ANNUAL NARRATIVE REPORT

1991

KOYUKUK NWR

NORTHERN UNIT, INNOKO NWR

KOYUKUK/NOWITNA NATIONAL WILDLIFE REFUGE COMPLEX

Galena, Alaska

REVIEW AND APPROVALS

Complex Manager	Date	Associate Manager	Date
		09/11/92	
Regional Office Approval	Date		
	3/23/93		

INTRODUCTION

This Annual Narrative Report is for the Koyukuk and Nowitna Refuges, and the Northern Unit of Innoko Refuge (Kaiyuh Flats). These three refuges are administered collectively as the Koyukuk/Nowitna Refuge Complex. Narrative items common to all three units are discussed in the Koyukuk 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. The Yukon River lies 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 the 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 10,000 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 2000 feet.

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 and 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 species are economically important to several countries for the thousands of dollars in income they generate.

Major programs of the Complex include resource inventory, research, subsistence management, wildfire management and prescribed burning, and information/ education programs. Field investigations collect baseline information and quantify important fish, bird, mammal, and habitat resources. Open communication through an information and education program with the eight villages in or near the Complex is vital to the management of these natural resources.

The complex staff has: 10 permanent, 9 temporary, 1 four year term appointment, and 3 YCC positions. Facilities include a 2208 sq. ft. "old" administrative office (to be converted to duplex quarters), a 2325 sq. ft. leased "new" administrative office and storage, a 4755 sq. ft. hanger and storage, three administrative cabins, six government residences, a bunkhouse and a leased apartment.

The Koyukuk/Nowitna Refuge Complex headquarters is in Galena, a small town 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 hub for transportation and services to smaller area villages. More like a town than a village, Galena has the advantages of direct air service to Anchorage and 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 928 persons, of which 628 persons live in Galena proper (approximately equal numbers of Alaska natives and caucasians) and 300 Air Force personnel. Most 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 supports two F-15 Eagle interceptor aircraft that are kept on 24 hour alert. Galena is the closest outpost to the air space of Russian Siberia

(formerly the Soviet Union) and in the past has been recognized for more intercepts with Soviet aircraft than all the intercepts made by the rest of the world.

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A. HIGHLIGHTS

Estimated duck production declined from the record high of 166,000 young ducks in 1990 to an estimated 93,500 in 1991. Estimated number of adult ducks summering on the refuge was 90,000, an increase from the 84,000 estimated in 1990. This was the second year in which standardized statewide ground and helicopter survey methods were implemented (Section G.3).

The first year of a four-year study to determine the effects of fire on furbearers and their habitats in Interior Alaska was completed in 1991. A comprehensive literature survey was completed and was made available in published and computerized formats. Detailed study plans for marten, lynx, and small mammals were written, approved, and implemented. Cooperation by trappers on the Koyukuk and Kaiyuh units was sought, but most activities occurred on the Nowitna unit (Section E.5).

A study to determine the relationships of wolf home range and predation in areas of known prey density was continued in 1991. Of the 12 wolves in five packs collared in 1991, only three collared wolves in three packs remained. The others have been harvested, dispersed, or were lost (Section G.10).

Public use increased during the year, especially from non-local moose hunters travelling by boat to the Koyukuk River in September. Record numbers of hunters were observed, but thanks to low water, numbers of moose harvested were near normal. There were perceived subsistence-sport hunter conflicts due to concentration and density of hunters along navigable channels, yet resource utilization seemed below the maximum sustainable level (Secton H.8).

The subsistence issue consumed a large amount of staff time, which included additional moose and wolf surveys; attending regular Fish and Game Advisory Committee meetings; conducting special subsistence meetings in each of eight surrounding villages; individual interaction with community elders and leaders; and coordination with the Regional Office Subsistence staff (Section H).

Several changes occurred in the refuge staff. Galena resident Barney Attla was hired as a Maintenance Worker. Fire Management Officer Mike Granger transferred to Charles M. Russell refuge in Montana after three years in Galena. Pete DeMatteo was hired as a Refuge Operations Specialist to act as a subsistence coordinator. Tom Paragi was hired as a wildlife biologist to work on the fire/furbearer project after serving on the station almost a year as a biological technician (Section E.1).

The local hire staff of Maudrey Honea, Theresa Williams, Jenny Lowe, Orville Huntington, and George Wholecheese, continued to provide lots of local knowledge and village awareness to our staff (Section E.1).

Our environmental education program increased in emphasis with many school presentations in Galena and seven surrounding villages. Heather Johnson was hired as a part-time Park Ranger to assist our interpretive and educational programs (Section H.3, 4, 6, 7).

We moved to a new office building - the two story Gana-A-Yoo Corporation building along the Yukon River in the old Galena townsite. The new office is spacious, accessible to the public, and much more functional than the old duplex residence on the Air Force Base. Other major improvements to facilities included leasing an aircraft hangar and warehouse/cold storage space (Introduction).

We were assigned a new Super Cub aircraft to help with subsistence wildlife surveys and village coordination (Section I).

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 late 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. The moderating effects from Bering Sea and Pacific storm fronts increase in frequency the farther west one proceeds in Interior Alaska. By late winter, snowpack in the valley bottoms averages 2-3 ft. The months of April and May are transitional, with the arrival of most waterfowl occurring in late April, and breakup of the Yukon River ice occurs in early to mid-May. Green-up of the trees and shrubs begins in late May. Summer daytime temperatures in western Interior Alaska are generally range from 50-70°F, but extreme highs have exceeded 90°F. Summers in Galena area are generally cooler, cloudier, and more moist than summers in Fairbanks, which is in the eastern Interior. Perhaps the most pleasant time of year is fall, 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 1991 in Galena was cold and snowy, with a mean temperature of -7.2°F (Figure 1). February started with a week of cold and snowy weather and a low on the 6th of a chilly -53°F. The last half the month was a pleasant change with warm temperatures and melting snow, the high of 38°F recorded on the 25th. Snow fell regularly throughout the month, missing only seven days. Precipitation in March was above normal with much snow and freezing rain interspersed with only a few days of cold and fog. The high for the month was 36°F on the 24th and the low was -33°F on the 16th. April was a bit drier than normal with a low of -16°F on the 1st and a high of 54°F on the 29th. The weather steadily warmed as the month progressed with warm, cloudy days, some rainfall and much snowmelt. By the end of the month, only about a foot of snow was left in the woods. By mid-May all but the largest lakes were ice free. Extreme flooding occurred on the Nowitna Refuge near the lower administrative cabin because of a local ice jam. For the fourth year in a row, breakup of the Yukon at Galena occurred on May 7th, which is also the earliest recorded date. Although water rose high enough to flood our float pond, the peak was eight feet below the 100 year flood level.

June was drier than normal with only a few thunder showers and rainy days on the 15th and 16th. The last half of the month was clear, dry, and hot (Figure 2), which encouraged some lightning-caused fires. The hot, dry weather continued into July and, except for a few showers, stayed dry throughout the month. August

began with some rain but remained mostly dry and warm; the high was 70°F on the 15th and the low was 31°F on the 26th, 27th, and 28th. By the end of the month, touches of fall color had appeared at several locations.

September was unusually mild and dry making the days particularly pleasant. However, the drought caused extremely low water making boat owners and moose hunters anxious. Also, a small fire 30 miles north of Galena caused smoke which impeded flying on the 10th, 11th, and 12th. The month closed with a few days of rain when nearly all the birch had lost their leaves. The high for September was 70°F on the 1st and 2nd, while the low was 30°F on the 22nd. October was also relatively dry and mild. The only significant snowfall occurred on the 19th, 20th, and 24th, combining for a total of four inches. Air traffic was hampered due to fog on eight days. The float pond froze over on the 9th and the lack of snow made great ice skating for the community. The float pond ice was thick enough to support aircraft by the end of the month.

Dry weather continued into November. The scarce snow cover delayed the aerial moose surveys and furbearer tracking studies. Local people took advantage of the thick ice and lack of snow by using pick-up trucks on frozen sloughs to haul firewood. The ice on the Yukon stopped moving on November 1; a late freeze up according to the elders. The month became colder, yet there was no snow until Thanksgiving when the temperature rose a little.

Precipitation in December shot way up past normal finally giving us some much needed snow. The month was warm, calm, and snowy, with the temperature dropping off for only a few days. A low of -52°F, threatened a cold Christmas on the 21st, brought several days of fog. Fortunately, the temperature rose again making the holiday warm and pleasant. The month continued with warm weather and a high of 16° on the 27th. It snowed continually throughout the period only missing five days, three of which were the coldest. The long awaited snow finally allowed the Furbearer crew to do some tracking on the Round Lake study area and even though December dumped 19.2 inches on us, the snow still wasn't deep enough for the crew to access some parts of the study area by snowmachine.

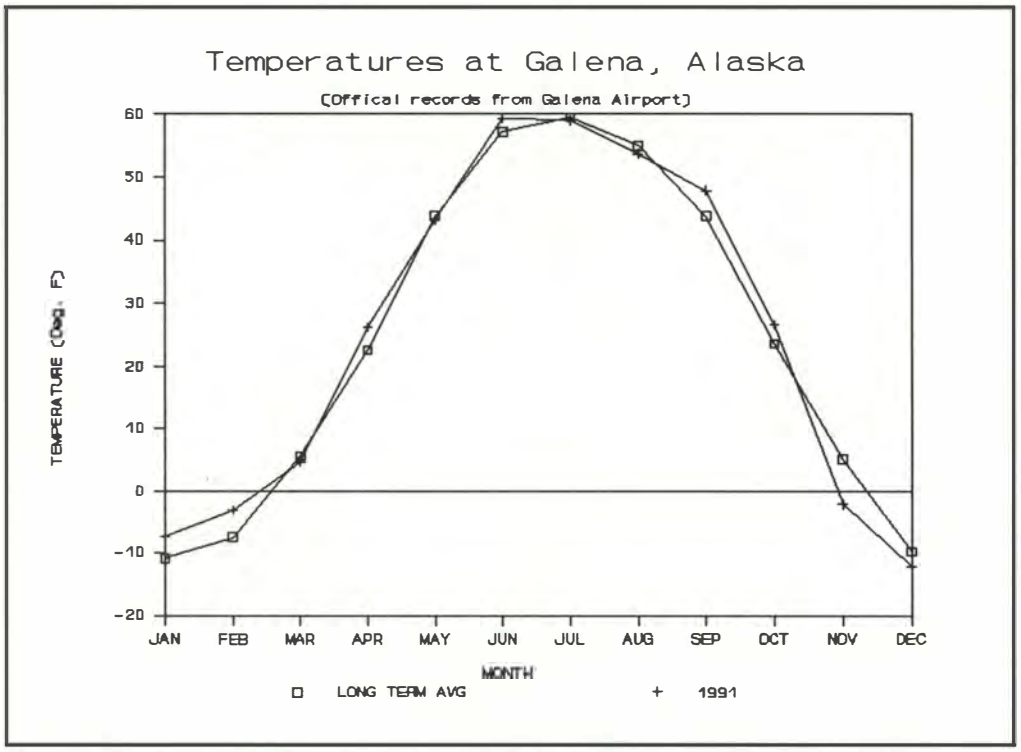


Figure 1. Long term average and observed temperatures in 1991.

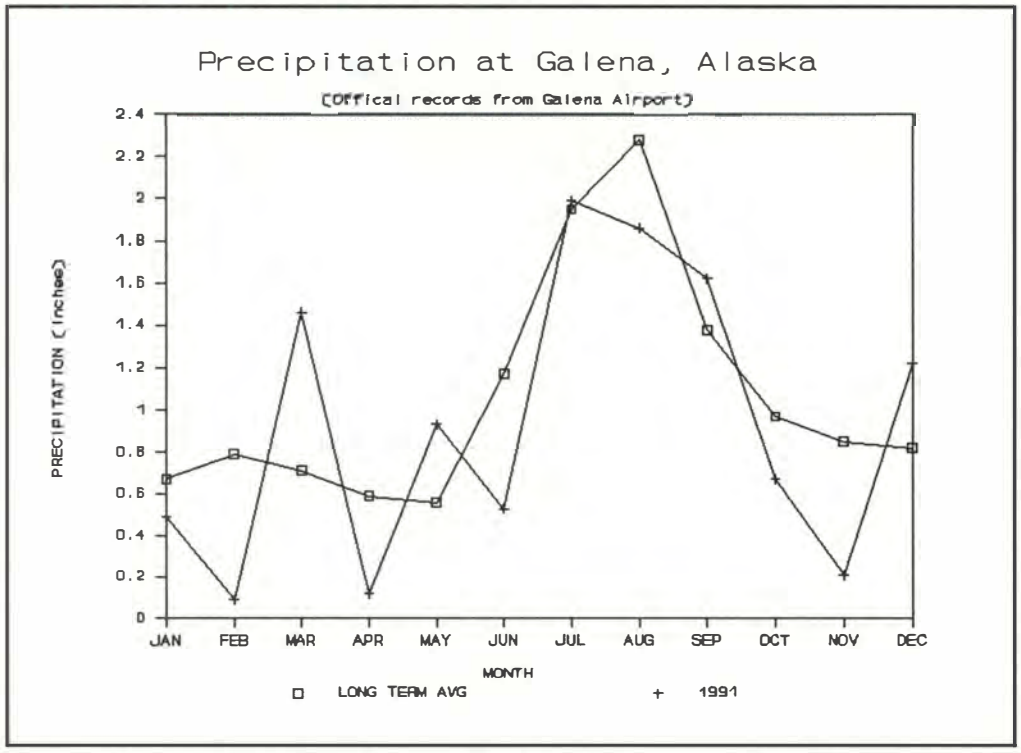


Figure 2. Long term average and observed precipitation in 1991.

For the fourth year in a row, breakup of the Yukon River at Galena occurred on May 7th, which is also the earliest date recorded.

C. LAND ACQUISITION

1. Fee Title

In 1990, a **Land Acquisition Priority System** was completed for all refuges in Alaska. Through this identification process the Koyukuk Refuge inholdings were listed as having high (437,589 acres), medium (241,890 acres), or low (135,720 acres) priority. This year was an interim year between completion of the Priority System and development of Land Protection Plans. These **Land Protection Plans** have already been started for some refuges in Alaska and should begin for the Koyukuk Refuge in 1993 or 1994.

2. Easements

The Service has a **Land Bank Agreement** with one of the major refuge inholders, Gana-A-Yoo, Ltd., the local native corporation for the villages of Galena, Koyukuk, Nulato, and Kaltag. The agreement provides for resource protection on these lands "in a manner compatible with the management plan for the Koyukuk National Wildlife Refuge...", provides for mutual access, limits major development or mineral exploration without mutual agreement, and gives immunity from tax liabilities to the corporation. The agreement is flexible and allows for amendments, withdrawal of selected parcels, and cancellation. There is a total of 496,800 acres covered.

No withdrawals were made from the Land Bank in 1991. The issue of the Land Bank and its relationship to the management of subsistence on Federal lands was raised by representatives of the Tanana Chiefs Conference during the year. After Regional Office review these lands are considered private lands under the subsistence management program and therefore, will not fall under Federal subsistence management.

3. Other

In February, a local commercial fisherman offered to trade his son's Native allotment on refuge lands for a parcel outside the refuge. The individual was advised that he would have to begin negotiations with BLM and by year's end we had heard no more about the request.

D. PLANNING

1. Master Plan

The FY 91 annual work plan advices and subsequent work, contained several activities that follow the Master Plan or as its called in Alaska, the Comprehensive Conservation Plan (CCP). Among the notable activities were wildlife monitoring, fire management, subsistence management, public use management, and permit administration. However, planning efforts related to the CCP itself were essentially nil. The end of the first interim periods between revisions of the CCP is rapidly approaching. The 1987 Nowitna and the 1986 Koyukuk/Innoko CCP's are scheduled for review no later than 1992. Decisions are now being formulated in the Region on how CCP reviews will be conducted. Few changes have taken place on the Complex since the CCP's were originally completed and it is unlikely that a full round of public involvement meetings will be necessary as part of the review.

2. Management Plan

The Complex Operational Plan continued to make its way to completion throughout the year. What had begun as a quick summary of our direction for a 3-5 year period, was going into its 14th month of development by the end of 1991. The Operational Plan is expected to be completed in early 1992. With this being the first operational plan completed for the Region, it is expected that those to follow will be somewhat expedited in their completion. The plan will fill a void that exists between yearly annual work plan advices and the long term Comprehensive Conservation Plan.

An environmental education plan was prepared for the Complex in June. All station plans were also reviewed. The activities were classified as either environmental education, interpretation or information or any combination, in order to refine the plans and clarify strategies for implementing EE.

The wildlife inventory plan for the Complex was completed by the end of the year. This large undertaking will be a major improvement in how we conduct the various wildlife inventories on the Complex. This is the first inventory plan to be completed and we have worked closely with the local ADFG biologist in its development.

3. Public Participation

In March and April, two meetings were held in Nulato to discuss a permit to be issued on the Upper Unit of Innoko Refuge for a sport fishing guide (further discussed in H.1). These meetings were called by the local community with the goal being an annual discussion of refuge programs, specifically special use permits and an opportunity for local input into management decisions. We welcome the opportunity to meet with local villages on more than an informal basis but will leave it up to the villages to schedule and host the meetings. We've found this to give them a greater ownership of the meeting and almost always assures better attendance and participation.

We made numerous visits to each of the eight surrounding villages during the past year to conduct closed season waterfowl policy meetings, subsistence management comment meetings, and school programs. The refuge attended four Fish and Game Advisory Committee meetings, and had many informal visits for various reasons related to refuge management.

5. Research and Investigations

The following are summaries of approved refuge wildlife studies. 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 Narratives.

The relationship of wildfire to lynx and marten populations and habitat in interior Alaska.

This comprehensive four year study is in its second year. Progress is reported in Sections A.5, G.10 and H.10 of the Nowitna Annual Narrative Report.

Wetland ecology and sightability correction for waterfowl productivity surveys on the Koyukuk NWR.

This study was initiated in 1989. Primary objectives of the study are to identify key physical or chemical characteristics that can be used to classify water bodies as to probable waterfowl productivity, and secondly, to determine the percentage of broods missed in standard waterfowl production surveys. The sightability aspect of the study was completed and reported in the 1990 narrative. The wetland ecology portion will be completed pending analysis of aquatic plant data by the Regional Botanist.

The effects of fire on wildlife populations.

This five-year study was initiated in 1987 and completed in 1991. Primary objectives were to determine vegetation changes and successional sequences caused by fire and to determine small mammal, furbearer, avian, and moose population changes caused by fire. Partial results of 1991 progress are reported in Section F.9.

An evaluation of the impact of the spruce bark beetle on spruce stands associated plant communities along the lower Yukon River.

This three year study was approved in 1990 and funded in 1991. Primary objectives are to determine the extent and rate of spread of spruce bark beetle infestations along the Yukon River between Holy Cross, and the mouth of the Koyukuk River, and to quantify changes in the plant community. In FY 91, a contract for $16,000 was issued to the U.S. Forest Service, Institute of Northern Forestry, University of Alaska, Fairbanks. The principal investigator is Richard A. Werner, who will supply a progress report in 1992 and a final report in 1993.

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 are 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. Collection of radio tracking data continued in 1991 and a final report will be prepared in 1992, when most collars are due to expire. Interim progress is reported in Section G.10.

Extent, causes, and timing of moose calf mortality on the Nowitna and Koyukuk National Wildlife Refuges.

This project was initiated in 1988 on the Nowitna Refuge. Primary objectives of this study were to compare moose calf mortality rates and causes between the two refuges and to determine what effect, if any, moose calf predation has on the population. Progress of this study is reported in Section G.8(A). In 1991, the data were presented to the North American Moose Conference, and a paper was submitted for publication in the journal Alces (Osborne, et al. 1991).

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

Begun in 1985, 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 pacer mining in uplands surrounding the refuge basins after releases naturally occurring heavy metals; likewise mercury pollution has been associated with refining gold ore. In 1991, efforts were made to re-test known hot spots and begin to ascertian whether the heavy metals were naturally occuring or mining related. See Section F.2 for results of 1991 work.

E. ADMINISTRATION

1. PERSONNEL

Permanent

1. F. David Stearns, Refuge Manager, GS-485-12, EOD 6/17/90, 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-485-4, EOD 12/02/91, PFT
5. Colin B. Brown, Airplane Pilot, GS-2181-12, EOD 4/84, PFT, Local Hire
6. Michael N. Granger, Fire Management Officer, GS-401-11, EOD 4/10/88, transferred 9/9/91
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, PFT
9. Thomas F. Paragi, Wildlife Biologist, GS-486-9, EOD 6/17/90, PFT
10. Maudrey M. Honea, Secretary (Typing), GS-318-6, EOD, 10/85, PFT, Local Hire
11. Theresa Williams, Clerk (Typing), GS-303-4, EOD 2/10/91, PFT, Local Hire

Temporary

1. Peter R. Reaman, Biological Technician, GS-404-5, EOD 6/16/91, TFT
2. Bernard Attla, Maintenance Worker, WG-4749-8, EOD 9/23/91, TFT
3. Heather N. Johnson, Park Ranger, GS-025-5, EOD 7/8/91, TFT
4. George M. Wholecheese, Biological Technician, GS-404-5, EOD 6/13/90, Local Hire, Intermittent
5. Jenny M. Lowe, Biological Technician, GS-404-5, EOD 6/17/90, Local Hire, Intermittent
6. Orville H. Huntington, Converted from Biological Technician to Cooperative Ed Student, GS-499-3, EOD 6/17/90, Local Hire, TFT
7. Claudette L. Lowe, Refuge Clerk (Typing), GS-303-4, EOD 6/7/90, Local Hire, Intermittent
8. Pamela S. Nelson, Biological Technician, GS-404-5, EOD 6/17/90,

9. Christopher T. Bryant, YCC Group Leader, GS-186-5, EOD 6/6/91, TFT
10. Jeffrey Huntington, YCC Enrollee, EOD 6/17/91
11. Olivia Huntington, YCC Enrollee, EOD 6/17/91
12. Bill Giese, Volunteer
13. John Giese, Volunteer
14. Kevin Lynch, Volunteer
15. Claudette Lowe, Volunteer
16. John Kurtz, Volunteer
17. Audrey Magoun, Volunteer
18 Kurt Mustian, Volunteer
19. Judi Piepgras, Volunteer
20. Dave Rush, Volunteer
21. Alice Stearns, Volunteer
22. Boy Scouts (3), Volunteers
23. Cheryl Quade, Volunteer
24. Denise Warren, Volunteer
25. 4-H Youths (4), Volunteers

The refuge welcomed new staff at the beginning of the year. Ms. Theresa Williams was selected as a GS-4 Clerk-Typist in January. The fire/furbearer project filled two positions: Tom Paragi was selected for a four year term appointment as a GS-9 Biologist in February, and Pete Reaman, a recent graduate from University of Maine, was hired as a GS-5 Biological Technician in June. Heather Johnson, was appointed to a temporary Park Ranger position in July after working on an intermittent basis for the Regional Office. In September, the staff welcomed Barney Attla who filled the new Maintenance Worker position. Barney was immediately put to work on a never-ending list of projects. At the end of the year, Pete DeMatteo was selected for the ROS-Subsistence position. Pete had spent a year working in the Subsistence office in Anchorage and we feel fortunate to have someone with this experience. ROS/P Liedberg was promoted to a GS-12 dual function pilot position. Due to budget cuts, seasonal Biological Technicians Jenny Lowe and George Wholecheese were placed on intermittent status at the end of the year.

Three employees were recognized for their outstanding achievement this year. Cooperative Education Student Orville Huntington received an award for his good performance. Orville was given several wildlife field guides by the staff before returning to school. RM Stearns was presented with an achievement award by Walt Steiglitz. Mr. Steiglitz also presented Mark Bertram with a letter of recognition for his work with the Boy Scouts.

During the year the staff attended several seminars and workshops in Anchorage.

RM Stearns attended the Project Leader's meeting, an OAS seminar and Cross Cultural Training. RM Stearns and ROS/P Liedberg attended the Draft EIS workshop for subsistence management. WB Bertram participated in a work group to draft a contingency plan for offering guide use areas on the refuges. Pilot Colin Brown, ROS/P Spindler and ROS/P Liedberg attended the FWS and OAS ground school. ROS/P Liedberg, PR Johnson and Kaltag school teacher, Denise Warren participated in an environmental education workshop. WB Johnson attended a one day workshop on the use of Procite, a bibliographic software package.

Several staff members traveled to the lower 48 for other training this year. PR Johnson travelled to Minneapolis/St. Paul for "Setting Environmental Education Directions" workshop given by Office of Training and Education and the annual North American Association of Environmental Education conference. FMO Granger attended Smoke Management Class in California. FMO Granger assisted with teaching a Basic Fire Management Class in April in Region 3, Minnesota. RM Stearns went to Fire Management for Line Officers (development course) training in West Virginia and EIS writing for Refuge 2003 in Washington, D.C. ROS/P Liedberg completed the nine week Law Enforcement Training program in Glynco, GA. RM Stearns and WB Johnson attended Law Enforcement Refresher in Marana.

FMO Granger was detailed to Selawik Refuge in March as acting refuge manager. In September, FMO Granger and family departed for Charles M. Russell Refuge in Montana, where Mike will serve as FMO. After spending 3 1/2 years in Galena, the Granger family will be missed in many ways.

The community welcomed the arrival of David Nelson Spindler, the Peruvian son of ROS/P Spindler and wife Pam Nelson who traveled to Peru in April to adopt him.

Before the start of the busy summer field season, permanent, temporary, seasonal biological technicians, and YCC staff attended an orientation/safety staff training session.

Jeff Huntington and Olivia Huntington served as YCC enrollees this year and Chris Bryant was the Group Leader. With the exception of Olivia Huntington being released from the program for disciplinary reasons in late July, the program was a success.

Complex Manager Stearns has had enough paperwork and is heading to the field.

Refuge Operation Specialist/Pilot Mike Spindler relishes his opportunities in the field and wishes they weren't so few and far between.

Refuge Operation Specialist/Pilot Liedberg had dual function pilot duties incorporated into his position to assist with flying needs of the Refuge.

Airplane Pilot Colin Brown (L) awards Refuge Operation Specialist Pete DeMatteo (R) with the "Flat Tire Award". The tire blew at 60 below.

Fire Management Officer Mike Granger departed for Montana in September after 3 years in Galena.

Wildlife Biologist Buddy Johnson heads the Fire/Furbearer Project. Buddy holds one of 19 marten captured during the project's first year. This project is studying on marten-prey-habitat relationships in post-fire seral stages.

Wildlife Biologist Bertram coordinates the waterfowl, moose and caribou surveys and water contaminant studies on the Complex.

Wildlife Biologist, Tom Paragi contributes his knowledge and field savvy to the Fire/Furbearer Project.

Secretary Maudrey Honea has her work cut out for her as she keeps the refuge budget operating smoothly.

Clerk Theresa Williams works on time/attendance and travel which challenges her sanity.

Bio Tech Pete Reaman gains some good field experience with the Fire/Furbearer Project.

Maintenance Worker Barney Attla hard at work on a never ending list of jobs.

Park Ranger Heather Johnson enjoys talking with students of Hughes about migratory waterfowl.

Biological Technician George Wholecheese preparing the banding site for white-fronted geese on the Koyukuk Refuge near Huslia.

Bio Tech Jenny Lowe with a radio collared marten enjoys field work above all her numerous tasks she performs at the refuge.

Pictured here outside the home in Huslia where he was raised, Orville Huntington worked on our staff as a Cooperative Education Student.

Biological Technician Pam Nelson worked periodically this year on subsistence questionnaires.

This year's YCC Program pictured from left to right YCC Supervisor Liedberg Enrollees Olivia Huntington, and Jeff Huntington, and Group Leader Chris Bryant.

University of Washington graduate student Cheryl Quade is responsible for the small mammal survey for the Fire/Furbearer Project. She also assisted with other aspects of the projects, as pictured here with a radio collared marten.

Cooperative Education Student Orville Huntington receives Special Achievement Award for good performance during his 1990 summer internship.

The Koyukuk/Nowitna Refuge Staff at the safety training seminar in June 1991.

2. Youth Program

The support efforts of our YCC program were appreciated during the short, busy summer season. Group leader Chris Byrant and Enrollees Jeff Huntington and Olivia Huntington were involved in painting refuge equipment and facilities, disassembling the old and installing the new float dock, and other small maintenance projects.

Several members of the refuge staff participated in education sessions with the enrollees. Programs were on refuge fire management with a visit to Alaska Fire Service headquarters in Galena, radio telemetry, conducting a duck brood survey, and identification of plants in the boreal forest habitat. Unfortunately, Olivia Huntington was terminated early from the program.

4. Volunteer Program

Volunteers made a generous contribution to our programs this year. Fifteen volunteers donated over 324 hours, working mostly in the areas of resource support and maintenance. Their skills varied from trail maintenance to technical assistance.

The Fire/Furbearer Project initiated this year received over 126 hours of volunteer efforts. Dr. Audrey Magoun visited staff in May to instruct WB's Johnson and Paragi in the use of Procite, a bibliographical software package. While in Galena, Audrey did a reconnaissance flight of the fire/furbearer study area, and discussed many aspects of the study with the projects' staff. Cheryl Quade, a graduate student conducting small mammal survey for the project, donated 30 hours preparing a representative sample of small mammal study skins and doing related work to benefit the refuge. Bill Geise, a wildlife biological technician at Blackwater NWR in Region 5 and his son John assisted with the construction of a new cabin at the Round Lake study site, and with marten and small mammal trapping. Bill is an experienced trapper and was very interested in that aspect of the study.

Denise Warren, a high school science teacher in Kaltag, received FWS EE training as a refuge volunteer. Denise will serve as part of a refuge/teacher team for presenting EE materials in the area.

Enrollee Jeff Huntington hauls gravel for the nature trail the Refuge created behind the Galena School.

During his visit to Alaska, Volunteer Bill Giese (a Bio. Tech. at Blackwater NWR) helps with cabin construction at Round Lake.

5. Funding

Fiscal year 91 was the first year the Koyukuk and Nowitna Refuges budgets were combined after the two stations were complexed in FY 89. This greatly simplified budget tracking for everyone. The only significant change in subactivities was the addition of the 1221 Subsistence Management fund. These funds were targeted mainly for PCS costs associated with a subsistence ROS position.

The Complex budget shown in Table 1, combines the budgets over the past five years. Previous narratives should be referenced for individual Refuge funding.

Table 1. Koyukuk/Nowitna Refuge Complex Funding, 1987-1991.

Program	FY87	FY88	FY89	FY90	FY91
1221					30,000
1230				15,000	5,000
1241				116,000	
1260	918,000	812,000	927,000		
1261				575,000	708,000
1262			190,000	336,500	295,000
8610	70,000	67,800	48,600	39,500	40,000
9110					61,000
9120					81,700
Totals	988,000	879,800	1,165,600	1,082,000	1,220,700

1221 - Subsistence Management
1230 - Migratory Birds
1241 - Fire Management
1260 - Refuge O&M
1261 - Refuge Operations
1262 - Refuge Maintenance
8610 - Quarters Maintenance
9110 - Fire Program Management
9120 - Fire Presuppression

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. In June, the

CPR, airplane and helicopter safety, and firearms/bear safety. We used a combination of videos from the Regional Library, hands-on demonstrations, and participatory exercises as well as lectures. Monthly safety meetings were held in job-related subjects such as: hypothermia, safety hazards around the office, automobile safety, use of PFD's in all water operations, boat safety, camp safety, gun safety, aircraft propeller strike awareness, airplane pilot pinch-hitting; use of personal protective equipment; and use of aircraft survival kits.

There were no major accidents in 1991 on the Koyukuk or Innoko units. Two employees experienced minor back pains after wrestling snowmobiles in deep snow, but, there was no lost time. One aviation safety incident occurred that was maintenance-related. During take-off from Galena, ROS/P Liedberg experienced failure of an oil seal on the newly-rebuilt Super Cub, N13833. He immediately landed with an obscured windshield and fortunately the only consequence was a very oily airplane. Apparently the engine shop had improperly installed the crankshaft plug in the engine. The incident could have been very serious had it not occurred at the airport. See Section I.7 (Aircraft) for other related aviation safety issues.

The annual station safety certification was completed by ROS/P Spindler on July 26, 1991. Some deficiencies were noted and subsequently corrected. Safety equipment such as fire extinguishers and first aid kits were ordered.

7. Technical Assistance

RM Stearns was detailed to Washington, D.C. to assist in writing the compatibility sections for the Refuges 2003 EIS. He was also detailed to Anchorage to assist with planning the spring closed season migratory birds enforcement efforts in 1992. Pilot Brown assisted Innoko NWR in logistical flying several times during the year because they had no pilot.

Staff assisted in a cooperative ADFG/Galena School project to radio track local foxes, lynx, and bears. RM Stearns trapped a lynx that students fitted with a collar. After a few months in the Galena area, the lynx departed and was found a few months later well east of Ruby, at the mouth of the Nowitna River. A week later, the lynx was repoted near Great Grass Lake, eight miles southeast of the mouth of the Nowitna. WB Bertram and refuge volunteer Kurt Mustian assisted with the collaring of three black bears. The refuge offered to track the bears by aircraft; however, it turned out that all three bears remained near Galena. These radio-tracking projects are excellent for involving students in hands-on field techniques with local wildlife.

8. Other Items

Considerable time was spent this year responding to a request by a Ruby resident to remove a B-17 aircraft from the Nowitna Refuge. Interested parties were made aware of the intent to remove the aircraft and no significant opposition was received by the State Historical Preservation Officer or private individuals. The potential permittee was originally working with the Flying Tigers Air Museum in Florida for restoration. However, this deal fell through and but by the end of the year he had another prospective salvager and restorer. Issuance of the permit will be contingent on a restoration plan and an identified curator.

F. HABITAT MANAGEMENT

1. General

The most conspicuous characteristic of vegetation on the refuge is the complex interspersion of vegetation types. Differences in vegetative cover are caused by soil types, erosion by streams and rivers, permafrost exposure, flooding and fire. There are three broad vegetation types 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 tall to moderately tall 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 tamarack, paper birch and willows and is locally interspersed with treeless bog. These tree species are 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.

2. Wetlands

The rivers in the refuge lowlands are characterized by low gradients, tortuously meandering courses and heavy spring flooding. Flooding during spring is typical and subsidence of the waters frequently continues through much of the summer. The rivers, in particular the Yukon and Koyukuk, carry a heavy silt load at flood stage. Creeks are typically shallow, slow, and meandering with steep banks. Narrow bands of white spruce line the higher banks, while willow and alder thickets are found in the lower areas.

Lake and pond types include upland basin, ice-formed lakes on the flats, river flooded lowlands, oxbows and bog lakes. Spring runoff, rain and river flooding charge lakes, resulting in variable water depths and shorelines from year to year. Depths seldom exceed 15 feet and are usually much shallower. Water temperatures in shallow lakes reach 70°F or more in mid-summer, creating ideal conditions for growth of aquatic plants and invertebrates. Among the aquatic

plants, duckweeds (Lemna), horsetail (Equisetum), water milfoil (Myriophyllum), mare's tail (Hippuris), and smartweed (Polygonum) are abundant. One or more of 12 species of pondweed (Potamogeton) occur in almost all lakes. Bog lakes usually contain water lilies (Nuphar).

Several species of sedge (Carex), bluejoint grass (Calamagrostis), foxtail (Hordeum) and fleabane (Erigeron) provide cover on exposed shorelines. These shallow basins are common along the Koyukuk River and are locally called "grass lakes". They are usually wetlands during spring breakup and during flooding, but otherwise are dry meadows and many have the beginnings of shrub and forest succession. During flooding, sedges and occasionally bluejoint grass, survive as emergent vegetation to water depths exceeding four feet. Shorelines of bog lakes vary in character but nearly always contain buckbean (Menyanthes), wild calla (Calla), and various species of sedge. Cattails (Typha) are found in only a few lakes.

Waterfowl use is related to the type and density of aquatic and shoreline vegetation. Preference is given to lakes with abundant submergents such as pondweeds, water milfoil, and horsetail and those 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 experience gradually receding water levels.

Contaminants

A contaminant study entitled, Investigation of mercury and copper concentrations in fish and wildlife resources on the Koyukuk/Nowitna Refuge Complex, was continued in 1991. See Section D.5. for a description of study objectives. Five watersheds were sampled from June 10-19 and August 28 on the Complex. Keith Mueller, Northern Alaska Ecological services, assisted with sampling in June. Standard water chemistry analyses were conducted at each site including water, sediment, and fish sample collections.

Sampling for this study was previously conducted in 1985, 1987, and 1988. In 1989 we were notified by Ecological Services that elevated mercury levels had been detected in seven of 13 northern pike from three watersheds, one on each refuge. The source of the mercury is not clear, but it is likely related either to historic placer mining activities or a natural source. The level of mercury we detected exceeded in some sites the level at which the U.S. Food and Drug Administration takes a contaminated product off the commercial market.

We felt a responsibility to notify the public regarding our findings because some of

Areas of mining effluent were sampled in 1991 to determine any negative impacts on wildlife and habitat resources. The 1991 contaminant sampling efforts were aimed at identifying areas of elevated heavy metal concentrations, and determining if they were mining-related or naturally occurring.

the drainages testing high for mercury are utilized by subsistence and recreational users. After a discussion with the RO, we posted warning signs at the confluence of each drainage and circulated a radio announcement. The radio announcement was later picked up by AP services and circulated across the state. The Anchorage Times ran an article on the issue. Although interest in the elevated mercury levels was short lived, we were pleased our findings received attention. The high level of concern also prompted Northern Alaska Ecological Services to produce a summary document of findings specific to the Nowitna Refuge from 1985-1988. This document is expected to be final in 1992. Further testing on all three refuges in cooperation with Alaska Health and Human Services, the Alaska Department of Fish and Game, and the State Department of Environmental Conservation is scheduled for 1993.

