structure received a new foundation, roofing, siding, decking and other minor improvements. Maintenance Worker Attla cut all the timbers for the foundation

on-site. Most of the materials were delivered to the mouth of the Nowitna River by commercial barge and transported two hours up river by refuge boat.



The Lower Nowitna River administrative cabin received some long overdue rehab during the year. BA

J. OTHER ITEMS

3. Items of Interest

In November, the staff along with Ecological Services in Fairbanks reviewed an EIS released by the Air Force that included changes to the Galena Military Operating Area which overlies part of the Nowitna Refuge. The proposed change was to reduce the hours and days of activity to Monday through Friday from 8:00 AM to 6:00 PM in the area as a result of the Galena AFB closure. The airspace use remained the same which is from 1,000 to 18,000 MSL. The MOA covers only a small southern portion of the refuge but includes the Nowitna River canyon area. No objections were submitted on the EIS.

4. Credits

Refer to the Koyukuk section of this report.

K. FEEDBACK

Refer to the Koyukuk section of this report.



United States Department of the Interior

FISH AND WILDLIFE SERVICE
Koyukuk and Nowitna National Wildlife Refuges
P.O. Box 287
Galena, Alaska 99741-0287

IN REPLY REFER TO:

KOYUKUK NATIONAL WILDLIFE REFUGE

Located 320 miles northwest of Fairbanks in west-central Alaska, the Koyukuk Refuge encompasses the flood plain of the Koyukuk River north of its confluence with the Yukon River. The extensive flood plain lies within a forested solar basin surrounded by hills. Lowland boreal forest of spruce, birch, and aspen gradually merges with tundra vegetation at elevations of 3,000 feet. This interior Alaska region is characterized by short, hot summers and long, cold winters. Long hours sunlight in the summer support lush vegetation and a variety of wildlife species.

The Koyukuk Refuge has significant breeding grounds for ducks and geese. On the average over 100,000 ducks (primarily northern pintails, American wigeon, scaup, green-winged teal, mallard, and scoters) are contributed annually to North American flyways. There is approximately 180 breeding pairs of trumpeter and tundra found on the refuge. The northwestern breeding limits of trumpeter swan lies within refuge boundaries, as well as tundra swans which are found on the northern half of the refuge. The moose populations exceeds 11,000 and form an important element in the subsistence economy of local villages. The refuge includes part of the winter range of the Western Arctic caribou herd which numbers about 500,000. With moose and caribou present, wolves are common in the area. Black bears are abundant in forested areas, and grizzlies are found in the open tundra of higher elevations. Furbearers such as beavers, marten, muskrats, and mink are locally abundant. Chinook and chum salmon are important commercial and subsistence fish migrating the larger rivers. Whitefish and northern pike are abundant in lowlands, and grayling are found in colder headwater streams.

The refuge has a 400,000 acre wilderness surrounding the 10,000 acre Nogahabara Sand Dunes, one of only two active dune fields in Alaska. Access to the interior of the refuge is by boat, aircraft, or snowmobile. There are no accommodations for tourists on the refuge, although there is a hotel in Galena. There are 8 predominately Native villages on the adjacent to the refuge, with numerous fish camps and allotments nearby. Travelers should inquire locally and respect private lands. Camping is allowed on the refuge; however, visitors should be prepared for dense concentrations of biting insects in the summer and extremes in weather throughout the year.

The Koyukuk National Wildlife Refuge is shown on the following 1:250,000 scale U.S. Geological Survey topographic maps: Hughes, Kateel River, Melozitna, Nulato, and Shungnak. The maps are for sale by the U.S. Geological Survey, Fairbanks, Alaska 99701; Denver, Colorado 80225; or Reston, Virginia 22092.

Moose may be new record

By KELLY BOSTIAN
Staff Writer

They hoped to take a big moose with a bow, but when you're carrying along a 24-pound movie camera—and camera man—settling for a possible world record moose taken with a muzzle loader isn't so bad.

Mike Chain of Oklahoma City downed a bull moose with antlers 72¼ inches wide hunting the area north of Huslia on Sept. 17. Chain said the bull scored an unofficial 216 4/8ths Boone and Crockett points. The mark out-scores the standing record by 30 points.

The top Boone and Crockett moose on record, with rifle, scored 255 points, Chain said.

The score should qualify the bull as the number one moose on record with the North American

Muzzle Loading Association, according to Chain. The association uses the Boone and Crockett scoring system.

Chain took the bull while hunting with Fairbanks guide Virgil Umphenour and an assistant Cue Bifelt, of Huslia. Also on the hunt was Paul Newsom, a hunting video producer also from Oklahoma City. "He carries along one of those big cameras like you would see a newsmen carrying on the street and big old tripod," Chain said.

The hunters found the moose in an area that held a series of lakes. They saw a cow moose at a lake and decided to try some calls to see if a bull was nearby.

"We would get out on these lakes and use a cow call or bull grunt and rake on the trees to see if bulls were around," Chain said.

They had been calling about 10

minutes when a second cow came out of the woods, Chain said. Then he saw part of the antler of a bull following her through the willows.

"I didn't see the whole moose right away because I was busy putting in a primer. I don't carry my gun loaded," he said.

The gun loaded, the hunters attempted to call the bull in closer for a possible shot with bow-and-arrow. But the bull was more interested in the real cow he was following than the imitations made by the hidden hunters.

"We couldn't get him in closer so I decided to go ahead and take him with the muzzle loader at about 65 yards," Chain said.

Chain said it will be more than a year before the hunting sequence is published as part of Newsom's, Master Sportsman's Series of videos.



RECORD BULL?—Fairbanks hunting guide Virgil Umphenour holds the antlers of a bull moose one of his hunting clients took recently in the Koyukuk National Wildlife Refuge.