ANNUAL NARRATIVE REPORT

Calendar Year

1990

KOYUKUK/NOWITNA
REFUGE COMPLEX

Galena, Alaska

ANNUAL NARRATIVE REPORT

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KOYUKUK/NOWITNA NATIONAL WILDLIFE REFUGE COMPLEX

KOYUKUK NWR

NOWITNA NWR

NORTHERN UNIT, INNOKO NWR

Galena, Alaska

REVIEW AND APPROVALS

Complex Manager — Date 4/29/91 — Associate Manager — Date

Paul R. Schmidt
Regional Office Approval — Date

KOYUKUK NATIONAL WILDLIFE REFUGE

Ancient meanders of the Koyukuk River have created parallel lines of willow succession, grass meadows, and wetlands. This differing terrain type combined with active natural fire has produced high vegetation diversity resulting in an abundance of waterfowl, small game, and moose.

INTRODUCTION

For the first time the Annual Narrative Reports for the three refuge units which comprise this complex, Koyukuk, Nowitna, and the Northern Unit of Innoko (Kaiyuh Flats), are combined into one document. Items common to all three units are discussed in the Koyukuk report. However, since the Complex's National Wildlife Refuge system contribution is over 7 million acres, it is important to maintain the identity of each unit and report area-specific activities separately. Thus, the units are tabbed to facilitate quick reference.

The newly combined staffs of the refuges have metamorphosed into a single staff with a very professional demeanor that is remarkable. Alaska and this refuge manager are very fortunate to have a very high level of talent and enthusiasm in this station.

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

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 Koyukuk National Wildlife Refuge 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. After the conveyance of native allotments, village and native regional corporation (Doyon, Inc.) lands, the refuge will contain 3.69 million acres.

The refuge is situated in a roughly circular floodplain basin of the Koyukuk River just north of its confluence with the Yukon River. The extensive forested floodplain is surrounded by the Nulato Hills, elevation 1500' -

3000' on the west; the Purcell Mountains and Zane Hills, elevation 3100 - 4000' on the north; the Galena Mountains, elevation 1500' - 3000' on the east and the Yukon River on the south.

The complex staff has also been delegated responsibility for managing the Northern Unit of the Innoko NWR (Kaiyuh Flats). This unit consists of 750,800 acres located south of the Yukon River with its northeastern boundary directly across the river from Galena. After the conveyance of native allotments, village and native regional corporation (Doyon, Inc.) lands, this unit will contain approximately 351,000 acres. This unit was also established by ANILCA. The majority of the flatland is dominated by a maze of sloughs, creeks, and lakes. The foothills of the Kaiyuh Mountains run along the southeastern border.

Vegetation types are typical of the boreal forest or taiga of Interior Alaska. White spruce occurs in large pure stands along rivers where soils are better drained. Numerous fires have set vast areas back to earlier seral stages consisting of aspen, birch and willow. Black spruce muskegs or bogs are a dominant feature and develop on the poorly drained permafrost soils. Dense willow and alder stands are common along the rivers and sloughs. The most conspicuous characteristic of the vegetation is the complex interspersion of types.

The refuge achieves some of its national and international significance through the contribution of waterfowl populations using all four 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.

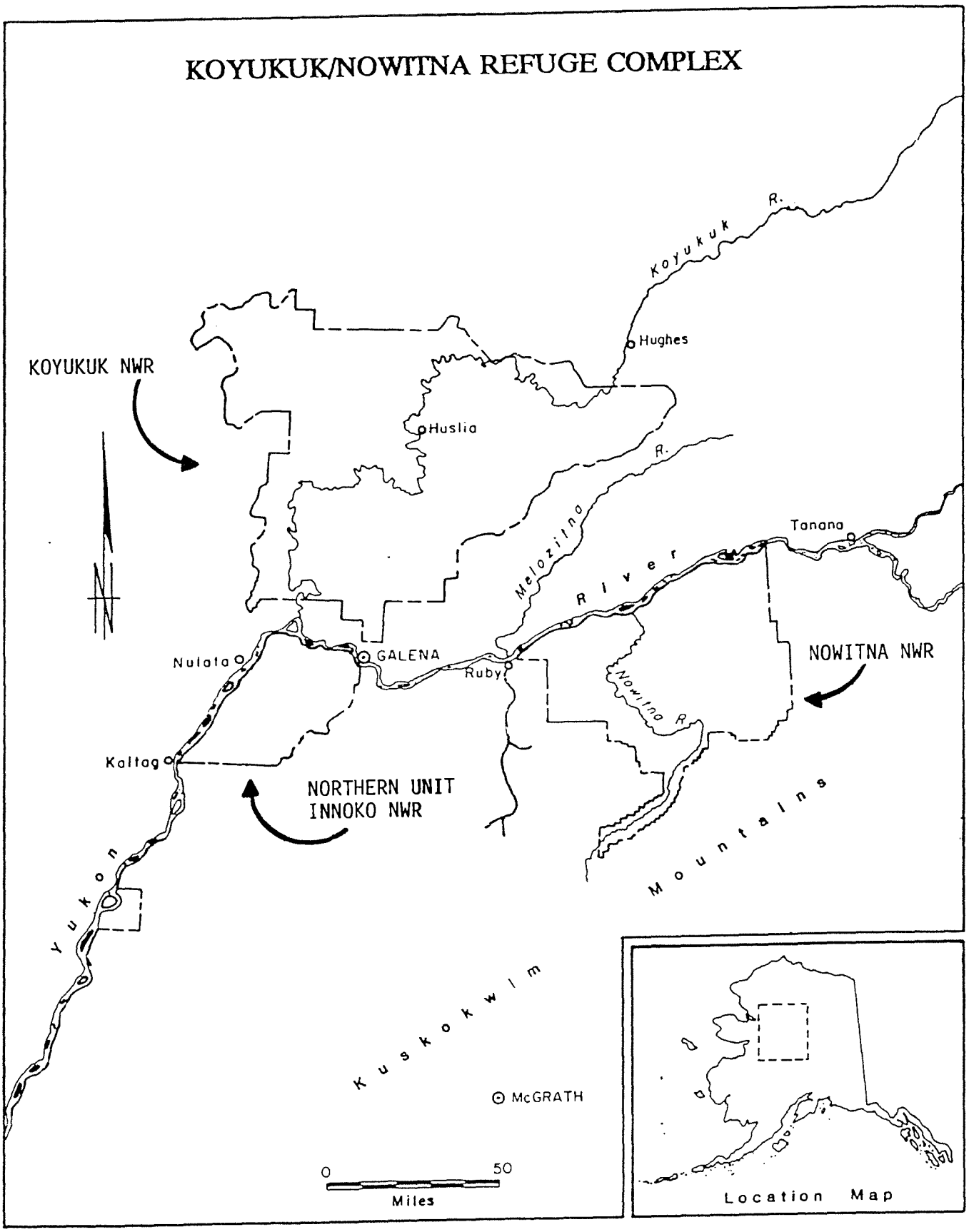
Fish abound in refuge streams and lakes supporting subsistence, commercial and sport fisheries. Salmon of three species involve several countries and international attention for the tens of thousands of dollars in income generated.

Complex headquarters is located in Galena, on the Yukon River approximately 6 miles south of the Koyukuk refuge. Galena, Alaska was established about 1919 as a supply point for the mining of galena (lead sulphite ore) deposits south of the Yukon River.

The City of Galena is now a "regional center" and not considered a typical Alaskan village. Life in Galena resembles a village more than a city, yet it has advantages of direct air service to Anchorage and Fairbanks, modern communications, river access, and such amenities as two general stores, hotel, health clinic, and a retail outlet for boats, motors, snowmachines and

generators. Galena's population of approximately 1,000 which includes 330 military personnel stationed at the Galena Air Base where two F-15 Eagle interceptor aircraft are kept on 24 hour alert.

Management of the refuge for the first ten years has consisted primarily of field investigation to quantify significant bird and mammal resources by habitat type on a seasonal basis. The goal of this effort has been to learn as much as possible in order to maintain refuge habitats in their present pristine condition in the face of development of lands within and adjacent to the refuge and to maintain healthy wildlife populations. In the future this work will continue as one of several refuge programs. In addition to the field investigations, emphasis is currently being placed on information and education in the nearby eight villages and schools. Several major FWS programs including subsistence management, fisheries management, prescribed burning, wildfire management, and the implementation of a public use program require support from the 2,500 residents in and surrounding the complex.


KOYUKUK/NOWITNA REFUGE COMPLEX
KOYUKUK NWR
Koyukuk R.
Hughes
Huslia
Melozitna R.
River
Tanana
NOWITNA NWR
Nulato
GALENA
Ruby
Nowitna R.
Kaltag
NORTHERN UNIT
INNOKO NWR
Yukon
Mountains
Kuskokwim
McGRATH
0
50
Miles
Location Map

INTRODUCTION

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A. HIGHLIGHTS

The most active fire year in Alaska's recorded history left its mark on 200,000 acres of habitat within the Koyukuk refuge.

A duck production survey estimated 166,000 young ducks were produced on the refuge in 1990, the highest number ever recorded. Average dabbler size was greater than previous years and exceeded statewide averages, while divers were lower than average. This was the first year the statewide survey methods were implemented, so population trends were not directly comparable with previous estimates due to differences in methods.