3. Forest

A study entitled An evaluation of the impact of the spruce beetle on spruce stands and associated plant communities along the lower Yukon River to be conducted by the Institute of Northern Forestry was initiated and funded in 1991. A cooperative contract was completed late in the fiscal year and field work will begin during the summer of 1992.

A general description of forest types is given in Section F-1.

9. Fire Management

Fire suppression activities on the refuge are guided by the Alaska Interagency Fire Management Plan. This plan is based on natural fire cycle in Interior Alaska which ranges from 40 to 120 years. The Seward/Koyukuk Fire Management Plan encompasses the entire refuge. Under this plan, refuge is designated under four management options: critical protection, full protection, modified action or limited action.

The critical protection option is for those areas where fire presents a real and immediate threat to human life and valued property such as villages and fish camps. Areas under this option are given the highest priority by fire suppression forces.

The full protection option is for the protection of cultural and historical sites with high resource values which require fire protection but do not involve the protection of human life and habitation. Only fires in the critical protection area receive a higher priority for suppression resources. Areas under full protection receive initial attack and suppression efforts until the fire is declared out.

The modified action option is given to those areas that require a relatively high level of protection during critical burning periods, but a lower level of protection during the non-critical burning periods when the risk of large damaging fires is diminished. During the critical burning periods, usually May 15 - July 10, fires in "modified action" areas receive aggressive initial attack. If a fire escapes initial attack and requires more than a modest commitment to contain it, an Escaped Fire Analysis is conducted to determine the level of suppression needed relative to the values at risk. Lands in this category are suited to indirect attack, the intent being to balance the acres burned with suppression costs. During the non-critical burning period, "modified action" areas do not receive initial attack of suppression; the intent being to reduce suppression cost and achieve resource management objectives through limited fire activity.

The limited action option recognizes areas where a natural fire program is desirable, or the values at risk do not warrant the expenditures of funds. Suppression actions are undertaken only to the extent necessary to keep a fire within the management unit or to protect higher classified sites within the area. The careful monitoring of fire behavior and fire weather conditions is essential on all fires in limited action areas.

Table 2. 1991 Fire season statistics Koyukuk/Nowitna Refuge Complex

Fire Number	Acreage	Protection Level	Ignition Date	Refuge	Date Out
B241	57,380 FWS 23,760 BLM	L	6/9	Nowitna	9/30
B250	False Alarm	L	6/11		06/11
B491	1,610	L	6/27		8/12
B658	6,540	L	7/3		8/27
B654	3,610	L	7/3		8/10
B211	1	M	6/6	Koyukuk	6/7
B490	3	M	6/27		6/28
B768	11,040	L	9/2		10/7

Table 3. Summary of Complex acreage burned in 1991.

Refuge	Number of Fires	Acreage
Nowitna	4	69,140
Innoko	0	0
Koyukuk	3	11,043
Totals	7	80,183

Refuge fire management goals are to allow natural fires to maintain natural habitat diversity. Without periodic fires, much of Alaska's taiga will grow old and unproductive and the soil layer that seasonally thaws would decrease.

Fire suppression on the Complex is provided by BLM's Alaska Fire Service. Initial attack is done with smoke jumpers and retardant bombers. Helicopters are used to pick up smoke jumpers and to ferry emergency fire fighter crews as needed. A listing of Emergency Fire Fighter wages paid to local villages in 1991 follows: Galena - $113,847, Hughes - $42,425, Huslia - $130,597, Kaltag - $118,865, Koyukuk - $70,177, Nulato - $133,123, and Ruby - $41,334. Firefighting wages in 1991 amounted to 45% of what was paid out in 1990. These wages are important to the local economies, and are often the main cash source for a family for the entire year.

The fire management officer's primary duty during the fire season is to serve as liaison officer with Alaska Fire Service. He is the fire suppression specialist for the refuge manager. Often this requires being an advocate for the refuge's fire management objectives. Even though the FWS is the landowner (and decision maker) there often is pressure from AFS and other political entities to initiate full suppression. The job requires diplomacy and steadfastness.

A prescribed burn (the "Lowe" unit) of 2,000 acres was planned for hazard fuel reduction on the Upper Unit of Innoko Refuge. The objectives of the prescribed burn was to reduce the fuels in an area adjacent to a permitted cabin. The burn was not completed this year. This is the third year since plans were initiated that we were unable to conduct a prescribed burn.

In Alaska, the window is very narrow for conducting prescribed fires. When conditions are conducive for prescribed burning, they are also good for wildfire. In addition, the logistics of trying to conduct a burn 100 miles from refuge

headquarters, inaccessible by road, with costly air support on stand-by, is probably not feasible on a limited budget. In our attempt to return to a natural fire regime, our greatest ally is most often lightning.

Fire management plan boundaries were changed on the Koyukuk Refuge from the modified to limited suppression alternatives prior to the fire season.
FMO Granger and ROS/P Liedberg held consultation meetings with the Alaska Fire Service, Gana 'A Yoo Village Corporation, Regional FMO, Bureau of Indian Affairs, and village representatives from Huslia and Koyukuk - the two villages most affected by the change.

Approximately 320,000 acres of the Koyukuk Refuge were converted to the limited suppression category. This change was made based on the limited value of resources and the absence of structures or other improvements in the area.

A review of the Koyukuk/Nowtina fire program was done by FMO Vanderlinden (Tetlin NWR) in June. Four aspects of the refuge fire program were reviewed: 1) Opportunities for fire management on the refuge; 2) On-going refuge fire research and monitoring projects; 3) opportunities for fire fuel break construction; and 4) opportunities for prescribed burning for habitat benefit.

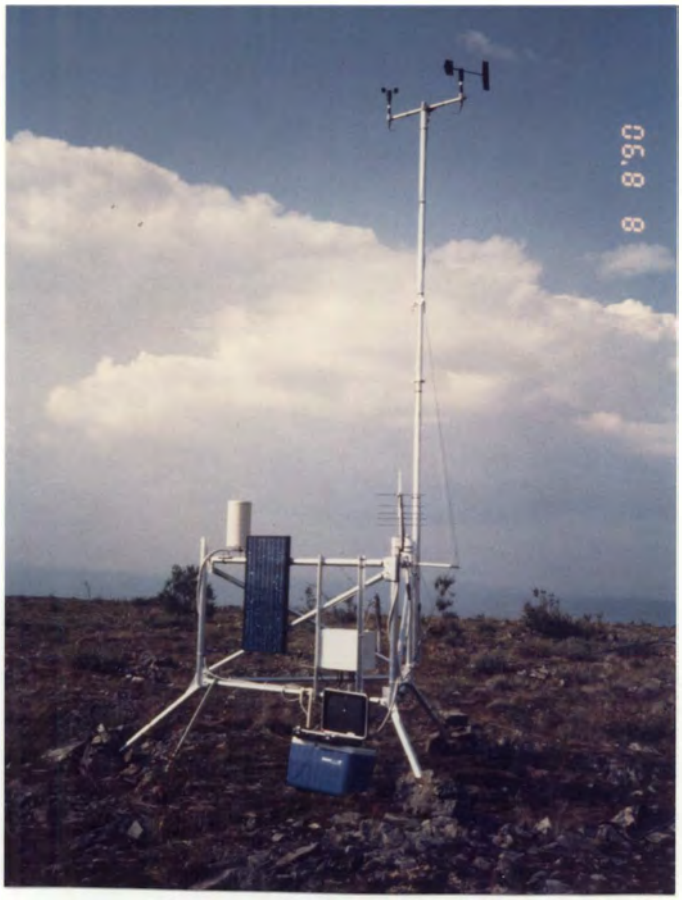
These four aspects were applied to the following six issues:

1. Is the fire management program on track on the Koyukuk/Nowitna NWR?
2. Is the FMO position needed at Koyukuk/Nowitna NWR?
3. Should a prescribed fire program be pursued at Koyukuk?
4. Has adequate support been provided to other refuges (Selawik, Innoko)?
5. What can be done to improve the fire management program at Koyukuk? Are there any opportunities that have been overlooked?
6. Are the fire effects research efforts redundant? Is there duplication between the fire effects study and on-going fire effects monitoring?

FMO Vanderlinden made recommendations on these issues which included: amending fire management plans and prescribed burn strategies, developing better defined agreements with Innoko and Selawik Refuges on the shared FMO responsibilities, and increase refuge staff interaction with AFS at all levels of their suppression operations. FMO Vanderlinden also commented on ongoing fire effects research projects.

The review provided a good opportunity to review our fire management program and make some appropriate changes to improve its effectiveness.

Two Remote Automated Weather System (RAWS) units were set up during the



Two remote automated weather station (RAWS) that was installed on VABM Octopus, 39 mi northwest of Huslia and at Hog River Mine, along the north boundary of the refuge.

An unusually late fire in September on the Koyukuk Refuge (Holndaktna Creek. Total acreage burned on the Koyukuk was 11,000 compared to 69,000 on the Nowitna in 1991.

year with the assistance of AFS technicians and helicopters. One unit was placed at the Selawik Refuge administrative cabin site at Upinnigvik and the second at VABM Octopus on the northwestern portion of the Koyukuk Refuge. An additional unit was purchased and will be placed within the fire-furbearer study area on the Nowitna Refuge in 1992. These RAWS units are part of a statewide network used by the NWS in making statewide, local, and spot weather forecasts that can be accessed by BLM, NPS, FWS, and AFS.

A study entitled The effects of fire on wildlife populations was completed in 1991. The objectives of the study were to:

1. Determine vegetation changes and successional sequences caused by fire.

2. Determine small mammal, furbearer, avian, and moose population changes caused by fire.

The study area was near the Hog River administrative cabin and included three sites. Two sites were in an area burned during the summer of 1986, one in the middle and the other along the perimeter of the burn. The third site was a control site.

BT Lowe summarized bird, small mammal and vegetation data. Several interesting findings were that the total number of birds observed in burned transects was greater than in unburned transects (362 vs. 201), while the number of species was greater in the unburned versus burned transects (23 vs 18). Small mammal trapping showed that in 1988 both burned and unburned habitats peaked in numbers, unburned transects being slightly higher. The numbers fell off rapidly in 1989; however, total catch in the burned areas was double that of the unburned transects. Vegetation species lists were prepared, but we have yet to analyze quantitative data.

12. Wilderness and Special Areas

The 400,000 acre 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). The Koyukuk Wilderness surrounds the geologically unique Nogahabara Sand Dunes and the Three Day Slough. It is theorized that the dunes are wind-blown deposits of sand that originated in glaciated areas to the northwest and were deposited in the unglaciated Koyukuk area. Three Day Slough contains several large meanders of an old Koyukuk River channel which represent the Complex's best moose habitat with the densest concentrations of moose (and moose hunters).

G. WILDLIFE

1. Wildlife Diversity

The Koyukuk National Wildlife Refuge has high diversity of habitat types primarily resulting from a rich fire history. 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 19 fish species are thought to occur on refuge lands.

To compare phenology among years, records of annual spring arrival dates for common and conspicuous birds were summarized (Table 4). In 1991, waterfowl arrived earlier than usual, which is similar to the pattern observed in 1990. Songbirds, with the exception of olive-sided flycatcher, also arrived earlier than normal in 1991, but differed from the 1990 pattern, in which they arrived later than normal.

Table 4. Arrival dates of common birds at Galena, Alaska 1982-1991.

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

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

2. Endangered and/or Threatened Species

The American Peregrine Falcon is the only endangered species known to occur on the Koyukuk Refuge. Fourteen nests were monitored in 1991 in or near the refuge. A discussion of peregrines observed in the raptor survey is included in Section G.6.

3. Waterfowl

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

Waterfowl inventories conducted on the Koyukuk NWR in 1991 included duck, goose, and swan production surveys. Duck breeding pair counts are conducted annually by the Division of Migratory Birds, Juneau. Swan nesting surveys and fall production surveys were first initiated in 1986, and have been repeated annually.

Weather Conditions and Waterfowl Migration Chronology

Break-up on the upper Koyukuk River in 1991 occurred in early May with break-up at Huslia occurring in mid-May. By late May, all but the largest lakes were ice-free. Major flooding transpired in most of the drainages and extensive ice-jam flooding occurred between the Dulbi River and Treat Island. The Koyukuk River floodplain includes prime waterfowl nesting grounds and was underwater through most of June. As a result of extensive flooding during and following breakup nesting waterfowl did not fare well in 1991.

Duck Brood Surveys

Waterfowl brood surveys have been conducted on the Complex since 1983. Since 1990 the refuge has participated with the Division of Migratory Birds in a state-wide waterfowl production survey. The Koyukuk and Northern Unit of the Innoko refuges are part of Koyukuk Production Unit Six under this survey system (see Figure 3). Also included in Production Unit Six is the Kanuti Refuge and BLM lands.

Sampling schemes and methods varied until 1990, when they were standardized. The Koyukuk Refuge was initially stratified in 1986 into high, medium, and low density strata based on amount of water. In 1990, the Northern Unit of the Innoko Refuge was similarly stratified and the Koyukuk Refuge was re-stratified. The refined stratification technique used color infra-red CIR photos instead of topographic maps originally used in 1986. All one-square mile sections within refuge boundaries were classified as habitat or non-habitat based on the presence

or absence of water. Plots within waterfowl habitat were then assigned to one of three strata representing expected waterfowl density (low, medium, or high). Density was based on the amount of water and the presence or absence of bog habitat as determined by distance to the plot from the nearest river-connected waterway.

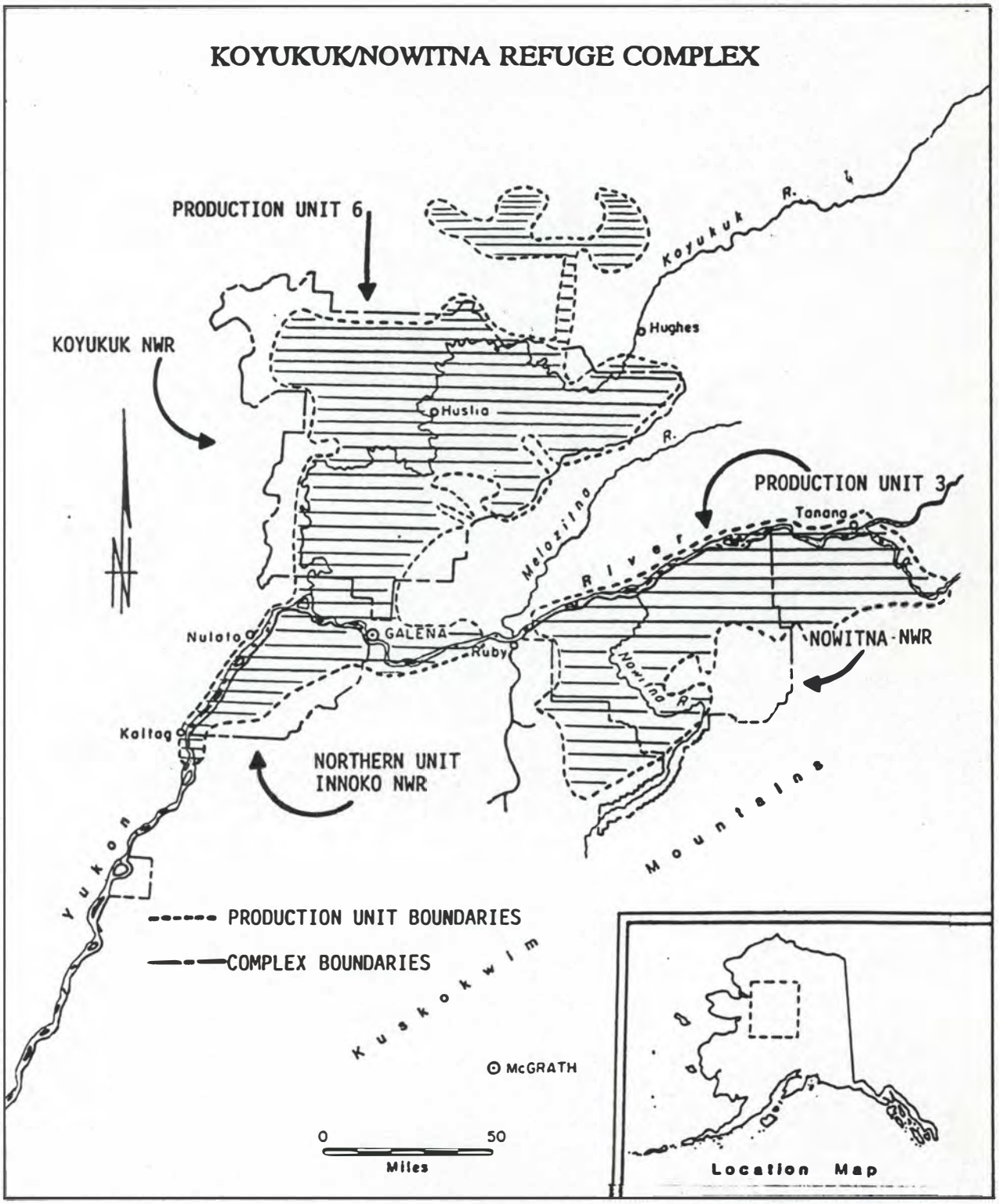


Figure 3. Location of waterfowl production units in the Koyukuk/Nowitna Refuge Complex, Alaska, 1991.

A Cessna 185 and two PA-18's, both equipped with floats, provided access into medium and high density strata plots. All low density stratum plots were accessed and surveyed by helicopter. All medium and high density strata plots were surveyed by canoe, walking, or both. Total time to conduct surveys in 1991 was 25 days compared to 18 days in 1990. Duck production surveys were delayed in 1991 due to weather and aircraft maintenance. However, all ground brood plots were surveyed by August 2nd. Helicopter surveys of low density plots did not fare as well. Although helicopter surveys completed 10 of 11 plots on the Koyukuk and Northern Unit of the Innoko refuges, work was not completed until August 2nd, after the majority of ground plots were completed. Our objective to survey helicopter plots in the same time frame as ground work was not met.

Four hundred and twenty-three broods were observed during waterfowl production surveys on the Koyukuk and Northern Unit of the Innoko refuges between July 8th-August 2nd. Total brood observations were down 33% compared to 1990. Dabbling duck broods accounted for 74% of the observations. As in past years, the most commonly observed dabbler brood was American wigeon and the principal diving species was scaup.

An estimated 20,718 duck broods were produced on the Koyukuk and Northern Unit of the Innoko refuges in 1991 (Table 5). The coefficient of variation (or CV = variation relative to the means of the sample) for this estimate was 0.24. Dabbler brood estimates were highest for American wigeon (n=5,711, CV=0.25), mallard (n=2,459, CV=0.22), and green-winged teal (n=2,152, CV=0.36). Diver brood estimates were highest for scaup spp. (n=3,813, CV=0.48). Surf scoters were the most numerous sea duck with expanded brood estimates of 1,837 (CV=0.58). Total brood estimates were down 39% compared with 1990 estimates. Estimated broods for dabblers were 13,706 (CV=0.22) and for divers 4,579 (CV=0.40), both down 22% and 61%, respectively, from 1990 estimates.

Production appears to be directly linked with the timing, extent, and duration of flooding on the Koyukuk and Yukon River corridors. Flooding of adjacent nesting grounds near the Koyukuk River corridor lasted into late June in 1991 and had a great impact on production, especially divers. This year was very similar to 1989, in which flooding persisted into late June and resulted in total production decreases of 68%.

The production estimate for all species in 1991 was 93,520 ducklings (Table 5). The coefficient of variation for this estimate was 0.23 and the 90% confidence level was $\pm$ 38%. Dabbler production estimates were highest for American wigeon (26,392), mallard (10,974), and green-winged teal (8,871). Diver production estimates were highest for scaup spp. (59,251) and goldeneye spp. (3,948). Surf scoter young estimates were 20,160. Dabbler production was

estimated at 59,325 and diver production at 21,890, both down 34% and 72%, respectively, from 1990 estimates. Although total production appears to be down 53% compared to 1990, it should be noted that total production estimates for 1990 were imprecise with a CV of 0.60 and a 90% confidence level of $\pm$ 99%. A major objective of the survey was to obtain a coefficient of variation equal to or less than 15% for estimated broods and young (roughly $\pm$ 30% at the 90% Confidence Level). The CV for all estimated duck broods for all strata sampled decreased markedly from 0.57 in 1990 to 0.24 in 1991 due to increased sampling in the low density stratum. We will again attempt to increase our sampling of the low density stratum in 1992 with the intent of reducing overall strata variation to 15%.

Over 53% of dabbler ducklings observed were aged as Class 1C and 2A, 12% Class 1A and 1B, 19% Class 2B and 2C and 16% Class 3. Diver Class 1 composition was 70%. Another major objective of the survey was to maximize observations of Class 1C and 2A dabblers and Class 1 divers on all refuges. This objective was met on the Koyukuk and Northern Unit of the Innoko refuges with 53% dabbler Class 1C and 2A observed and 70% diver Class 1 observed. It would appear that early survey delays may have aided to maximize observations. Phenological criteria have not yet been developed to prompt initiation of brood surveys, but this will be a priority in 1992.

Adult population estimates by species were also made but should be interpreted with caution (Table 6). Although most dabbler estimates increased in 1991, the variance was extremely high (CV=0.51). This was due to very high variance among plots in the low density stratum (CV=0.73). However, divers exhibited a comparably low variance of 0.27 and may provide more reliable adult population estimates. Although most adult diver species increased in 1991; scaup, which comprise over 85% of the estimated adult diver population, decreased by 44%. Total population estimates for adult divers decreased by 43% in 1991. Total adult estimates in 1990 and 1991 were 84,000 and 90,000, respectively.

Due to the high variance among adult dabbler estimates, the collective plot sample was analyzed for abundance of observed adults in 1990 and 1991 in hopes of obtaining more reliable adult trend information. Thirty-eight plots were compared for abundance of observed adults in 1990 and 1991. Fewer adult dabblers were observed in 1991 (range -4% to +38%, mean -16%) with the exception of green-winged teal which increased 32%. All diver observations increased (range +3% to +700%, mean +16%) in 1991 with the exception of bufflehead which decreased 63%. Sea duck observations more than doubled in 1991. Overall adult observations increased 9% in 1991 (Figure 4).

Production during 1988-1991 ranged from a low of 62,648 in 1989 to a high of 199,155 in 1990 (Table 6). See Figure 5 to compare production of ducklings on the Koyukuk and Northern Unit of the Innoko refuges since 1988. Total cost for the production surveys was $29,624.79.

We assisted Kanuti Refuge in 1991 in a study entitled, Helicopter versus ground counts in waterfowl production surveys in interior Alaska. The objective of the study was to compare duck observations between ground and helicopter surveys and determine if one method was more effective over the other. The results of this study compiled from 1990 were inconclusive due to insufficient sample size. Results from 1991 have not yet been summarized.

The Koyukuk Refuge has an active banding program for Northern pintails. We had limited success in 1991, banding 30 pintails, 32 green-winged teal, and one wigeon.

Table 5. Estimated broods by species with coefficient of variation, Koyukuk NWR and Northern Unit of the Innoko NWR (Kaiyuh Flats), Alaska, 1990-1991.

	Total Broods			
Species	1991	1990	1989	1988
Wigeon	5,711 (0.25)	7,790 (0.36)	5,874 (0.50)	11,138 (0.28)
G-W Teal	2,152 (0.36)	3,411 (0.41)	3,943 (0.53)	5,941 (0.30)
N. Pintail	1,601 (0.31)	2,504 (0.56)	284 (0.46)	4,606 (0.35)
N. Shoveler	1,783 (0.58)	1,522 (0.50)	89 (0.59)	1,010 (0.85)
Mallard	2,459 (0.32)	2,413 (0.36)	1,423 (0.64)	2,402 (0.55)
DABBLERS	**13,706 (0.22)**	**17,641 (0.32)**	**11,613 (0.53)**	**25,097 (0.35)**
Canvasback	371 (0.92)	0 (0.00)	95 (1.00)	350 (1.00)
Scaup spp.	3,813 (0.48)	10,277 (0.92)	713 (0.55)	3,909 (0.42)
Ring-necked	162 (0.66)	49 (1.00)	0 (0.00)	740 (0.90)
Goldeneye spp.	78 (0.68)	752 (0.91)	0 (0.00)	740 (0.90)
Bufflehead	155 (0.56)	803 (0.86)	212 (0.59)	1,033 (0.67)
Redhead	0 (0.00)	0 (0.00)	60 (0.58)	24 (0.97)
DIVERS	**4,579 (0.40)**	**11,882 (0.84)**	**1,080 (0.60)**	**6,796 (0.61)**
Oldsquaw	0 (0.00)	0 (0.00)	16 (0.93)	408 (0.44)
Surf Scoter	1,837 (0.58)	392 (0.51)	76 (0.39)	1,789 (0.44)
Black Scoter	0 (0.00)	125 (0.87)	1,074 (0.49)	948 (0.48)
W.W. Scoter	0 (0.00)	0 (0.00)	76 (0.66)	455 (0.48)
Common Merganser	14 (1.00)	0 (0.00)		
R.B.Merganser	49 (1.00)	0 (0.00)		
Unknown	205 (0.47)	53 (0.45)	123 (0.79)	737 (0.67)
TOTALS	**20,718 (0.24)**	**34,074 (0.56)**	**14,058 (0.45)**	**36,230 (0.25)**

Table 6. Estimated young and adults by species with coefficient of variation, Koyukuk NWR and Northern Unit of the Innoko NWR (Kaiyuh Flats), Alaska, 1988-1991.

	Estimated Young[1]				Estimated Adults[1]	
	1991 (CV)	1990 (CV)	1989[2] (CV)	1988[2] (CV)	1991 (CV)	1990 (CV)
Species						
Wigeon	26,392 (0.26)	40,292 (0.44)	22,619 (0.56)	48,084 (0.29)	41,121 (0.67)	23,906 (0.27)
G-W Teal	8,871 (0.38)	20,495 (0.42)	19,039 (0.64)	21,123 (0.35)	7,832 (0.50)	5,401 (0.29)
N. Pintail	6,855 (0.29)	9,541 (0.48)	1,448 (0.44)	17,353 (0.33)	8,059 (0.63)	3,751 (0.46)
N. Shoveler	6,233 (0.61)	7,394 (0.48)	505 (0.62)	2,955 (0.76)	2,055 (0.47)	4,873 (0.31)
Mallard	10,974 (0.32)	12,487 (0.44)	8,128 (0.67)	7,402 (0.55)	6,675 (0.32)	5,794 (0.17)
DABBLERS	**59,325 (0.22)**	**90,209 (0.29)**	**51,739 (0.60)**	**96,917 (0.34)**	**65,742 (0.51)**	**43,724 (0.22)**
Canvasback	1,892 (0.91)	0	290 (0.99)	1,030 (0.98)	400 (0.86)	26 (1.00)
Scaup spp.	18,489 (0.49)	71,787 (0.94)	3,634 (0.47)	23,209 (0.40)	12,688 (0.29)	22,632 (0.39)
Ring-necked	479 (0.60)	393 (1.00)	0	6,122 (0.83)	309 (0.55)	49 (1.00)
Goldeneye spp.	290 (0.63)	3,132 (0.88)	0	2,628 (0.72)	1,285 (0.64)	878 (0.79)
Bufflehead	741 (0.62)	3,553 (0.86)	691 (0.70)	5,078 (0.65)	317 (0.40)	2,920 (0.40)
Redhead	0	0	297 (0.59)	116 (0.57)	0	0
DIVERS	**21,890 (0.41)**	**78,866 (0.88)**	**4,852 (1.00)**	**38,183 (0.54)**	**14,999 (0.27)**	**26,505 (0.36)**
Oldsquaw	0	0	60 (0.95)	1,398 (0.49)	0	0
W.W. Scoter	1,825 (0.62)	27,242 (0.98)	505 (0.78)	4,281 (0.48)	1,276 (0.58)	9,879 (0.90)
Surf Scoter	9,242 (0.55)	1,842 (0.50)	373 (0.44)	8,912 (0.41)	7,183 (0.66)	2,010 (0.59)
Black Scoter	0 (0.00)	772 (0.96)	4,816 (0.57)	4,687 (0.59)	735 (0.94)	767 (0.61)
C. Merganser	14 (1.00)	0	0	0	28 (1.00)	9 (1.00)
R.B.Merganser	246 (1.00)	0	0	0	49 (1.00)	0
Unknown	978 (0.48)	225 (0.47)	243 (0.66)	877 (0.59)	204 (0.47)	1,554 (0.89)
TOTALS	**93,520 (0.23)**	**199,155 (0.60)**	**62,648 (0.49)**	**155,255 (0.24)**	**90,217 (0.41)**	**84,448 (0.25)**

[1] Sampling strategies differed from 1988-90; production estimates are provided from previous years for general trend comparisons only.

[2] During 1988-89 Kaiyuh Flats was not stratified and had total CV's of 0.48 and 0.66. CV on the stratified Koyukuk Refuge during these years was much lower with a mean CV of 0.37.

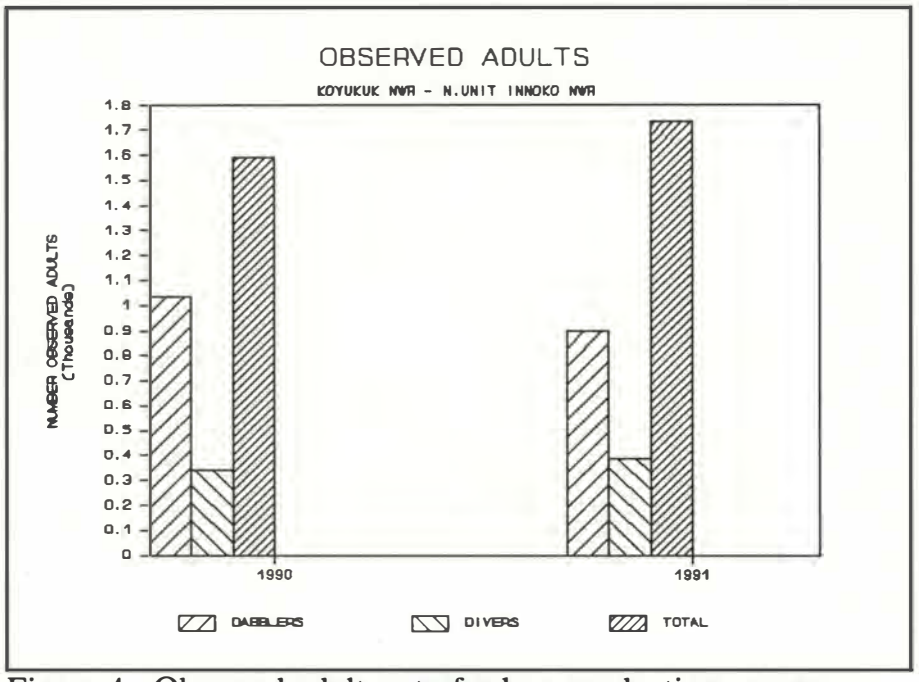


Figure 4. Observed adult waterfowl on production surveys, Koyukuk NWR and Northern Unit of the Innoko NWR (Kaiyuh Flats), Alaska, 1990-1991.

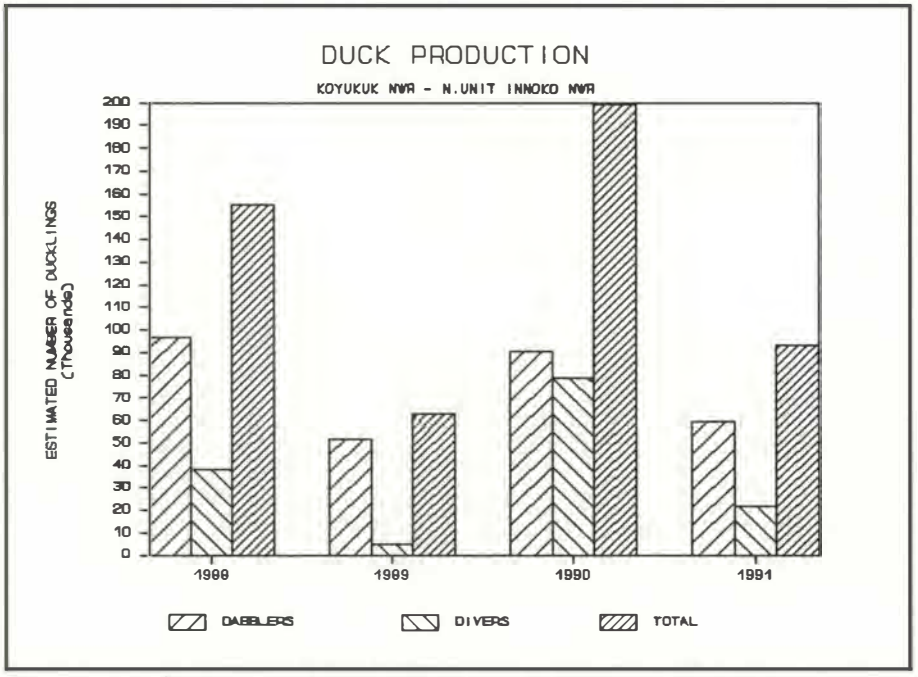
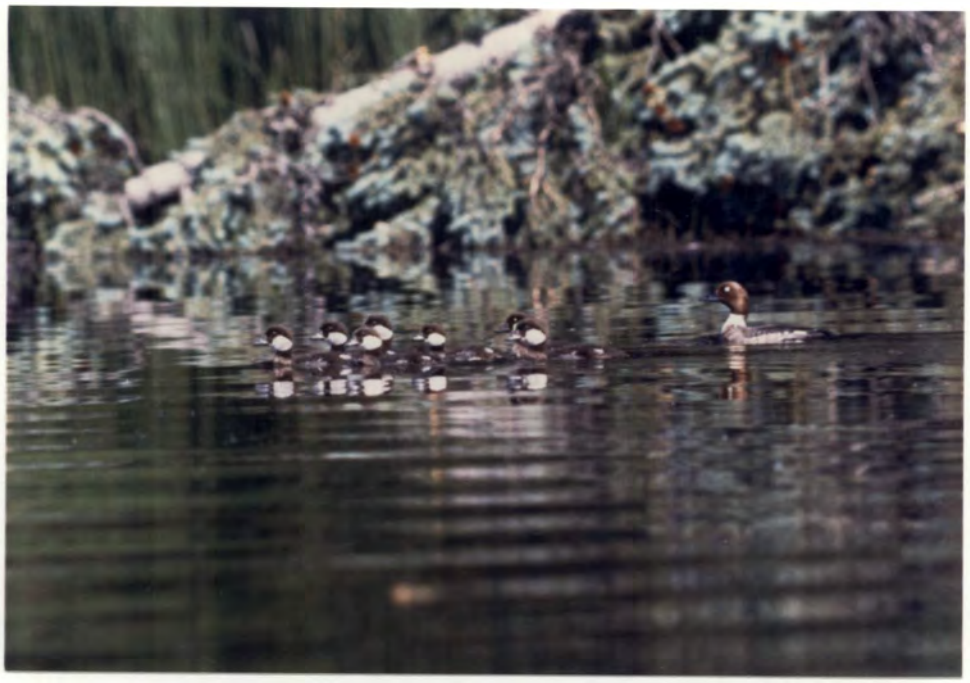


Figure 5. Comparison of estimated waterfowl production on the Koyukuk NWR and Northern Unit of the Innoko NWR, (Kaiyuh Flats), Alaska, 1988-1991.



Extensive flooding of adjacent nesting ground in 1991 near the Koyukuk River corridor resulted in a 68% decrease in total duck production compared to 1990. Total production was estimated at 93,500 and total adult population was estimated at 90,000 in 1991.

YCC Enrollee Jeff Huntington pre-baits a pintail banding site at Willow Lake with cracked corn and oats. Capture methods include rocket nets and swim-in traps.

Goose Production

Goose production surveys have been conducted on the Dulbi River and Dubli Slough since 1984 and 1986, respectively (Figures 6 and 7). On June 24-26 production surveys for white-fronted geese and Canada geese were conducted along the Dulbi River and Dulbi Slough. Both waterways were surveyed to assess goose production as well as to document other wildlife. All geese observed were tallied and recorded by species, sex, and age-class when possible. Six hundred ninety-five adult and 29 gosling white-fronted geese plus 181 adult and 30 gosling Canada geese were observed along 56.75 miles of the Dulbi River. Observations of white-fronted adults and goslings were up 242% and 101%, respectively, in 1991. However, observations of Canada adult and goslings were down 65% and 60%, respectively. On the 69 mile stretch of Dulbi Slough, 570 adult and 52 gosling white-fronted geese plus 13 adult Canada geese and no goslings were observed . White-fronted adult and goslings were down 68% and 88%, respectively. Canada adult and goslings were also down 57% from 1990. Lack of goose production on the Dulbi Slough is likely due to the extended flooding conditions of the Dulbi Flats which lasted into mid-July.

Swan Production

Much of the Koyukuk NWR is located on the transition between tundra and taiga, so it is not surprising that 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 known that a few tundra swans did nest 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 prior years, a few selected "trend maps" were surveyed to monitor trends in swan population and production. On the Koyukuk Refuge, there was an increase in numbers of young produced, numbers of paired swans, and mean brood size, while the numbers of flocked and singles and breeding effort remained the same between 1990 and 1991 (Figures 8 and 9). In the Kaiyuh Flats, between 1990 and 1991, there was an increase in cygnet production, pairs, and non-breeding swans (flocked and singles), but a slight decrease in mean brood size and breeding effort (Figures 10 and 11).

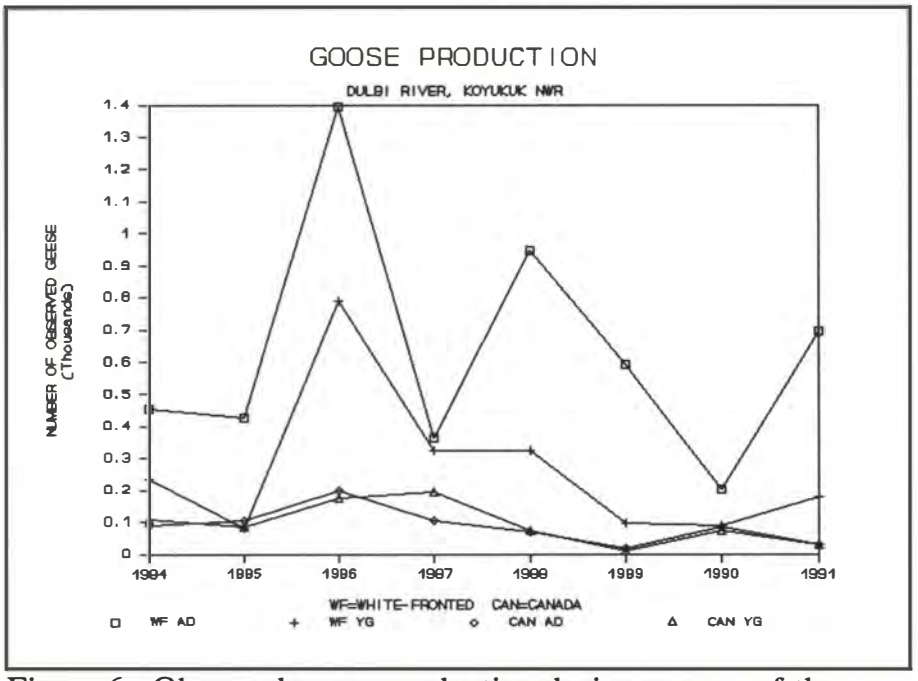


Figure 6. Observed goose production during surveys of the Dulbi River, Koyukuk NWR, Alaska, 1984-1991.

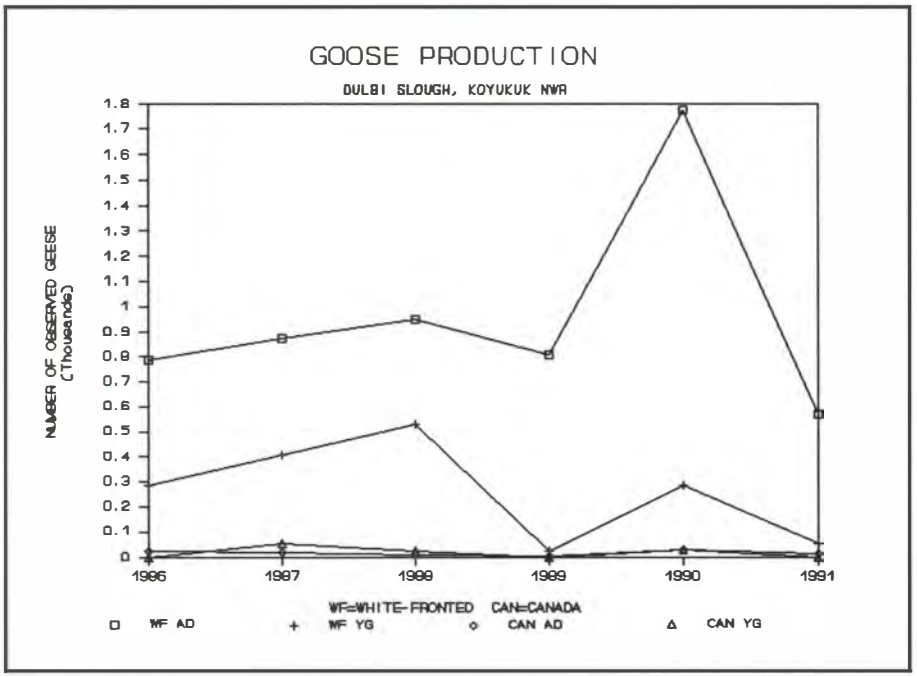


Figure 7. Observed goose production during surveys of the Dulbi Slough, Koyukuk NWR, Alaska, 1986-1991.

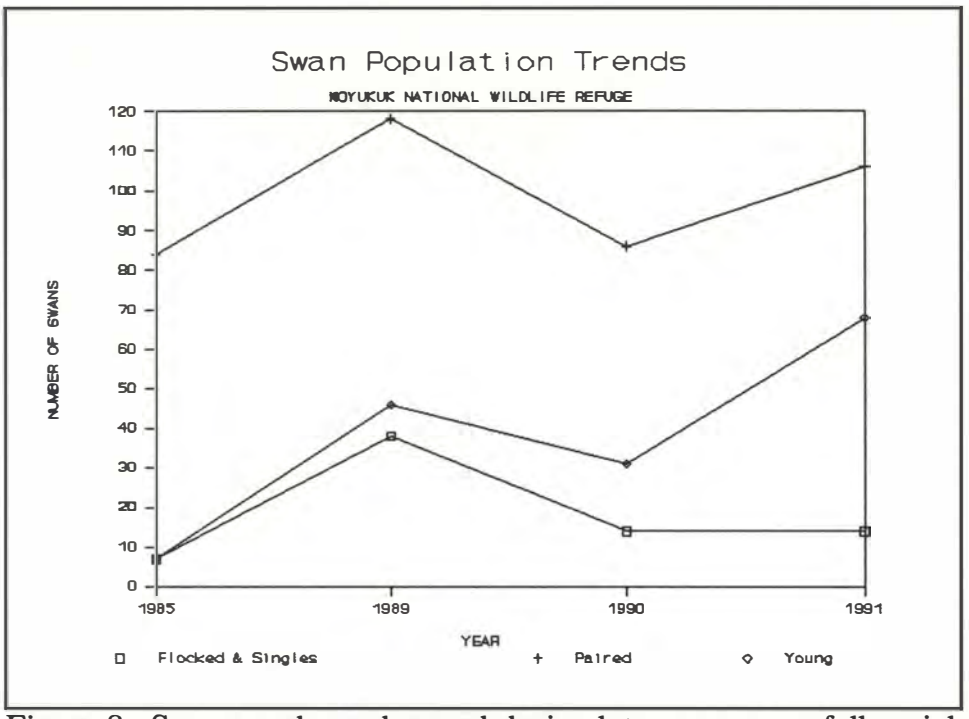


Figure 8. Swan numbers observed during late summer or fall aerial surveys of the Kateel River A2, C1, D1, and D3 maps.

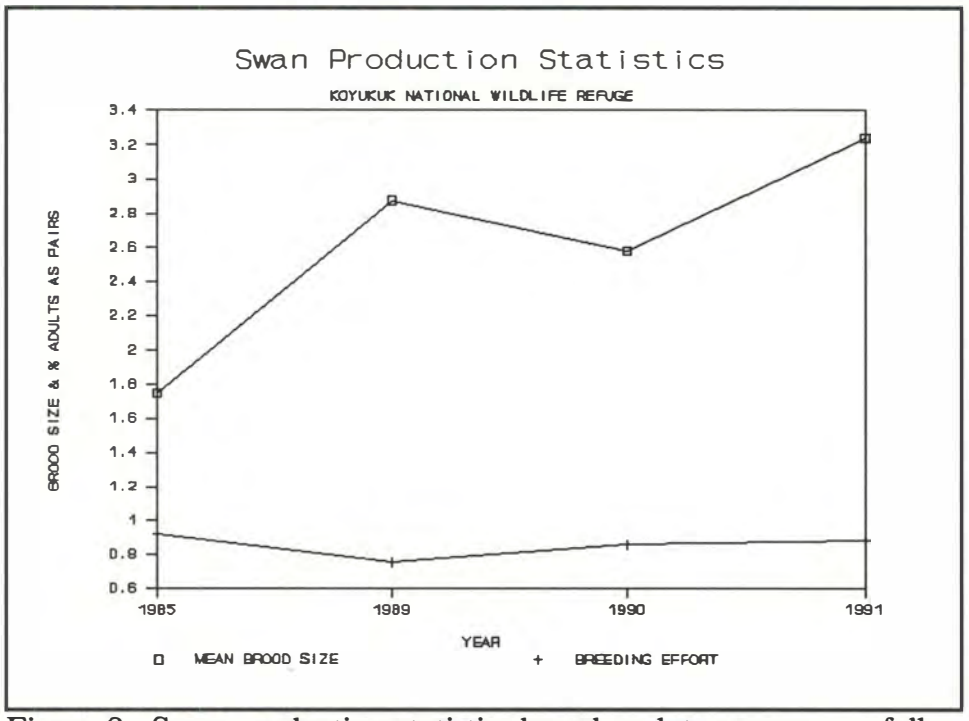


Figure 9. Swan production statistics based on late summer or fall surveys of the Kateel River A2, C1, D1, and D3 maps.

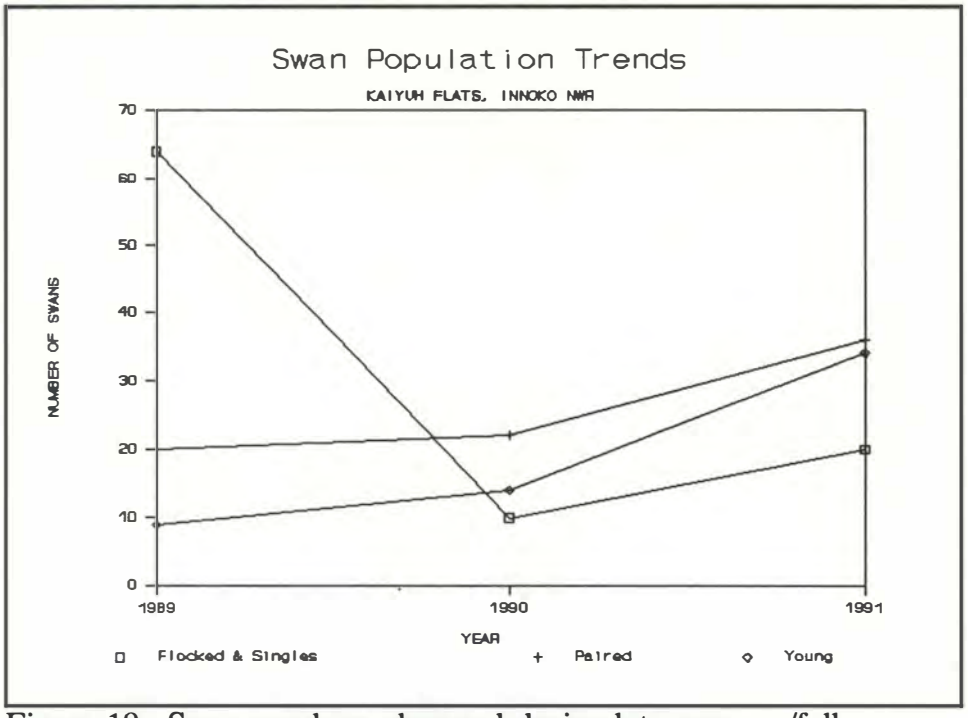


Figure 10. Swan numbers observed during late summer/fall aerial surveys of the Nulato B4 and B5 trend maps.

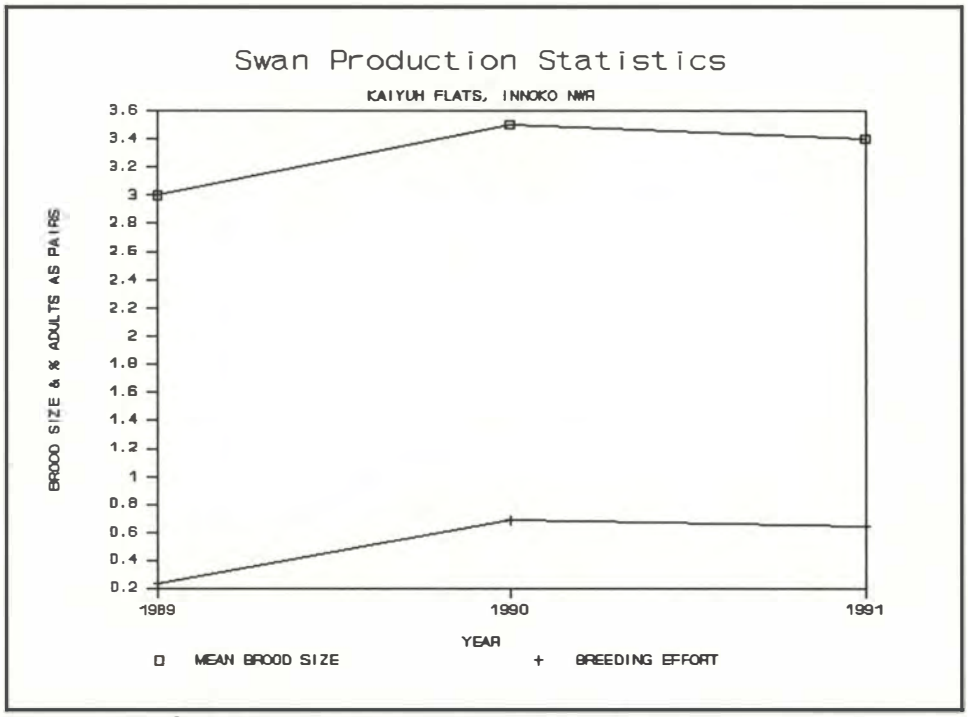


Figure 11. Swan production statistics based on late summer/fall surveys of the Nulato B4 and B5 trend maps.

Goose production surveys conducted on the Koyukuk Refuge in 1991 showed observations of white-fronted adults and goslings were up 242% and 101% on the Dulbi River, respectively in 1991, while adults and young were down 68 and 88% on Dulbi Slough, respectively. The great difference was likely due to flooding on the latter location.

This molting tundra swan was photographed while conducting waterfowl surveys. Both tundra and trumpeter swans breed on the Koyukuk Refuge. Swan breeding pairs and production increased slightly on the Koyukuk and Kaiyuh units in 1991 as compared to 1990.

4. Marsh and Water Birds

Common, Pacific and red-throated loons; red-necked and horned grebes; and sandhill cranes are common on the refuge. Yellow-billed loons are noted as occasional.

5. Shorebirds, Gulls, Terns, and Allied Species

Numerous species of shorebirds inhabit the refuge. These species include: lesser and greater yellowlegs, Arctic tern, glaucous gull, mew gull, Bonaparte's gull, herring gull, long-tailed jaegar, semipalmated plover, common snipe, spotted sandpiper, least sandpiper, pectoral sandpiper, solitary sandpiper, northern phalarope, Hudsonian godwit, and whimbrel.

6. Raptors

The refuge has nesting populations of rough-legged hawks, merlins, sharp-shinned hawks, northern harriers, red-tailed hawks, goshawks, great horned owls, great gray owls, boreal owls, northern hawk owls, peregrine falcons, and bald eagles.

A raptor survey was conducted on the Yukon and lower Koyukuk rivers from June 22-July 10 in cooperation with Peter Bente, USFWS - Endangered Species Office, Fairbanks, and Tim Osborne, ADFG Biologist. The purpose of the annual survey is to ascertain general trends in raptor numbers. This survey had been conducted independently by the Endangered Species Office since 1979 to document peregrine falcon use of the Yukon River. During the survey, 14 active peregrine nest sites were visited between Galena and Kaltag. Adults were captured using harnessed pigeons with foot snares. Three adults were captured, banded, and morphological information was recorded. Fourteen nest sites were visited and 26 young were banded. According to Bente nest fidelity is strong in the area between Galena and Kaltag and most of the available habitat is filled. The general trend in peregrine abundance is up in recent years. Other sightings during the survey included one rough-legged hawk nest (breeding pair present), two Harlen's hawk nest sites (two breeding pairs present), a defensive pair of breeding merlins (no nest observed), one sharp-shinned hawk, and one red-tailed hawk were also observed.

7. Other Migratory Birds

Numbers and species composition of passerine birds fluctuate with the seasons. Common and hoary redpolls, common raven, black-capped and boreal chickadees,

Red-necked grebes are very common nesters on the Refuge because of the high proportion of bog habitat on the Refuge.

Peter Bente, USFWS Endangered Species, Fairbanks, holds an adult peregrine falcon which was captured during the annual raptor survey on the Yukon River. A total of 14 nest sites were visited and 26 young were banded.

and pine grosbeaks are common winter residents. In contrast, species commonly seen in the spring and summer include alder flycatcher, olive-sided flycatcher, tree swallow, gray jay, robin, gray cheeked thrush, Bohemian waxwing, yellow warbler, rusty blackbird, savannah sparrow, dark-eyed junco, tree sparrow, white-crowned sparrow, fox sparrow, Lincoln's sparrow, and song sparrow. In 1991, refuge staff assisted with the Breeding Bird Survey for nongame species in the Galena area. Two routes were surveyed: the Galena road system (dike road and Campion road), and the Bear Creek/Crow Creek route. These two routes have been surveyed since 1985 by the ADFG area biologist.

On December 22, refuge staff participated with ADFG and local Galena residents in the annual Christmas bird count (Table 7). Record numbers of ravens, redpolls, and black-capped chickadees were seen, but there was also a greater effort in terms of party hours and participants in 1991, as compared to previous years. It was also the coldest count day on record, although temperatures rose steadily throughout the day, and ended in the -20°F range.

Table 7. Results of the Galena Christmas Bird Count, 1982-91.

Species	Year									
	1982	1983	1984	1985	1986	1987	1988	1989	1990	1991
Northern Goshawk	2						1		cw[1]	2
Willow Ptarmigan	cw		cw		cw	5	23	6	44	cw
Spruce Grouse			2					2		
Ruffed Grouse						3	6	3		
Hawk Owl	1						1			
Great Gray Owl			cw	cw	1		1			1
Great Horned Owl							cw			
Downy Woodpecker			2		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
Common Raven	206	152	121	240	230	276	334	226	225	391
B.C. Chickadee	5	2	13	11	10	10	30	3		34
Boreal Chickadee	7	1	20	41	1	9	58	3	8	30
Siberian Tit			2							
Northern Shrike			cw							
Snow Bunting		cw			20	80				
Pine Grosbeak	1	28	13	7			2	40	cw	6
W.W. Crossbill			50						2	
Common Redpoll	65	74	144	101	19	102	45	153	15	244
Total Species	8	6	10	7	8	8	12	9	9	12
Participants	4	2	6	5	4	4	5	9	9	15
Party Hours	14	10.5	22	17	11	10.5	21	23.7	27.7	29
Party Miles	94	76	121	69	65.5	48	137	134	86.5	122.5
Lowest Temp.	-10	18	18	25	-40	25	20	-35	-42	-52

[1] cw=seen during count week

8. Game Mammals

Moose, caribou, black and grizzly bear, wolf, marten, beaver, wolverine, lynx, otter, red fox, and snowshoe hare are found throughout the refuge. Moose, caribou, and black bear are commonly the most harvested game mammals by subsistence and sport hunters. Marten and beaver are the most economically important furbearers.

Moose

Moose are the most important game and subsistence mammal on the Complex. They are found in almost all habitats, but are most numerous in the riparian habitat. Historically, moose were first reported in this area in the early 1940's.

Three major projects concerning moose were conducted during the year. The moose calf mortality study was completed in May, an ADFG-manned hunter check station was operated on the lower Koyukuk River at Ella's cabin during the September hunting season, and population trend surveys were conducted in November. Moose hunting and the hunter check station are discussed in Section H.8.

A. Moose calf mortality study

In response to a decline in the Nowitna moose population in 1986, the Nowitna Refuge staff initiated a three year telemetry study to identify the causes and extent of moose calf mortality and to determine if calf mortality could be responsible for the observed decline in the population. This study was amended to include the Koyukuk Refuge in 1990. Annual moose surveys on both refuges indicated similar calf:cow ratios, suggesting adequate reproduction on both refuges. It was hoped that the inclusion of the Koyukuk in this study would enable biologists to compare moose calf mortality rates on the Koyukuk, with a healthy population, and the Nowitna, with a struggling yearling population component.

Annual survival rates of all calves in 1988 (0.34, n=42), and 1989 (0.29, n=47), on the Nowitna Refuge and in 1990 (0.25, n=62) on the Koyukuk Refuge were not significantly different. Survival rates of male and female calves were not significantly different during any year, but annual survival of single calves was significantly higher than twins in 1989 (0.56 vs. 0.20) and 1990 (0.46 vs. 0.30). Black bears were the main predator, killing 40% of all calves (Figures 12, 13, 14, 15, Table 8). Wolves killed 9% of all calves, unknown predators killed 8%, grizzly bears killed 3% and 5% died from other causes. Calf predation was high and moose numbers increased in both refuges during the study. In comparing results

of this study with other calf mortality studies in interior Alaska, it does not appear that the rates of calf mortality observed are limiting non-calf moose abundance in populations that are declining, stable, or increasing. Results of the study were submitted to the journal Alces for publication (Osborne et al. 1991).

Table 8. Causes of annual mortality (May-May) for moose calves of known fate and number of censored calves on the Nowitna NWR in 1988 (n=42) and 1989 (n=47) and the Koyukuk NWR, Alaska in 1990 (n=62).

	Nowitna NWR	Koyukuk NWR	Combined	
Mortality cause	1988 (n=42)[1]	1989 (n=47)	1990 (n=64)	1988-1990
Black bear	14 (33%)	20 (42%)	26 (42%)	60 (40%)
Brown bear	1 (2%)	1 (2%)	3 (5%)	5 (3%)
Wolf	6 (14%)	4 (9%)	3 (5%)	13 (9%0
Unknown predator	2 (5%)	5 (11%)	5 (8%)	12 (8%)
Drowning	2 (5%)	0 (0%)	1 (1%)	3 (2%)
Unknown cause[2]	1 (2%)	2 (4%)	6 (5%)	6 (4%)
All causes	26 (62%)	32 (68%)	40 (65%)	98 (65%)
Censored[3] calves	0 (0%)	8 (17%)	6 (10%)	14 (9%)

[1] n = number of calves at start of each monitoring session is in parentheses.

[2] In 1988, the probable cause was starvation. In 1989, the possible causes were disease or starvation. In 1990, two sets of twins had one calf censored, suggesting death, and one calf likely died of starvation.

[3] Censored calves are calves of unknown fate.

B. Moose population trend surveys

Trend surveys have been conducted annually on the refuge since 1981. Trend surveys were not completed in 1990 due to conflicts with a Nowitna moose census, extreme cold, and poor flying weather. A moose inventory plan was completed in 1991 after a historical review of past survey data. Trend areas outlined in the plan are presented in Figure 16.

In 1991, surveys were completed November 18, 20, 21, and 29 for Three-Day-Slough and partially completed for Pilot Mountain/Squirrel Creek trend areas. Unfortunately, due to lack of adequate snow cover, most surveys were conducted late in the month under poor survey conditions and required cautious data intrepretation. In general, moose densities in both areas have increased. Moose density in the Pilot Mountain/Squirrel Creek has risen significantly from 1.3 moose/mi^2 in 1984 to over 7 moose/mi^2 in 1991 (Figures 17 and 18). However, 1991 figures are not representative of the entire trend area due to the small proportion of the total trend area that was surveyed (23.2 mi^2 of 72.6 mi^2).

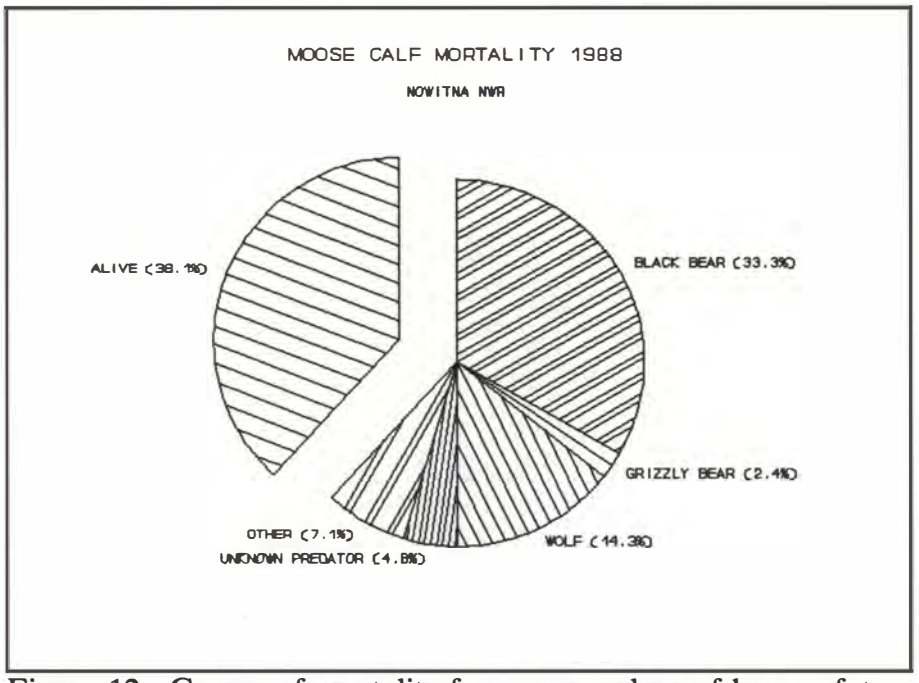


Figure 12. Causes of mortality for moose calves of known fate on the Nowitna NWR in 1988 (n=42).

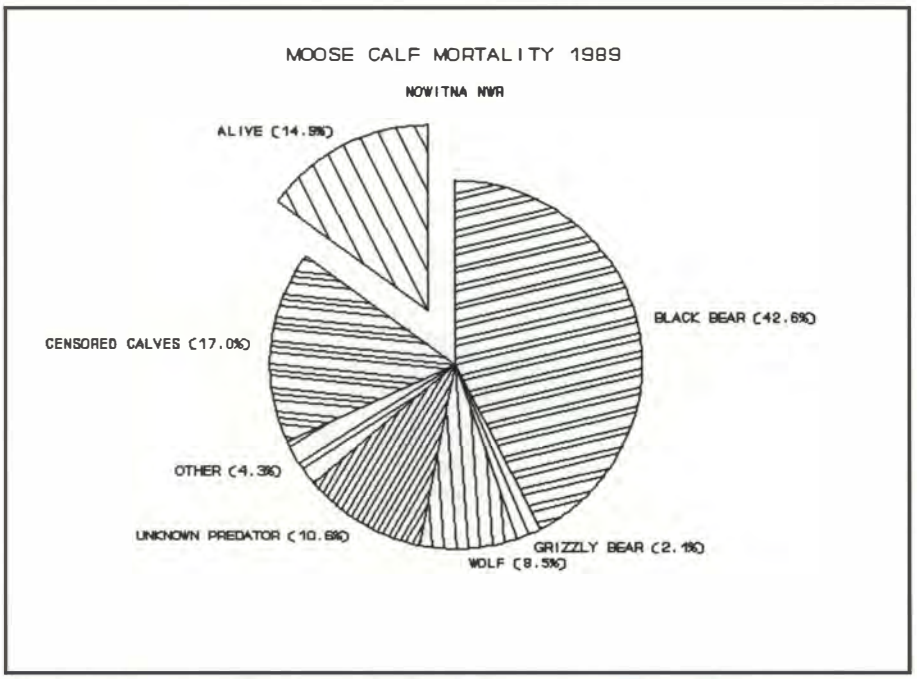


Figure 13. Causes of mortality for moose calves of known fate and unknown fate (censored) on the Nowitna NWR in 1989 (n=47).

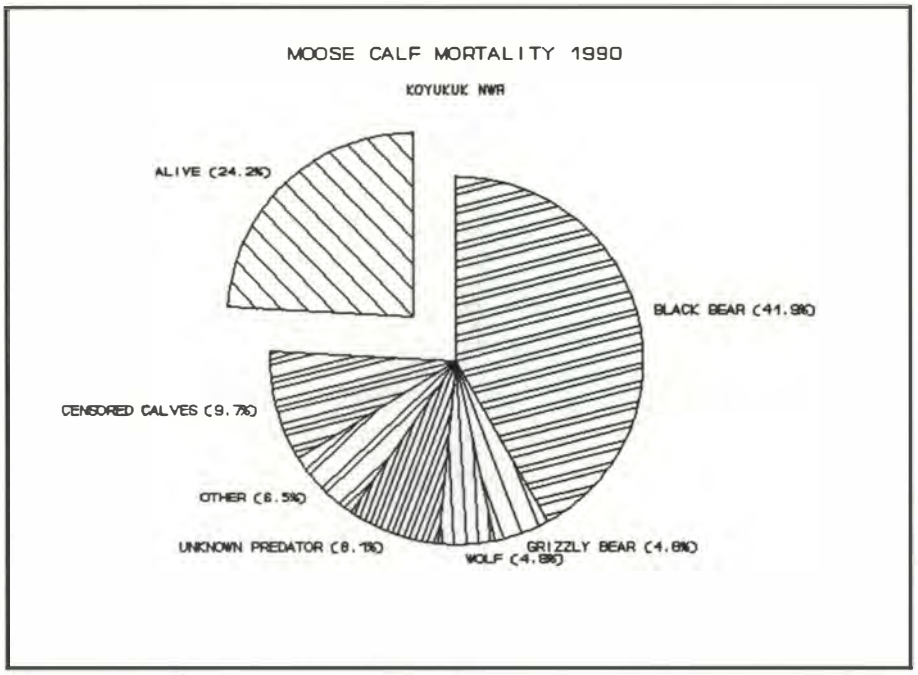


Figure 14. Causes of mortality for moose calves of known fate and unknown fate (censored) on the Koyukuk NWR in 1990 (n=62).

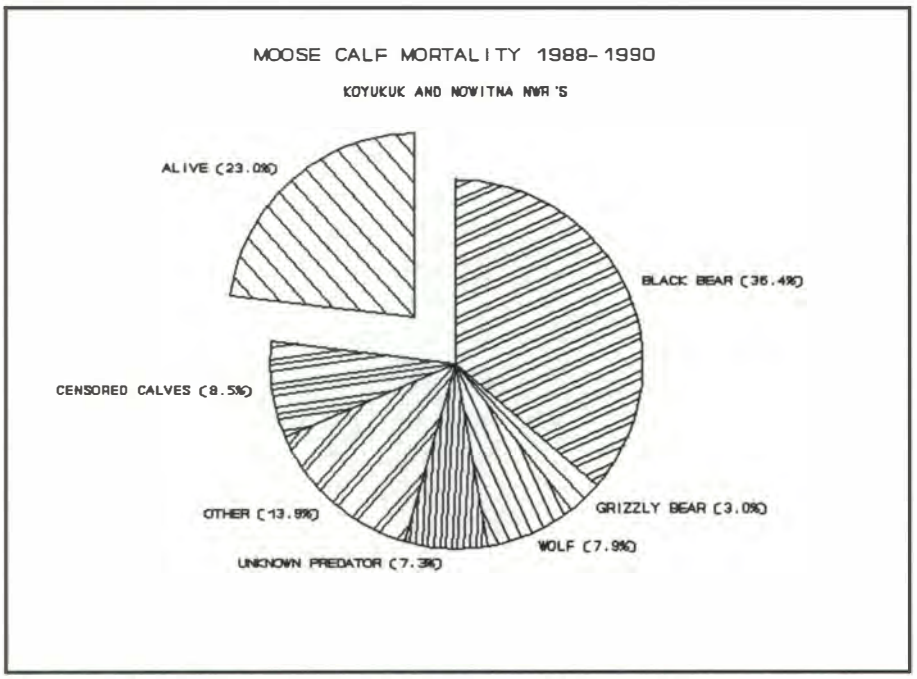


Figure 15. Causes of annual moose calf mortality of known and unknown fate (censored) on the Koyukuk and Nowitna NWR, 1988-1990 (n=151).

Moose observations at the Three-Day-Slough trend area also increased in 1991 (Figure 19). Although the bull:cow ratio is stable at 34:100 (Figure 20) and the herd is increasing, the low percentage of large adult bulls (3%) in the herd is reason for concern in this heavily hunted population (Figure 21). After a review of 1984-1987 telemetry data and hunter harvest data we estimated that at least 4.2% of the population was being harvested in 1991. If the trend of increased hunting pressure observed in 1991 continues into the future we estimated that over 5% of the herd could be harvested in 1992. Based on these data and user conflicts, we recommended a shorter sport season and smaller bull harvest at Three-Day-Slough for 1992.

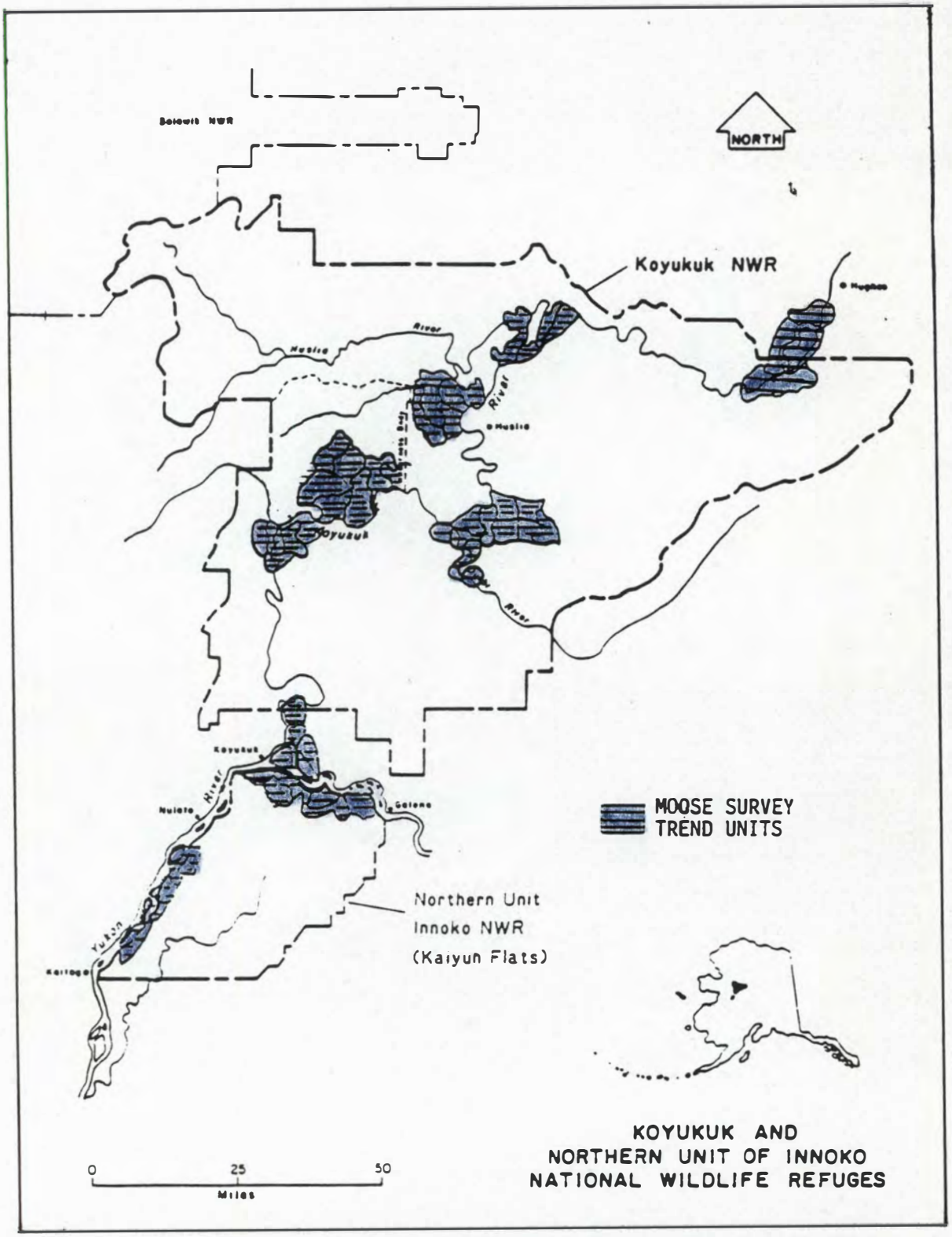


Figure 16. Moose trend areas for the Koyukuk Refuge and Northern Unit of the Innoko Refuge.