A study to determine the effects of fire on furbearers and their habitats in Interior Alaska, long proposed and awaited by several agencies, was funded by the Regional Office and assigned to the Koyukuk/Nowitna Complex. The first year of work will produce a literature survey, published bibliography, and detailed study plans for 1991 and beyond.

A moose calf mortality study was completed on Koyukuk NWR and showed that a majority of predation was attibutable to black bears; similiar to losses on the Nowitna NWR the previous two years.

A study to determine the relationships of wolf home range and predation study in areas of known prey density was initiated in 1990. A total of 20 wolves in 8 packs were collared.

Many changes occurred in the refuge staff - Manager Mike Nunn transferred to Region 1 after six years in Galena. David Stearns, an old Alaska hand from Tetlin and more recently Arrowwood in N.D., returned to Alaska to run the Koyukuk/Nowitna Complex. Two new assistant managers, Mike Spindler and Paul Liedberg, both pilots, replaced Greg Rost and Tim Patton, who, along with Joy Rost, perished during their vacation in Idaho in 1989. Biologist Jim Bodkin transferred to Research in Anchorage. Refuge Secretary Maudrey Honea, and Biologists Johnson and Bertram received much deserved promotions.

Local hire biological technicians Jenny Lowe, Orville Huntington, George Wholecheese, as well as Clerk-Typist Claudette Lowe brought lots of new local knowledge and village awareness to our staff.

Our environmental education program increased in emphasis with many school presentations in Galena and six surrounding villages. Also, "Teach About Fire" curriculum was coauthored by refuge volunteer (and later EIR

employee) Heather Johnson and refuge Biological Technician Pamela Nelson.

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 in winter, which lasts from late October to early April. The winters in the Galena area tend to fluctuate between periods of extreme cold (to -70°F), caused by clear skies and no wind, to milder temperatures (-20°F to +20°F) with clouds, snow, and light to moderate winds. The moderating effects from wind and clouds 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 transistional, with the arrival of most waterfowl occurring in late April, and breakup of the Yukon River ice ususally occurring in early or mid-May. Green-up of the the trees and shrubs usually occurs in late May. Summer temperatures in western Interior Alaska are usually in the 50-70°F range, but extreme highs have exceeded 90°F. Summers in our area are generally cooler, cloudier, and moister than summers in Fairbanks, which is located 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 1990 in Galena was colder and snowier than normal (Figure 1). In February 1990 we had a cold spell that was not as extreme as the record-breaking 1989 snap but it was certainly longer. March started out with a week of cold and mostly clear weather interspersed with days of heavy snow, followed by record warm temperatures and melting snow. Also, some freezing rain occurred at month's end which, combined with the melting and refreezing of snow, made for some difficult crusty snow conditions for moose and caribou. Precipitation and temperatures in March were above average. The mild weather continued into April with many warm cloudy days, rainfall and much snowmelt. Later in the month, temperatures dropped to below normal and there were several days of freezing weather with snow, which slowed some bird arrivals. By early May all but the largest lakes were ice free. Some flooding caused by ice jams occurred on the Koyukuk River north of Huslia, while the Yukon escaped widespread flooding for another year. Breakup of the Yukon at Galena occurred on May 7th, which tied the previous early record set in 1988.

June was cooler and much wetter than normal, with lots of heavy rain showers and few really clear days (Figure 2). This trend reversed by the end of the month when it became hot and dry. The very dry conditions

persisted through early August and fire danger was extreme. By July's end the Nowitna and Koyukuk Rivers were so low that it was difficult for outboard boats to find the channel in places. Even the Yukon had more numerous sand bars showing than normal. We don't know how the low water levels may have affected spawning success for salmon and sheefish. The dry weather caused major wilting and early fall coloring on birches, willows, and alders in several locations. Even large amounts of rain at the end of August did not alleviate the wilting. By the end of August the tributaries of the Nowitna River were flooding in some places, while the Koyukuk River was still low, and touches of fall color had appeared all over.

September was cool, and an early fall expected by the old-timers: 3.0 inches of snow fell the 26th and the 28th. By this time nearly all of the birch had lost their leaves and many smaller wetlands had skim ice over their entire surface. The floatpond froze over on September 30th. October temperatures were near normal but above normal precipitation was experienced. Near mid-October we had a major thaw with rain and puddles everywhere, however, the month ended with -30^{o}F, and little snow on the ground. The Yukon River at Galena froze solid the night of October 25. November averaged below normal in temperature and precipitation. Three big snow storms in late December dumped more snow in Galena in a one week period than anyone, including elders, could remember. A total of 10.5" of snow fell on the 28th alone, with a monthly total of 31 inches, which far exceeded average. December temperatures were normal. At the end of the month there was about three feet of snow in the woods.

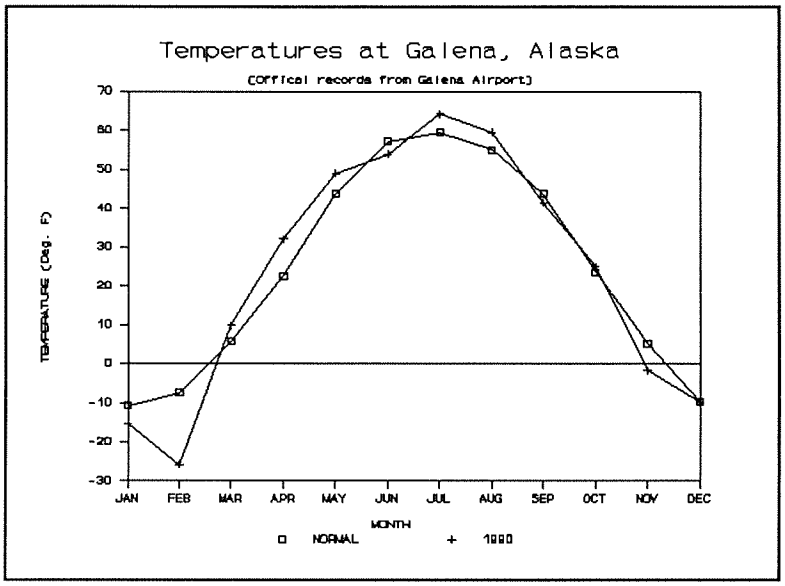


Figure 1. Normal and observed temperatures in 1990.

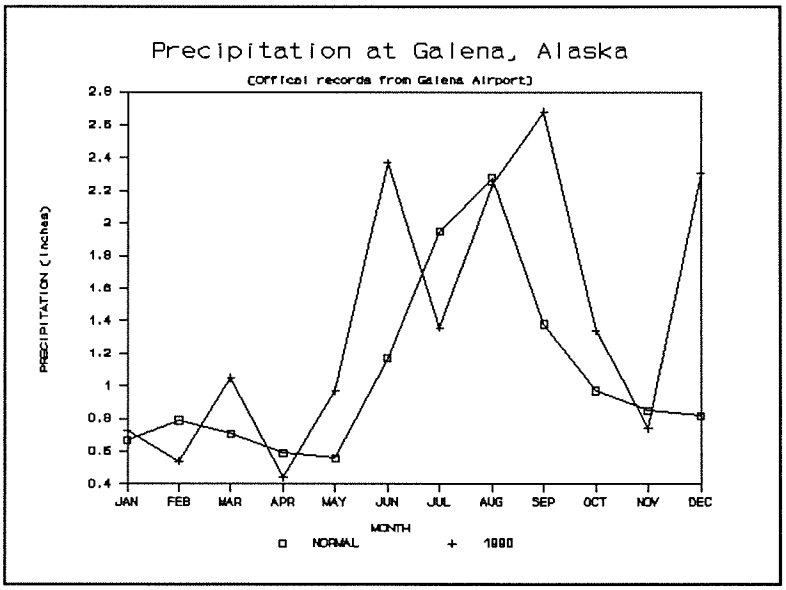


Figure 2. Normal and observed precipitation in 1990.

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. The system prioritized potential acquisitions of private and state-owned inholdings within refuge boundaries should those inholdings become available on the market. In 1989 the team gathered input on resource values directly from refuge biologists and managers, then assigned scoring criteria for each resource, based on Regional and National significance. The map-based resource information was digitized and the scores of each refuge inholding ranked region-wide. To many managers the score assignments seemed arbitrary because they felt it did not adequately address individual refuge uniqueness values among other things. There are few things worse for a manager than to find out one of their favorite "important" and "valuable" parts of the refuge got ranked very low! Nevertheless, acquisition priorities were systematically established on a region-wide basis for the first time ever.

The final acquisition report, released in January 1990, identified 437,589 acres of high, 241,890 acres of medium, and 135,720 acres of low priority potential acquisitions on Koyukuk NWR, not including the Kaiyuh Flats (Northern Unit Innoko NWR). In the report, acreages for Kaiyuh Flats were included within the totals for Innoko NWR proper. A majority of the inholdings within the Kaiyuh had high rankings. Even though the ranking process was mandated by Congress, at present there are no acquisition funds designated for the Koyukuk NWR.

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 ammendments, withdrawal of selected parcels, and cancellation. There is a total of 496,800 acres covered by the Land Bank Agreement.

In 1990 we concurred with a request from Gana-A'-Yo, Ltd. to withdraw some lands from the Land Bank Agreement for the Koyukuk Airport expansion. We also held discussions with Gana-A'-Yoo Corporation regarding our assisting them with tresspass and wildlife related violations on their lands. It was our response that we would give advice but do little on-the-ground work.