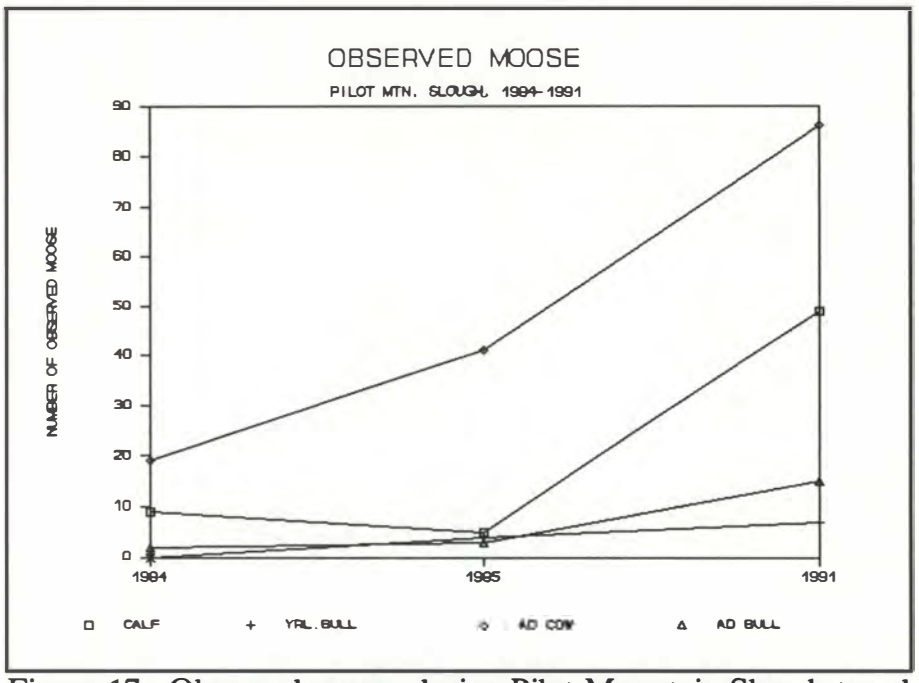


Figure 17. Observed moose during Pilot Mountain Slough trend surveys, Koyukuk NWR, Alaska, 1984-1991.

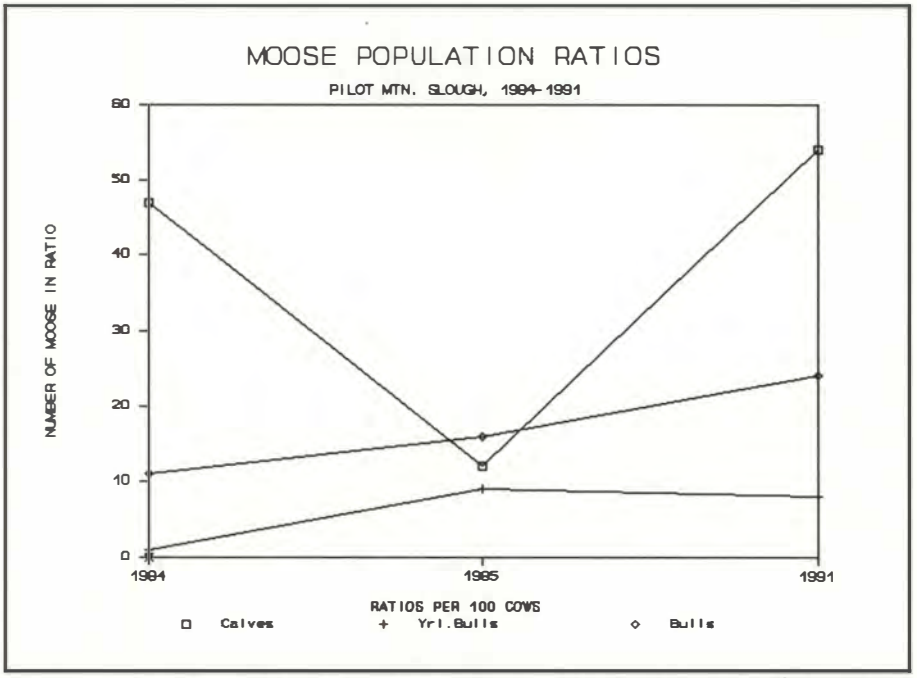


Figure 18. Moose population ratios of Pilot Mountain Slough trend surveys, Koyukuk NWR, Alaska, 1984-1991.

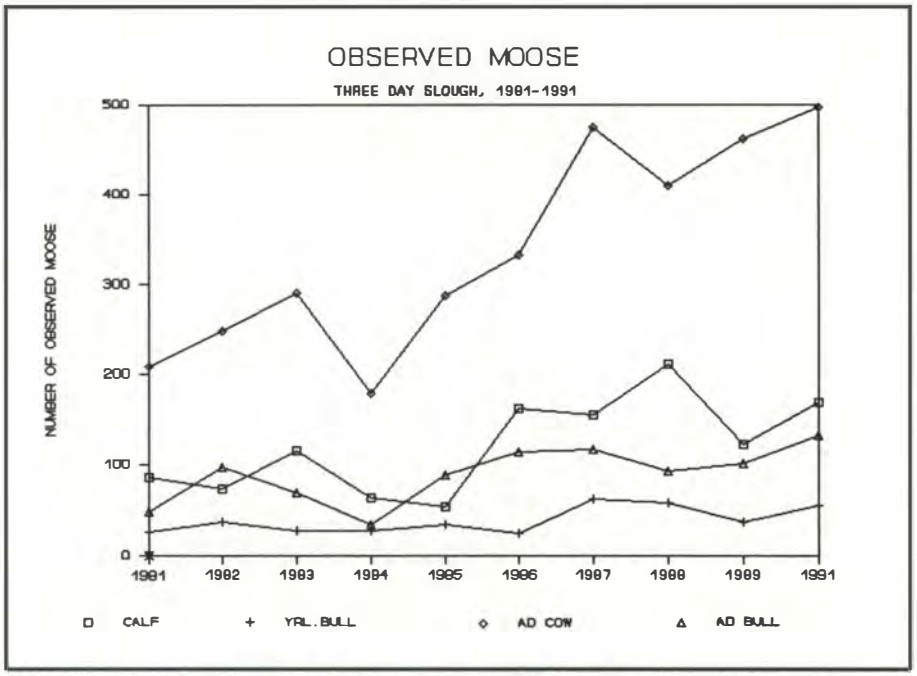


Figure 19. Observed moose during Three-Day-Slough trend surveys, Koyukuk NWR, Alaska, 1981-1991 (data courtesy ADFG, Galena).

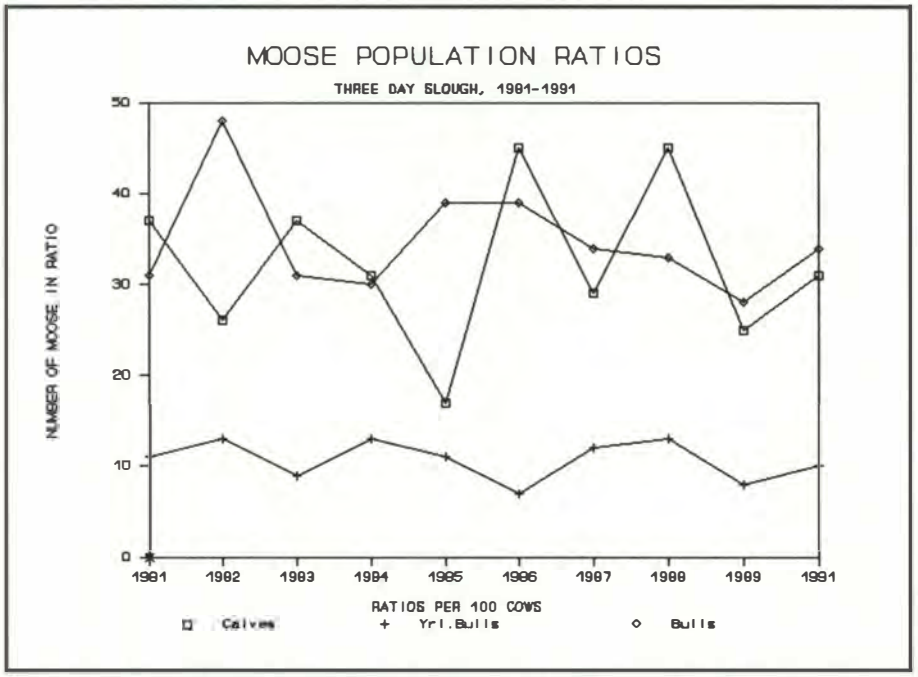


Figure 20. Moose population ratios of Three-Day-Slough trend surveys, Koyukuk NWR, Alaska, 1981-1991 (data courtesy ADFG, Galena).

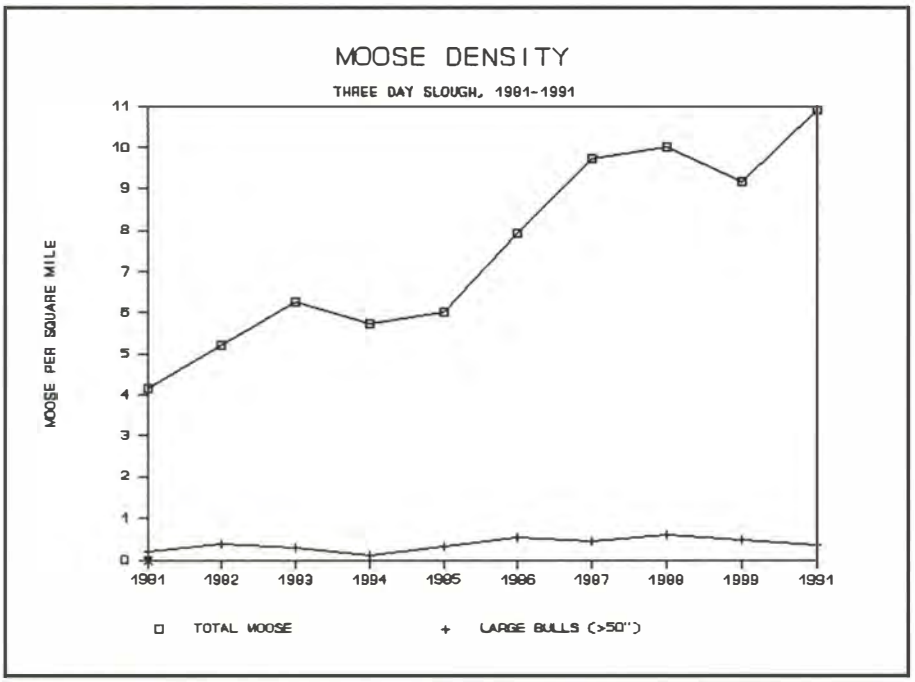


Figure 21. Observed total moose and large bull densities during Three-Day-Slough trend surveys, Koyukuk NWR, Alaska, 1981-1991 (data courtesy ADFG, Galena).

Moose surveys in 1991 indicate a thriving population on the Koyukuk Refuge. Densities in the Three Day Slough area of the Koyukuk Refuge reached 11 moose per square mile in 1991, although most of the refuge averages 2-3 moose per square mile. Total population was estimated at 11,000 in 1989.

Caribou

The ranges of two caribou herds include portions of the refuge. The Galena Mountain Herd (GMH) is a small herd estimated at 300, that calves in the mountains of the Melozitna River drainage and winters on the southern Koyukuk flats (Figure 22). A small portion of the winter range of the Western Arctic Herd (WAH), the largest caribou herd in Alaska, has utilized the same area in recent years but typically uses other northern and western sections of the refuge. The WAH has been growing steadily since its crash in the 70's, and is presently estimated at about 420,000. During the winters of 1988-89, 1989-90 and 1990-91 the Western Arctic herd shifted migration patterns and travelled through areas in the southwestern and southern regions of the refuge normally only occupied by the GMH (Figure 23).

In the winter of 1990-1991, the WAH migrated southeast using the Nulato Hills near Kaltag and the Natlaratlen River drainage on the southern end of the refuge. The Alaska Department of Fish and Game announced an "emergency" opening of the caribou season on December 17, 1990 which allowed local residents the opportunity to harvest caribou from the WAH during this eastern shift in migration patterns. An estimated 2,000+ caribou were observed on an aerial tracking flight on February 25th. After the closing of the emergency opening on February 28, 1991, it was estimated that at least 100 animals had been harvested by Huslia and Galena residents. We had concern about the mixing of the two herds and the possible overharvest of the GMH because of an unknown amount of mixing of the two herds where most hunting takes place (along the Galena to Huslia trail).

During the winter of 1991-1992 the WAH followed its traditional migration route passing through northern and western sections of the refuge which it had been following prior to 1989. Tracking flights in June, November, and December identified 200-300 GMH animals using their traditional wintering areas near Hozatka Lakes about 30 miles north of Galena.

Bears

Black bears are abundant in the lowland forest habitat of the refuge. Hunting pressure is low and habitat quality is excellent. About 40% of the refuge is rated as good black bear habitat. Grizzly bears, while uncommon, can be found on the refuge in open upland areas. No grizzly bears were sighted on the refuge by the staff in 1991. Our knowledge of grizzly bear numbers is extremely limited. We conclude that their density is low, but local residents in Huslia and Hughes reported an increase over previous years.

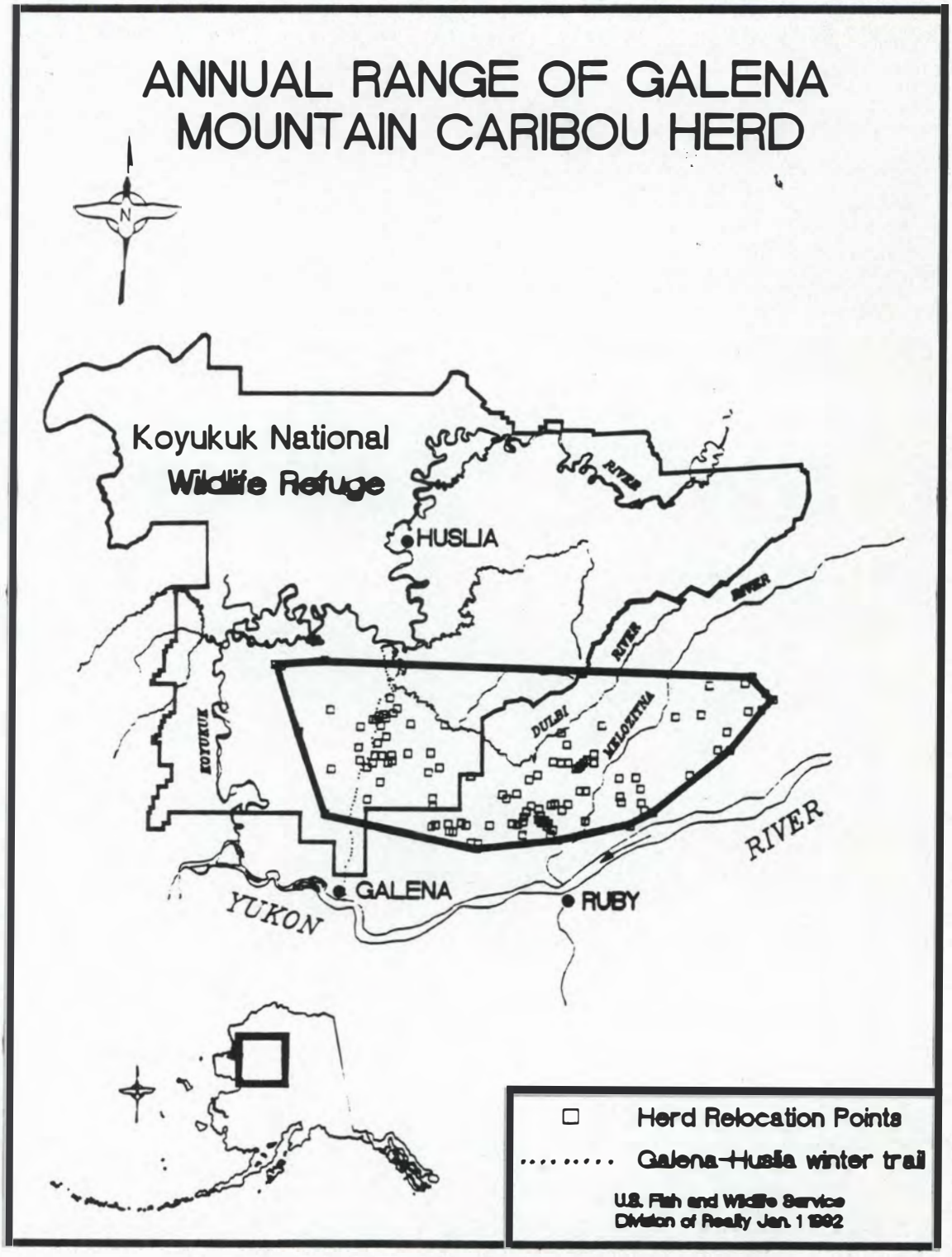


Figure 22. Annual distribution (based on radio telemetry) of the Galena Mountain Caribou Herd, Koyukuk NWR, Alaska.

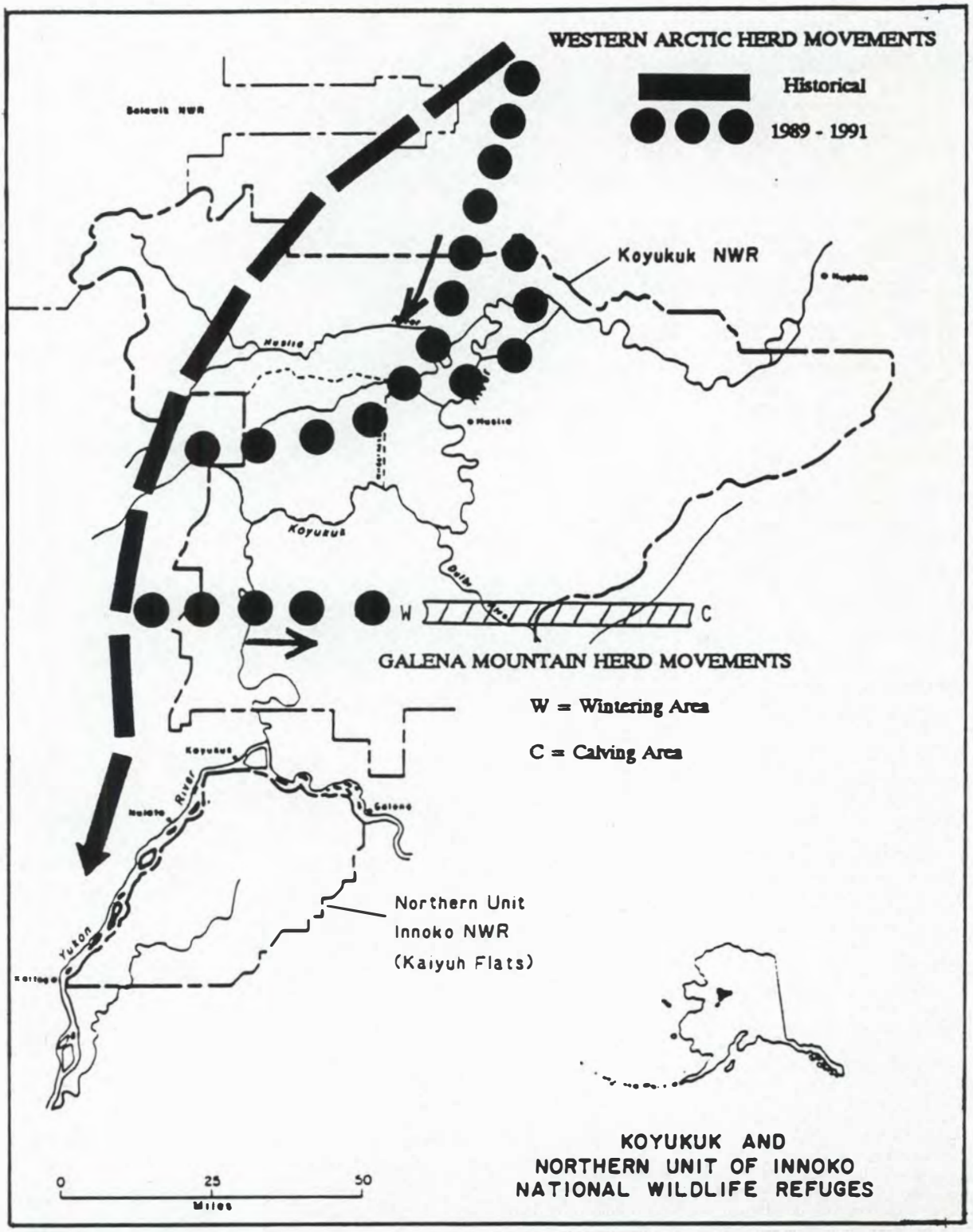


Figure 23. Historical distribution of the Galena Mountain and Western Arctic Caribou Herds, Koyukuk NWR, Alaska.

The Galena Mountain Caribou herd (GMH), a small herd estimated at 300 - 500, winters on the southeast portion of the Koyukuk Refuge. In 1991, the Western Arctic Herd estimated at 450,000 (the largest herd in Alaska), mingled with GMH due to its range expansion.

10. Other Resident Wildlife

Furbearers

A number of furbearers occur commonly on the Koyukuk Refuge and Innoko's Kaiyuh unit. They include marten, mink, beaver, lynx, otter, red fox, wolverine, muskrat, red squirrel, shorttail weasel, coyote and wolf. Marten, beaver, and lynx are the primary species of interest to local trappers. Little is known about the distribution and population status of most furbearers. Refer to Section H.10 for a discussion of trapping of these furbearers. Also, refer to Nowitna Section G.10 for a progress report of the Fire/Furbearer Study.

Beaver

Presently, beaver populations in much of Interior Alaska are high. Beavers are common throughout the refuge and are frequently seen during the summer. Beaver is an important source of fur and food for local people and accounts for a large portion of the fur harvest. The fur is used locally for hats and as trim on gloves, slippers, and mukluks. Beaver meat is also highly prized for its fat content and is a welcome change from moose in the diet of local residents or their dogs.

Little is known about the status and distribution of beaver on the refuge. When time and dollars permit, beaver cache surveys are flown in October to determine trends in the relative abundance of beaver within the Complex. In 1991, beaver cache surveys were conducted October 15-18, and the 21st. On the Koyukuk Refuge, 85% of beaver caches observed in seven townships were active and density was 0.9 active caches per square mile. Over 87% of caches observed in six townships on the Northern Unit of the Innoko Refuge were active and density was 1.3 active caches per square mile.

Wolverine

Relatively little is known about the status of the refuge wolverine population. They are occasionally harvested by refuge trappers.

Lynx, Marten, Mink, Red Fox, and River Otter

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

Wolves

Wolves are found throughout the Koyukuk NWR and Kaiyuh Flats Unit. Although wolves may prey on a wide variety of species, they depend primarily on large ungulates. Consequently, wolf numbers are often highest where moose and/or caribou are abundant. Another factor that effects wolf populations is the human harvest on wolves and their primary prey, moose and caribou. Presently, healthy populations of wolves and moose occur on the Koyukuk NWR and Kaiyuh Flats Unit. A population estimate of the wolf population on these two areas will be done in 1992.

Wolf Telemetry Study

A telemetry study was initiated in 1986 to examine the seasonal movements and home range of three wolf packs on the Koyukuk NWR. The study objectives were to determine pack size, locations, home ranges, seasonal habitat use, and estimate wolf/prey ratios. During the original study, seven transmitters were fitted on wolves between April 1986 and March 1987. Unfortunately, most of these animals quickly "left the air" with at least four wolves killed by hunters, one apparently killed by another wolf, one radio failure, and one moving more that 650 km to the northeast. The study was amended in 1989 to include the entire Complex and in 1990 twenty wolves were captured and fitted with radio collars on the Koyukuk and Nowitna refuges. Twelve wolves were collared from five packs on the Koyukuk and eight wolves were collared in three packs on the Nowitna. Bi-monthly tracking was completed for most of the months, with a total of 18 monitoring flights on the Koyukuk and 29 flights on the Nowitna. At the end of 1991, only three of the twelve wolves collared on the Koyukuk and two of the eight collared on the Nowitna remained on the air (Table 9). A progress report on the status of the wolf telemetry study will be completed in 1992.

Table 9. Status of wolves radio-collared during Spring 1990 on the Koyukuk/Nowitna Refuge Complex, Alaska.

ID No.	Capture Date	Status
W08	3/14/90	Active - Upper Dulbi Pack
W09	3/14/90	Dead - Upper Dulbi Pack
W10	3/14/90	**Active** - Dakli Pack
W11	3/14/90	Slipped Collar - 3 Day Slough Pack
W12	3/14/90	**Active** - 3 Day Slough Pack
W25	3/18/90	Dead - Trapped - 3 Day Slough Pack
W26	3/18/90	Dead - Trapped - 3 Day Slough Pack
W13	3/16/90	**Active** - Lower Dulbi Pack
W23	3/18/90	Dead - Shot - Lower Dulbi Pack
W24	3/18/90	Missing - Lower Dulbi Pack
W14	3/16/90	Dead - Trapped - Nayuka Pack
W15	3/16/90	Missing - Nayuka Pack
W16	3/17/90	Dead - Lone Wolf
W17	3/17/90	Dead - Trapped - Ham Island Pack
W18	3/17/90	Missing - Ham Island Pack
W19	3/17/90	**Active** - Monzonite Pack
W20	3/17/90	Suspect Mortality - Monzonite Pack
W21	3/17/90	Missing - Monzonite Pack
W22	3/17/90	Dead - Trapped - Novi Pack
W27	3/22/90	Dead - Novi Pack

11. Fishery Resources

Significant anadromous species found in the Koyukuk River include chum, chinook and coho salmon. Summer and fall runs of chum salmon and chinook salmon are the primary subsistence fish for the villages near the refuge. Coho are occasionally harvested, while pink and sockeye are rarely taken. We assisted the Fairbanks Fisheries Office in their involvement with Yukon River salmon studies. The Koyukuk NWR fisheries management plan is nearing completion as the staff reviewed a final draft at year's end.

Fresh water species found on the refuge include sheefish and burbot, both of which are important subsistence species. Other species which occur are broad whitefish, humpback whitefish, Alaska blackfish, least cisco, Arctic grayling, longnose sucker, northern pike, and ninespine stickleback.

Efforts were made to initiate some fisheries investigations in 1991. A fly-in fishing guide using the Kaiyuh Flats for a catch and release operation agreed to obtain scale samples and length measurements from pike caught by his clients. Other than contaminants sampling, limited funding prevented us from any more detailed work. Main concerns are identification of spawning and rearing sites, and proper allocation of harvest for subsistence priority.

16. Marking and Banding

The Koyukuk Refuge has had an active banding program for white-fronted geese and northern pintail since 1989. All banding activities have been a cooperative effort with the Division of Migratory Birds. We have received seventeen band return reports from the Bird Banding Laboratory in Laurel, Maryland since 1989 (Table 10). Four return reports were received in 1991. Most of our returns come from Canada but this year we received two from Arkansas and one from California (Figure 24).

Efforts were made in early July to band and collar white-fronted geese but aircraft maintenance problems prevented completion of the project. After several goose location flights were made prior to banding week, the C-185 received a punctured float from underwater scrap metal on the river and the Cub 4343 developed a leaky fuel tank. Cub 13833 was in Anchorage being fitted with floats during this period. By the time these problems were fixed, we had run out of time and had to begin brood surveys. Returns and recoveries of collared white-fronted geese in 1990 can be found in Table 10.

During the first two weeks in August, repeated attempts were made to capture and band northern pintails with rocket nets and later with swim-in traps proved

largely unsuccessful. We captured and banded 30 pintails, 32 green-winged teal, and one widgeon with four launches of the rocket net the first week. In spite of pre-baiting the trap site for a week, we were not able to attract large densities of ducks to the net. Swim-in traps used the second week did not attract ducks. The poor results with the swim-in traps could possibly be due to the very short pre-baiting period. Other refuges in Alaska have had success with walk-in traps with an extended pre-baiting period. Although walk-in traps are time-intensive we will likely employ this method in 1992. We will also select alternative trapping sites in addition to sites used in previous years.

Table 10. Band returns on the Koyukuk Refuge 1989-1991.

Species	Band Number	Banding Site	Recovery Location	Dates Banded/Received	
White-fronted goose					
	0807-61258	Dulbi River, AK	Alberta	07/07/89	09/16/89
	0807-61243	Dulbi River, AK	Saskatchewan	07/07/89	09/28/89
	1227-36673	Dubli River, AK	Alberta	07/11/89	10/07/89
	0807-61256	Dulbi River, AK	Saskatchewan	07/07/89	10/20/89
	0807-61255	Dulbi River, AK	Alaska (Galena)	07/07/89	05/01/90
	0807-61049	Willow Lake, AK	Alaska (Big Delta)	07/03/90	09/01/90
	1227-36211	3 Day Slough, AK	Alberta	07/05/90	09/06/90
	1227-36001	Dulbi River, AK	Alberta	07/04/90	09/08/90
	1227-36243	3 Day Slough, AK	Alberta	07/05/90	09/22/90
	0807-61120	Dulbi River, AK	Saskatchewan	07/03/90	09/29/90
	1227-36269	3 Day Slough, AK	Alberta	07/05/90	10/01/90
	1227-36741	Dulbi River, AK	Saskatchewan	07/11/89	10/04/90
	1227-36713	Dulbi River, AK	Alberta	07/07/90	10/06/90
	0807-61214	Dulbi River, AK	Arkansas	07/07/89	01/28/91
	1227-36308	3 Day Slough, AK	Arkansas	07/05/90	10/14/91
	0807-61155	Dulbi River, AK	Alberta	07/04/90	12/26/91
Northern Pintail					
	0976-81726	Willow Lake, AK	California (Salton Sea Refuge)	08/16/89	01/05/91

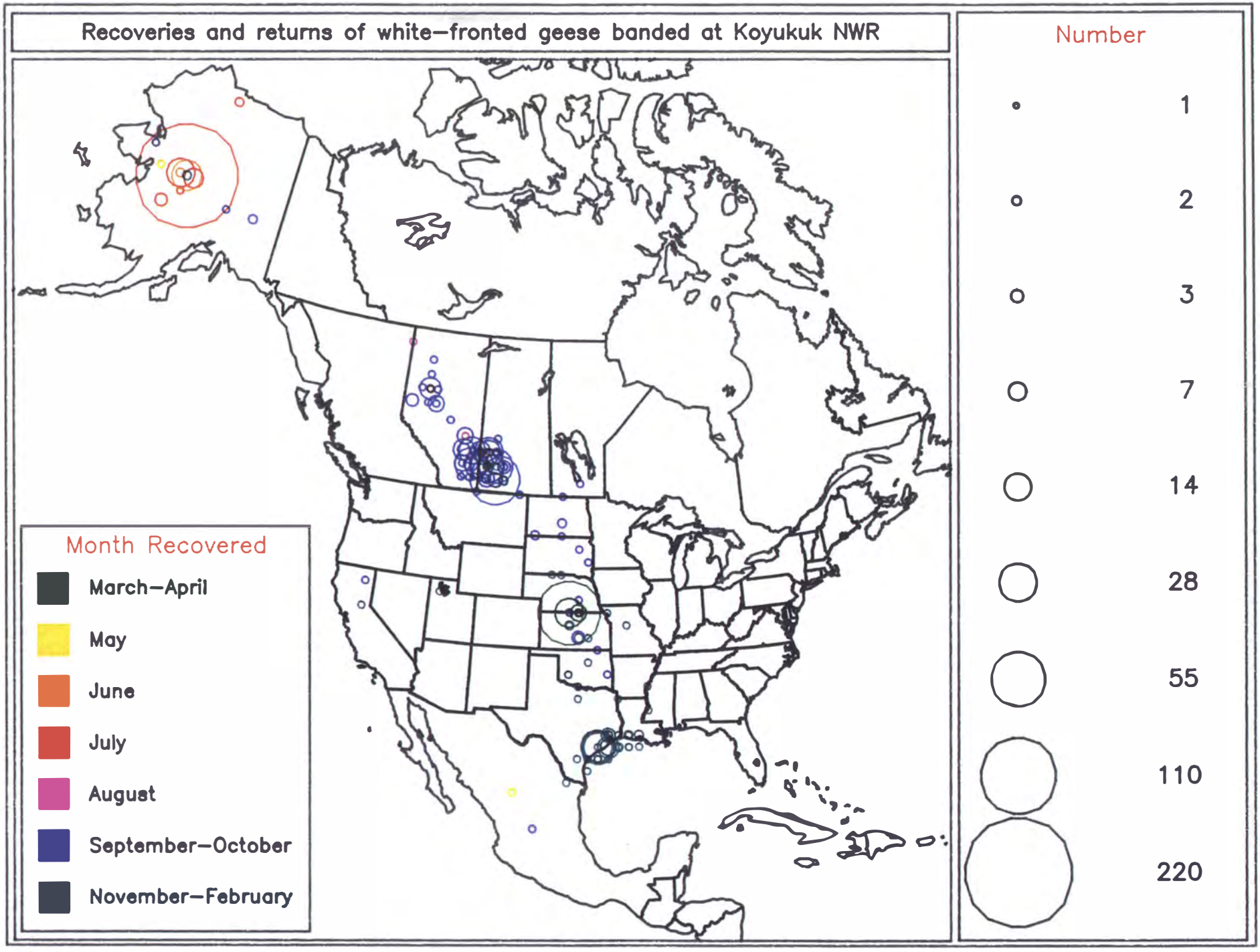


Figure 24. Recoveries and returns of white-fronted geese banded and collared on the Koyukuk NWR, 1990.

H. PUBLIC USE

1. General

The majority of public use on the Koyukuk and Northern Unit of the Innoko Refuges is subsistence hunting, fishing, trapping, and gathering. Activities range from putting meat, fish, and berries on the table to cutting house logs and firewood. Recreation and other uses are minor compared to subsistence. Recreational activities include sport fishing, trapping, and hunting for moose, caribou, wolves, and salmon, and some river float/powerboat trips on the Koyukuk River.

The 1991 hunting season was the first year steel shot was required for waterfowl hunting in Alaska. To educate and help hunters the ADFG and FWS held a steel shot seminar and shooting clinic in Galena in May. FMO Granger coordinated the seminar and assisted Robin West (Izembek NWR) and Dan Rosenberg (ADFG Biologist). The seminar was attended by sixteen people.

In June upon request from the Regional Office, the refuge prepared an Environmental Education plan. Throughout the rest of the year the plan was reviewed and environmental education was discussed in an attempt to refine the activities and clarify strategies.

The following special use permits were issued in 1991 for public use activities:

Company	Purpose	Refuge Unit
Tundra Air	Air Taxi	All Units
Fairbanks Float Plane Tour	Air Taxi	Nowitna
Unalakleet Lodge	Guided Fishing	Upper Innoko
Trail Ridge Air	Air Taxi	All Units
Wright Air Service	Air Taxi	Nowitna
Denali West	Guided Floats	Nowitna

This was the second year Unalakleet River Lodge was issued a permit to conduct guided sport fishing on the upper unit of the Innoko Refuge. This permit became controversial in 1990 when residents in Nulato and Kaltag complained of seeing dead or wasted fish in area lakes. This observation, combined with other complaints, resulted in closer cooperation with local residents prior to issuance of a permit in 1991.

Two meetings were held in late March and early April to discuss the issue. After the first meeting the villagers were tasked with finding an acceptable location where the guide could operate. We had already determined that there was not a subsistence conflict with this catch and release pike fishing operation and would not deny the permit on that basis.

After the second meeting we issued a permit for a small group of lakes that villagers assured us would meet the needs of the guide. When the guide did not like the area, we asked him to do his own coordinating with the local residents, something we had encouraged from the start without success. He met with several village leaders without success; however, he was able to obtain a two year lease on a private Native allotment for $600 per year. The guide used these private lands to pitch their tents and tie up boats overnight. The guide was now camping on an allotment and not the refuge, and using navigable waters for the fishing operations, therefore we had no authority and a special use permit no longer applied. We lost village support and a few more hairs. While taking the burden off of the Refuge to mediate the affair, similar situations in the future will undoubtedly put us in a very poor position when the stakes are higher and associated resources are in jeopardy.

The entire process was complicated when the lodge co-owner was killed in an airplane accident in the Alaska Range early in the summer. The lodge is now for sale. The prior owner said he would build a nice big new lodge on the private land in the middle of the refuge. We hope it does not materialize.

2. Outdoor Classroom - Students

The refuge staff presented 24 programs to 482 students in eight villages this spring. School programs focused on two themes; National Wildlife Week's Theme of the Arctic and Antarctic and migratory waterfowl populations. The staff discussed adaptations and habitats of animals that live in the Arctic and Antarctica noting the similarities and differences between these two polar environments. The Arctic tundra was associated with other waterfowl nesting habitats in Alaska and waterfowl production. Continent-wide problems facing waterfowl and spring waterfowl hunting in Alaska were also discussed. Elementary grades participated in an activity that simulated waterfowl hunting to show the effects of overharvesting on waterfowl production. High school students compared the responsibilities of the Service to those of state wildlife agencies. Staff also discussed the current Service policy on subsistence hunting on federal lands with high school students. The refuge encouraged community members to attend refuge programs through invitations from the schools. About 10 village leaders and parents attended Kaltag's high school program, making it one of the best visits.

Galena and Huslia high school classes participated in a spring waterfowl migration activity. Students recorded species, date, location, sex and if leg bands or collars were present. Copies of the book Wildlands for Wildlife were given to the top three students for participation. We hope to expand the study next spring and have some exchange of information between village schools.

Throughout the year, several refuge programs were given to Galena students. At the request of the Galena wildlife biology teacher, WB Johnson spoke to a group of high school students about proposed subsistence regulations on federal lands and the advantages/disadvantages of federal versus state responsibility for subsistence. FMO Granger gave a presentation on polar bears to the Galena second graders after his detail to Selawik NWR where he observed the radio collaring of polar bears. PR Johnson presented a program on animal adaptations to winter at the refuge office during the Christmas vacation. Kids made field notebooks and went on a field trip to look for snow tracks and other winter animal signs.