3. Other

We cooperated with the Bureau of Land Management, Alaska Fire Service, U.S. Air Force, and the Alaska Dept. of Transportation & Public Facilities (Airports) in review of the Galena Airport Master Plan. A major reorganization of the airport layout will require moves by the private charter services and the BLM. We requested designation of a lease lot for a future Service airplane hangar site. We also requested construction of a new floatpond and ski strip on the airport (See Section I.8. for discussion of the problems with the existing floatpond). The second draft of the plan incorporated our suggestions. The first change to the airport will be a new taxiway, however, most of the major changes in the airport may not occur until the next century.

A. PLANNING

1. Master Plan

The FY 90 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, the planning efforts that related to the CCP itself were essentially nil. The first of the three to five year interim periods between revisions of the CCP is rapidly approaching. The 1987 Nowitna and the 1986 Koyukuk/Innoko CCP's are scheduled for review to consider changes not later than 1992. The required revisions will be done as per the CCP by holding public meetings in 3-4 places and putting out a news releases to solicit comments from the public at large concerning the FWS administration of the CCP. A summary of this input with subsequent management decisions will be appended to each CCP as a revision in late 1992.

2. Management Plan

After a rather extended hiatus several basic management plans were started in late 1990 to hopefully guide, focus, and streamline the management of the newly formed Complex. Foremost among these will be an Operational Plan. This document will simply be a "short list" of salient work to be done in the Complex over the next 5 years with details of funding, staffing and strategies. As might be expected, this document will be the bridge between the CCP and each AWP. The specific management plans (i.e. fire, wildlife inventory, etc.) will be coordinated by this operational plan. The draft is now circulating within the Regional Office with a final version to be completed in mid-1991.

The Interagency Fire Management Plan was updated in several ways for the entire Complex. This is reported in Section F.9.

The wildlife inventory plan for the Complex was begun at year's end and will be done at the end of FY 91. This large undertaking will require nearly a full FTE but should document for the first time, the procedures used in the field over the past 10 years. ARMP Spindler is heading this effort and at years end is just beginning the writing.

At the request of the Regional Office, a five-year telecommunications plan was drafted. The plan included proposed improvements to the radio, telephone, and computer systems.

5. Research and Investigations

The following are a summary and brief description of approved refuge studies.

Wetland Ecology and Sightability Correction for Waterfowl Productivity Surveys on the Koyukuk NWR.

This study was initiated in 1989 and was continued in 1990. Primary objectives of the study are to attempt 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. In 1990 only the second objective was investigated. Results of this study can be found in section G.3.

The Effects of Fire on Wildlife Populations.

This five-year study was initiated in 1987 and continued in 1990. Primary objectives are to determine vegetation changes and successional sequences caused by fire and determine small mammal, furbearer, avian, and moose population changes caused by fire. Results of 1990 progress are reported in section F.9

An Evaluation of the Impact of the Spruce Bark Beetle on Spruce Stands and Associated Flora and Fauna along the Lower Yukon River.

This study was approved in 1990 but lacks funding. Primary objectives are to determine the extent and rate of spread of spruce bark beetle infestations between Holy Cross, Alaska and the Koyukuk River, and to quantify changes in the plant community.

Seasonal Movements and Home Range of Three Wolf Packs on the Koyukuk National Wildlife Refuge (Project No. 75615-85-01).

This project was initiated in Spring 1990. Primary objectives of the study are to determine pack sizes, location, home ranges, and general age class of three wolf packs on the Koyukuk Refuge, determine seasonal habitat use, and develop an estimate of wolf/prey ratios in an area of known prey density. Results from this year 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.

An amendment was made in 1990 to increase this study to three years and to include the Koyukuk Refuge in the study area. This project was initiated in 1988 on the Nowitna Refuge. Primary objectives of this amendment are 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 of the Koyukuk moose herd. Results of this study can be found in section G.8.

E. ADMINISTRATION

1. PERSONNEL

Permanent

1. Michael L. Nunn, Refuge Manager, GS-485-12, EOD 5/26/84, transferred 2/24/90
2. F. David Stearns, Refuge Manager, GS-485-12, EOD 6/17/90, PFT
3. Michael A. Spindler, Assistant Refuge Manager (Airplane Pilot), GS-485-12, EOD 2/11/90, PFT
4. Paul A. Liedberg, Assistant Refuge Manager, GS-485-11, EOD 2/11/90, 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, PFT
7. Jim Bodkin, Wildlife Biologist, GS-486-11, EOD 5/31/89, transferred 8/21/90, PFT
8. Walter L. Johnson, Wildlife Biologist, GS-486-11, EOD 5/21/89, PFT
9. Mark R. Bertram, Wildlife Biologist, GS-486-9, EOD 4/10/88, PFT
10. Maudrey M. Honea, Secretary (Typing), GS-318-6, EOD, 10/85, PFT, Local Hire

Temporary

1. Peter DeMatteo, Biological Technician, GS-404-5, EOD 4/89
2. Theresa M. Ferraro, Biological Technician, GS-404-5, EOD 6/17/90, terminated 8/10/90
3. Orville H. Huntington, Biological Technician, GS-404-5, EOD 6/17/90, Local Hire, Intermittent
4. Claudette L. Lowe, Refuge Clerk (Typing), GS-303-4, EOD 6/7/90, Local Hire, Intermittent
5. Jenny M. Lowe, Biological Technician, GS-404-5, EOD 6/17/90, Local Hire, Intermittent
6. Pamela S. Nelson, Biological Technician, GS-404-5, EOD 6/17/90, Intermittent
7. Thomas F. Paragi, Biological Technician, GS-404-5, EOD 6/17/90, TFT
8. George M. Wholecheese, Biological Technician, GS-404-5, EOD 6/13/90, Local Hire, Intermittent

Refuge Manager Dave Stearns arrived in July 1990

After more than six years in Galena, Refuge Manager Mike Nunn transferred to Region 1.

Assistant Refuge Manager/Pilot Mike Spindler transferred to Galena from Kotzebue in February 1990.

After a six-month detail from Arctic NWR, Assistant Manager Paul Liedberg's transfer to Galena was final in February 1990.

Wildlife Biologist Buddy Johnson on the way to Nowitna Refuge on the Yukon River. Buddy is leading the fire-furbearer study.

Wildlife Biologist Jim Bodkin decided to transfer back to research to become the sea otter project leader.

Fire Management Officer Mike Granger on top of Purcell Mountain on a trip to service radio repeaters in July 1990.

Wildlife Biologist Mark Bertram coordinated and supervised the waterfowl brood survey, waterfowl banding and moose census.

Secretary Theresa Williams (left) and Secretary Maudrey Honea. Without their able assistance we would get nowhere.

Wildlife Biologist Tom Paragi works primarily on the furbearer studies. He started with us in June 1990 as a biological technician.

Airplane Pilot Colin "Brownie" Brown has flown professionally in the Galena area for 15 years. He passed his 10,000 hour mark in 1990.

Biological Technician George Wholecheese - brings us lots of local knowledge about the trails and waterways of the Galena area.

Biological Technician Pamela Nelson drove her dog team from Kotzebue to Galena in March 1990. She worked on the duck brood survey and helped write the "Teach About Fire" curriculum.

Education Specialist Heather Johnson worked on "school presentations", such as National Wildlife Week, and several field projects. She was hired by the Regional Office to assemble the "Teach About Fire" curriculum, which was drafted in August and revised in January 1991.

Biological Technician Jenny Lowe helped with the Nowitna River barrel clean-up, duck brood survey, and swan surveys. She grew up helping her dad on the trapline and now is working on a degree in biology at UAA.

Biological Technician Orville Huntington helped with the duck brood survey and swan surveys as well as computer data entry. In late 1990 he was selected for a cooperative education position while he completes his wildlife degree at UAF.

Secretary Claudette Lowe worked in summer 1990 to help with clerical work while the permanent position was vacant. She also helped with field work as needed.

Biological Technician Peter Dematteo worked on the brood survey, radio telemetry, safety, and logistics. In September 1990 he was detailed to the Regional Office to help with subsistence management.

9. Mary Ann Sam, Secretary, GS-318-5, EOD 6/12/89, terminated 1/19/90, Local Hire

Several staff changes occurred in 1990: After more than six years in Galena, Refuge Manager Mike Nunn transferred to a Deputy Associate Manager position in Region 1, Portland. The Refuge Manager position was filled by Dave Stearns, of Arrowwood NWR, and formerly Tetlin NWR. ARM/Pilot Mike Spindler transferred from Selawik NWR to this station. After a seven month detail to Galena, Paul Liedberg was selected for the second ARM position on the staff. He had been Administrative Officer at Arctic NWR. His position will include incidental flying duties, and will be converted to full dual-function piloting after a year in grade. Clerk typist Mary Ann Sam ended her temporary appointment with the refuge when she moved back to Huslia. Wildlife biologist Jim Bodkin decided to transfer back to Research. He became the Sea Otter project leader effective August 27, however, his move did not take place until September. A long-awaited Cooperative Education Student position was filled by Galena resident Orville Huntington. Orville is working on a Bachelor's in Wildlife at the University of Alaska.

RM Stearns hit the ground running when he arrived in Galena because shortly after moving into his house he went to the Regional Office for a two-week detail to fill in for Associate Manager George Constantino. In September our highly motivated logistician and coordinator, BT Pete Dematteo was detailed to the Regional Office subsistence management program for the remainder of the year. Our crew of Seasonal Biological Technicians, Theresa Ferraro, Tom Paragi, Pam Nelson, Orville Huntington, Jenny Lowe, and George Wholecheese did a great job during our short summer of intense field work. They did such a good job, and we needed their help so much, that two were kept working full time through the fall and winter and the rest were placed on intermittent status so they could be easily reactivated: BT Jenny Lowe and Secretary Claudette Lowe returned from college in December and worked for us during the Christmas break, and Pam Nelson worked on various part-time projects through the winter. Pilot Colin "Brownie" Brown passed his 10,000 flight hour milestone in 1990, and we are fortunate to have his experience on our staff. Pilots Spindler and Liedberg frequently seek advice from Brownie.

A Refuge Inspection was completed December 10-13. Members of the inspection team were George Constantino, Paul Schmidt, Robyn Thorson, Ed Merritt, and Fred Nolke. The review provided a great opportunity for many productive discussions about refuge management. During the review several decisions were made that should improve our interactions with the Regional Office and improve our facilities and working conditions.

Unfortunately the weather did not cooperate for effective village and refuge tours.

Several emplyees received training during the year. WB's Johnson and Bodkin attended Arctic Survival Training at Eielson AFB, Fairbanks. FMO Mike Granger attended Basic Refuge Academy, Prescribed Firing Boss and Aerial Ignition Device training. ARMP Spindler also attended the latter training. ARM Liedberg, BT DeMatteo, WB Bodkin, WB Bertram, and Pilot Brown completed Basic Fire Management Training in Soldotna. ARM Liedberg attended the April 1990 Project Leader's meeting and Drug Free Workplace training April 3-6. Liedberg also completed necessary pilot checkouts for his Incidental Pilot qualification.

Cross cultural training was presented to the entire staff by Darlene Romer on June 25th. The six biotechs and Associate Manager George Constantino attended the field safety orientation held by the staff for the summer crew during the week of July 18. An excellent scope of topics and instructors was presented.

Heather Johnson and Pam Nelson attended a workshop on available environmental education curricula in Alaska. This was to assist them help in preparation for a future workshop presenting "Teach about Fire" materials. WB Johnson attended Law Enforcement refresher at Marana, Arizona in March 1990. RM Stearns and WB Johnson attended Law Enforcement firearms requalification in Fairbanks in August. WB Johnson also attended an informal refresher on search and seizure. Pilots Brown, Liedberg, and Spindler attended the OAS recurrent ground school in December.

Several staff members earned awards for their excellent performance during the year. A Special Achievement Award was given Pete Dematteo for his thorough job in organizing, preparing and helping present the safety orientation. Buddy Johnson and Jim Bodkin earned Performance Awards, and Mark Bertram earned a Quality Step Increase. Jim Bodkin was selected as an Academic Representative for the Western Society of Naturalists. Stearns was give a Special Achievement Award for his work in North Dakota.

2. Youth Programs

Initial inquiries were made as to the possibility of starting a YCC program in Galena in 1991.

4. Volunteer Program

Several volunteers served the refuge in 1990. Heather Johnson assisted with Environmental Education, public information, and moose check station duties. She organized and presented several school programs, coordinated the Galena Nature trail cleanup, and assisted with other refuge field work. Kevin Lynch assisted in operation of the moose check station and the moose census on the Nowitna. Alice Stearns assisted at the moose check station and "other duties as assigned". Donna Bodkin helped type and assemble last year's annual narrative reports, as well as other office work. Anne Cain helped BT George Wholecheese build a storage shed at the lower Nowitna administrative cabin.

5. Funding

Even though Koyukuk and Nowitna refuges were complexed in August 1989, the budgets were kept separate in FY90. The budget for Koyukuk NWR is shown in Table 1. The remainder of the budget is presented in the Nowitna Section.

Table 1. Koyukuk National Wildlife Refuge Funding

Program	FY86	FY87	FY88	FY89	FY90
1230					5,000
1241					116,000
1260	375,000	430,000	440,000		
1261				273,000	290,000
1262				190,000	171,000
8610	22,000	40,000	39,100	20,589	22,725
Totals	397,000	470,000	479,100	483,000	604,000

It was a pretty good year financially as the budget increased about 25%. The additional funds in FY90 allowed the staff to perform some long-delayed maintenance work around the office and bunkhouse as well as initiate several wildlife studies. We were also thankful that this was the first year fire funding was budgeted as a separate category which simplified matters. The total amount dedicated to fire, however, decreased from 136K in FY89 to 116K in FY90.

Village leader and member of the Alaska Board of Game Sidney Huntington addressed the refuge staff during the summer field season orientation program.

Refuge staff gets a safety briefing on the Cessna-185 during June orientation week.

6. Safety

Probably the single most important action the Service can do to improve safety in remote locations such as Galena is extensive pre-field work safety training. The staff spent most of the week of June 18-25 covering such topics as first aid, CPR, hazardous materials handling, aircraft and helicopter safety, and firearms/bear safety. We used a combination of videos from the Regional library, hands-on demonstrations and practice, as well as lectures. Throughout the year we also had safety meetings after regular staff meetings. Because all staff are required to fly in small aircraft frequently to perform their duties, most of the topics were aviation-related: aircraft propeller strike awareness, airplane pilot pinch-hiting, use of personal protective equipment, teamwork for safe radio-telemetry, and aircraft survival kit usage. Pilot Brown prepared a handout on awareness of aircraft weight and performance limitations to be given to uninitiated field workers. Other safety meetings discussed home fire safety, wood burning stoves, fire extinguishers, winter survival, back-strain, and other pertinent subjects.

The refuge had no lost time accidents during the year. We did have two minor back strains which could have been avoided, and will make more efforts at training in the future. There were three aviation safety incidents that were maintenance-related. While ferrying the station C185 from Anchorage to Galena ARMP Spindler had to make a precautionary landing and spend the night on the Nowitna River due to an improperly venting gasoline cap. During November moose surveys a Super Cub, without the required cold weather crankcase vent hole, blew a nose seal and lost oil pressure. Pilot Liedberg flew to Ruby and landed without incident. The plane required a new engine. Also on the same day at Ruby ARMP Spindler returned to Ruby three minutes after take-off due to dropping oil pressure. The oil cooler had vibrated loose and fatigued a pressure hose fitting which caused the engine to lose most of it's oil in short order. Also during the summer the refuge C185 was grounded for a week due to metal in the oil. Its engine also had to be changed. All staff pilots are thankful that their hide was spared in these incidents, but we do wonder about the maintenenace at times. It seems like OAS quality may be declining.

The annual safety certification was completed. Some deficiencies were noted, and the needed safety equipment such as fire extinguishers, flammable storage cabinets, proper signs, and first aid kits were ordered.

7. Technical Assistance

Staff provided comments on a BLM waterfowl progress report and a moose inventory summary report for lands adjacent to the refuge (Pah River and Nulato Hills). WB Bodkin spent several days in Bettles, assisting the Kanuti Refuge in the capture and collaring of wolves on that refuge. Pilot Brown assisted Kenai NWR in flying for a moose census February 12-19th. ARM Liedberg was loaned to the Arctic NWR for moose surveys in October but only two days of surveys were done due to the wind and poor visibility. Refuge pilots Brown and Spindler made numerous flights to the Southern Unit of Innoko NWR and McGrath to assist in the absence of their pilot who quit in mid-summer.

8. Other Items

Administration and monitoring of Special Use Permits has become an increasingly significant duty on this station. The refuge issued a total of 14 permits in 1990. Four were on the Koyukuk, three were on the Northern Unit of Innoko, and seven were on the Nowitna. It takes a considerable amount of time to research a permit application and make necessary compatibility and subsistence determinations. Finally after the permit is issued, it is important to monitor the activity to ensure that the special conditions on the permit have been complied with. This latter aspect has taken an increasing amount of time and effort.

Permits issued on Koyukuk and Northern Unit of Innoko:

1/25/90	Don Lowe	Trapping Cabin
4/4/90	Tundra Air	Air Taxi
6/27/90	Sourdough Air	Air Taxi
8/1/90	Lynn Castle, Unalakleet Lodge	Guided Fishing
8/6/90	Fairbanks Floatplane Tours	Air Taxi
8/30/90	K2 Aviation	Air Taxi
9/13/90	Stephen & Catherine Attla	Trapping Cabin/Shelter Cabin

One permit in 1990 to Lynn Castle, a fly-in fishing guide based at Unalakleet Lodge, became controversial. In late July we heard complaints from residents of Nulato who said they observed the camp of a fly-in fishing guide and dead or wasted fish in the lakes of the Kaiyuh Flats. RM Stearns and ARM Liedberg investigated and found it to be a catch and release fishing guide and camp with no wasted fish, but without a valid permit. The owner said he had applied and paid for a permit on the Southern Unit of the Innoko Refuge, but this year he found no fish where he used to operate. He moved to the Kaiyuh Flats on the Northern Unit

of the Innoko, thinking his permit would still be valid. We checked with the McGrath office and found that the refuge did not issue him a permit for 1990. We issued a permit to him for the Northern Unit. Unfortunately, we continued to receive complaints from Nulato residents, who feared the operation would interfere with subsistence hunting and fishing. Liedberg and Stearns told the guide to move his camp away from nearby allotments and river-accessible lakes and sloughs. That was not the end of it. A few weeks later the camp manager reported a defense of life and property black bear killing, but upon investigation by refuge staff we found the hide had not been salvaged. A few weeks later there was a second report of a bear killing, but this time the bear escaped wounded. To avoid further conflicts with subsistence, the guide was told to close the camp by the start of moose season. The guide wants a permit for 1991, and we're working on getting the guide to talk to the Nulato Village before he sets up camp, or he won't get a permit.