The refuge continues to provide information and activities on environmental education topics to teachers for use in their classrooms. The school presentations given by refuge staff focus on specific refuge programs, i.e., waterfowl populations, current subsistence temporary regulations, etc. This year refuge programs were done in conjunction with National Wildlife Week.

3. Outdoor classrooms - Teachers

PR Johnson presented activities from The Role of Fire in Alaska curriculum at the Regional EE workshop in Anchorage held in September. This curriculum covers boreal forest and tundra ecology, fire effects on the boreal forest and tundra ecosystems, fire management and people's perspectives on fire. Positive feedback was received by the teachers and Service EE personnel on the materials developed in the curriculum. The curriculum is complemented by a teacher informational manual and a slide program for classroom use. A fire display and four information sheets were also developed by the Regional Office as part of the Fire Information and Education Program. Denise Warren, a high school teacher in Kaltag, had the opportunity to join refuge personnel for a portion of the workshop in Anchorage. The objective for training local teachers is to form a refuge/local teacher team to implement refuge EE programs in the schools.

A teacher workshop held in Galena in November drew thirteen teachers from the villages of Galena, Koyukuk, Huslia, Nulato, Kaltag, Ruby and Tanana. Teachers enjoyed participating in activities from the Role of Fire in Alaska and Wetland and Wildlife curricula. Teachers also developed interdisciplinary units on waterfowl and caribou with community involvement. Many teachers took the workshop for one graduate credit through a course coordinated by the Regional

Paul Liedberg talks to students of Hughes about the current situation with waterfowl in Alaska. The refuge staff presented 24 programs to 482 students in eight villages this spring.

In November, a refuge teacher workshop held in Galena drew thirteen teachers from the villages of Galena, Koyukuk, Huslia, Nulato, Kaltag, Ruby and Tanana. The workshop was aimed at presenting FWS EE Curricula "Wetlands and Wildlife" and "The Role of Fire in Alaska".

Office with the University of Alaska - Fairbanks. The refuge provided lodging, meals at a reasonable cost and transportation costs for one teacher from each of the eight villages. Two villages were unable to send a teacher, however Huslia School persuaded their school district to charter a plane so all six of their teachers could attend! The refuge/teacher network which resulted from this workshop will allow refuge staff to keep teachers updated on refuge environmental education programs.

4. Interpretive Foot Trails

Refuge staff and Galena kids pitched in to clean up a foot trail behind Galena school in early summer 1990. This year, YCC enrollees widened the trail by brush cutting and constructed a path of sand and gravel. The nature trail passes through a mature hardwood/conifer forest with a bog at the trail's end.
PR Johnson conducted activities from the Role of Fire in Alaska and the Wetland and Wildlife curricula along the trail in the spring. She also compiled and presented a variety of activities on boreal forest and bog ecology for teachers to use with their classes. A copy of the trail activities was sent to a Ruby teacher who is interested in developing a nature trail.

6. Interpretive Exhibits/Demonstrations

PR Johnson ordered two portable Dowling displays and developed photos and text to highlight key refuge programs. One of the displays is set up in the foyer of the refuge office to serve as an attractive exhibit in our visitor contact station.

7. Other Interpretive Programs

Fourteen activities from The Role of Fire in Alaska curriculum were tested in three village schools this spring. PR Johnson continued working with the Regional Office staff on the draft version of the curriculum through the summer.

The refuge had displays, interpretive activities and sold Alaska Natural History Association (ANHA) books at several community events. For the Galena Air Show in July, the refuge had a display and made a big profit with book sales. The refuge also attended the 4-H Agricultural Fair in August and the Koyukon Jamboree in October. The refuge had a display with game boards on duck identification and local wildlife and videos at both events. An additional activity at the Jamboree was a steel shot quiz drawing. To enter the drawing, people wrote their responses to three questions about steel shot but did not need the correct answers to qualify for prizes. Two adult's and one student's name were selected for book prizes. The most frequent incorrect answer was the question "What is the number of waterfowl that die each year from lead poisoning?"

"Mapping a Fire Plan" was one of the 14 activities from the Role of Fire in Alaska curriculum tested this spring in three village schools.

A new interpretive Dowling display highlights key refuge programs in the Visitor Contact Station.

On November 27th, the refuge held an open house to welcome the community to the new office. The entire staff participated in special exhibits and demonstrations on waterfowl identification for kids, slides on the fire/furbearer project and small mammals from an early young burn site, aging marten teeth, winter survival pack display, slides on refuge programs and computer tracking of wildlife populations. The open house was considered a success with over 50 adults and 20 kids in attendance.

The "Take Pride in America" display was put up at Galena High School for two weeks in March. There was some confusion with the interactive mechanics of the display; however, the display was informative.

ROS/P Liedberg and staff from the ADFG and Alaska Fish and Wildlife Protection gave a cooperative program on moose hunting in the local area to Galena Air Force personnel.

8. Hunting

The primary big game species targeted by subsistence and sport hunters on the refuge are moose and black bear. Ducks, geese, sandhill cranes, hare, grouse, caribou, and grizzly bears are also taken. Although accurate harvest estimates from the surrounding villages are not available, subsistence surveys done in Huslia, Hughes, Nulato, Ruby, and Koyukuk over the last several years have provided us with a general estimate of subsistence harvest.

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."

No permits were issued for commercially guided hunts during 1991. Only one guide has been issued permits over the last few years and he was inactive in 1991. The entire system of allocation of guide use areas has been handled historically by the State but their system was ruled unconstitutional by State courts in 1988. After the State failed to pass legislation in 1990, the Alaska Big Game Commericial Service Board was established to develop a guide allocation system. The Board has developed guidelines for a guide allocation system but the State has failed to implement the system to date. The Service is now developing a guide allocation system for federal lands in Alaska and a draft policy was prepared and distributed to the public for comment by year's end.

RM Stearns and ROS Liedberg talk with Galena community member Ed Pitka at the refuge open house which attracted over 50 adults and 20 kids.

Attendance was good at the steel shot seminar held in Galena in May.

Trail Ridge Air was issued a Special Use Permit in 1991 to operate in the refuge. They transported 10 hunting parties, including 26 hunters, into Units 21A and 21D during September. These hunters harvested 15 moose and 4 caribou.

Caribou from the Western Arctic Herd crossed the Koyukuk River moving east, and mingled with the much smaller Galena Mountain Herd late in 1990. Local interest in harvesting Western Arctic Caribou prompted the ADFG area biologist to prepare an "emergency opening" for caribou west of the Huslia-Galena Trail. The opening went into effect December 17, 1990 and remained until February 28, 1991. An estimated 100 caribou were harvested by Huslia and Galena residents. See Section G.8 for further discussion on caribou status. The federal subsistence season was also open to keep subsistence priority in effect.

Hunter Check Station

ADFG Area Game Biologist Tim Osborne has operated 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 barring aircraft access for moose hunting, the check station provides a good source of harvest information from the majority of refuge hunters who gain access from the Yukon River. The ratio of non-local resident and non-resident hunters to local resident hunters is about 2:1. Stopping at the check station has been mandatory since 1990.

Moose season in 1991 was extremely dry and warm, one of the driest low water years that local residents can remember. As a result, Three-Day-Slough and other heavily hunted sloughs and inlets were inaccessible to most boats. The west slough entrance was only accessible to small boats equipped with jet units for the first 1-2 miles. All camps were established on the main Koyukuk River corridor and positioned on nearly every bend of the river. Although the low water induced a crowded hunting situation on the Koyukuk River it did prevent hunters from hunting most of the area encompassed by Three-Day-Slough. As a result even though the number of hunters using the area increased by nearly 25% this year, the harvest increased only 14%. Later analysis of moose trend survey information collected in November indicated a low composition of large bulls in the areas. Further analysis of movement data suggested that we may be reaching maximum harvest levels for this moose herd (see Section G.8(B)). This low water year may have been a blessing in disguise for the well being of the moose herd.

Hunters checked 208 moose through the station during September 1991. This is the largest harvest on record and is more than three times the harvest first recorded in 1983 (Figure 25, Table 11). There has also been a substantial increase in the number of non-local hunters, especially in recent years (Figure 26, Table 12). Of the 380 hunters, less than half (136) were GMU 21D residents, 189

were non-local state residents, and 55 were out of state non-residents. A breakdown of local moose hunters by village is given in Table 13.

Wolf Hunting

Wolf hunting in the Complex is done both with the use of snowmachines and airplanes. The hunting season runs from August 10 through April 30 with a limit of 10 wolves. Wolves may also be harvested under a trapping license from November 1 to March 31 with no harvest limit. Most wolf hunting with the use of aircraft and snowmachine occurs in March when a combination of warming temperatures, adequate daylight (approximately 14 hours), and deep snow for tracking and limiting wolf movement, all combine to make the airborne or snowmachine hunters more effective.

Aerial hunting of wolves was historically done by federal agents and later as a state-sanctioned population control method or as a legal sport hunting method. This activity is under close scrutiny by all types of users and land managers in this part of Alaska. Illegal aerial hunting of wolves does occur, especially in the northern reaches of boreal forests and in the open tundra of the Koyukuk. Each year in late winter several land-and-shoot wolf hunters come to Galena. Although legal land-and-shoot wolf hunting does occur, the temptation also exists to shoot while airborne, communicate between aircraft, or herd animals into large lakes or openings suitable for landing, which are all illegal. Another more common illegal method is the use of snow machines to "run down" the wolves just before they are shot. The number of wolves taken with the use of aircraft in 1991, legal or illegal, is not known. We did receive a report from Huslia that 30-40 wolves had been harvested by local residents. Total refuge wolf harvest by hunting is estimated to be 50 or more per year. Reports from local people indicate that both pack sizes and number of packs are increasing.

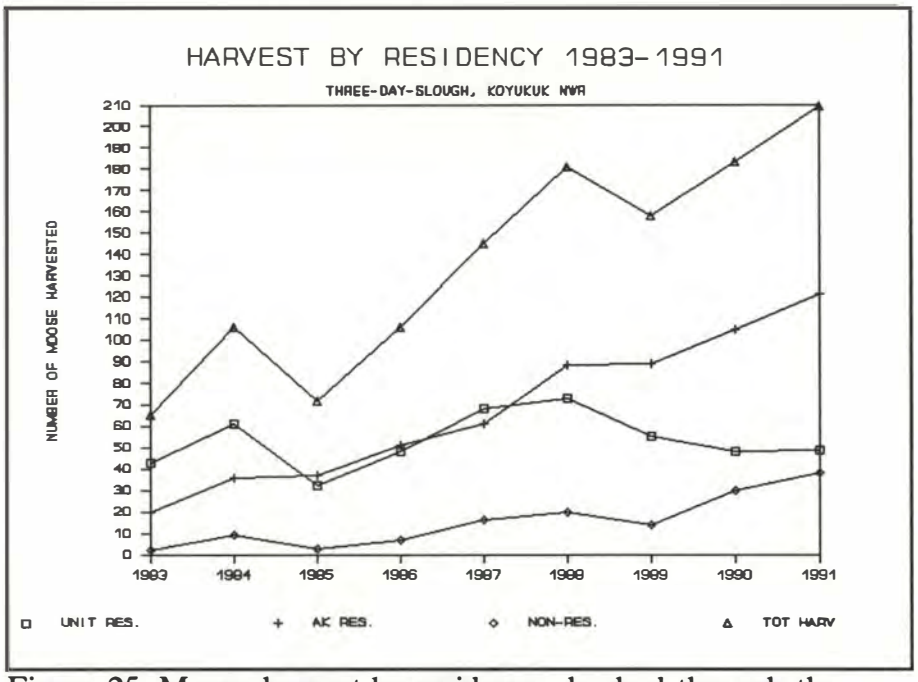


Figure 25. Moose harvest by residency checked through the Koyukuk River Check Station, Koyukuk NWR, Alaska, 1983-1991 (data courtesy ADFG, Galena).

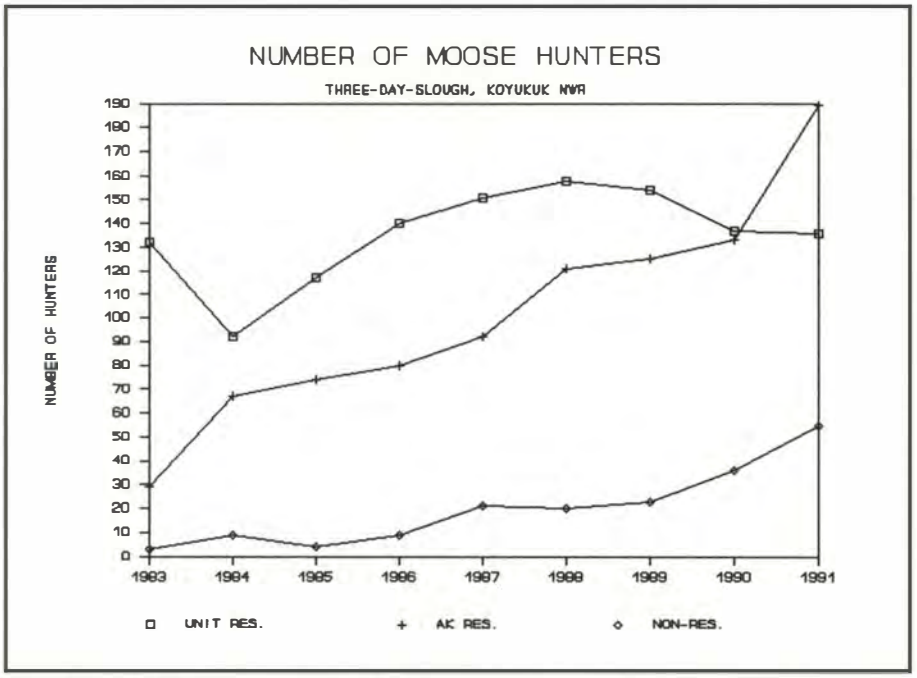


Figure 26. Number of moose hunters by residency checked through the Koyukuk Check Station, Koyukuk NWR, Alaska, 1983-1991 (ADFG, Galena).

Table 11. Number of moose hunters by residency class checked through the Koyukuk River Check Station[1] (Data courtesy ADFG, Galena).

Year	Non-Local	Non-Res.	Unit Res.[2]	Total Hunters
1983	29	3	132	164
1984	67	9	92	168
1985	74	4	117	195
1986	80	9	140	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

[1] checking in and out was not mandatory until 1990 and compliance was lower during the first year, 1983.
[2] 1983-86 includes every trip made by hunter

Table 12. Harvest by moose hunters and hunter success () by residency class checked through the Koyukuk River Check Station[1] (Data courtesy ADFG, Galena).

Year	Non-Local	Non-Res.	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%)

[1] checking in and out was not mandatory until 1990.

Table 13. Number of moose hunters from local villages (Unit Residents) checked through the Koyukuk River Check Station, 1987-1990 (Data courtesy ADFG, Galena).

Year	Galena	Koyukuk	Nulato	Kaltag	Ruby\Huslia*
1987	84	40	23	0	4
1988	82	45	29	1	1
1989	84	40	23	0	4
1990	68	37	27	2	3
1991	60	40	35	0	1

*Most Huslia hunters do not pass through the check station, but hunt near the village up-river from the the station.

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 are shown in Table H10-1. These figures provide a conservative estimate of harvest since some skins, especially beaver and wolves, are kept by trappers for personal use. There are no sealing requirements for marten or mink.

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. However, when disputes do occur, they can be heated at times. Beaver trapping is not done within strictly controlled trapping territories, but rather 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. Some trappers use airplanes for access and a few simply walk their traplines. Marten, the biggest catch, are generally taken using pole sets and/or cubby sets. Beaver are taken with snares through the ice while most wolves are shot or trapped with snares around kill sites.

Table 14. Furbearer harvest on the Koyukuk NWR and Northern Unit of the Innoko NWR (Kaiyuh Flats) during the 1990-91 trapping season.[1]

	Species				
Area	Beaver	Lynx	Otter	Wolf[2]	Wolverine
Kaiyuh Flats	46	2	2	0	0
Lower Koyukuk	0	1	0	0	0
Lower Dulbi	38	0	2	0	0
Koyukuk Mouth	14	0	0	0	0
3-Day Slough	29	0	1	0	0
Nikolai	14	0	0	0	0
Bear Creek	5	0	0	0	0
Huslia West	52	0	0	1	9
Huslia East	74	2	4	0	3
TOTALS	272	5	9	1	12

[1]Based on sealing records obtained from Tim Osborne, Area Biologist ADFG.
[2]This figure grossly underestimates actual harvest. Huslia residents estimated harvest to be 30 to 40 wolves and ADFG Biologist T. Osborne estimates 10 wolves were taken by Galena residents.

17. Law Enforcement

ROS/P Liedberg attended the Basic LE training from January through March at Federal Law Enforcement Training Center. This brought to three the number of refuge officers on staff.

ROS/P Liedberg, with assistance of WB Johnson, conducted meetings in five villages to discuss the Service law enforcement policy for subsistence waterfowl hunting. Subsistence waterfowl hunting takes place anytime the regular season is closed (March 30 - September 1), but most activity takes place over a two to three week period as soon as the birds return in the spring and before they disperse to the breeding grounds. In this area, depending on the time of year, this period is generally from late April to early May.

In a draft report prepared by the Alaska Department of Fish and Game on subsistence harvest of migratory birds, it is estimated that 8,553 ducks and 3,602 geese were harvested for subsistence in the six communities nearest the Koyukuk Refuge.

For the first year the refuge initiated anonymous harvest surveys in four villages. A local resident in each village was paid $100 if they collected the information from the village and sent it to the refuge. Two of the four contacts responded with harvest information. Huslia was reported as taking 405 geese and 340 ducks for the entire harvest period and Nulato reported a harvest of 91 geese and 19 ducks for approximately the first half of the harvest period.

This was a poor year for subsistence harvest because breakup occurred so quickly which prevented access by snowmachine, the standard mode of transportation for spring waterfowl hunting. Poor conditions that prevented access by local residents also prevented access for law enforcement efforts. Boats could not be used because there was too much ice; snowmachines could only be used in the immediate vicinity because there was too much water; and an airplane on skis could not land in many areas because of deteriorating snow conditions. Overflights were made and some contacts were made in the villages and Galena. No citations were issued based on our efforts during the spring season.

ROS/P Liedberg assisted in a Region-wide effort at conducting LE and closed-season policy meetings on the Yukon Delta NWR in May. He piloted an aircraft for LE patrols and conducted four meetings in Yukon Delta villages.

Refuge officers Stearns and Johnson attended refresher training at Marana, Arizona in March and handgun requalification at Fairbanks in August.

Moose season hunting patrols were conducted mainly by two Alaska Fish and Wildlife Protection officers stationed in Galena. Two of the best moose hunting areas in the region are both located on refuge lands and consequently they are heavily patrolled by State officers in fixed wing, helicopter and boat. Refuge officers assist the State whenever possible including communications and equipment loans.

18. Cooperating Associations

Operations of the new Middle Yukon Branch of the Alaska Natural History Association began in May. The outlet carries 11 publications and 8 different USGS maps. Several of the more popular items are: USGS maps, The Middle Yukon by Alaska Geographic, Alaska Wildlife Coloring Book, and Zoobooks. Sales have been out of the office and at local events. Several attempts were made to set-up sales operations at the Galena Air Force Base; however neither have proved profitable. We will continue working with the Air Force sales operations to maximize promotion of sales. By the end of the fiscal year, the Middle Yukon Branch had grossed $625.00, and sales continue to increase.

The new Middle Yukon branch of Alaska Natural History Association (ANHA) grossed $625.00 since its opening in May.

I. EQUIPMENT AND FACILITIES

2. Rehabilitation

Late in the year, work began on converting our old office back into a duplex to house staff. Materials were ordered for this force account project to include recarpeting, sheetrocking, insulating windows, and bathroom and kitchen rehabilitation. The work is expected to be complete in early 1992.

3. Major Maintenance

A heat trace was installed in the sewer line from the bunkhouse and duplex to prevent a freeze-up like that experienced during the winter of 89/90. There were no problems with the line during the year.

As an energy conservation measure, garage doors on most of the quarters were repaired and/or adjusted in February. An immediate difference was recognized in the heat holding ability of the lower floor of the houses.

A week was spent in June working on the Hog River cabin. A kitchen sink, a new window, and better screens were installed in the cabin and a snowmobile storage shed was built nearby.

The asbestos problem in the crawl space of the duplex (old office) was handled by covering the asbestos laden soil with visqueen. This complied with recommendations from the Regional Engineering and Safety offices.

4. Equipment Utilization and Replacement

A new 1,000 gallon double wall avgas tank was installed at the floatpond in Galena. A new dock was also installed which will make spring put-in and fall take-out procedures extremely easy compared with the old wood and 55 gallon drum dock. The new dock, made by Jetfloat, comes in one-half meter square floating sections that can be put together with pins to make whatever configuration we want. The only downside is the price. Our dock, capable of mooring three airplanes, cost over $19,000 by the time it was delivered to Galena, but the zero-maintenance feature and the ease by which it can be moved makes the cost worth the price. The dock should last more than 20 years.

Two 1500 gallon double-walled bulk avgas tanks were installed during the year -

A snowmobile and flammable materials storage shed was built adjacent to the Hog River administrative cabin.

Two double wall 1500 gallon bulk avgas tanks were installed, one at Ruby and one at Huslia. The purposes of the bulk tanks were to make refueling safer and to eliminate as many fuel caches as possible in remote field areas. The bulk tanks are filled once per year by barges originating at the railhead in Nenena.

one at Ruby and one at Huslia. The tanks were delivered early in the summer via barge and filled later in the season also via barge. Our intent is to maintain safe and secure fuel storage that is easy to refuel and refill at these two villages. In addition, we can eliminate as many fuel caches as possible in remote areas of the field.

A new 4x4 Dodge Ram pickup was delivered in Fairbanks where was winterized and put on the barge in Nenana. It was off-loaded in Galena in August.

5. Communications Systems

In 1986, the Complex began an on-going saga of attempting to modernize communications by using light, portable VHF-FM radios and mountain-top repeaters. The system was in the acquisition and installation phase until late in 1988, when it was finally put into operation. The radio system has not worked well from the beginning, and 1991 was no different. We had good communications only during the summer, June through September. For the remainder of the year, we were plagued with failures of repeater radios, batteries and antenna systems at our main remote site, Totson Mtn. Our system relies on two mountain top repeater sites (Purcell and 2321) that relay signals to the centrally located Totson site, which is technically called a remote base. At Totson we had shared antenna towers, solar panels, and batteries with BLM - Alaska Fire Service, all of which failed late in 1990. Additionally, our radio fried itself by trying to work on low voltage. To alleviate these problems we rebuilt the Totson site in June 1991 to include an independent shelter that contained the antennas and batteries internally. Only the solar panels were left exposed to the weather. We also ordered brand new arctic-grade radios and freeze-proof NICAD batteries for the site. We had hoped this would fix the recurring problem. In September, the contract radio technician installed the new batteries using the stock connectors that were supplied by the battery manufacturer. The system became inoperative by mid-October (due to failure of the connectors, which cracked in the cold). The new radios we ordered arrived in December, when darkness and inclement weather prevented access to Totson Mtn. to install the new radios and recheck the battery connections. The staff, therefore, have had to operate on the refuges most of the winter without communications. If in a base camp, or cabin, we were fortunate to be able to use old fashioned, heavy, much cheaper but more reliable, single sideband HF radios. Hopefully, in 1992 we will be able to have the new arctic-grade radios installed at all three repeater sites, and will once and for all have a reliable system. Safety is an ever present concern.

ROS/P Spindler, BT Wholecheese and FMO Granger prepare the site and assembled the new radio shelter on Totson Mtn, 25 mi SW of Galena. New solar panels, batteries and antennas were connected to the old radio equipment. All but the solar panels are contained within the new shelter. Despite these efforts the low bid battery connectors cracked in the cold and radios failed in the fall of 1991.

BT Jenny Lowe adds a coat of log sealer to the Hog River administrative cabin. BT's Lowe, Huntington and Wholecheese, along with FMO Granger spent a total of 2 weeks doing maintenance work on the cabin and building an adjacent equipment storage shed.

6. Computer Systems

The station ADP plan was updated in 1991 to include purchase of two more PC's and a systemizer to tie everything to our laser printer. By year's end the systemizer has not been hooked up because more cabling was needed. When completed, computer work may be printed much more efficiently. Software packages now in use include DBASE III & IV, WORD PERFECT 5.1, SYSTAT, MYSTAT, LOTUS 1-2-3, PRO-CITE, MICROMORT, MCPAAL, BITCOM, GRAMMATIK and SIGMA PLOT. The staff now spends a significant part of their day behind a computer screen.

7. Other (Aircraft)

The main highlight of the year was that our three pilots flew 1065 hours in Service aircraft without any accidents or injuries. This is the eighth consecutive accident-free year. The off-airport float, ski, and wheel landings, low level surveys, and operations in remote areas without communications or readily available weather information always provide challenging and interesting flying but also constitute much higher risks than average airport to airport flying.

During the year, we acquired a third aircraft, a newly rebuilt Super Cub wheelplane, N13833, that was put on floats in July and on straight skis in November. The addition of this third airplane to our existing fleet of a Cessna 185 - N714KH, and a Super Cub - N4343, provided us with the ability to simultaneously perform needed subsistence survey work over the three units of the Complex. For many of our surveys (eg. wolf or furbearer track survey) we have a short 3-7 day window of opportunity with weather and snow conditions. The extra plane allows us to do this survey work and still perform logistics such as field camp support, attend village meetings and EE programs with the Cessna 185.

We were elated to receive official word that much of our aircraft maintenance could be performed by the commercial shop, Northland Aviation, in Fairbanks. This shop has done a very good job in a timely manner and we do not have to contend with the weather problems of ferrying aircraft across the Alaska Range (see below).

The main low point of the year, aircraft-wise, was the continual maintenance problems we experienced. It was often an exercise in frustration dealing with the maintenance department of the Office of Aircraft Services because they had undergone severe staff shortages and turnover in their two top positions during the busiest time of the year. At times, we felt glad to have three aircraft assigned to the station because only one was airworthy! Especially in the summer and fall of 1991, our field operations were severely hampered by lack of availability of the

two Super Cubs. We were unable to perform any goose banding and the duck brood survey was extended over a longer period than desirable for data comparability. We were unable to radio track marten on a weekly schedule and wolves on a monthly schedule in fall 1991. Had it not been for the lack of snow in November in our area, we would have had to cancel moose surveys in several areas. Fortunately, lack of aircraft coincided with lack of snow. When we finally did get snow, we had to borrow N91251 from Innoko and Selawik NWR's to get the survey done on the Nowitna. The average down time for maintenance with OAS in Anchorage was 20 days, and the maximum down time was 51 days. In contrast, when we had the option for maintenance work and inspections to be done by local mechanics in Galena or by Northland Aviation in Fairbanks, the average down time was three days. The maximum down time was one week (for an engine change and 100 hr. inspection on N4343). As a result of these maintenance delays, we (meaning the taxpayers) paid daily availability to OAS for a total of 82 days, a charge of $2214.00, when in actuality, the planes were not available for use. Additional costs to us for chartering, ferrying and associated travel, project delays, and overtime for us to catch up when planes did become available, are not indicated but exceeded several thousand dollars.

On a positive note, we received approval to lease a hangar large enough to store the two Super Cubs. This will improve safety and security of the aircraft and allow us to do preflight inspection, minor maintenance, and emergency repairs in the comfort of a heated hangar.

ROS/P Spindler tops off the tanks on the station's newly acquired super cub N13833. One of the lightest cubs in the fleet, it is excellent for low level wildlife surveys where safe flight and maneuverability at low speeds is important. We had some mechanical problems in its first 150 hours of use which caused some nerve racking landings. These problems have now been resolved and the plane works very well.

J. OTHER ITEMS

4. Credits

ROS/P Liedberg was responsible for Sections C, D.1-4, E.5, F, H.1 and 17, I.1-4 and 7. Sections D.5-6, E.6-8, G.1 and 11, I.5-6 and 8 were written by ROS/P Spindler. WB Bertram was responsible for Section G.3-9 and a portion of G.10. The G.10 (Furbearer section) was written WB Johnson. Sections E.2-4, H.2-7, and 18 were done by PR Johnson. RM Stearns wrote Sections J.1-3. Section G.14 was written by WB Paragi. SEC Williams wrote section E.1. RM Stearns and ROS/P Spindler edited and Sec. Honea proofed the report. PR Johnson and Sec. Williams finalized and PR Johnson, Sec. Honea, BT Lowe and Vol. Davis assembled the narrative.

5. Literature Cited

See the Nowitna Narrative for references and literature cited in this report.

K. FEEDBACK

In terms of management efficiency it makes good sense to associate closely related functions such as realty, refuge operations, refuge planning, resource support, and so on. I believe the ARW and RD have done a good job with one possible exception.

The latest complicating addition to our already complex lives is a program called Subsistence. This activity has changed many aspects of administration within the Region. Initially, out of deference to the time deadlines and a host of pending legal actions, field managers for many months operated in parallel to the folks in the new division. The time may have come to correct this relationship.

The underlying problem is a lack of communication between the people on the ground doing much of the actual administration and the involvement of the two divisions in the region. The corrective action seems obvious; administer these related activities under a single Assistant Regional Director. This could be done by placing subsistence under the ARD for ARW. The duplication of data gathering, meetings in villages and communications from the subsistence administration would, I believe, improve markedly. The new subsistence staff position in the associate manager's shop will improve some of the communication problems but the ideal situation is to have subsistence under ARW.

ANNUAL NARRATIVE REPORT

1991

NOWITNA NWR

KOYUKUK/NOWITNA NATIONAL WILDLIFE REFUGE COMPLEX

Galena, Alaska

REVIEW AND APPROVALS

Complex Manager	Date 5/1/92	Associate Manager	Date

Regional Office Approval	Date

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 were established are:

1. To conserve the 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 for 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. 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 by airplane, boat, snowmachine, foot, or dog sled. The Complex aircraft, two Super Cubs and a Cessna 185, as well as two river boats and several snowmobiles provide transportation. The refuge headquarters is located in Galena, a village of approximately 900 people, of which 300 are military personnel stationed at the Galena Air Force Station. See the Koyukuk report for a description of Galena. In 1989, the Nowitna Refuge was fused into a complex with the Koyukuk NWR and the Northern Unit of the Innoko NWR. Items common to all refuges are presented in detail under the Koyukuk report.

INTRODUCTION

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H. PUBLIC USE

I. EQUIPMENT AND FACILITIES

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K. FEEDBACK

A. HIGHLIGHTS

The first year of a four-year study to determine the effects of fire on furbearers and their habitats in interior Alaska was completed in 1991. A comprehensive literature survey was completed and made available in published and computerized formats. Detailed study plans for marten, lynx, and small mammals were written, approved, and implemented. A base camp was built at Round Lake, which has three seral stages available for study in close proximity. Over 40 km of trails and transects were cut for track surveys, small mammal trapping, and marten trapping. In the marten study, a total of 19 animals were radio-collared and monitored.

Estimated duck production dropped from a record of 17,500 ducklings in 1990 to 4,900 in 1991. A similar pattern of production occured in 1988 and 1989, when a peak was followed by a low caused by extreme flooding in the river corridors. Flooding was so extreme in 1991 that the lower Nowitna Administrative cabin floated off it's foundation! The cabin is located on a high river bank which rarely floods.

A study to determine the relationships of wolf home range and predation in areas of known prey density continued in 1991. By the end of the year, there was only one radio collared wolf in one pack remaining from the original eight collared in three packs.

Moose harvest and number of hunters were below average in 1991, due to the low water and mild fall.

Evidence on a law enforcement case for the removal of fossilized ivory from the refuge was gathered after receiving a tip from the village of Tanana.

B. CLIMATIC CONDITIONS

Specific climatological data are not recorded on or near the Nowitna NWR. The nearest reporting stations are Galena and Tanana. Refer to the Koyukuk section of this report.

C. LAND ACQUISITION

1. Fee Title

In response to the Alaska Submerged Lands Act, a Regional Office team was formed to devise a **Land Acquisition Priority System** for Alaska Refuges. See the Koyukuk report for a description of the system. The final acquisition report, released in January 1990, identified 227,898 acres of high, 62,899 acres of medium, and 197,993 acres of low priority potential acquisitions on Nowitna NWR. Even though the ranking process was mandated by Congress, there are no acquisition funds presently designated for the Nowitna NWR. The ANWR issue may prove helpful in securing these inholdings.

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).

This project will determine 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. The project leader WB Buddy Johnson, who is assisted by WB Tom Paragi, BT Pete Reaman, and University of Washington graduate student Cheryl Quade and Biological Technician George Wholecheese and Jenny Lowe. The work has been

coordinated with other Alaska Refuges, notably Tetlin and Kanuti, as well as NPS, ADFG, USFS and UAF. At the end of four years there will be a minimum of four study areas in interior Alaska where comparable methods were used simultaneously. For results during 1991, see Sections G.10 and H.10.

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 1991 can be found in Section G.10.

Amendment to Project No. 75620-88-01: Extent, causes, and timing of moose calf mortality on the Nowitna and Koyukuk National Wildlife Refuges.

This project was initiated in 1988 on the Nowitna Refuge. An amendment was made in 1990 to increase this study to three years and to include the Koyukuk Refuge in the study area. Primary objectives of this amendment were to compare moose calf mortality rates and causes between the two refuges and to determine what effect, if any, moose calf predation has on the population. This study was completed in 1991, and the results were submitted for publication in the journal Alces. An abstract can be found in the Koyukuk narrative, Section G.8.

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.

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

One lost time accident occurred on the Nowitna during the year. In early September, BT Wholecheese cut his knee with a machete during trail clearing operations for the fire/furbearer project. He was brought to the Galena Clinic where he received stitches. He was back to work in a few days. The lesson to be learned is that a machete should be aimed at the base of the bush or stem. If aimed at mid-stem, the machete can easily bounce off its' target. For other general safety items, refer to the Koyukuk section of this report

7. Technical Assistance

Refer to the Koyukuk section of this report

8. Other Items

Refer to the Koyukuk section of this report

F. HABITAT MANAGEMENT

1. General

Habitat types on the Nowitna NWR are characteristic of interior Alaska. The majority of refuge lands are forested and belong to three major plant communities: spruce/poplar forest, lowbush and muskeg, and lowland spruce/hardwood. Extensive bottomland spruce/poplar forests are found along the Nowitna River drainages, and to a lesser extent, along smaller streams and tributaries. Lowland spruce/poplar forest is composed of black spruce, white spruce, balsam poplar, quaking aspen and paper birch. Shrubs include alder, willows, rose, cranberries and blueberries. Herbs, grasses, ferns, mosses, and lichens are also present. The low-bush bog and muskeg community, found predominantly in the northern lowlands of the refuge, is comprised of black spruce and tamarack. Shrubs include Labrador tea, crowberry, willow, bog cranberry, rose, blueberry, alder, resin and dwarf birch. Sedges, rushes, and cottongrass, as well as mosses and lichens, are also present. The largest plant community on the refuge is the lowland spruce-hardwood forest. This forest type is dominated by black spruce, but white spruce, tamarack, paper birch, balsam poplar and quaking aspen are also present. Understory vegetation includes willows, dwarf birch, blueberry, rose, Labrador tea, crowberry, bearberry, cottongrass, ferns, horsetail, lichens, and sphagnum and other mosses.

2. Wetlands

The principal rivers on 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 Yukon River at Ruby carries an estimated seventy million tons of sediment per year. Annual spring floods from these rivers recharge nearby wetlands with nutrients.

The Nowitna River is the heart of the refuge. This meandering river constantly creates a diversity of habitats for fish and wildlife. The Nowitna's floodplain extends for 8-10 miles on both sides of the river. Annual spring floods bring nutrients to oxbow lakes and sloughs.

Limestone, near the headwaters of the Nowitna, contribute carbonates which buffer the acidic qualities of the river and make it more productive than many of its Interior Alaskan counterparts. The lower half of the river ranges from 150-450 feet wide and flows at an estimated rate of 2-4 miles per hour. The main channel in the lower river is typically 20-30 feet deep in early summer. From the refuge's southern boundary, the Nowitna River flows approximately 220 miles north through the refuge to the Yukon River.

Placer mining for gold and other minerals was stimulated by the lifting of Federal restrictions on gold prices in the early 1970's and has gone through a drastic resurgence in the past decade. In 1983, more than 300 placer miners were in operation throughout the state, producing an estimate 169,000 ounces of gold. Large amounts of soil are removed to reach gold, and active streams are frequently used to wash the site. This technique makes placer mining a major source of aquatic and riparian habitat destruction in Alaska. The only active mining that occurred in the region was south and west of the refuge.

Contaminants

A contaminant study entitled, "Investigation of mercury and copper concentrations in fish and wildlife resources on the Koyukuk/Nowitna Refuge Complex," was continued in 1991. See Koyukuk Section G.2 for a detailed discussion of field activities and other issues relating to the study.

3. Forest

An unusual feature of the Nowitna NWR, compared to Alaskan refuges, is that over 80% of its lands are forested. An estimated 16% of the refuge supports potentially marketable timber. 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. 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 highest quality timber on the refuge grows along the Nowitna River, whose Comprehensive Conservation Plan (CCP) and Wild River designation precludes commercial timbering. Local interest in commercial logging operations on islands of the Yukon River has been expressed. This activity is addressed in the Nowitna CCP which prohibits commercial timber harvesting.

9. Fire Management

Four wildfires occurred on the Nowitna Refuge in 1991 totaling 69,140 acres. The largest fire (B241) which originated on June 9 and was not declared out until September 30. A total of 57,380 acres burned on the refuge and 23,760 acres on adjacent BLM lands. For much of the summer, this was the largest fire burning in the state and received much attention. One cabin was protected by AFS and smoke jumpers were used to backfire the area near the cabin.

A full summary of the fire management program on the complex is included in the Koyukuk section of this narrative.

11. Water Rights

No work was done to establish water rights for the refuge this year. Instream flow data are needed for all streams and rivers which originate from lands outside the refuge. A water management plan is scheduled to be written as a step down plan following the comprehensive conservation plan; this is a far bigger project than the present staff can handle.

12. Wilderness and Special Areas

The entire 223-mile portion of the Nowitna River contained within the refuge boundaries is classified as "wild" under the Wild and Scenic Rivers Act. (The 40-mile portion of the Nowitna River headwaters above the refuge boundary is State land which has a few remote homesteads.) The Nowitna is a beautiful river accessible to the general public only by boat or airplane. A management plan, to be written in 1992-93, will guide the management of its resources.

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, 145 species of birds, 20 species of fishes, and one species of amphibian are known to occur on or adjacent to the refuge.

2. Endangered Species

The only endangered species known to occur on the refuge is the American Peregrine Falcon. Seven active nest sites in or near the refuge were visited in 1991. See Section G.6 for a discussion on falcons observed during the raptor survey.

3. Waterfowl

Wetlands within the Nowitna and Yukon river floodplain support large numbers of waterfowl. Principle duck species include American widgeon, 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, redhead, surf scoter, oldsquaw, harlequin duck, and bufflehead. Arctic, red-throated and common loons, and 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 are along the rivers during the spring and fall migrations. Waterfowl inventories conducted on the Nowitna NWR in 1991 included duck production, goose production, and swan production surveys.

Weather Conditions and Waterfowl Migration Chronology

Break-up on the Nowitna River in 1991 occurred during late April and early May. Flooding was extensive on the Yukon and Nowitna river corridors and continued until mid-June. As a result of high water, many nesters were not successful in 1991.

Duck Production Survey

Waterfowl brood surveys began on the refuge in 1983. Since 1990, the refuge has participated with the Division of Migratory Birds in a state-wide waterfowl production survey. The Nowitna Refuge is included in the Tanana/Kuskokwim Production Unit Three (see Koyukuk Section G.3, Figure 3). The Tetlin Refuge, Department of Defense, Tanana Valley, Minto Flats State Wildlife Refuge, and National Park Service are also included in Production Unit Three.

Sampling scheme and methods for duck production surveys were varied until 1990. The Nowitna Refuge was initially stratified in 1987 into five broad geographic areas based on expected differences in waterfowl production. This stratification technique was followed until 1990 when the Nowitna was stratified using the same methods employed by the Koyukuk and Northern Unit of the Innoko refuges (See description of method in Koyukuk Section G.3).

A Cessna 185 and PA-18, both equipped with floats, provided access into medium and high density strata plots. All low density stratum plots were accessed and surveyed by helicopter. All medium and high density strata plots were surveyed by canoe or walking, or both. Duck production surveys were continually delayed in 1991 due to weather and aircraft maintenance constraints. Brood surveys in 1991 required 12 days on the Nowitna Refuge compared to 5 days in 1990. On the Nowitna Refuge, only 6 of 12 low density plots were completed. The primary objective to survey 12 low density plots with helicopter, simultaneous to ground work, in 1991 was not met.

From July 8-19, one hundred and fifty-six duck broods were observed during waterfowl production surveys on the Nowitna Refuge. Total brood observations were down 51% compared to 1990. Dabbling duck broods comprised 71% of the

observations. American widgeon were the most commonly observed dabbler brood and scaup was the principal diving species.

An estimated 1,136 duck broods (CV=0.43) were produced on the Nowitna Refuge in 1991 (Table 1). Dabbler brood estimates were highest for American widgeon (n=600, CV=0.50), mallard (n=356, CV=0.67), and green-winged teal (n=51, CV=0.43). Diver brood estimates were highest for goldeneye spp. (n=24, CV=0.52) and scaup spp. (n=23, CV=0.44). Total estimated broods were down 65% compared with 1990 estimates. Dabbler and diver brood estimates were 1,063 (CV=0.46) and 53 (CV=0.31), respectively. These estimates are down 48% and 93% from 1990 estimates. Production appears to be linked with the timing, extent, and duration of flooding on the Nowitna and Yukon river corridors. Flooding of adjacent nesting grounds near the Nowitna River corridor lasted into late June in 1991 and had a great impact on production, especially for divers. This year was very similar to 1989 when flooding persisted into late June and resulted in a total production decrease of 75% on the Nowitna Refuge.

An estimated 4,855 ducklings were produced in 1991 (Table 2). The coefficient of variation for this estimate was 0.38 and precision at the 90% confidence level was $\pm$ 63%. Production was down 66% compared to 1990 figures. Dabbler production estimates were highest for American widgeon (2,299), mallard (1,176), and green-winged teal (242). Diver production estimates were highest for scaup spp. (141) and goldeneye spp. (140). Dabbler production was estimated at 4,448 young and diver production at 310 young, both estimates were down 45% and 91%, respectively, compared to 1990. A major objective of the survey was to obtain a coefficient of variation equal to or less than 15% for estimated broods and young (roughly $\pm$ 30% at the 90% Confidence Level). In 1991, on the Nowitna Refuge, variation for estimated broods increased except for the high density stratum. Overall variation increased from 0.39 in 1990 to 0.43 in 1991. Much of the variation in the sample can be attributed to the low density stratum which contains over 1,400 mi^2 of habitat (94% of available waterfowl habitat). It is recommended that sampling be increased in the low density stratum from 6 to 12 plots in 1992 to reduce variation.

About 52% of ducklings observed were aged at Class 1C or 2A, 23% were Class 1A and 1B, 23% Class 2B and 2C, and 2% Class 3. Diver Class 1 composition was 91%. Another major objective of the survey was to maximize observations of Class 1C and 2A dabblers and Class 1 divers on all refuges. This objective was met on the Nowitna Refuge with 52% Class 1C and 2A dabblers observed and 91% Class 1 divers observed. Early survey delays may have aided in maximizing observations because hatching was delayed in 1991 due to extended flooding into the nesting season.

Waterfowl brood surveys have been conducted on the Nowitna Refuge since 1983. Production appears to be linked directly with timing, extent, and duration of flooding on the Yukon and Nowitna River corridor. In 1991 production was down about 50%.

Adult population estimates by species were made for the Nowitna Refuge. These figures should be interpreted with caution due to high variance in dabblers (range = 0.46 - 0.73) and divers (range 0.56 - 1.00) (Table 2). Increases in green-winged teal and mallard raised 1991 adult estimates 19% over 1990 levels. Estimates for most adult diver species decreased, but total diver estimates increased +51% due to increases in ringneck and goldeneye. Total adult estimates for all species increased +16% from 5,077 in 1991 to 5,874 in 1990; however, variance of the estimate also increased from 0.36 in 1990 to 0.48 in 1991 (Table 2).

Due to high variance among dabbler and diver adult estimates the collective sample of all plots was also examined in 1990 and 1991 for abundance of observed adults to obtain more reliable adult trend information. Twenty-two plots were compared for general abundance of observed adults in 1990 and 1991. Although observations of adult widgeon and pintails increased (13% and 125%, respectively) in 1991, all other dabblers decreased (range 26% to 49%), and overall dabbler observations decreased 14% in 1991. Conversely, all diver observations increased in 1991 (range 20% to 400%) with the exception of bufflehead. Overall, diver adult observations increased 130% in 1991 (Figure 1). Observations of adults from both groups combined decreased only one percent in 1991. Total numbers of observed adults were very similar in 1990 and 1991.

Table 1. Estimated broods by species with coefficient of variation, Nowitna NWR, Alaska-1990-91.

Species	Total Broods 1991	1990
Wigeon	600 (0.50)[1]	1,007 (0.33)
G-W Teal	51 (0.43)	339 (0.69)
N. Pintail	28 (0.69)	329 (0.72)
N. Shoveler	27 (0.49)	54 (0.38)
Mallard	356 (0.67)	310 (0.75)
DABBLERS	**1,063 (0.46)**	**2,041 (0.32)**
Canvasback	5 (0.77)	7 (1.00)
Scaup spp.	23 (0.44)	284 (0.83)
Ring-necked	0 (0.00)	6 (0.86)
Goldeneye spp.	24 (0.52)	25 (0.51)
Bufflehead	0 (0.00)	398 (0.98)
Redhead	1 (1.00)	7 (0.75)
DIVERS	**53 (0.31)**	**721 (0.87)**
Surf Scoter	13 (0.68)	477 (0.98)
Black Scoter	1 (1.00)	0 (0.00)
Common merganser	4 (0.72)	0 (0.00)
Unknown	2 (1.00)	10 (0.61)
TOTALS	**1,136 (0.43)**	**3,249 (0.38)**

1 Coefficient of variation in parenthesis

Table 2. Estimated young and adults by species with coefficient of variation, Nowitna NWR, Alaska, 1988-1991.

	Estimated Young[1]				Estimated Adults[1]	
	1991 (CV[2])	1990 (CV)	1989 (CI)[3]	1988 (CI)	1991 (CV)	1990(CV)
Wigeon	2,299 (0.51)	3,296 (0.30)	1,427 (0.19)	4,720 (0.23)	1,476 (0.50)	1,684(0.43)
G-W Teal	242 (0.38)	933 (0.52)	108 (0.53)	2,424 (0.27)	1,254 (0.73)	387 (0.62)
N. Pintail	101 (0.62)	1,368 (0.69)	153 (0.35)	2,623 (0.31)	53 (0.46)	366 (0.65)
N. Shoveler	131 (0.48)	296 (0.39)	354 (0.12)	716 (0.47)	63 (0.56)	188 (0.60)
Mallard	1,476 (0.65)	2,194 (0.85)	205 (0.34)	3,204 (0.34)	744 (0.64)	395 (0.60)
DABBLERS	**4,448 (0.42)**	**8,096 (0.33)**	**2,247**	**13,687**	**3,590 (0.42)**	**3,026 (0.34)**
Canvasback	19 (0.72)	6 (1.00)	0	9 (0.79)	8 (0.68)	9 (0.66)
Scaup spp.	141 (0.44)	1,780 (0.80)	859 (0.41)	1,977 (0.46)	694 (0.61)	1,136 (0.58)
Ring-necked	0 (0.00)	46 (0.94)	0	0	470 (0.99)	1 (1.00)
Goldeneye spp.	140 (0.55)	173 (0.48)	240 (0.45)	637 (0.42)	1,032 (0.91)	46 (0.38)
Bufflehead	0 (0.00)	1,200 (0.97)	40 (0.73)	553 (0.44)	6 (0.56)	263 (0.89)
Redhead	10 (1.00)	61 (0.81)	151 (1.00)	35 (1.00)	1 (1.00)	3 (0.73)
DIVERS	**310 (0.33)**	**3,266 (0.79)**	**1,290**	**3,211**	**2,210 (0.63)**	**1,461 (0.54)**
W.W. Scoter	0 (0.00)	0 (0.00)	140 (0.45)	0	1 (1.00)	8 (1.00)
Surf Scoter	75 (0.70)	2,866 (0.98)	10 (0.80)	163 (0.80)	33 (0.62)	510 (0.92)
Black Scoter	10 (1.00)	0 (0.00)	0	3	3 (0.68)	0 (0.00)
C. Merganser	6 (0.70)	0 (0.00)	0	0	0 (0.00)	0 (0.00)
R.B.Merganser	0 (0.00)	0 (0.00)	0	0	6 (1.00)	6 (0.84)
Unknown	5 (1.00)	42 (0.58)	522 (0.15)	76 (0.16)	19 (0.62)	67 (0.48)
TOTALS	**4,855 (0.38)**	**14,270 (0.35)**	**4,209**	**17,140**	**5,874 (0.48)**	**5,077 (0.36)**

[1] It should be noted that sampling strategies differed from 1988-90; production estimates are provided from previous years for trend or abundance comparisons only.

[2] Coefficient of variation

[3] Estimated young calculated at the 90% confidence level.

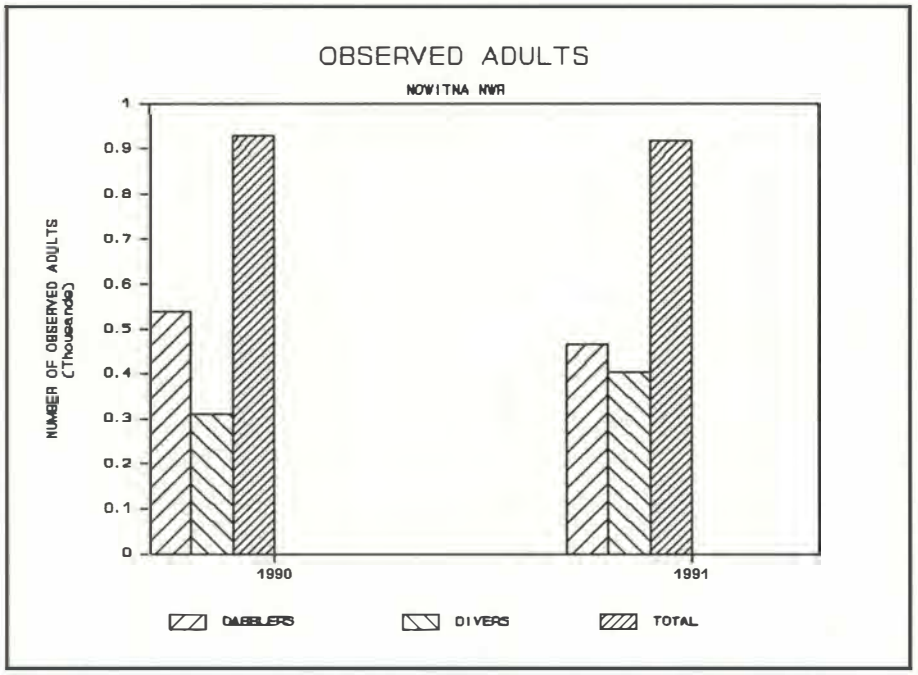

Figure 1. Observed adult waterfowl on production surveys, Nowitna NWR, Alaska, 1990-1991.

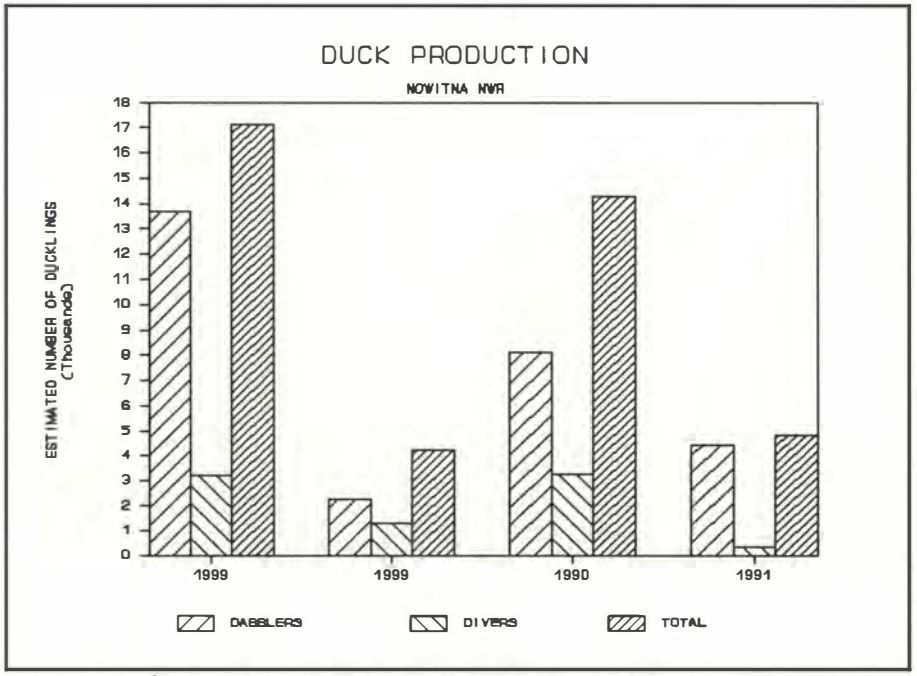

Figure 2. Comparison of estimated waterfowl production on the Nowitna NWR, Alaska, 1988-1991.

Production has ranged from a minimum of 4,209 in 1989 to a maximum of 17,140 in 1988 (Table 2). See Figure 2 to compare production of ducklings on the Nowitna Refuge since 1988. Total cost for the production surveys was $15,747.74 in 1991.

Goose Production

A 61 mile stretch of the upper Nowitna River was surveyed by canoe from June 24-26 to assess goose production and to record observations of other wildlife. All geese observed were tallied and recorded by species, sex, and age-class when possible. One hundred-ninety adult and 86 gosling Canada geese and 53 adult and 144 gosling white-fronted geese were observed. Age class estimates were difficult to make because of the evasive action of the broods. All broods were estimated as Class 1. Observations of white-fronted goslings increased 33% in 1991 (Figure 3). There was a 3% increase in Canada adult observations and Canada goslings decreased 53%.

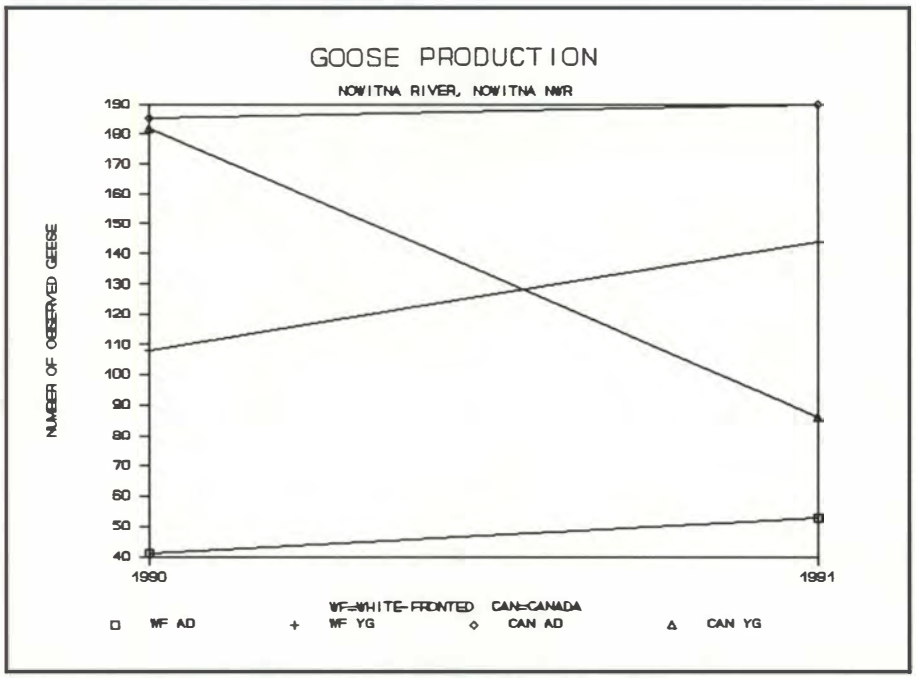

Figure 3. Goose production on the Nowitna River, Nowitna NWR, Alaska, 1990-1991.

Swan Production

On the Nowitna, the majority of swans identified were trumpeter swans, although tundra swans also occur infrequently occur (Loranger and Lons 1987). In prior years, a few selected "trend maps" were surveyed to monitor trends in swan population and production. In 1991, there was a decline in the number of cygnets and paired swans, but an increase in the number of non-breeders (flocked and singles), and the mean brood size (Figures 4 and 5). During the spring breakup of the Nowitna River, a local ice jam resulted in extreme flooding near the lower administrative cabin. Evidence of flooding was also apparent along the Yukon River corridor near the Nowitna mouth. The decrease in young and pairs and the increase of non-breeders (flocked and singles) suggests that the flood conditions lowered the success rate of breeding pairs.

4. Marsh and Waterbirds

Lesser sandhill cranes, Arctic and common loons, and horned and red-necked grebes are all confirmed nesters on the refuge. Yellow-billed loons are an occasional visitor. Observations of these species are made and recorded during the duck production survey.

5. Shorebirds, Gulls, Terns and Allied Species

The Charadriiform species that have been reported on the refuge are: common snipe; whimbrel; western, semipalmated, least, pectoral, spotted, Baird's, and solitary sandpipers; lesser and greater yellowlegs; golden, black-bellied, semipalmated, and upland plovers; long-billed dowitcher; and northern phalaropes. Mew, herring, and Bonaparte's gulls are common, as are Arctic terns and long-tailed jaegars. No active survey or studies were conducted to assess population distribution or status of the species in 1991.

6. Raptors

The refuge supports a diverse raptor population, including northern harriers, rough-legged hawks, red-tailed hawks, goshawks, sharp-shinned hawks, golden and bald eagles, and great-horned, great gray, boreal, short-eared and hawk owls. Probable nesters include the osprey, American kestrel, merlin and peregrine falcon. Swainson's hawks and gyrfalcons are occasional visitors.

A raptor survey was conducted on the Yukon River from Galena to Ruby from June 22-24 and July 14 in cooperation with Peter Bente, USFWS Endangered

In 1991, a decrease in cygnets and paired swans suggests that flood conditions lowered the success rate of breeding pairs.

Species, Fairbanks, and Tim Osborne, ADFG Biologist. The purpose of the survey was to ascertain general trends in raptor numbers. This survey has been conducted independently by the Endangered Species Office since 1979 to document peregrine falcon use of the Yukon River. During the survey, 7 active peregrine nest sites were visited between Galena and Ruby. Adults were captured using harnessed pigeons with foot snares. One adult was captured, banded, and morphological information recorded. Seven nest sites were visited and 11 young were banded. According to Bente, nest fidelity is strong in the area between Galena and Ruby and most of the available habitat is filled. In recent years the general trend is up in peregrine abundance. Two adult Harlan's hawks and two adult merlins were also observed.

7. Other Migratory Birds

A diverse group of migratory bird species use the refuge throughout the spring and summer months. Of the 50 passerines occurring on the refuge, the most commonly observed are Swainson's and grey-cheeked thrushes; yellow-rumped and blackpoll warblers; tree, white-crowned, and Savannah sparrows; and cliff, barn, and tree swallows. Common non-passerine birds nesting on the refuge include the downy and hairy woodpeckers and belted kingfisher.

The number of bird species using the refuge declines from 145 in the summer to 28 during the winter months. Most wintering birds are passerines. Ravens, gray jays, redpolls, black-capped and boreal chickadees and pine grosbeaks are the most commonly observed.

Refuge staff participated in the Galena Christmas bird count; results of this survey and past surveys are in the Koyukuk Refuge narrative under Section G.7.

8. Game Mammals

Moose, black and grizzly bear, wolf, marten, beaver, wolverine, lynx, otter, red fox, and snowshoe hare are found throughout the refuge. Moose and black bear are the most commonly harvested game mammals. Marten are the most economically important furbearers.

Moose

Moose are present throughout the refuge, their highest densities occurring along the lower Nowitna river drainage. The refuge moose population is important as a subsistence resource for local residents and a recreational resource

Annual goose production surveys are conducted on the Nowitna River to document white-fronted and Canada goose production. White-fronted goose observations were up in 1991.

The Nowitna Refuge supports a diverse raptor population including the American peregrine falcon. A success story in Alaska, this bird is under consideration for de-listing in 1992.

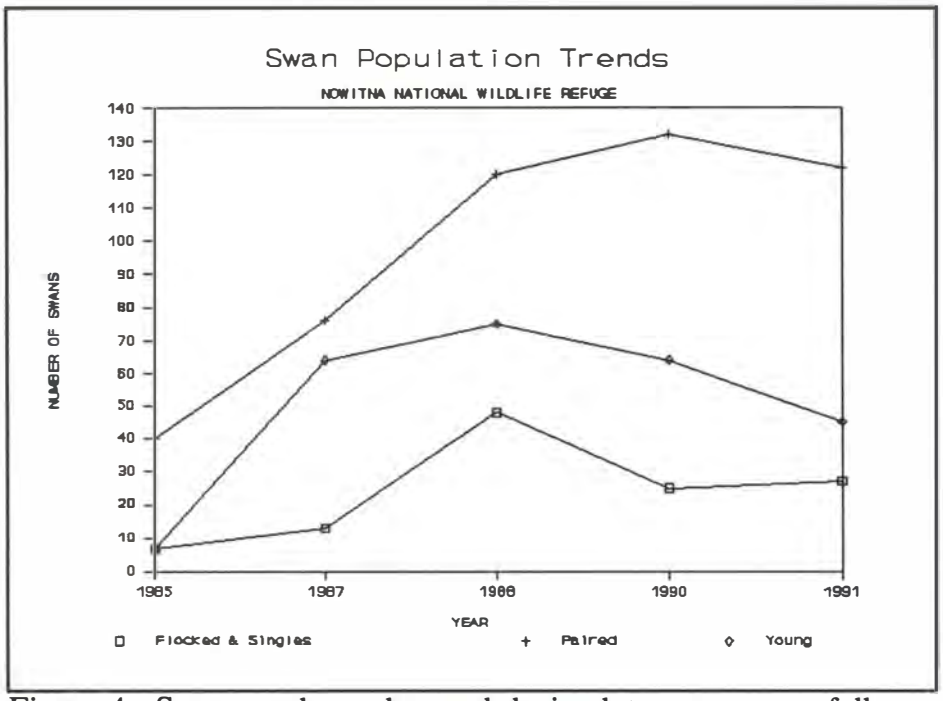

Figure 4. Swan numbers observed during late summer or fall aerial surveys of the Ruby C3, C4, D2, D3, D4, and Melozitna A1 and A2 trend maps.

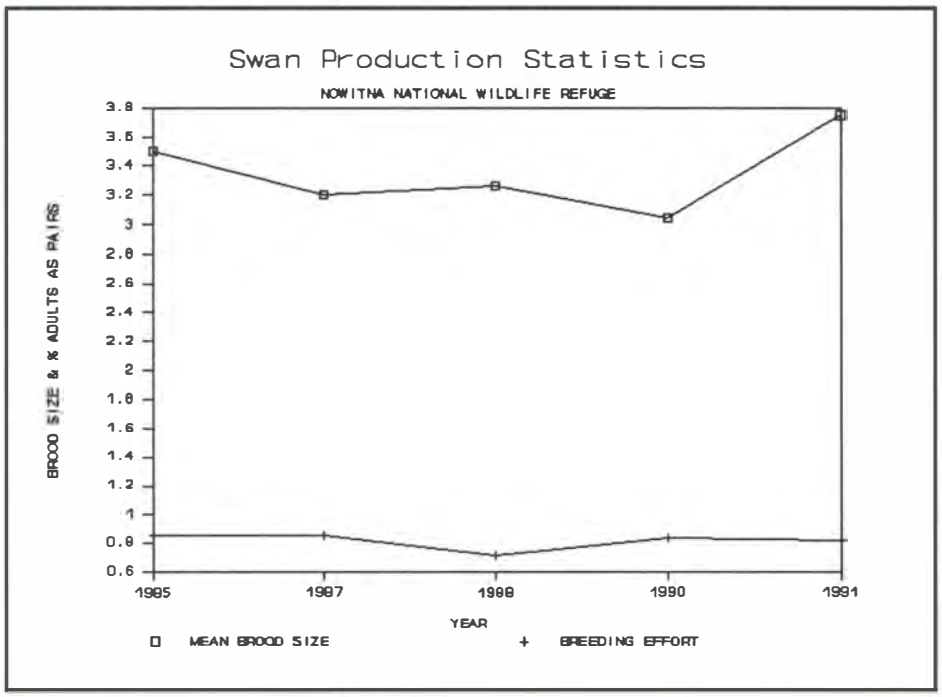

Figure 5. Swan production statistics based on late summer or fall surveys of the Ruby C3, C4, D2, D3, D4, and Melozitna A1 and A2 trend maps.

for non-local Alaskans. Moose hunting during September represents the largest public use activity on the refuge.

Two moose projects were conducted during the year. A hunter check station was operated on the lower Nowitna River during the September moose hunting season and population trend surveys were conducted in November. In addition, a final report summarizing the 1990 moose census was prepared (Bertram 1991). Moose hunting and the hunter check station are discussed in Section H.8.

The moose telemetry study to determine the extent, timing, and causes of mortality in calves on the Nowitna and Koyukuk refuges was completed in May 1991. The study included the Nowitna Refuge as the study area from 1988-1989 and the Koyukuk in 1990. The results of this study, including findings from the Nowitna study area, are in Koyukuk Section G.8, and published in the journal Alces (Osborne et al 1991).

Moose population trend surveys

Trend surveys have been conducted annually on the refuge since 1980 to assess the relative abundance and demographics of the population. A moose inventory plan was completed in 1991 after a historical review of past survey data. Trend areas outlined in the plan are presented in Figure 6.

The Nowitna River/Sulatna Confluence trend area was surveyed on November 26. Since only a small sample of the lower Nowitna River moose population was sampled in 1991 due to time and weather constraints, therefore, the data should be interpreted with caution. The results indicated an increase in density in 1991 to 2.7 moose/mi^2 (Figure 7, Table 3). This estimate exceeds the eleven year average population density of 2.4 moose/mi^2. Since 1988, low bull:cow ratios and bull composition continue to be evident (Figure 8, Table 4). The population continues to grow in spite of a decreased bull component.

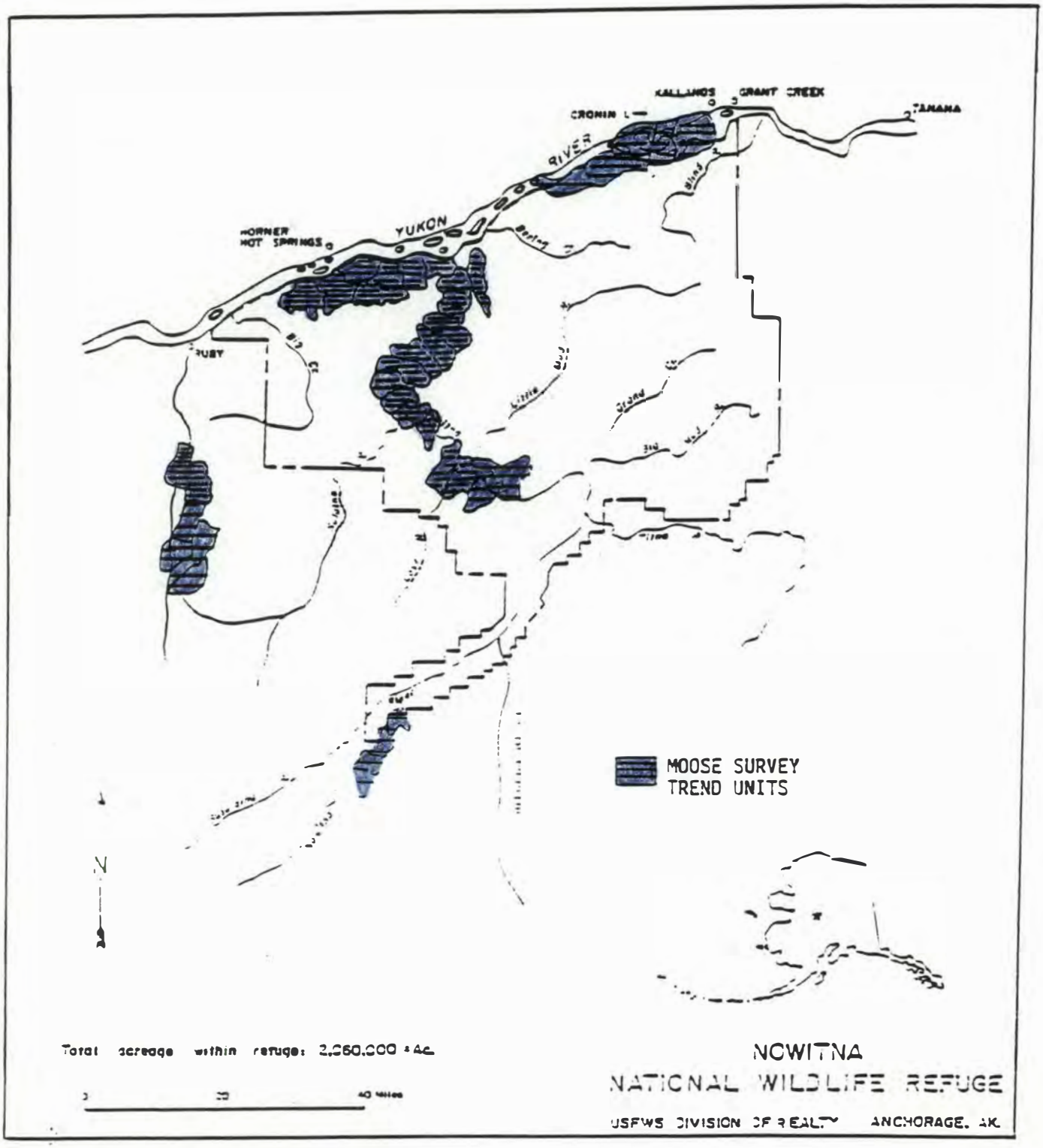

Figure 4. Moose trend areas for the Nowitna Refuge.

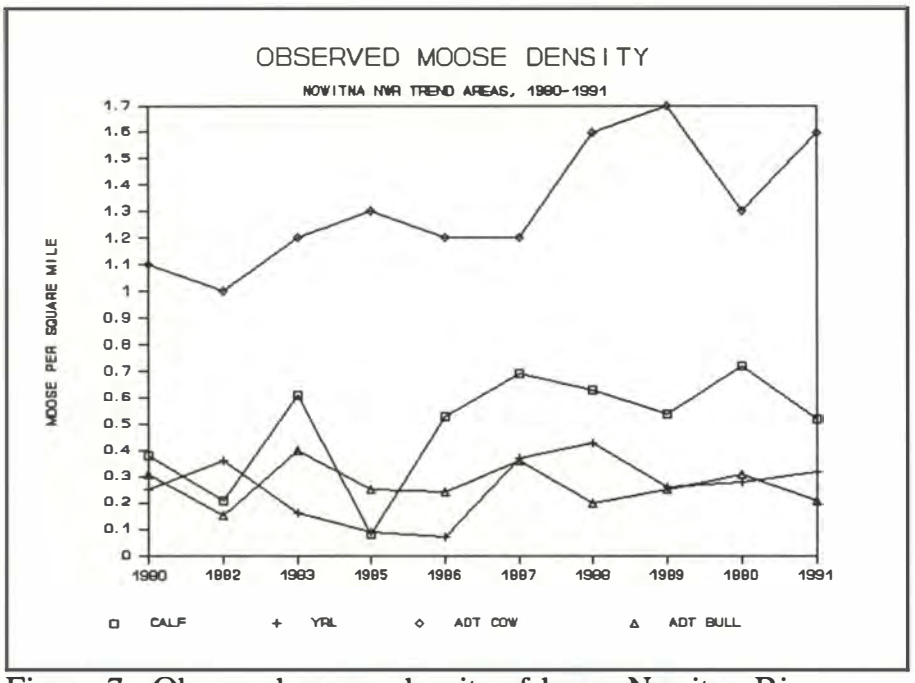

Figure 7. Observed moose density of lower Nowitna River trend surveys, Nowitna NWR, Alaska, 1980-1991.

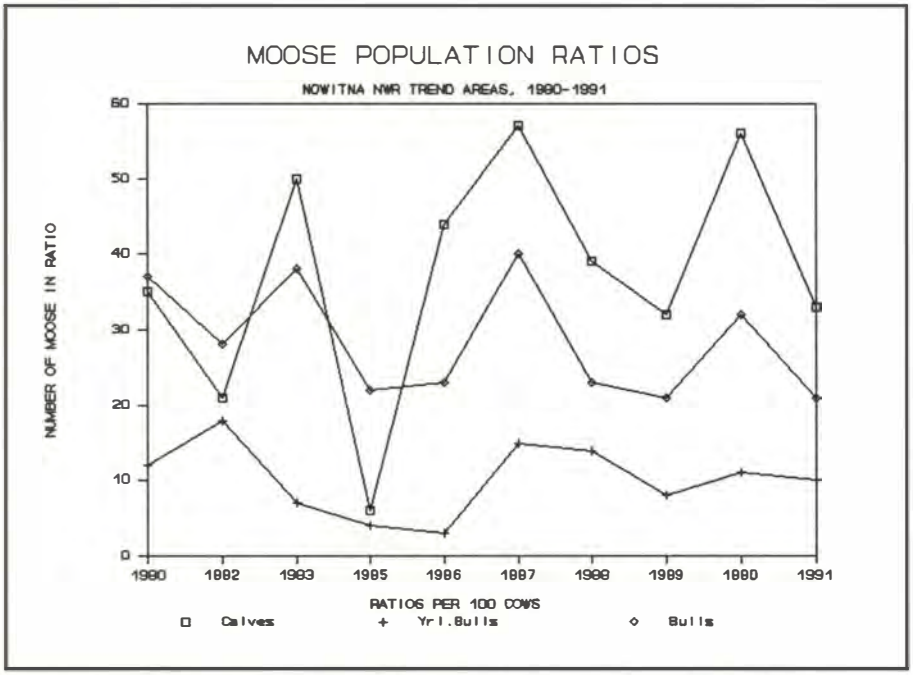

Figure 8. Moose population ratios of lower Nowitna River trend surveys, Nowitna NWR, Alaska, 1980-1991.