We are concerned about the resource impact of the Air Taxi Special Use Permits. On all three units managed out of the Galena office the single most common permit catagory (5 of 14) in 1990 was for Air Taxi. Of the Air Taxi operators, the primary (99%) use is transport of fly-in moose hunters. A few rare air taxi trips are for other purposes, e.g. for river floaters, etc. We issue the Air Taxi permits as per policy, almost routinely, yet they are one of the main factors in determining moose harvest on the refuges. A future step-down plan may have to consider allocation of Air Taxi permits or limitation on numbers of clients for hunting.

F. HABITAT MANAGEMENT

1. General

Located 270 miles northwest of Fairbanks in west central Alaska, the Koyukuk Refuge lies within a roughly circular basin and connects the floodplain and the Koyukuk River just north of its confluence with the Yukon River. The extensive floodplain is a forested basin surrounded by high hills and characterized by many lakes. The terrestrial vegetation is typical of the boreal forest or taiga of Interior Alaska and northwestern Canada.

The most conspicuous characteristic of vegetation on the refuge is the complex interspersion of types. Differences in vegetation 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.

Wildfires are a crucial fact in maintaining vegetation diversity in the environment of Interior Alaska. In 1990 an estimated 220,000 acres burned on the Koyukuk NWR and 86 acres burned on the Norther Unit of Innoko NWR. About 3,000 acres burned on Nowitna NWR.

A single fire, A204, burned 165,290 acres in the Northeastern Koyukuk NWR near Hog River and Florence Island. This fire burned a considerable segment of riparian habitat that should regenerate into ideal moose habitat. After heavy rains in late August some of the sedge meadows began to green-up.

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 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 forest 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 bogs. They are found on north facing slopes and poorly drained lowlands usually underlain by permafrost.

Tressless bogs make up the bulk of the vegetation type in the center of the refuge. The vegetation of these bogs consists of various species of grasses, sedges and moss, especially sphagnum. 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 predominate 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, horsetail, water milfoil, mare's tail, and smartweed are abundant. One or more of 12 species of pondweed occur in almost all lakes. Bog lakes usually contain water lilies.

Several species of sedge, bluejoint grass, foxtail and fleabane 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 beginings of shrub and forest succession.

The Nogahabara Sand Dunes are a remnant from glacial wind-blown deposits. The Koyukuk Wilderness surrounds the dunes and includes 400,000 acres, extending from the premier moose habitat of Three Day Slough on the Koyukuk to the Huslia River.

Galena Airport and Air Force Base provide our community with a number of facilities not present in other villages of 700-1000 people - a big paved, lighted runway, movie theater, restaurant, and base exchange.

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, wild calla, and various species of sedge. Cattails are found in only a few lakes.

Waterfowl use is related to both 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.

Botanist Steve Talbot notified the refuge that he had documented a major range extension of an aquatic plant collected in 1989 as part of the wetland ecology study on the Koyukuk Refuge. The plant, a water milfoil (Myriophyllum farwellii) had a previous range noted in Canada. This finding will extend its range considerably farther north.

Contaminants. Some off-refuge placer mining occurs on several streams that flow into the refuge. Investigations undertaken in 1986-87, downstream from these mines, indicated that some northern pike from the Hog River on the Koyukuk and Sulukna River on the Nowitna contained mercury concentrations that exceeded U.S. Food and Drug Administration (FDA) standards. Other results from around the state show that mercury poisoning has the potential of being a major problem in Alaska. The Northern Alaska Environmental Center (NAEC) in Fairbanks inquired about the results of these investigations and what steps the Service was taking to alleviate the problem. In response, the refuge informed NAEC of 1) a proposal to do a more thorough investigation of mercury and copper contamination on the refuge, and 2) efforts to place signs along creeks where infected fish were collected. Objectives of a proposed 1991 study are: 1) To quantify the level and distribution of elevated mercury concentrations within the Koyukuk and Nowitna National Wildlife Refuges; 2) To compare heavy metal concentrations between watersheds known to have supported placer mining and those that have not; and 3) to determine the level of contaminants in wildlife that utilize contaminated water-sheds.

3. Forest

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

Infestations of spruce bark beetle (Dendroctonus rufipennis) are not new to Alaska, the most recent outbreak was noted in 1986, when a beetle infestation erupted along the lower Yukon River, resulting in an estimated 225,000 acres (2.5 billion board feet) affected between Galena and Anvik. Much of the infestation is within the external boundaries of the Innoko, and the Koyukuk Refuges, although most of the infected land is located on inholdings of native ownership. The accelerated expansion of the beetles up the Yukon River prompted Gana 'A Yoo, Ltd, to hold a conference in Galena in late October 1989 to discuss the problem among landowners and seek possible alternatives for solving the problem. At the end of the conference, Gana 'A Yoo, Ltd. decided that commercially harvesting the infested timber was the answer.

Assistant Manager Liedberg and FMO Granger, along with representatives from BLM, BIA, Institute of Northern Forestry (INF), Doyon, Tanana Chiefs Conference and Gana' A Yoo, met in Fairbanks several times during the year to discuss environmental implications and feasibility of logging on the Lower Yukon and long range ramifications of a rather large beetle kill with it's effects on local residents. Commercial timber harvest on the refuge is not allowed since the CCP has ruled this activity as incompatible.

The desire to know more about this particular beetle infestation motivated Granger and Dr. Skeeter Werner (INF) to submit a proposal to "Evaluate the Impact of the Spruce Bark Beetle on Spruce Stands and Associated Flora & Fauna Along the Lower Yukon", which, to date is unfunded.

9. Fire Management

Fire suppression activities on the refuge are guided by the Alaska Interagency Fire Management Plan. This plan is designed on the premise that prior to man's interruption, the fire cycle in Interior Alaska ranged from 40 to 120 years. The forests are adapted to this type of burning cycle and wildlife depends on it. The Seward/Koyukuk Planning Area encompasses the entire refuge. Under this plan, refuge land is put into one of 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 and high value physical developments. These areas or sites are occupied villages and fish camps. The highest priority in the allocation of suppression forces is given to sites in this option.

The full protection option is designed for the protection of cultural and historical sites, high resource value areas 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 so designated receive initial attack and suppression efforts until the fire is declared out.

The modified action option is designed for 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 a risk of large damaging fires is diminished. During the critical burning periods, 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 in relation 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.

The summer of 1990 was a record year for wildfires on the Koyukuk Refuge. Twenty-two fires burned approximately 237,507 acres. With all that area burned, only one un-permitted, previously un-mapped trapping/shelter cabin and one allotment were burned. Most fire professionals have a hard time comprehending burning 220,000 acres and only losing one structure! But, in Interior Alaska this isn't an uncommon occurrence. A listing of individual refuge fires is given in Table 2, and a summary of acreage by refuge is given in Table 3.

Table 2. 1990 Fire Season Statistics-Koyukuk/Nowitna Refuge Complex

Fire Number	Acreage	Protection Level	Ignition Date	Refuge	Date Out
A115	3000	L	6/25	Nowitna	7/15
A248	.1	F	7/3		7/7
A443	.1	F	7/25		7/26
A163	35	L	7/1		7/2
A168* FWS	680	L	7/1		8/25
BLM	2350				
A190	1	L	7/2	Innoko	7/10
A228	40	L	7/3		7/10
A229	.5	F	7/3		7/4
A286	4	L	7/4		7/10
A322	5	L	7/5		7/10
A354* FWS	488	L	7/1		9/4
STA	1211				
A027	250	L	5/28	Koyukuk	5/30
A034	5	M	5/29		5/30
A037	20	L	5/29		5/31
A053	95	M	5/30		5/31
A104	10	M	6/12		6/14
A107	1	L	6/12		6/13
A182	3	F	7/1		7/2
A204	165,290	L&M	7/2		9/11
A209	20	M	7/2		7/4
A211	20	M	7/2		7/3
A213	60,000	M	7/2		10/1
A214	1,500	M	7/2		7/14
A215	75	M	7/2		7/9
A231	20	L	7/3		7/10
A234	1	F	7/3		7/4
A236	.3	M	7/3		7/11
A237	550	M	7/3		9/11
A254	2800	L	7/3		9/11
A426	6800	L	7/20		9/11
A445	2.5	M	7/25		7/29
A460	5	F	8/6		8/8
A461	40	M	8/7		8/13

Table 3. Summary of Complex acreage burned in 1990.