Table 3. Observed moose density based on trend surveys of the Lower Nowitna River Subunit, 1980-91, Alaska

Yr.[1]	Area (mi^2)	Total Moose	Density (#/mi^2) Calves	Yearlings	Females	Males	Total
1980	39	78	0.38	0.25	1.1	0.31	2.0
1982	66	114	0.21	0.36	1.0	0.15	1.7
1983	63	148	0.61	0.16	1.2	0.40	2.4
1985	106	186	0.08	0.09	1.3	0.25	1.7
1986	108	221	0.53	0.07	1.2	0.24	2.0
1987	129	330	0.69	0.37	1.2	0.36	2.6
1988	92	260	0.63	0.43	1.6	0.20	2.8
1989	143	391	0.54	0.26	1.7	0.25	2.7
1990	116	303	0.72	0.28	1.3	0.31	2.6
1991	75	200	0.52	0.32	1.6	0.21	2.7
means	94	2231	0.49	0.26	1.3	0.27	2.4

[1] No surveys conducted in 1981 and 1984.

Table 4. Herd composition and adult age structure of the Lower Nowitna River Subunit, 1980-90, Alaska

Year[1]	Composition (% of herd) Ad. Bulls	Ad. Cows	Yrlgs	Calves	Bulls/100 Cows
1980	16	53	13	19	37
1982	8	57	21	12	28
1983	17	50	7	26	38
1985	14	75	5	5	22
1986	12	58	4	26	23
1987	14	45	15	27	40
1988	7	55	15	22	23
1989	6	61	10	20	21
1990	12	50	10	28	32
1991	8	61	12	20	21
mean	11	57	11	21	29

[1] No surveys were not conducted in 1981 and 1984.

Two major field projects concerning moose were conducted during the year on the Nowitna Refuge. A hunter check station was operated on the Nowitna River in September and population trend surveys were conducted in November.

Bears

Black bear densities on the refuge appear to be high. They are commonly observed along rivers and lowland areas. Black bears were the major predator on moose calves on the refuge in 1988-89. Local residents occasionally harvested black bear in the spring and summer, especially in the vicinity of fish camps. Most harvest is incidental to moose hunting in September.

Brown bears occur throughout the refuge, but are less numerous than black bears. Highest densities occur in the foothills of the Kuskokwim Mountains located in the southern portion of the refuge. The Kokrine Hills on the northern border support moderate brown bear densities. Salmon runs along the Yukon River and its tributaries attract some of these bears during the summer months. Of 53 radio-collared moose calves killed by predators, two were taken by grizzly bear during the summers of 1988 and 1989. Grizzly bear harvest generally occur during the summer months and during the September moose season.

10. Other Resident Wildlife

Furbearers

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

Beaver

Beaver populations are presently high in much of interior Alaska. They are common throughout the refuge; active beaver lodges were observed in the majority of wetlands surveyed during the 1991 duck production survey. Beaver is an important source of fur and food for local resource users. Beaver meat is highly prized and is a welcome change from moose in the diet of local residents. No monitoring was done in 1991 on the Nowitna Refuge.

Wolverine

Relatively little is known about the status of the refuge wolverine population. They are occasionally harvested by refuge trappers, but are rarely seen. Refer to Table 14, Section 10 for harvest information.

Lynx, Marten, Mink, Red Fox, and River Otter

The population status of these furbearer species is undetermined 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 species are occasionally harvested by refuge trappers (See Table 14).

Wolves

Two major projects, a wolf census and a radio telemetry study, were conducted on the refuge in 1991. Previous aerial wolf surveys conducted on the Nowitna in 1985, 1987, 1988, and 1989 have generated estimates ranging from 57 to 81 wolves in 6 to 9 packs. This survey requires about four to five days of ideal tracking and light conditions. In 1991, we funded a survey by Danny Grangaard, a very experienced aerial wolf tracker from the ADFG and Ron Warbelow, an experienced tracking pilot. The survey was completed under ideal tracking conditions from March 18-22 and 80 wolves were estimated. This estimate is believed to be conservative and we feel that the wolf population is either stable or increasing. The estimates do not include single or pairs of wolves.

Eight wolves from three packs were collared in 1990 to determine territory size and wolf/prey ratios. The three wolf packs were intensively tracked March 4-21 to estimate pack size and kill rates. Packs were monitored daily over the three week period with the exception of one day. During the tracking period, six adult and two calf moose were observed being consumed. Twenty-seven monitoring flights were conducted throughout the year. At years end, only one wolf from one pack was still on the air. A progress report on the status of the wolf telemetry project is expected to be completed in 1992.

Fire/Furbearer Project

A large scale project coordinated and conducted by Complex staff, to examine the relationships between wildfire and furbearer populations in interior Alaska, began the Fall 1990. Basic information regarding wildfire and furbearers is needed to address the growing concerns of resource users and to better predict the results of management policies and actions involving fire. We began the planning process by preparing a study proposal that outlined a strategy for a broad-based investigation of marten and lynx ecology in interior Alaska (Johnson 1990). From this outline, specific study proposals were generated and presented to groups at the Northern Furbearer Conference (Fairbanks, AK, April 1991) and at the Symposium on the Biology and Management of Marten and Fishers (Laramie, WY, May 1991) for comment. Project proposals were also discussed at village meetings and comments were solicited from refuge trappers.

The basic goals of the project are to examine the relationships between wildfire and furbearer populations in interior Alaska and to obtain baseline ecological data on marten and lynx habitat relationships, seasonal distribution, population parameters, and prey relationships. Specific objectives have been incorporated into several complementary studies and work items. General project objectives are as follows:

1) To complete an extensive literature review of the effects of fire on marten and lynx populations with emphasis on literature from the USSR, Alaska, Canada, and Northern Europe.

2) To develop relationships models based on a review of the literature that defines the life cycle requirements of marten and lynx as they relate to habitat, prey abundance and fire effects.

3) To determine habitat use, movement patterns, home range dynamics, and the extent and timing of dispersal of marten and lynx in burned and unburned habitats.

4) To obtain annual indices of abundance of small mammals known to constitute important marten and lynx prey in known-age burned and unburned habitat.

5) To estimate the seasonal density and relative abundance of marten and lynx occurring within each study area.

6) To test and refine inventory techniques for lynx and marten on large land management units.

7) To quantify habitat components of marten and lynx and their primary prey (microtines and snowshoe hare).

8) To determine the sex, age, and reproductive status of marten and lynx harvested within and adjacent to study areas.

9) To prepare an informational leaflet summarizing the objectives of the project and what is presently known about the effects of fire on furbearers.

10) To classify the vegetative composition of each study area for pre- and post-burn periods.

An accurate evaluation of the <u>effects</u> of wildfire on furbearer and prey populations and their habitat would require a extensive, long-term comparison study of pre-burn data and post-burn data to unburned controls. Pre-burn baseline data from

replicate areas in mature forest, followed by prescribed burns in some replicates would be needed to obtain post-fire burn data. Post-fire communities would be monitored until mature forests develop in the burned areas and then compared to unburned controls. Fiscal and temporal constraints preclude such intensive efforts. This project will evaluate post-fire seral stages for suitability as marten and lynx habitat based on their relative abundance and an understanding of how and why habitat types are used by marten, lynx and their prey.

A 600 km^2 area adjacent to the Little Mud drainage in the Nowitna refuge (64° 40' N, 154° 00' W) has a recent burn in moss-herb stage (1985, ca. 140 km^2), an older burn in tall shrub-sapling stage (1966, ca. 210 km^2), and mature coniferous forest in proximity (Figure 9). This area has been chosen as the primary study site for several studies associated with the project because three structurally-definable stages are juxtaposed, and the interior of each seral stage is accessible by small, fixed-wing aircraft most of the year. Potentially similar areas exist in the Koyukuk refuge (65-66° N, 154-158° W) and adjacent lands which may be later incorporated into the study.

A brief overview and status report for all studies and tasks associated with the project follows:

Literature Review. The first step in our examination of wildfire and furbearers was to complete an extensive literature review of marten, lynx, and their major prey with emphasis on their relationship to fire-induced habitat changes in the boreal forest. The completed literature review was to establish a benchmark for the current state of knowledge concerning marten and lynx ecology and the relationships of fire and furbearers. The information would then be used to develop relationships models and to generate more specific and meaningful objectives for associated studies.

A contract for the literature review was awarded to Audrey Magoun in September 1990. The review was completed in March 1991, and compiled as an annotated bibliography containing 858 citations. Although not all inclusive because of time constraints, it contains citations from all over the world, including hard to find "grey" literature such as unpublished agency reports. In July 1991, the bibliography was edited and revised for publication. In August, "Wildfire and Furbearers in the Boreal Forest with Emphasis on Marten, Lynx, and Their Prey: An Annotated Bibliography" was published (Magoun and Johnson 1991). Funding for the printing costs was obtained through a cooperative agreement with the National Park Service. Initial distribution filled requests made before publication from around the world and included several university and institutional libraries. Copies were also sent to the FWS Region 1 Office in Portland for inclusion into their resource database and to the FWS Fire Ecologist in Boise for possible use in the Fire Effects Information System (FEIS) under development. Additional

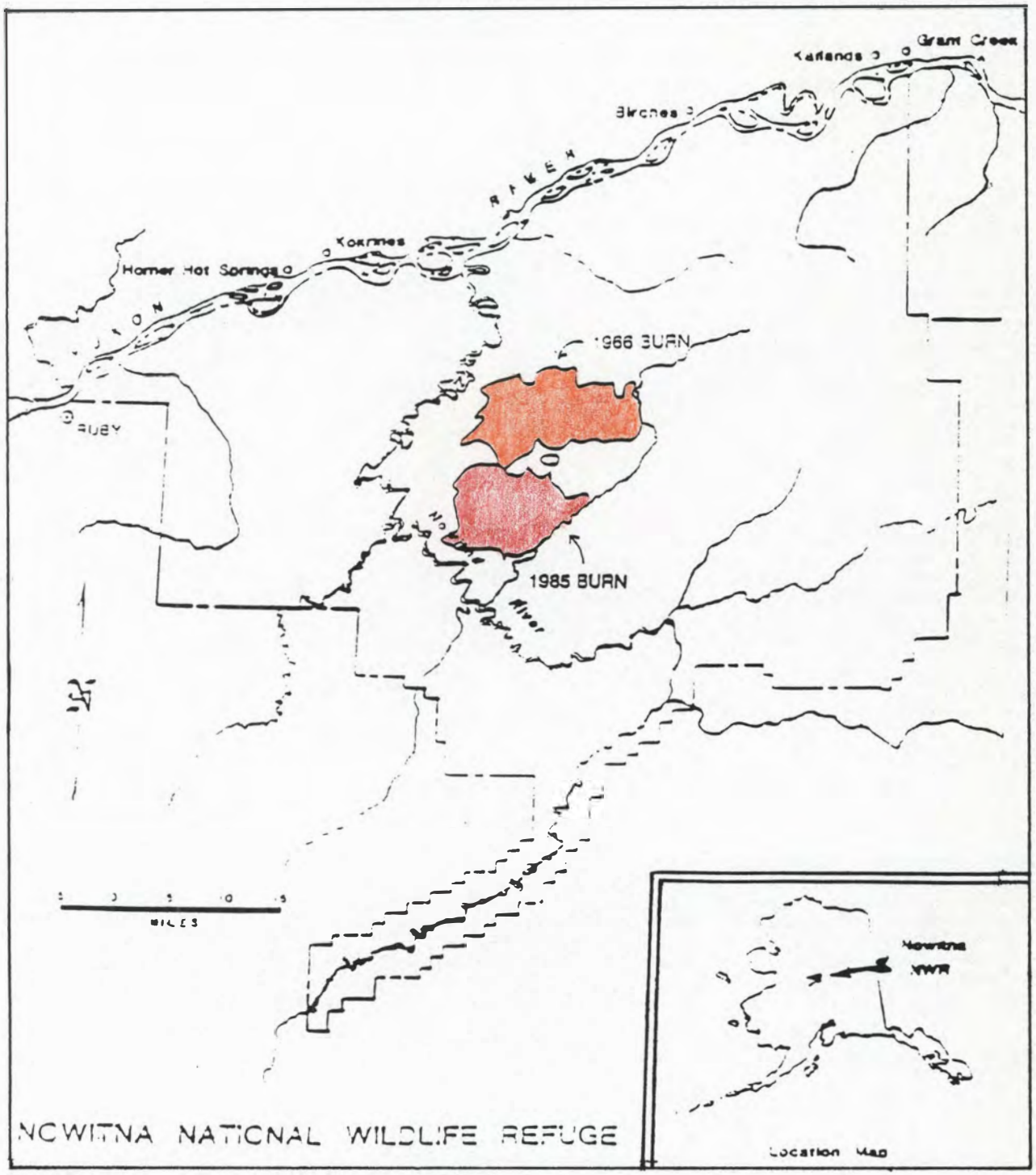

Figure 9. Location of burns chosen for Fire/Furbearer study on the Nowitna NWR, Alaska.

copies of the bibliography and Pro-cite database files were sent to the FWS Regional Library in Anchorage for further distribution.

The bibliographic database will continue to be updated as new literature is received and will be available through the FWS Regional Office in Anchorage. It is expected that demand for the published bibliography will exceed supply and a revised edition may be published later.

Relationships Models. We plan to use information from the literature review and on-going studies to develop relationships models. These models will define life cycle requirements of marten and lynx and relate them to habitat variables, prey abundance, and fire effects. Procedures similar to those used to develop Habitat Suitability Indexes (HSI) will be used to correlate habitat variables with population attributes. In addition to current literature, expert opinions from an interagency work group may be used to refine models and identify the most important information gaps.

In association with the literature review, Audrey Magoun was contracted to investigate the feasibility of developing relationships models for marten and lynx in interior Alaska. She concluded that there is not enough information presently available for marten to develop meaningful HSI models for interior Alaska (Magoun 1991*a*). Although various HSI models for marten exist (Allen 1984, Banci 1988, Suring et al. 1988, Patton and Escano 1990), most were developed outside Alaska and focus on mature forest components. Magoun (1991*a*) states "focusing only on mature spruce forest as optimal marten habitat may lead to erroneous conclusions concerning marten carrying capacity for interior Alaska. Understanding how marten use the various successional stages should be the first step in deriving marten HSI models for the Interior".

Magoun (1991*b*) identified four key points concerning the link between wildfire and lynx: "1) lynx are dependent on snowshoe hares; 2) snowshoe hares are dependent upon early and mid-successional stages of forest succession; 3) early and mid-successional communities are created primarily by wildfire in interior Alaska; and 4) therefore, lynx are dependent on wildfire in interior Alaska." Despite this intuitive association, the relationship of the habitat features created by wildfire to lynx populations is poorly understood in the Interior.

Magoun (1991*a*,*b*) made several research recommendations that address the relationship of marten and lynx to various post-fire habitats. Where possible, these recommendations have been incorporated into on-going and planned studies. The results of these studies should help identify those variables that will be most useful in predicting the capability of burns to support marten and lynx. The feasibility of creating habitat models for lynx and marten in the Interior will be assessed at the completion of the project.

Marten Study. The basic goal of this study, Relationships among wildfire, marten populations, and marten habitat in interior Alaska is to gather baseline data on marten-prey-habitat relationships on post-fire seral stages in interior Alaska. Hypotheses that are logistically feasible to test at our study site will be formulated to help explain inconsistencies in marten-habitat relationships across Northern America (Buskirk 1991, Magoun 1991*a*). Objectives are as follows:

1) Determine the relative abundance (tracks per km) and distribution (presence/absence) of martens among post-fire seral stages.

2) Determine habitat selection of martens by cover type.

3) Obtain indices of abundance (captures per trapnight, tracks per km) or estimates of density (number per ha) of known prey and other foods of martens on a seasonal or annual basis.

4) Determine age, sex, and reproductive status of martens harvested in the post-fire seral stages.

5) Determine extent and timing of movements by martens.

6) Using existing data on marten harvest, wildfire history, climate, and vegetation cover type throughout interior Alaska, identify areas of similar seral stage with with different marten yield to analyze factors potentially influencing habitat suitability and identify additional questions for future study.

Snow-tracking surveys were conducted on short sections of the flagged trail in the mature forest (28 Dec) and new burn (30 Dec; Table 5). (shallow snow [ca. 40 cm] without a crust prevented snowmachine travel over longer sections because of deadfalls present in the new burn). The single bout of snow- tracking suggested that martens were more abundant in the new burn, but trail coverage was limited. Martens and weasels were apparently hunting near the trail in the new burn as their tracks zig-zagged to investigate holes, stumps, and deadfall. Their tracks often followed one another, but a light dusting of snow precluded determining whether one species consistently followed the other.

Marten trapping was exploratory during the spring. Trails were made in each burn during the first week of March. Unusually deep snow (1 m on the level, $\geq$2 m in drifts near hills) facilitated travelling over areas of deadfall and brush. Storms passed through the area every few days, with the most extreme conditions on 16 March (-31 C, winds 30 kph gusting to 50 kph).

Although methods and trap locations differed between seasons, catch-per-unit-effort (capture success) of livetrapping during spring and fall suggested that

martens were most abundant in the new burn and least abundant in the old burn (Table 6). The proportion of juveniles in our live-trapping catch (74%; Table 7) was higher than a sample of live-trapped martens from an area of intensive trapping harvest where ages of live-trapped martens were determined (39%, $\underline{n}$ = 54; Katnik et al. 1991). Our study site may be a "sink" (Van Horne 1983) for dispersing juveniles in search of unoccupied habitat (Archibald and Jessup 1984), because no adult (age $\geq$2 years) females have been captured. However, the relatively large burned areas in close proximity to the peninsula of mature forest where we trapped martens (Figure 10) could confound our interpretation of age-sex differences for martens inhabiting the different seral stages.

Telemetry data were insufficient to determine movements or home range fidelity of martens during the first half of the 1991-92 trapping season (Table 7). Our sample of radio-collared martens quickly dwindled after the spring and fall live-trapping session because of natural mortality and presumed dispersal (loss of contact). Animals that could not be heard from aircraft might have dispersed, experienced transmitter failure, or simply not have been detectable (e.g., broken antenna on collar or animal underground). A radio-collared marten was trapped 75 km west of the study area in late 1991, but the collar was discarded by the trapper, so the identification of the marten is unknown. The status of all collared marten is shown in Table 8.

Snow tracking is being used to assess habitat use and determine relative abundance and distribution of martens among post-fire seral stages.

Table 5. Abundance index (tracks/km) for martens, weasels, and their prey along a flagged snowmachine trail in the mature forest (5 days after snowfall [DAS]) and in the new burn (7 DAS) in late December 1991 on the Nowitna NWR, Alaska.

	New burn (3.37 km)		Mature forest (0.86 km)	
	Tracks[a]	Index	Tracks	Index
Marten	74	22.0	7	8.2
Weasel[b]	59	17.5	4	4.7
Snowshoe hare	4	1.2	1	1.2
Grouse/ptarmigan	7	2.1	0	0
Small mammal	0	0	1	1.2

[a]Track intersects on the trail; multiple intersects by individuals counted separately.
[b]Includes least weasels (*Mustela nivalis*) and short-tailed weasels (*Mustela erminea*).

Table 6. Livetrapping data for martens during spring and fall 1991 in post-fire forest stages on the Nowitna NWR, Alaska. Capture success (CS) is martens caught per 100 trapnights (TN).

	Spring				Fall			
Site	Dates	TN	Marten	CS	Dates	TN	Marten	CS
Mature Forest	15 Mar-5 Apr	243	3	1.2	27 Aug-2 Sep, 19-29 Sep	352	5	1.4
Old burn (1966)	14-26 Mar	197	0	0	3-10 Sep	139	0	0
New burn (1985)	21 Mar-5 Apr	177	4	2.3	12-19 Sep	127	7	5.5
All sites		617	7	1.1		618	12	1.9

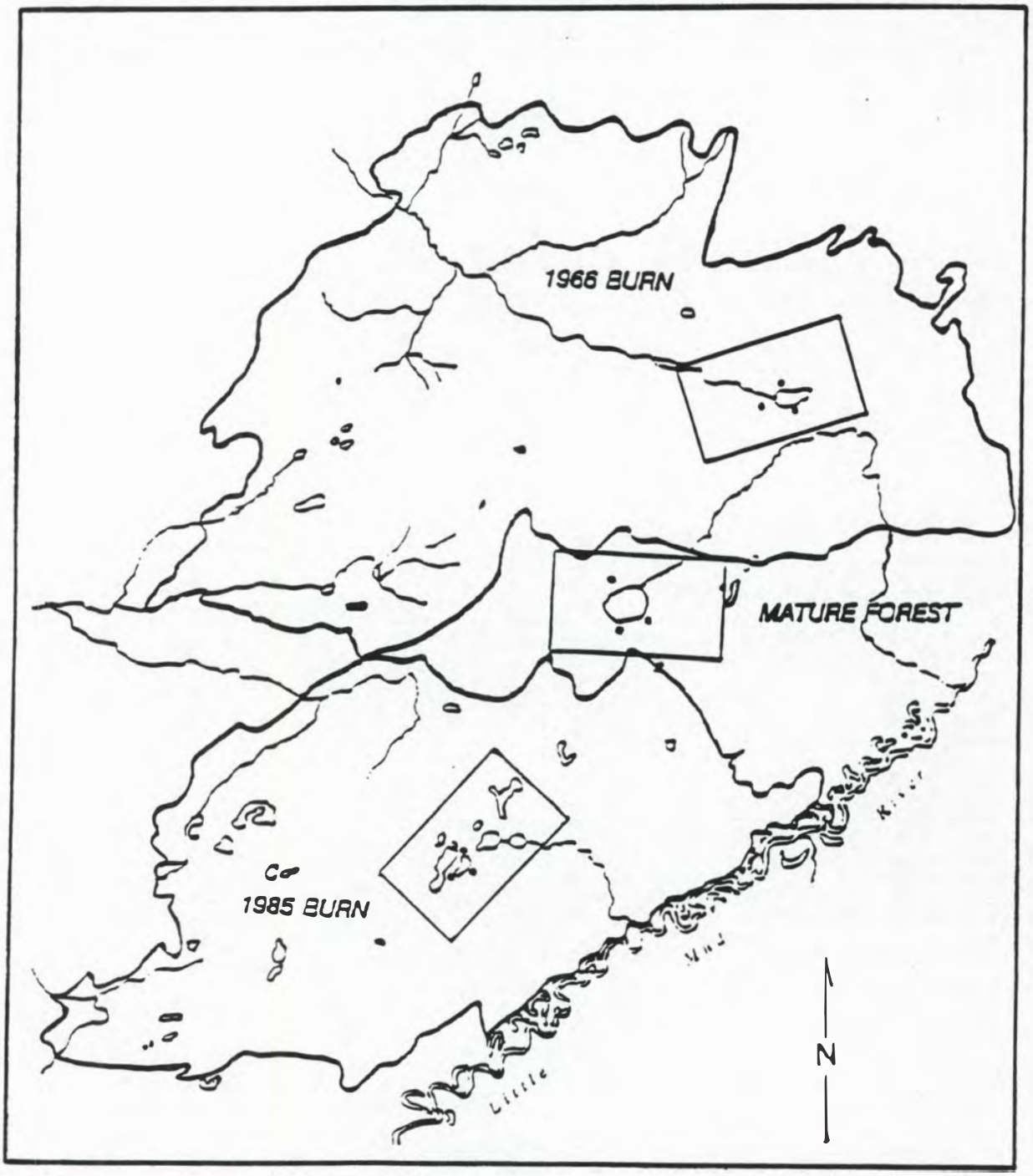

Figure 10. Location of core areas and small mammal trapping grids on study area, Nowitna NWR, Alaska.

Table 7. Number of locations (aerial telemetry and trap sites) during 1991 for 19 martens captured during spring (Mar-Apr) and fall (Aug-Sep) on the Nowitna NWR, Alaska. Juveniles are <1 year old; only 1 adult (a male) was >1 year old.

	Males		Females	
	Juvenile	Adult	Juvenile	Adult
Individuals				
Spring:	3	0	2	2
Fall:	7	2	2	1
Total:	10	2	4	3
Number of locations[a]				
Spring:	17	0	16	9
Fall:	36	21	11	6
Total:	53	21	27	15
Mean locations/individual				
Spring:	5.7	0	8.0	4.5
Fall:	5.1	10.5	5.5	6.0
Total:	5.3	10.5	6.8	5.0

[a]Locations per individual ranged 2-10 for juveniles and 3-11 for adults.

Table 8. Status of martens captured during 1991 on the Nowitna NWR, Alaska.

ID	Age[a]	Sex	Initial capture		Number of Locations[c]	Fate[d]	Comments
			Date	Site[b]			
26	0	F	22 Mar	MF	10	Unk.	Last location 10 June
29	0	M	23 Mar	NB	7	Unk.	Last 30 Apr/heard 10 Oct
31	0	F	24 Mar	MF	6	Unk.	Last location 23 April
33	1	F	31 Mar	NB	6	Dead	Natural mort. 23-30 April
34	1	F	3 Apr	NB	3	Slip	Slipped collar 6-10 April
36	0	M	3 Apr	MF	7	Unk.	Last location 6 May
38	0	M	4 Apr	NB	3	Unk.	Last location 10 April
40	2	M	1 Sep	MF	10	Alive	Last loc. 24 January 1992
42	0	M	1 Sep	MF	7	Unk.	Last location 17 October
44	0	M	13 Sep	NB	5	Unk.	Last location 17 October
47	0	M	17 Sep	NB	4	Dead	Natural mort. 2-11 October
48	0	F	18 Sep	NB	2	Unk.	Last location 25 September
53	1	M	31 Aug	MF	11	Unk.	Last location 14 November
55	0	M	29 Aug	MF	2	Dead	Recapt. mort. in trap 31 Aug
57	0	F	13 Sep	NB	9	Alive	Last loc. 24 January 1992
59	0	M	15 Sep	NB	8	Alive	Last loc. 24 January 1992
62	0	M	16 Sep	NB	7	Dead	Natural mort. 17-28 October
68	0	M	25 Sep	MF	3	Dead	2-11 Oct/not yet retrieved
73	1	F	17 Sep	NB	6	Unk.	Last location 17 October

[a]Year of age was estimated from cementum annuli of 1st premolar by Matson's Laboratory (Milltown, MT).
[b]MF = mature forest, NB = new burn.
[c]Includes trap sites (capture and recaptures).
[d]As of 31 December. Unk. = unknown, assumed to have dispersed from study area.

In the aerial photo of the fire-furbearer study the main camp is located in the mature forest next to the large lake at the top of the picture. A spike camp was established among a cluster of lakes (center of photo) in the new burn.

A tooth was extracted from live captured marten to determine age.

The Fire/Furbearer crew - L to R, WB Johnson, BT Reaman, graduate student Quade and WB Paragi.

Our interpretations of habitat selection may be limited because Alldredge and Ratti (1986) found a likelihood of high Type II error rate (not rejecting the null hypothesis of no selection when there actually is selection) for samples as great as 15 observations on a few animals. Habitat use might be determined by pooling across seasons and age-sex classes, and comparing it to availability on a larger scale (eg. study area). However, this approach lumps juvenile/transient individuals with adults/residents, two groups that likely exhibit different degrees of resource or habitat selection based on social status and the resulting spatial organization (Buskirk 1991--ideas presented in talk). The resulting "average" depiction of habitat selection might not be representative of either group.

A trapper harvested 30 martens (age-sex unknown) in the old (1966) burn during the 1988-89 trapping season, three (2 juvenile males, 1 juvenile female) during the 1989-90 trapping season, and none during 1990-91 (M. Quinn, pers. comm.). Age-sex ratios of martens trapped in the mature forest and new burn (Table 9) generally suggest that the population in the study area is dominated by juveniles, similar to our conclusions from live trapping.

Table 9. Age-sex ratios of martens harvested during the 1989-90 and 1990-91 trapping seasons in the mature spruce forest and the new (1985) burn on the Nowitna NWR, Alaska.

	Mature Forest				New Burn			
	%J	*M:F*	*J:F≥1 yr*	*J:F≥2 yrs*	*%J*	*M:F*	*J:F≥1 yr*	*J:F≥2 yrs*
1989-90[a] (1 trapper)								
Ratio:	39	1.8	1.8	-	64	1.5	16.0	-
Numbers:	35/89	57:32	35:20	35:0	16/25	15:10	16:1	16:0
1990-91 (2 trappers)								
Ratio:	73	1.1	10.2	51	77	2.3	-	
Numbers:	51/70	36:34	51:5	51:1	10/13	9:4	10:0	10:0

[a]Data courtesy A. J. Magoun (in litt.); age classes (juvenile [<1 year] and adult) assigned based on skull musculature (Magoun et al. 1988).

Marten carcasses were purchased for $3.00 each from trappers on the Nowitna Refuge as an established procedure (Section H.10) for gathering data on age, sex, and date of capture during the trapping season (1 November-28 February). Juveniles (age <1 year) were screened from the sample based on characteristics of skull musculature (Magoun et al. 1988), and age of adults was determined by examining cementum layers of canine or 4th premolar teeth (Strickland and Douglas 1987). Reproductive tracts of females from the 1990-91 harvest were examined for corpora lutea (CL--ovulation), blastocysts (BC--fertilization), and placental scars (PS--implantation; Gilbert 1987) to document reproductive characteristics of Nowitna marten. We examined the utility of collecting and interpreting these data relative to post-fire seral stages.

Reproductive data from the entire Nowitna Refuge were sparse (only 7 of 23 females examined for CL and BC were $\geq$1 year old), so we did not analyze it relative to seral stage. CL and BC were found in all 7 martens (age 1 and 2), but no PS were seen in fresh uteri. (Martens first breed at age 1 and whelp at age 2 [Strickland and Douglas 1987], so we expected PS only in martens $\geq$2 years old.)

The marten harvest on the Nowitna Refuge ranged 188-602 during 1984-91, based on carcasses purchased from trappers (See Section H.10 - Marten)

Fur buyers in Fairbanks classified regions of the Interior in terms of marten habitat using the categories "very good, good, fair, or poor," based on their knowledge of trapper harvest or personal experience with furbearer trapping. Each drew boundaries for these regions (often hundreds of km^2) on a 2.5 cm = 42 km (1 in = 25 mile) scale map.

In general, the 1992 field work will be used to gather more baseline data on marten and prey abundance by seral stage and on habitat use and movements of martens. Associated projects such as aerial snow tracking and remote sensing will be pursued to determine the utility of these techniques and quality of data generated. Detailed results and more specific plans can be found in the 1991 project progress report, " The relationship of wildfire to lynx and marten populations and habitat in interior Alaska" (Johnson and Paragi 1992).

Lynx Study. The goal of the study, Relationships among wildfire, snowshoe hares, and lynx in interior Alaska is to investigate the contribution of various fire regimes and post-fire habitat features to lynx and hare populations in interior Alaska. Specific objectives are as follows:

1) Determine the relative abundance (tracks per km) and habitat use of lynx and snowshoe hares within various post-fire seral stages by ground snow tracking.

2) Develop and employ an aerial track survey that is applicable to large areas and several post-fire seral stages to derive an index to hare and lynx abundance (tracks per km).

3) Obtain indices of abundance (captures per trapnight, tracks per km) of alternative prey for lynx within various post-fire seral stages.

4) Determine the sex, age, and reproductive status of lynx harvested within the study area by seral stage on the Complex.

5) Analyze historical data from interior Alaska on lynx harvest, wildfire history, and vegetative cover type to determine relationships between habitat features and lynx populations in interior Alaska.

A preliminary study proposal was submitted to the FWS Biological Study Review Panel in December of 1991. The proposal was ranked high and will be resubmitted in February 1992.

An aerial wolf survey in March 1991, showed that lynx tracks were abundant in the old burn relative to other parts of the refuge; however this track count would be considered moderately abundant compared to the eastern Interior (D. V. Grangaard, Pers. Comm.). No lynx tracks were seen during preliminary track surveys in the mature forest or new burn in December 1991.

Pending approval of the study proposal, we will be seeking cooperative funding to complete work associated with objective 5. Other field work will be completed incidental to the marten study and the aerial snowtracking surveys.

Small Mammal Study. A study entitled Seasonal abundance of microtine rodents in post-fire forest communities in interior Alaska was initiated last year in cooperation with the University of Washington and the Washington Cooperative Fish and Wildlife Research Unit.

Relative density estimates based on trapping will be used in this study to investigate the response of microtines to wildfire according to the following objectives:

1) Describe the microtine communities of the primary post-burn seral habitats on three sites chosen for intensive study of marten.

2) Index population abundance and biomass just after snowmelt (June 1992) and in autumn (1991 and 1992).

3) Describe and quantify "edge effect" for microtine rodents along the transition

zone between burned and unburned forest.

4) Devise a logistically feasible method for routinely monitoring microtine rodent abundance on the marten study sites.

In addition, studies involving small mammals currently underway throughout the Interior are being coordinated to increase the span of post-fire seral stages examined and allow for comparisons between different regions of the Interior. The Kanuti NWR began a long-term monitoring effort on a recent burn near Bettles during 1991. In cooperation with the Fire/Furbearer Project, they are replicating our sampling methodology. Kanuti completed their first field season in summer 1991.

Project staff also contacted Joe Cook, Curator of Mammals at the University of Alaska Museum to: 1) discuss cooperation with the museum's tissue collection program, 2) solicit assistance in food habits (both for marten and yellow-cheeked vole (*Microtus xanthognathus*)), and 3) to donate 175 skulls from cementum-aged martens to the museum.

Table 10 summarizes capture data from 8,100 trap nights within nine grids. As expected from West (1979), red-backed voles (*Clethronomys rutilus)* were found in all seral stages while yellow-cheeks were found primarily in the 1985 burn. In eight of nine grids, red-backed voles were the numerically dominant microtine captured. Absent from the trapping effort was the tundra vole (*Microtus oeconomus)*. Although West (1979) reported this species to be the most dominant *Microtus* on his study sites and several reference sources report tundra voles in this region (e.g., Hall 1981), none were captured in the study area. The sampled area may represent an ephemeral gap in the distribution of the tundra vole possibly caused by the random nature of recolonization after a burn (West 1979). Also, the absence could be an artifact of the sampling effort. While the tundra vole may inhabit the area, the number of individuals present may have been too small in 1991 to be detected by the sampling procedure. This species is known to exhibit multi-annual population fluctuations in other regions (Whitney 1976, Krebs & Wingate 1985).

Table 11 summarizes the sampling effort along the burned/unburned edge. The two most dominant microtine species appeared to be segregated along the edge; red-backed voles were not trapped more than 20m from the mature forest while yellow-cheeked voles were captured mainly in the burned area (Figure 11). This contrasts with the grid trapping where red-backed voles are distributed across all seral stages (Table 10).

Three small mammal trapping grids were located in each of three post-fire seral stages: "new burn (6 yrs.), "old burn" (25 yrs.), and "mature forest".

Table 10. Results of small mammal trapping (snap traps and conical pitfall traps) in 3 post-fire seral stages, Nowitna NWR, Alaska 1991.

		SPECIES CAPTURED ON GRIDS						
	Grid	R-B. Vole	Y-C. Vole	Bog Lemming	Meadow Vole	Brn. Lemming	Shrew Spp.	Total Ind.
Mature Forest	1	13	1	0	0	0	17	31
	2	19	0	0	0	1	17	37
	3	6	0	0	0	0	16	22
1966 Burn	4	3	0	0	0	0	20	23
	5	3	0	1	1	0	35	40
	6	7	0	0	0	0	22	29
1985 Burn	7	10	4	1	0	0	25	40
	8	7	11	1	0	0	25	44
	9	10	3	1	0	0	15	29
		78	19	4	1	1	192	295

Total Voles:	103
Total Shrews:	192
Grand Total:	295

Table 11. Results of small mammal trapping (snap traps and conical pitfall traps) on 4 transect lines in the mature forest/1985 burn transition zone during August 1991, Nowitna NWR, Alaska.

Line	R-B.Vole	Y-C. Vole	Brn. Lemming	Shrew spp.	TOTAL
1	9	10	1	8	28
2	1	23	2	20	46
3	4	11	1	19	35
4	8	6	4	24	42
	22	50	8	71	151

Total Voles:	80
Total Shrew spp:	71
Grand Total:	151

Figure 12 compares the efficiency of the two trap types employed. Although an occasional red-backed or yellow-cheeked vole was trapped with a pitfall trap, they were much more likely to be captured by the snap traps. Pitfall traps were more effective for shrews (Sorex spp.).

Plans for the upcoming field season are being drafted. Under consideration are the following:

1) Repeat grid sampling in June & September.

2) Measure habitat variables to correlate with species distribution and abundance including horizontal vegetative cover and vertical structure (both live vegetation and dead and woody debris).

3) Measure surface variables to correlate with *M. xanthognathus* distribution including depth of the duff layer and depth of active layer to permafrost.

4) Continue investigation of edge effect.

Project personnel will continue to coordinate trapping efforts with Kanuti NWR. In addition, the USNPS is cooperating with the Fire/Furbearer Project on other studies underway in the Interior. One study entitled Small mammal distribution along the Upper Kobuk River, Gates of the Arctic National Park and Preserve, Alaska will replicate our study methods and examine recently burned sites adjacent to the Kobuk River. Another Park Service study focusing on marten in the Yukon-Charley Rivers National Park and Preserve may also replicate our small mammal sampling techniques. A meeting of all cooperators involved with small mammal work is being planned for June 1992 in Fairbanks.