Refuge	Number of Fires	Acreage
Nowitna	3	3000
Innoko	8	86
Koyukuk	22	220,032
Totals	33	223,118

Refuge fire management goals are to allow natural fires to maintain natural habitat diversity. Much of Alaska's taiga without periodic fire will grow old and unproductive and the soil will become increasingly ice-laden. We felt pleased that natural fire was allowed to do its work in maintaining habitat diversity on the refuge in 1990. The A204 burn, in particular, will no doubt create much improved moose habitat near the Koyukuk River. The A213 burn did damage some caribou winter range, but fortunately the most extensive and heavily used areas near Hogatza Lakes were not burned. We would have liked to see smaller burns scattered throughout many locations instead of these two huge burns dominating a few areas on the Koyukuk. Unfortunately, when a fire is discovered early in the fire season, and a decision made to allow it to burn, there is no way of knowing what the final outcome will be. Most of the time rain will put it out within a few days, however, sometimes a fire will continue to burn throughout the summer and burn much larger blocks of habitat than is desired. We feel the natural fire regime in the past has been altered to the point that current fires such like that ones we had in 1990 can become unusually large when the fire danger is extreme due to fuel accumulation. It will take years of naturally occurring fire to recreate the diverse mixture of forest types and ages that existed before man intervened in the 40's and 50's to suppress all fires. Once a natural vegetation diversity has been allowed to become reestablished, future burns most likely will not be so extensive.

Fire suppression on the Complex is provided by B.L.M.'s Alaska Fire Service. Initial attack is achieved with smoke jumpers and retardant bombers such as C-119's, DC-6's and 7's, Catalina PBY's and a Navy version of the B-24, the PB4Y. Helicopters are used to pick up smoke jumpers and to ferry emergency fire fighter crews as needed. In 1990 the fire season began on May 28 and ended on October 1 (fire #A213

smouldered until freezup). Four continuous months of fire fighting boosted the income of local fire fighters considerably. A listing of Emergency Fire Fighter wages paid to local villages follows: Galena-$264,852, Hughes-$139,185, Huslia-$240,426, Kaltag-$303,446, Koyukuk-$155,593, Nulato-$275,833, and Ruby-$90,883. This amounted to average pay per person ranging from $3836 in Koyukuk to $18,276 in Galena. These wages are important in the local economies, and are often the main cash source for a family for the entire year. Our interests in limiting fire suppression in some areas runs directly against the short-term economic interests of most villagers. Hence the interest in a "Teach About Fire" program for fire education (see section H.7.).

FMO Granger's primary activity in fire season is as liason 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 often requires alot of diplomacy and steadfastness.

FMO Granger completed burn plans and an environmental assessment for three prescribed burns, one near Kaltag and the other two southwest of Huslia. The latter two were for habitat improvement, and the one near Kaltag was for hazardous fuel reduction and spruce bark beetle management. The prescribed burn plans were discussed in informal visits at the villages of Kaltag, Hughes, and Huslia. Favorable reception to the idea was received in all three villages. In preparation for a prescribed burning program, an Aerial Ignition Device ("ping-pong ball machine", or AID), was purchased and FMO Granger obtained approval (with assistance of Regional Aircraft Manager, John Sarvis) to install it in the refuge's Cessna 185 floatplane. Igniting prescribed fires from a fixed wing aircraft would save the refuge thousands of dollars over the cost of a helicopter. Unfortunately, all of our work was for naught. The Kaltag Spruce Bark Beetle Reduction Burn was put on indefinite hold pending further review of burn plans and field studies. The two other habitat improvement burns were cancelled due to extreme burning conditions and a statewide ban on open fires.

In Alaska, the window for conducting prescribed fires is very narrow, and when conditions are conducive for efficient, effective prescribed burning it's also good for wildfire. Also, the logistics of trying to conduct a burn 100 miles from refuge headquarters, inaccessible by road, and on a limited budget, can almost be insurmountable. Add to that, the cost of a helicopter standing by at $800.00 per day waiting for the right conditions,

and it's no wonder few prescribed burns are ignited in Interior Alaska. Our greatest ally is lightning! Some will strongly disagree, but when we allow limited fires to burn, in accordance with Alaska Interagency Fire Management Plans, the refuge and wildfire resources can benefit greatly.

A study entitled "The Effects of Fire on Wildlife Populations" was continued in 1990. The objectives of this study are 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 consists of three sites. Two are in an area burned during the summer of 1986. One is in the middle of the fire area and the other is along the perimeter of the burn area. The third site is an unburned control site.

Low water conditions this summer prevented access to the burn site. Hence, the lack of complete data precludes any type of valid comparison between this year and previous years. Hopefully low water conditions won't prevail in the forthcoming year.

In 1990 three Remote Automatic Weather Stations (RAWS) were acquired for placement on the Innoko, Selawik and Koyukuk refuges. These RAWS units are now a part of a statewide network accessible by BLM, NPS, FWS, NWS, and AFS and will aid in predicting statewide, local and spot weather forecasts. Total cost for the three units was $43,000.

The staff implemented the new Regional cabin policy which included a warning about the limitation of fire protection to permitted cabins. Information posters were placed around town and a radio program was prepared and aired.

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. Since the Koyukuk area is unglaciated it is theorized that the dunes are wind-blown deposits of sand that originated in glaciated areas to the northwest. The Three Day

Slough area 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 145 bird species, 30 mammal species and 19 fish species are thought to occur or potentially occur on refuge lands (See Appendix A).

Records of spring arrival dates for common and conspicuous birds were summarized for use in comparing phenology from year to year (Table 4). In 1990 waterfowl arrived earlier than normal, possibly due to the early snow melt. Passerine birds, however, arrived later than normal, perhaps because of the cold spell that followed initial early snowmelt in 1990.

Table 4. Arrival dates of common birds at Galena, Ak., 1982-1990.

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

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. The only peregrine nest monitored in 1990 was near the administrative cabin near Hog River; adults were observed but apparently did not nest.

3. Waterfowl

Wetlands in the Koyukuk River floodplain and in the Kaiyuh Flats support extensive 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 1990 included duck, goose, and swan production surveys. Duck breeding pair counts have been conducted on the refuge since 1986. In 1990 breeding pairs were surveyed on waterbodies chosen for the sightability study but time did not allow the usual trend plots to be surveyed. Swan nesting surveys and fall production surveys were first initiated in 1986, and have been repeated annually. Due to the priority of surveying the entire refuge, only fall swan production surveys were conducted in 1990.

Weather Conditions and Waterfowl Migration Chronology

Break-up on the upper Koyukuk River in 1990 occurred in early May with break-up at Huslia occuring in mid-May. Very minor flooding transpired in most of the drainage, however, extensive ice-jam flooding occurred between Huslia and Treat Island. By mid-May all but the largest lakes were ice free. As a result of generally favorable breakup conditions nesting waterfowl fared well in 1990.

Duck Brood Surveys

Duck production surveys have been conducted on the Koyukuk and Northern Unit of the Innoko (Kaiyuh Flats Unit) refuges since 1983. The sampling schemes and methods have varied from year to year. Trend data were collected from 1983-85 and rough population estimates were made in 1984 and 1985. In 1986 the Koyukuk Refuge waterfowl habitat (excluding the Kaiyuh Flats) was stratified into low, medium, and high density plots with the intent of producing a more precise population estimate. The stratification was based on the amount of water present and the presence of bog or non-bog habitat. The parameters were taken from 1:63:360 topographical maps. Helicopters have been used since 1986 to survey low

density and inaccessible plots. The number of surveys has also varied from one to two.

In 1990 several major changes were again made in the waterfowl inventory design with the intent of standardizing sampling techniques among refuges in the state, to produce a more precise waterfowl production estimate on each refuge, and, for the first time, to obtain a statewide waterfowl production estimate. The new sampling approach used in 1990, via a cooperative effort between the Divisions of Migratory Birds and Refuges, divided the state into production units. The Koyukuk Refuge and the Kaiyuh Flats are part of the Koyukuk Unit or Production Unit 6 (Figure 3). Also included in the unit are Kanuti Refuge and B.L.M. lands.

A stratification technique similar to the method used in 1986 was implemented on the Koyukuk Refuge and for the first time on the Kaiyuh Flats in 1990. All references to waterfowl in the remainder of this section include the Kaiyuh Flats. Using color infra-red CIR photos, 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) based on the amount of water and the presence or absence of bog habitat as seen on the CIR photos. (Table 5).

About 48% of the refuge was classified non-habitat (2,087 mi^2), the remaining 4,318 mi^2 was classified as habitat and stratified as follows: low density stratum - 3,429 mi^2, medium density stratum - 590 mi^2, and the high density stratum - 299 mi^2 (Table 6). Sample effort among strata was optimally allocated based on observed waterfowl variances since 1986. A random selection of about 250 waterbodies was made which included 10, 13, and 39 plots sampled from the low, medium, and high density strata, respectively.

Two Cessna 185's and one PA-18 equipped with floats provided access into low, medium, and high density strata plots. Some low density stratum plots were accessed and surveyed by helicopter. Some low and all medium and high density strata plots were surveyed by canoe, walking, or both.

Species, sex, and age class of all duck broods were recorded, as were numbers and species of broody hens. No attempt was made to distinguish between lesser and greater scaup or between Barrow's or common goldeneye. A vegetation description was also recorded for each waterbody surveyed by ground methods.

Figure 3. Location of waterfowl production units surveyed by the Koyukuk/Nowitna National Wildlife Refuge Complex staff as part of the Alaska duck production survey.

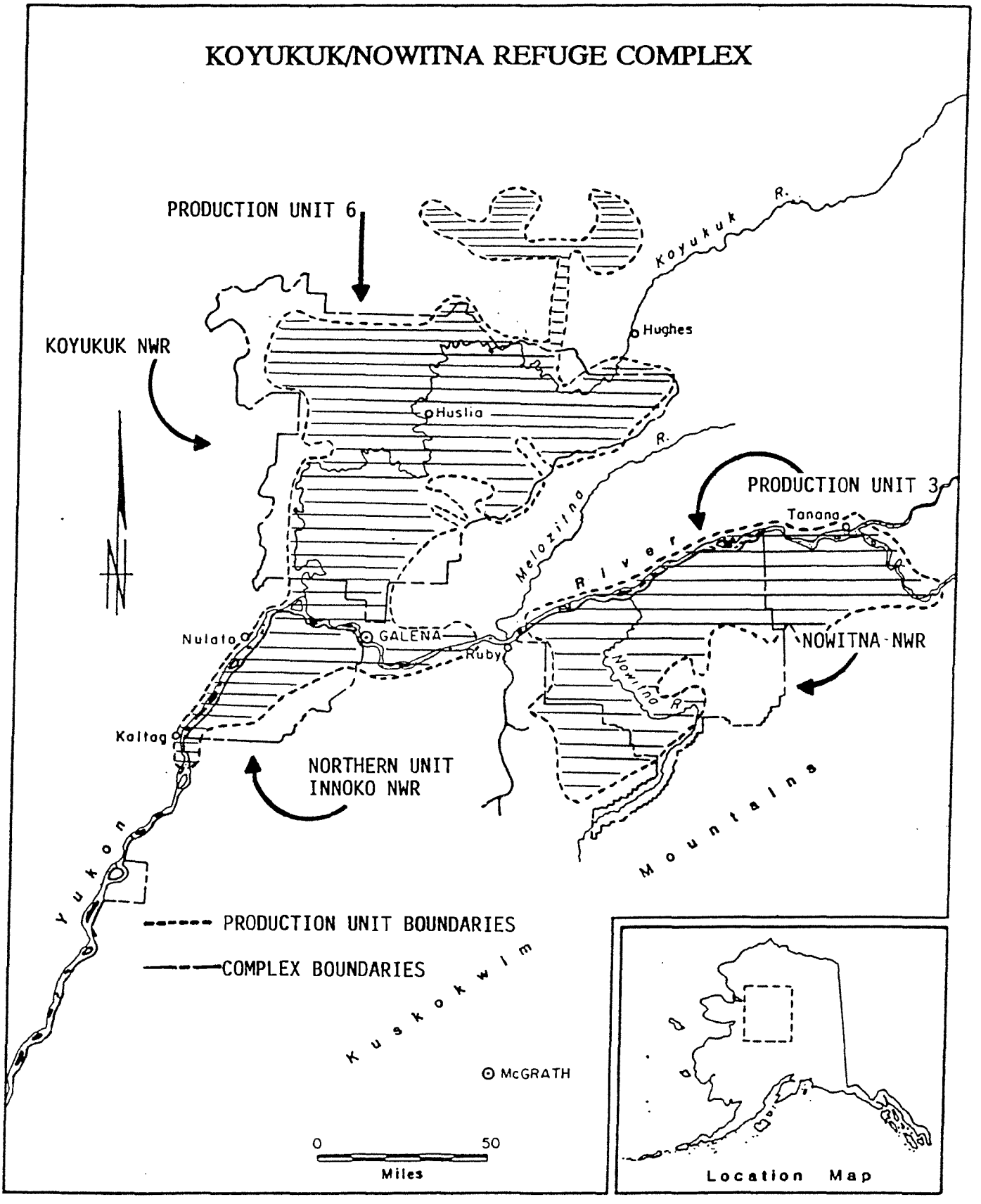


Table 5. Criteria used in waterfowl habitat stratification, Koyukuk NWR.

Population Strata	Habitat Acreage	
	Bog	Non-Bog
Low	< 100	< 60
Medium	> 100 - <200	> 60 - < 100
High	> 200	> 100

Table 6. Strata size and allocation of sampling effort for waterfowl production surveys, Koyukuk NWR and Innoko NWR (Kaiyuh Flats) Alaska-1990.

Unit/* Stratum	Size (mi^2)	mi^2 sampled	% of stratum sampled
Koyukuk			
Low	2,523	3	.1
Medium	474	10	2.1
High	229	30	13.1
subtotal	3,226	43	1.3
Kaiyuh Flats			
Low	906	2	.2
Medium	116	2	1.7
High	70	5	7.1
subtotal	1,092	9	.8
Total	4,318	52	1.2

*Sample units were 1 mi^2 sections on topographic maps.

Note: the Koyukuk Refuge and Innoko NWR Kaiyuh Flats contained 2,087 mi^2 of non-habitat.

Six hundred and thirty-one broods were observed during waterfowl production surveys between July 16 and August 2 (Table 7). Dabbling duck broods accounted for 70% of the observations.

Table 7. Number, average brood size, and age distribution of observed broods, Koyukuk NWR, and Innoko (Kaiyuh Flats) NWR, Alaska-1990.

Species State	Class 1		Class 2		Class 3		Broody	Total	State Historical	1990 Koyukuk
	N	Size	N	Size	N	Size	Hens	Broods	Avg.Size	Avg. Size
Wigeon	43	5.3	94	5.0	17	3.2	37	191	4.9	4.8
G-W Teal	12	5.3	47	4.6	11	5.4	16	86	4.8	4.2
N. Pintail	14	6.2	20	4.6	40	3.9	17	91	4.7	4.4
N. Shoveler	5	5.2	26	4.8	2	3.5	8	41	4.8	4.6
Mallard	10	6.0	41	4.7	12	4.3	20	84	5.0	4.5
DABBLERS	84	5.5	228	4.8	83	4.0	98	493	4.9	4.5
Canvasback	0	0.0	0	0.0	0	0.0	0	0	0.0	5.6
Scaup spp.	51	6.5	20	4.8	0	0.0	4	75	5.8	6.2
Ring-necked	1	8.0	0	0.0	0	0.0	0	1	8.0	5.2
Goldeneye spp.	3	6.0	0	0.0	1	3.0	0	4	5.3	5.7
Bufflehead	7	4.4	1	5.0	0	0.0	2	10	4.5	4.5
Redhead	0	0.0	0	0.0	0	0.0	0	0	0.0	11.0
DIVERS	62	6.2	21	4.8	1	3.0	6	90	5.6	5.6
Surf Scoter	18	5.0	4	5.0	0	0.0	0	22	4.6	5.2
Black Scoter	2	2.0	2	6.8	0	0.0	0	4	4.5	4.7
W.W. Scoter	12	5.8	7	4.3	0	0.0	0	19	5.1	5.8
Unknown	0	0.0	3	4.1	0	0.0	0	3[a]	3.5	3.7
TOTALS	178	5.7	265	4.8	84	4.0	104	631	5.0	4.7

[a] Total includes broods of unidentified species and age class

Table 8. Estimated numbers of broods by age class with coefficient of variation, Koyukuk NWR, and Innoko (Kaiyuh) NWR, Alaska-1990.

Species	Class (C.V)			Broody Hens	Total Broods
	1	2	3		
Wigeon	895 (0.26)	3996 (0.43)	863 (0.80)	1874 (0.74)	7628 (0.33)
G-W Teal	902 (0.77)	1283 (0.56)	135 (0.54)	895 (0.78)	3215 (0.44)
N. Pintail	159 (0.52)	256 (0.34)	1061 (0.66)	1026 (0.69)	2501 (0.56)
N. Shoveler	124 (0.55)	383 (0.35)	58 (0.86)	949 (0.77)	1513 (0.50)
Mallard	844 (0.82)	1072 (0.66)	228 (0.37)	211 (0.32)	2355 (0.37)
DABBLERS	2924 (0.33)	6989 (0.37)	2344 (0.60)	4955 (0.56)	17212 (0.32)
Canvasback	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
Scaup spp.	9908 (0.96)	251 (0.38)	0 (0.00)	34 (0.60)	10194 (0.93)
Ring-necked	49 (1.00)	0 (0.00)	0 (0.00)	0 (0.00)	49 (1.00)
Goldeneye spp.	744 (0.92)	0 (0.00)	9 (1.00)	0 (0.00)	752 (0.91)
Bufflehead	100 (0.58)	9 (1.00)	0 (0.00)	694 (0.99)	803 (0.86)
Redhead	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)
DIVERS	10801 (0.86)	260 (0.37)	9 (1.00)	729 (0.94)	11798 (0.85)
Surf Scoter	236 (0.53)	156 (0.68)	0 (0.00)	0 (0.00)	392 (0.51)
Black Scoter	17 (0.70)	108 (1.00)	0 (0.00)	0 (0.00)	125 (0.87)
W.W. Scoter	3922 (0.99)	60 (0.73)	0 (0.00)	0 (0.00)	3982 (0.97)
Unknown	0 (0.00)	26 (0.56)	0 (0.00)	0 (0.00)	26 (0.56)
TOTALS	17901 (0.72)	7598 (0.34)	2353 (0.59)	5683 (0.60)	33535 (0.57)

The total production estimate for all species in 1990 was 166,064 ducklings (Table 9). Production estimates were highest for scaup spp. (59,251), American wigeon (37,224), white-winged scoter (20,160), green-winged teal (15,480), and northern pintail (11,798). Dabbler production was estimated at 83,515 and diver production at 66,534. The relative abundance in 1990 of dabbler observations was similar to that recorded in previous years with the exception of mallards which increased in 1990. Direct statistical comparisons are not possible between 1990 and previous years because of the different sampling schemes initiated in 1990. Production has likely rebounded from the low of 76,407 ducklings estimated

in 1989 (Table 10). Estimated production of 166,064 ducklings in 1990 is the highest recorded production since waterfowl production surveys were initiated on the refuge in 1984.