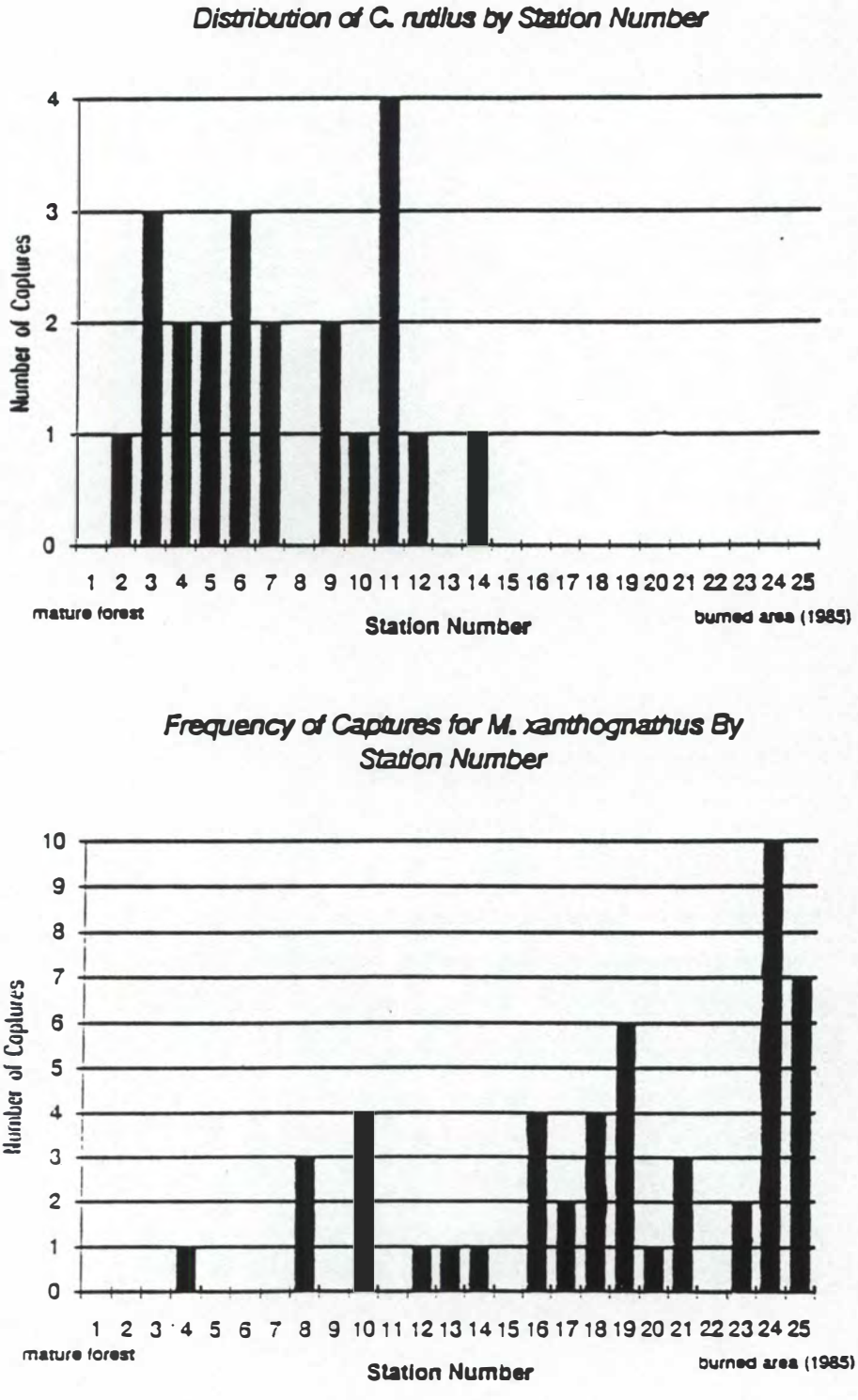

Figure 11. Distribution and frequency of captures of two microtine species along traplines bisecting burned area and mature forest during August 1991, Nowitna NWR, Alaska.

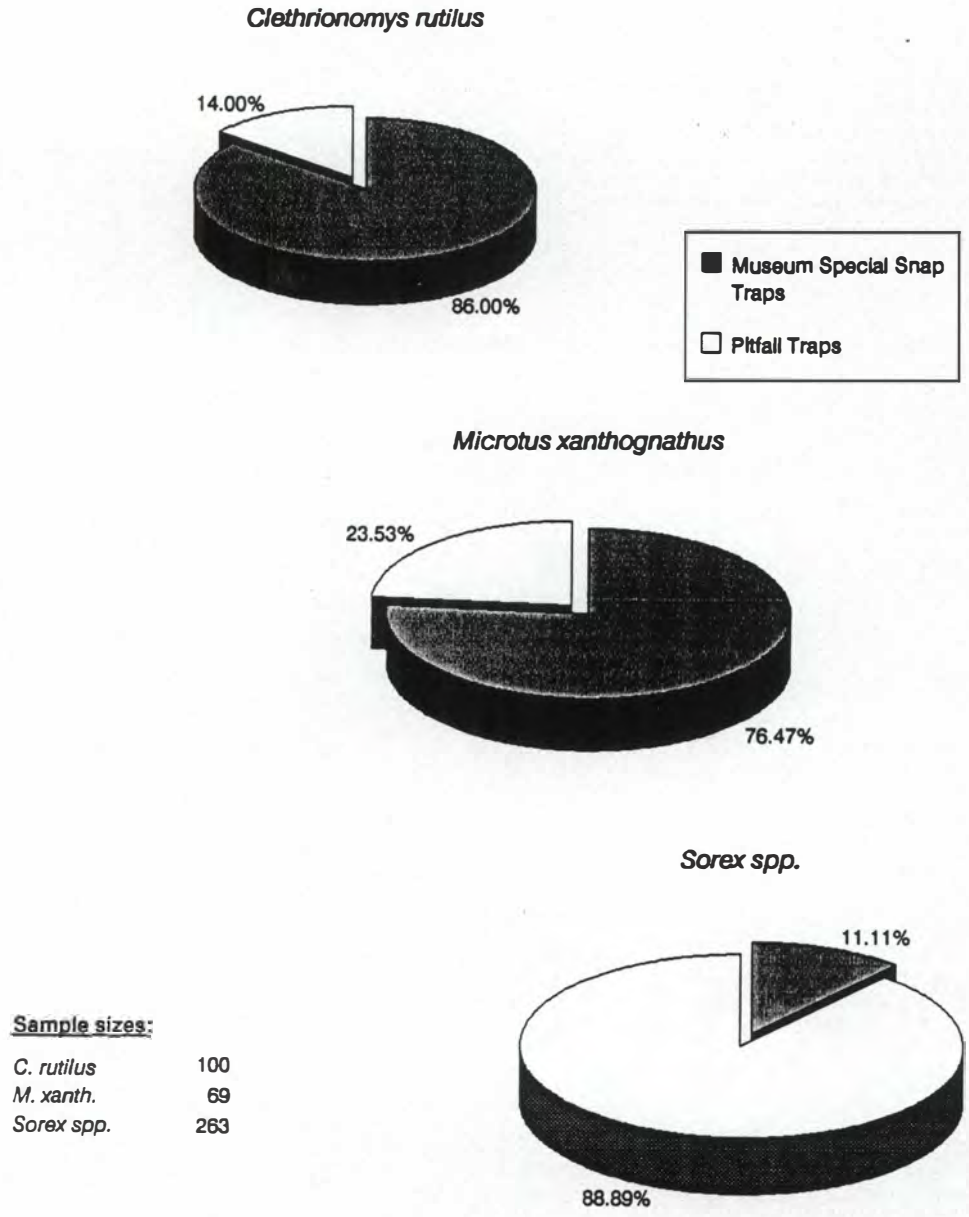

Figure 12. Comparison of trap efficiency for three species of small mammals.

Development and testing of aerial snowtracking surveys. This study is a cooperative effort between ADFG, USNPS, and the Service to test aerial track count indices. ADFG Biologist Howard Golden is the principal investigator for this cooperative study that addresses several objectives of the Fire/Furbearer Project.

The goal of this study is to test the capability of aerial and ground winter track-counts to monitor population trends of lynx, marten, and snowshoe hare, and to develop appropriate and reliable techniques based on those tests. Objectives are as follows:

1) To measure and compare track deposition rates for lynx, marten, and snowshoe hare over time and in different habitat conditions.

2) To determine the level of track retention and accumulation for lynx, marten and snowshoe hare over time and under different habitat conditions.

3) To evaluate and compare the precision and utility of aerial versus ground track counts.

4) To measure the degree of bias in track identification and enumeration among multiple observers in different habitat types.

5) To determine the difference in sightability between aerial and ground track counts for lynx, marten, and hare among broad classifications of vegetative cover.

6) To design aerial and ground track-count techniques for monitoring lynx, marten, and snowshoe hare trends.

This study will use a primary testing site in the Nelchina Basin and Wrangell-St. Elias area and three secondary testing sites where portions of this study will be done in cooperation with other studies. All jobs will be conducted at the primary site. The three secondary sites will provide opportunities to examine track deposition rates of lynx and marten with a high proportion of the animals being radio-collared. Marten are being studied in the Fire/Furbearer Project on the Nowitna Refuge and the NPS study on the Yukon-Charley Rivers National Preserve. Lynx are being studied on the Tetlin National Wildlife Refuge. Tests, other than those on track deposition of known animals, will also be conducted in the Koyukuk/Nowitna Complex. The ability to work cooperatively with biologists and to share expenses in conjunction with other ongoing projects, will improve the quality and extensiveness of the testing phase of this study. The development of

appropriate monitoring techniques will also be refined through this cooperative effort.

A draft study proposal was prepared by ADFG Biologist Howard Golden and reviewed by cooperators. Howard came to Galena in November to discuss track counting techniques and procedures and to visit the study area. Aerial transects were selected and survey maps prepared for the aerial survey. One ground track survey was completed in December (see marten study).

Ground tracking surveys are planned for each winter (November to March) through 1994. In February 1992, aerial transects will be mapped and vegetation classified. Aerial surveys will begin in February, pending appropriate snow conditions.

Informational Leaflet. The purpose of the leaflet is to 1) provide an overview of what we know about the effects of wildfire on furbearer populations; 2) outline the objectives of current studies; 3) solicit input from trappers and the public; and 4) identify future research needs. The leaflet can be updated and revised as new information is obtained from ongoing studies.

An outline of the leaflet has been drafted and plans for art work and layout have been discussed with FWS personnel. ADFG personnel were contacted during 1991 but no commitments for cooperation were made. A draft of the leaflet should be ready for review by spring of 1992 and the final version ready for printing before the end of the year.

Remote Sensing. Remote sensing will be used to 1) classify the vegetative cover types within the study area and; 2) obtain pre-burn data on vegetative cover and determine changes in cover and composition over time.

A cooperative agreement was initiated between project personnel, USFWS Information Resource Management (IRM) and the Earth Resources Observation System (EROS) field station for acquisition and processing of Landsat TM scenes. Jerry Minik with IRM reviewed existing imagery (Talbot and Markon 1986) with project staff and prepared enlarged field maps of core study areas. The latter were used in the field over the summer to help evaluate the existing classifications.

Before purchasing a relatively expensive TM scene from 1985, the corresponding (and relatively inexpensive) MSS scene was purchased to evaluate image quality and coverage. Subsequently, a Landsat TM scene from 1986 has been ordered and will be prepared by the EROS field office. Project staff will assist IRM with the initial cover classification of the new scene using existing training blocks. Field maps of each core area will be produced and used to ground-truth and refine cover classifications. A cover map for each seral stage will be produced after the

final classification is completed. Acquisition of a new scene is scheduled for the summer, pending an adequate window of good weather.

H. PUBLIC USE

1. General

The main public use activities on the Nowitna Refuge are subsistence hunting, fishing, trapping, and gathering. These activities range from putting meat, fish, and berries on the table to cutting house logs and firewood. Sport hunting for moose is another major activity on the refuge; however, recreational hunting is minor compared to subsistence hunting.

2. Outdoor Classroom - Students

Refer to the Koyukuk section of this report

3. Outdoor Classroom - 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 public use on the Nowitna Refuge. The refuge 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 on the refuge are moose and black bear. Ducks, geese, sandhill cranes, hare, grouse, and grizzly bears are also taken. Although annual harvest from the surrounding villages is not known, subsistence surveys done in Huslia, Hughes, Nulato, Ruby, and Koyukuk over the last several years have provided us with a general estimate of subsistence harvest (see Koyukuk Section H.8).

Trail Ridge Air, Tundra Air, Fairbanks Floatplane Tours, and Wrights Air were all issued Special Use Permits to operate in the refuge in 1991. Trail Ridge Air transported one party of four into Unit 21B in September, and harvested one moose. Tundra Air transported two parties totalling six hunters and harvested five moose. No reports have been received from the other carriers.

A moose hunter check station was operated at the mouth of the Nowitna River in cooperation with ADFG Biologist Tim Osborne. Water levels were low during September and weather was unusually warm and dry. Both harvest (n=46) and the numbers of hunters (n=154) were below average this year (Table 12). As in previous years, non-local hunters, specifically Fairbanks residents, comprised the bulk of hunters stopping at the check station (Table 13).

Table 12. Nowitna River moose hunter check station data 1988-91. 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. Stopping at the check station was voluntary.

	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

Table 13. Residency (N), harvest (n), and success (S%) of moose hunters stopping at the Nowitna NWR hunter check station 1988, 1990, and 1991.

	Local Villages			Fairbanks			Other Residents			Non-resident			Unknown			Total		
	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%

9. Fishing

Northern pike and sheefish are the most popular non-anadromous species for recreational fishing on the refuge. Fishing pressure is light from June through August, and is conducted primarily by floaters and fly-in anglers with float-equipped aircraft.

No formal surveys are conducted to assess fishing pressure on the refuge. Use of the Nowitna River by floaters is very light. Put-in and take-out points are not conducive for refuge contacts. Unless we have incidental contact with floaters when working in the area, they go undetected.

10. Trapping

Trapping continues to be one of the major subsistence activities on the refuge. Many residents in the villages of Ruby and Tanana supplement their incomes with trapping. The reported harvest of furbearers (sealing records) on the Nowitna is shown in Table 14. These figures may be inflated because they include some areas adjacent to the refuge. Sealing records, however, are generally considered to be conservative estimates of harvest because some fur is often kept for personal use and not sealed (especially beaver). There are no sealing requirements for marten or mink.

Traplines are not registered, but are generally passed down from generation to generation within a family and are usually associated with a cabin or camp. At least one trapper on the Nowitna uses an airplane to reach remote lakes and traps their periphery. Most trappers use snowmobiles for transportation and a few occasionally use dog teams. Martens are generally taken using pole sets and/or cubby sets. Beaver are taken with snares through the ice and most wolves are shot or trapped with snares placed around kill sites.

Marten are the most economically important species in the Nowitna region and most trappers focus their efforts on this species. Studies are presently underway examine several aspects of marten ecology. Refuge trappers have been very cooperative in our study efforts (see Section G.10).

Danny Grangaard, an ADFG seasonal employee and a renowned trapper, conducted trapping clinics in Galena and Ruby in March while in town to conduct wolf surveys (Sect. G10). ARM Spindler filled in for Danny for a clinic scheduled in Huslia.

Table 14. Furbearer harvest on the Nowitna NWR during the 1990-91 trapping season.[1]

Area	Species				
	Beaver	Lynx	Otter	Wolverine	Wolf
Deep Creek	0	0	0	0	1
Lower Nowitna	27	1	2	3	6
Yukon-Blind River	9	0	0	1	3
Titna	0	0	0	0	1
Nowitna-Sulatna	0	0	0	0	4
Big Mud	0	2	0	0	0
Big Creek	21	0	0	0	0
Little Mud	0	3	0	0	4
Total	57	6	2	5	19

[1]Based on sealing records obtained from Tim Osborne, Area Biologist, ADFG.

Marten

The Nowitna region is considered by many to be some of interior Alaska's premier marten habitat. Approximately 18 trappers, most from Ruby and Tanana, have active traplines on the refuge (not all may trap in a given year). Because there are no sealing requirements for marten in interior Alaska, limited information is available on annual harvests. Known harvest on the refuge (based on skull and carcass collections and trapper logbooks) has ranged from 188 to 602 animals annually. Actual harvest is likely higher because not all trappers participate in skull or carcass collection programs. 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 (Loranger 1989). Tooth sectioning and analysis of cementum annuli and radiographs are being used to age animals. Trapper questionnaires provide 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.

Methods. Marten skulls from the 1990-91 harvest were purchased from trappers who regularly trap on the refuge. Two of the trappers used airplanes to access remote lakes and trapped their periphery. Other trappers used more traditional

means of transportation and trapped on established traplines. Trappers were required to record the sex of each marten and the date it was trapped, and attach a corresponding numbered tag to each marten skull. In addition, trappers were asked to record their efforts on a trapline calendar and to complete a questionnaire at the end of the trapping season.

Completed trapline calendars were used to calculate catch per unit effort for individual traplines. "Trapnights" were calculated as 24-hour periods in which a trap is available for capturing an animal. Because trappers may be away from their traplines for several days at a time, two assumptions were made unless specific information is given: (1) traps remained operating for five days following the last visit before snow or ice makes them inoperable, and (2) all traps were operable the first day trappers visited the trapline after being away for more than five days. This information is most useful on larger lines where the annual effort and catch are substantial.

Initial aging of each skull was done using a field technique based on cranial muscle development (Magoun et al. 1988). The technique has proved to be very effective for identifying most juveniles of both sexes. All skulls that could not be classified as juveniles and a random sample of skulls identified as juveniles were aged via tooth analysis. A canine and 4th lower premolar was extracted from each skull and sent to Matson's Laboratory (Milltown, MT.) for sectioning and age determination by cementum analysis. Radiographs were used to identify juvenile animals prior to tooth sectioning.

Reproductive organs of female martens were examined to obtain estimates of litter size by 3 different methods. First, the corpora lutea (CL) in the ovaries, was examined to measure how many eggs were ovulated during the breeding season. Second, the blastocysts (BC), (fertilized eggs that form in the uterus after breeding) were counted. Third, the placental scars (PS) (dark spots on the uterus where young had been attached during pregnancy the previous year) were noted. The ovaries were sent to Matson's Laboratory (Milltown, MT) for processing.

Age-sex Distribution. Refuge trappers provided 350 martens from the 1990-91 harvest. The percentage of juveniles in the harvest (66%; Tables 14 and 15) was within the range of previous seasons (49-77%) since carcass collections began in 1984-85. The sex ratio (1.5 males : 1 female; Table 15) is similar to previous seasons. The number of juveniles per adult female (age 2 years or older) is also high (Table 16), suggesting that the Nowitna martens are not being too heavily harvested.

Reproductive Indices. We obtained reproductive tracts from 23 female marten. Sixteen of the martens were age 0 and showed no CL or BC. (In effect, this was to test the accuracy of the lab worked because martens don't breed until age one.)

CL from martens one and two years old indicated potential litter sizes of five, although the BC counts suggested that a maximum of four eggs get fertilized (Table 17). Martens age two had more CL than BC, on average, than did martens age one (Table 17). No PS were seen, which may mean that none of the martens in this small sample of young adults had given birth, or our technique for observing PS does not work. We plan to collect reproductive information during 1991-92. The reproductive organs will be sent to Rodney Mead at the University of Idaho who uses chemical staining to better see PS in furbearers.

Trapline Data. Four trappers filled out a trapline calendar to record numbers of traps set and martens harvested. Overall capture success of 1.2 martens per 100 trapnights (Table 18) is similar to success rates of trappers in Quebec (annual rates of 1.3-1.9 martens per 100 trapnights). Quebec is the only other area in which capture success by marten trappers has been calculated. Capture success by individual traplines (Table 18) is also within the range of livetrapping studies on the Nowitna refuge (1.1-11.8 martens per 100 trapnights). Calculation of trapnights is sometimes difficult using calendars because snowstorms close down sets and trappers leave the trapline for a period of time. Nevertheless, we hope to continue collecting this information at least during the course of the Wildfire/Furbearer Project to see whether trends in trapper success reflect trends in number of marten tracks seen during snow-tracking surveys (two independent methods).

Six trappers completed the annual questionnaires. Three of six were not using the same trapline from the previous season (two of these trappers were operating together but using different sets). Two trappers used primarily airplanes, one setting at approximately 20 lakes (40 mi^2) while the other covered 40 miles of flightline. Two other trappers used snowmachines, one used a dog team, and one used snowshoes only (fly-in camp). Traplines of ground-based trappers were 10, 14, 20, and 40 miles long. The number of traps used ranged from 30-220 ($\bar{x}$ = 99), and traps were set 6-120 days ($\bar{x}$ = 85).

Four trappers rated weather conditions for trapping as "poor" because of deep snow, severe cold, or poor flying conditions. The trapper on snowshoes rated weather as "fair," noting that there wasn't much snow in November. The trapper using a dog team noted that dogs can move readily over shallow snow and rated weather as "good."

These same trappers harvested six additional species: 7 wolves, 2 lynx, 3 otters, 28 beavers, 2 wolverines, 17 mink. Prey abundance (reported as number of trappers that gave a particular rank) was as follows:

	High	Medium	Low
mice, voles, shrews	2	4	0
snowshoe hares	1 *	5 *	1
ruffed grouse	2	3	1
spruce grouse	1	3	2
ptarmigan	1	2	3

*one trapper reported 2 ranks because abundance varied over areas

Table 15. Total number and age-sex ratios of martens harvested by 7 trappers during the 1990-91 trapping season, Nowitna NWR, Alaska.

		Ratios in harvests				
Trapper Number	Total Marten	Males/ female (all ages)	Males/ female (both ≥ 1.5 yr.)	Juveniles per female ≥ 2.5 yr.	Juveniles per female ≥ 1.5 yr.	% Juveniles
01	28	1.8	4.0	-	4.3	43
05	83[a]	1.7	2.2	22	13	83
07	22[b]	0.8	1.3	4.5	2.3	50
10	51	1.1	8.0	-	42	82
12	106[c]	1.5	2.9	6.5	9.3	63
13	30	1.3	2.5	16	4.0	53
14	34	2.1	5.0	16	5.3	47
Total	350	1.5	1.4	16	7.6	66

[a] Includes 1 male and 1 female classified as adult (based on skull musculature) whose age was not determined by counting cementum annuli in teeth.
[b] Ratios based on 18 martens.
[c] Includes 2 marten skulls of unknown sex (no carcass, skulls were damaged) but with tooth age of 0.

Table 16. Age distribution of martens harvested by 7 trappers during the 1990-91 trapping season, Nowitna NWR, Alaska.

Trapper Number	Age Class 0	1	2	3	4	5	6	7	8	9	10	Total
Male martens												
01	5	8	2	1	0	1	1	0	0	0	0	18
05	41	5	2	2	1	0	0	0	0	0	0	51
07	3	1	2	1	0	0	0	0	0	1	0	8
10	19	2	4	1	0	0	0	0	1	0	0	27
12	33	10	11	1	0	2	2	0	1	1	1	62
13	7	8	1	0	0	0	0	0	0	0	1	17
14	8	3	6	1	1	1	2	0	1	0	0	23
Total	116	37	28	7	2	4	5	0	3	2	2	206
Female martens												
01	7	3	0	0	0	0	0	0	0	0	0	10
05	26	1	3	0	0	0	0	0	0	0	0	30
06	6	2	2	0	0	0	0	0	0	0	0	10
10	23	1	0	0	0	0	0	0	0	0	0	24
12	32	3	2	1	0	1	0	1	1	0	1	42
13	9	3	1	0	0	0	0	0	0	0	0	13
14	8	2	1	0	0	0	0	0	0	0	0	11
Total	111	15	9	1	0	1	0	1	1	0	1	140
Both Sexes	227	52	37	8	2	5	5	1	4	2	3	346

Table 17. Counts of corpora lutea(CL) and blastocysts (BC) from female martens during 1990-91 on the Nowtina NWR, Alaska.

age (yrs)	CL n	CL x	CL range	BC x	BC range
1	3	3.3	0-5	1.7	0-4
2	4	3.8	3-5	2.8	2-4

Table 18. Capture success (martens per 100 trapnights) of 3 trappers during 1990-91 on the Nowitna NWR, Alaska.

trapper no.	Max. No. Traps Set	Total Trapnights	No. Martens	Capture Success
01	34	1321	29	2.2
05	207	10,048	86	0.86
07	57	415	22	5.3
Total		11,784	137	1.2

17. Law Enforcement

A majority of enforcement activities on the Nowitna were coordinated efforts of the Koyukuk NWR and the Alaska Fish and Wildlife Protection Division (See Koyukuk, H.17). We feel the purpose of the hunter check station at the mouth of the Nowitna River is to provide the public with information and to gather harvest information. Therefore, we have minimized enforcement activities at the check station and have focused enforcement activities on patrolling other areas of the refuge.

In a draft report prepared by the Alaska Department of Fish and Game on subsistence harvest of migratory birds, it is estimated that 2382 ducks and 1372 geese are harvested for subsistence in the two communities nearest the Nowitna Refuge.

An investigation of reported fossilized ivory raiding at the Palisades on the Nowitna Refuge, resulted in the apprehension of two individuals digging in the bluffs. Several large pieces of mastodon tusks and several large sacks of bones and ivory were recovered at their camp. There was reportedly $40,000 worth of ivory and other mastodon parts taken from the area by two individuals last year. We were assisted by special agents from the Fairbanks office on the case and by year's end, citations had not yet been issued because of possible ties to cases which were being investigated.

18. Cooperating Associations

Refer to the Koyukuk section of this report.

I. EQUIPMENT AND FACILITIES

1. New Construction

A 12'x 16' plywood cabin was built on a pre-existing tent frame at Round Lake. The cabin is insulated and equipped with a wood and an oil stove, and bunks for four persons. The cabin was built to replace a weatherport that bears continually damaged, despite extreme precautions and camp sanitation. The cabin will be a safe and comfortable year round base for the fire/furbearer crew.

3. Major Maintenance

The field crew spent several days cleaning up and re-leveling the Lower Nowitna River Administrative Cabin. Extreme flood waters from an ice jam in May, caused the cabin to float off its foundation. The cabin was not damaged but settled to ground level and the floor was covered with a layer of mud and silt. Several days of hard work, jacking, leveling, and cleaning were necessary to make the cabin presentable again. This was the first time in anyone's memory that spring flooding caused this damage. The cabin and storage shed were painted during the summer.

4. Equipment Utilization and Replacement

Refer to the Koyukuk section of this report.

5. Communications

Refer to the Koyukuk section of this report.

6. Computer System

Refer to the Koyukuk section of this report.

A small cabin was built at Round Lake to replace a Weatherport that had become a staple in the diet of the local black bear population.

Airplane Pilot Colin "Brownie" Brown and the flood damaged lower Nowitna administrative cabin. An ice jam on the Nowitna River caused flooding on high banks which rarely flood. The cabin was jacked up and leveled back onto its foundation. This cabin was given a major cleaning and painting after the flood in 1991.

8. Other

Refer to the Koyukuk section of this report.

J. OTHER ITEMS

4. Credits

ROS/P Liedberg was responsible for Sections C, D.1-4, E.5, F, H.1 and 17, I.1-4 and 7. Sections D.5-6, E. 6-8, G.1 and 11, I. 5-6 and 8 were written by ROS/P Spindler. WB Bertram was responsible for Section G.3-9 and a portion of G.10. The G.10 (Furbearer section) was written WB Johnson. Sections E.2-4, H.2-7, and 18 were done by PR Johnson. RM Stearns wrote Sections J. 1-3. Section G.14 was written by WB Paragi. Sec. Williams wrote section E.1. PR Johnson, RM Stearns and ROS/P Spindler edited and Sec. Honea proofed the report. PR Johnson and Sec. Williams finalized and PR Johnson, Sec. Honea, BT Lowe and Vol. Davis assembled the narrative.

5. Literature Cited

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K. FEEDBACK

Refer to the Koyukuk section of this report.

IN REPLY REFER TO:

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Koyukuk/Nowitna Refuge Complex
P.O. Box 287
Galena, Alaska 99741-0287
(907) 656-1231

KOYUKUK NATIONAL WILDLIFE REFUGE

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

Waterfowl production for the refuge contributes 3,000 Canada and white-fronted geese and 150,000 ducks (primarily northern pintails, American wigeon, scaup, and scoters) to North American flyways each year. The Koyukuk Refuge includes the northwestern limits of the trumpeter swans, with about 150 breeding pairs. Moose are abundant 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. 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, muskrats, mink, and marten are locally abundant. Chinook and chum salmon are important fisheries on 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, 1 of only 2 active dune fields in Alaska. Access to the interior of the refuge is by boat, aircraft, or snowmobile. The are no accommodations for tourists on the refuge, although there is a hotel in Galena. There are 8 predominately Native villages on and 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.

BIRD SPECIES LIST OF KOYUKUK AND NORTHERN UNIT-INNOKO REFUGES.

COMMON NAME	SCIENTIFIC NAME	BREED	NON-BREED MIGRANT (M) RARE (R)
LOONS	**GAVIIFORMES**		
Pacific Loon	Gavia pacifica	X	
Red-throated Loon	G. stellata	X	
Common Loon	G. immer	X	
GREBES	**PODICIPEDIFORMES**		
Horned Grebe	Podiceps auritus	X	
Red-necked Grebe	P. grisegena	X	
STORM PETRELS	**PROCELLARIIFORMES**		
Fork-tailed Storm-Petrel	Oceanodroma furcata		R
WATERFOWL	**ANSERIFORMES**		
Tundra Swan	Cygnus columbianus	X	
Trumpeter Swan	C. buccinator	X	
Greater White-fronted Goose	Anser albifrons	X	
Snow Goose	Chen caerulescens		M
Brant	Branta bernicla		M
Canada Goose	B. canadensis taverneri	X	
Green-winged Teal	Anas crecca	X	
Mallard	A. platyrhynchos	X	
Northern Pintail	A. acuta	X	
Blue-winged Teal	A. discors		NO RECORDS
Northern Shoveler	A. clypeata	X	
Gadwall	A. strepera		NO RECORDS
American Wigeon	A. americana	X	
Canvasback	Aythya valisineria	X	
Redhead	A. americana	X	
Ring-necked Duck	A. collaris	X	
Greater Scaup	A. marila	X	
Lesser Scaup	A. affinis	X	
Steller's Eider	Polysticta stelleri		R
Harlequin Duck	Histrionicus histrionicus	X	
Oldsquaw	Clangula hyemalis	X	
Black Scoter	Melanitta nigra	X	
Surf Scoter	M. perspicillata	X	
White-winged Scoter	M. fusca	X	
Common Goldeneye	Bucephala clangula	X	
Barrow's Goldeneye	B. islandica	X	
Bufflehead	B. albeola	X	
Common Merganser	Mergus merganser		NO BREEDING RECORD
Red-breasted merganser	M. serrator	X	
EAGLES, HAWKS AND FALCONS	**FALCONIFORMES**		
Osprey	Pandion haliaetus	X	
Bald Eagle	Haliaeetus leucocephalus	X	
Northern Harrier	Circus cyaneus	X	
Sharp-shinned Hawk	Accipter striatus	X	
Northern Goshawk	A. gentilis	X	
Red-tailed Hawk	Buteo jamaicensis	X	
Rough-legged Hawk	B. lagopus		M
Golden Eagle	Aquila chrysaetos	X	
American Kestrel	Falco sparverius	X	
Merlin	F. columbarius	X	
Peregrine Falcon	F. peregrinus	X	
Gyrfalcon	F. rusticolus		M

GALLINACEOUS BIRDS	**GALLIFORMES**			
Spruce Grouse	Dendragapus canadensis	X		
Willow Ptarmigan	Lagopus lagopus	X		
Rock Ptarmigan	L. mutus	X		
Ruffed Grouse	Bonasa umbellus	X		
Sharp-tailed Grouse	Tympanuchus phasianellus			R
CRANES	**GRUIFORMES**			
Sandhill Crane	Grus canadensis	X		
SHOREBIRDS, GULLS	**CHARADRIIFORMES**			
Black-bellied Plover	Pluvialis squatarola			M
Lesser golden Plover	P. dominica	X		
Semipalmated Plover	Charadrius semipalmatus	X		
Greater Yellowlegs	Tringa melanoleuca	X		
Lesser Yellowlegs	T. flavipes	X		
Solitary Sandpiper	T. solitaria	X		
Wandering Tattler	Heteroscelus incanus			M
Spotted Sandpiper	Actitis macularia	X		
Upland Sandpiper	Bartramia longicauda			M
Whimbrel	Numenius phaeopus	X		
Hudsonian Godwit	Limosa haemastica	X		
Ruddy Turnstone	Arenaria interpres			M
Black Turnstone	A. melanocephala			R
Surfbird	Aphriza virgata			NO RECORDS[1]
Sanderling	Calidris alba			NO RECORDS[1]
Semipalmated Sandpiper	C. pusilla			M
Western Sandpiper	C. mauri			R
Least Sandpiper	C. minutilla	X		
Baird's Sandpiper	C. bairdii			M
Pectoral Sandpiper	C. melanotos			M
Buff-breasted Sandpiper	Tryngites subruficollis			M
Long-billed Dowitcher	Limnodromus scolopaceus			M
Common Snipe	Gallinago gallinago	X		
Red-necked Phalarope	Phalaropus lobatus	X		
Pomarine Jaeger	Stercorarius pomarinus			R
Parasitic Jaeger	S. parasiticus			M
Long-tailed Jaeger	S. longicaudus	X		
Bonaparte's Gull	Larus philadelphia	X		
Mew Gull	L. canus	X		
Herring Gull	L. argentatus	X		
Glaucous Gull	L. hyperboreus	X		
Black-legged Kittiwake	Rissa tridactyla			R
Ross' Gull	Rhodostethia rosea			R
Sabine's Gull	Xema sabini			M
Arctic Tern	Sterna paradisaea	X		
OWLS	**STRIGIFORMES**			
Great Horned Owl	Bubo virginianus		X	
Snowy Owl	Nyctea scandiaca			M
Northern Hawk Owl	Surnia ulula	X		
Great Gray Owl	Strix nebulosa	X		
Short-eared Owl	Asio flammeus	X		
Boreal Owl	Aegolius funereus	X		
KINGFISHERS	**CORACIIFORMES**			
Belted Kingfisher	Ceryle alcyon	X		
WOODPECKERS	**PICIFORMES**			
Downy Woodpecker	Picoides pubescens	X		
Hairy Woodpecker	P. villosus	X		
Three-toed Woodpecker	P. tridactylus	X		
Northern Flicker	Colaptes auratus		X	

PASSERINE BIRDS	PASSERIFORMES	
Olive-sided flycatcher	Contopus borealis	X
Western Wood-Pewee	C. sordidulus	NO RECORDS
Alder Flycatcher	Empidonax alnorum	X
Hammond's Flycatcher	E. hammondii	X
Say's Phoebe	Sayornis saya	M
Horned Lark	Eremophila alpestris	X
Tree Swallow	Tachycineta bicolor	X
Violet-green Swallow	T. thalassina	X
Bank Swallow	Riparia riparia	X
Cliff Swallow	Hirundo pyrrhonota	X
Barn Swallow	H. rustica	R
Gray Jay	Perisoreus canadensis	X
Common Raven	Corvus corax	X
Black-capped Chickadee	Parus atricapillus	X
Siberian Tit	P. cinctus	NO BREEDING RECORD
Boreal Chickadee	P. hudsonicus	X
American Dipper	Cinclus mexicanus	NO RECORDS[1]
Arctic Warbler	Phylloscopus borealis	NO RECORDS[1]
Ruby-crowned Kinglet	Regulus calendula	X
Northern Wheatear	Oenanthe oenanthe	M
Mountain Bluebird	Sialia currucoides	R
Townsend's Solitaire	Myadestes townsendi	NO BREEDING RECORD
Gray-cheeked Thrush	Catharus minimus	X
Swainson's Thrush	C. ustulatus	X
American Robin	Turdus migratorius	X
Varied Thrush	Ixoreus naevius	X
Yellow Wagtail	Motacilla flava	NO RECORDS
American Pipit	Anthus rubescens	X
Bohemian Waxwing	Bombycilla garrulus	NO BREEDING RECORD
Northern Shrike	Lanius excubitor	X
Orange-crowned Warbler	Vermivora celata	X
Yellow Warbler	Dendroica petechia	X
Yellow-rumped Warbler	D. coronata	X
Blackpoll Warbler	D. striata	X
Northern Waterthrush	Seiurus noveboracensis	X
Wilson's Warbler	Wilsonia pusilla	X
American Tree Sparrow	Spizella arborea	X
Savannah Sparrow	Passerculus Sandwichensis	X
Fox Sparrow	Passerella iliaca	X
Lincoln's Sparrow	Melospiza lincolnii	X
Golden-crowned Sparrow	Zonotrichia atricapilla	X
White-crowned Sparrow	Zonotrichia leucophrys	X
Dark-eyed Junco	Junco hyemalis	X
Lapland Longspur	Calcarius lapponicus	M
Snow Bunting	Plectrophenax nivalis	NO BREEDING RECORD
Rusty Blackbird	Euphagas carolinus	X
Pine Grosbeak	Pinicola enucleator	X
White-winged Crossbill	Loxia leucoptera	X
Common Redpoll	Carduelis flammea	X
Hoary Redpoll	C. hornemanni	X

[1]Never sighted but thought to occur in or near the refuge