When scheduling only one survey in 1990 it was our intent to survey at a time when the bulk of dabbler ducklings were class II and the majority of the divers were class I. Over 58% of dabbler ducklings observed in 1990 were class one, and 79% of the diver ducklings were class one (Table 9). Because of this we feel the survey occurred somewhat early in 1990 although it was initiated at about the same time as in previous years (July 16), and apparently nesting chronology was near normal in 1990. Survey timing will have to be more accurate in 1991.

Our intentions with the new sampling scheme in 1990 were to achieve a 15% coefficient of variation (CV). In 1990 the estimated dabbler brood coefficient of variation (CV) was 0.32, and the diver CV was 0.85. Table 11 displays the amount of variation contributed by each stratum to the overall coefficient of variation and the estimated number of young per stratum. Much of the variation in dabbler and diver broods observed can be attributed to the low density stratum; the CV was 0.53 in dabblers, 0.92 in divers, and 0.76 overall. Variance in the medium and high density strata were acceptable at 0.28. and 0.18 CV, respectively. Because the low density stratum contains over 3,429 mi^2 of habitat (79% of available waterfowl habitat) and less than 1% of the stratum was sampled, the variation observed in this stratum was essentially the determining factor in overall variation in brood estimates. In 1991 we will decrease effort in the high stratum and increase effort in the low stratum with the intent of lowering overall variance in brood estimates. Fifteen fewer high plots will be surveyed and 10 more low plots will be survey. This will be accomplished through increased helicopter survey efforts. It was also estimated that variance could be reduced by combining the medium and high into a single stratum. When medium and high density strata were combined, estimated dabbler brood CV decreased 3%, and overall brood estimate variance decreased 4%.

We assisted Kanuti Refuge in 1990 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 were not available by February.

Our concurrent participation in the brood surveys, helicopter study, and sightability study (summary follows this section) was an exercise in complicated logistics but the work was completed for the most part. (See

Table 12 for a summary of cost and effort for the production surveys in 1990.)

Table 9. Number and age distribution of observed young and estimated young production, Koyukuk NWR, and Innoko (Kaiyuh Flats) NWR, Alaska-1990.

	Class									Estimated Young
Species	1A	1B	1C	2A	2B	2C	3	Total	% of Total	
Wigeon	7	82	141	160	167	137	55	749	28.59	37224
G-W Teal	9	34	21	46	96	73	59	338	12.90	15480
N. Pintail	0	50	35	26	30	38	156	335	12.79	11798
N. Shoveler	0	20	6	18	49	56	7	156	5.95	7314
Mallard	2	30	28	46	46	104	53	309	11.79	11726
DABBLERS	18	216	231	296	388	408	330	1887	72.02	83515
Canvasback	0	0	0	0	0	0	0	0	0.00	0
Scaup spp.	18	237	77	58	26	12	0	428	16.34	59251
Ring-necked	0	0	8	0	0	0	0	8	0.31	393
Goldeneye sp	0	0	18	0	0	0	3	21	0.80	3948
Bufflehead	4	16	11	5	0	0	0	36	1.37	3615
Redhead	0	0	0	0	0	0	0	0	0.00	0
DIVERS	22	253	114	63	26	12	3	493	18.82	66534
Surf Scoter	27	35	29	4	16	0	0	111	4.24	1813
Black Scoter	0	2	2	7	8	0	0	19	.73	562
W.W. Scoter	6	60	1	10	20	0	0	97	3.70	20160
Unknown	0	0	0	0	5	7	0	12	0.46	90
TOTALS	73	566	377	380	464	427	333	2620	100.00	166064

Table 10. Comparison of 1990 and earlier Koyukuk Refuge waterfowl waterfowl production estimates.

Year	Production estimate by unit			Area surveyed (mi^2)		Total mi^2 surveyed
	Koyukuk	Kaiyuh Flats	Total	ground	helicopter	
1990	Units combined in 1990		166,064	50	2	52
1989	37,723	38,684	76,407	40	15	55
1988	116,571	24,925	141,496	70	20	90
1987	133,327	31,176	164,503	59	15	74

Note: sampling strategies differed from 1988-90; production estimates are provided from previous years for general comparisons only.

Float trips on the Dulbi and Kateel rivers were conducted 26-28 July primarily to document goose production, but duck production information was also recorded. The Dulbi River was surveyed by canoe with motor. On 56.75 miles of river, 15 young (3 broods, 3 species) were observed. With a minimum of 445 miles of this habitat type, at least 118 young could be added to the total duck production figures for the Koyukuk NWR. These estimates for Dulbi River are much lower than in previous years. However, this survey was conducted about one week earlier than surveys in previous years and waterfowl production was just beginning. The Kateel River was also surveyed with one person canoes. No broods were observed on the trip, however, adult American wigeon, northern pintail, goldeneye, and bufflehead were observed.

Table 11. Estimated numbers of broods with coefficient of variation and estimated young production by stratum for waterfowl production surveys, Koyukuk NWR, Alaska-1990.

Stratum/ Estimated Species	Estimated Broods	Coefficient of Variation	Young
Low			
Dabblers	10287	0.53	56579
Divers	10837	0.92	93919
Sea ducks	3871	1.00	29678
Unident.	0	0.00	0
Total	24995	0.76	162467
Medium			
Dabblers	3442	0.31	19128
Divers	393	0.46	2114
Sea ducks	354	0.75	1818
Unident.	0	0.00	0
Total	4189	0.28	23006
High			
Dabblers	3484	0.20	16358
Divers	568	0.30	3124
Sea ducks	274	0.50	1203
Unident.	26	0.56	90
Total	4532	0.18	20799
Total All Strata			
Dabblers	17112	0.32	83515
Divers	11798	0.85	66534
Sea ducks	4499	0.86	21620
Unident.	26	0.56	90
Total	33535	0.57	166064

A portable tower was used in the duck brood sightability study.

The sightability study include an average of 7.2 hours of observation time on six waterbodies just prior to the standard brood survey. About 37-43% more broods and 50% more young were seen during the intensive sightability observations compared to the standard brood survey. Sample size, however, was limited (25 broods on 6 waterbodies).

Table 12. Summary of cost and effort for the waterfowl production surveys, (includes sightability study) Koyukuk NWR, and Innoko (Kaiyuh Flats) NWR Alaska-1990.

Aircraft	Hours	Hourly Charges	Fuel	Total Cost
		(@$234.00/hr)	($33/hr)	
C-185 (Charter)	36.84	9,066.01	1,215.72	10,281.73
		($75/hr)	($33/hr)	
C-185	60.7	4,552.50	2,003.10	6,555.60
		($52/hr)	($18/hr)	
PA-18	31.90	1,658.80	574.20	2,233.00
subtotal	129.44	15,277.31	3,793.02	19,070.33
helicopter	15.3*	4707*	416.10*	11,112.00
Total				30,182.33
Effort (16 different personnel and 83 person days)				
Personnel costs (includes salary, overtime, and benefits)				11,897.87
			Total	42,080.20

*Actual use and cost

Goose Production

On 26-28 July goose production surveys for white-fronted geese and Canada geese were conducted along the Dulbi and Kateel rivers. Both rivers were surveyed to assess goose production as well as to document other wildlife observations. All geese observed were tallied and recorded by species, sex, and age-class when possible (Table 13). Two hundred and three adult and 90 gosling white-fronted geese plus 84 adult and 75 gosling Canada geese were observed on the Dulbi River. The majority of the young were class 1B.

On the Kateel River 137 adult and 127 gosling white-fronted geese plus 200 adult and 112 gosling Canada geese were observed. Again the majority of the broods observed were class 1B.

Table 13. Observations of geese, on the Dulbi and Kateel Rivers, Koyukuk NWR, 26-28 June 1990, Alaska.

			Age Class Young		
River	Species	Adult	1A	1B	1C
Dulbi	Canada Geese	84		8	67
	White-fronted geese	203		9	83
Kateel	White-Fronted Geese	137		104	23
	Canada Geese	200	7	87	18

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 August 1990 swans on the entire Koyukuk and Kaiyuh Flats units were aerially surveyed as part of the five-year statewide trumpeter swan survey. The procedures, assignment of survey maps, and funding were coordinated by the Migratory Bird Management Office in Juneau. Our contribution to the statewide effort required 135 hours of flight time by three different aircraft over a three week period. Totals of 460 adult and 157 cygnet swans were seen in the first survey ever completed of the entire Koyukuk. Of these totals, 80 adults and 45 cygnets were seen on the Kaiyuh Flats unit.

In prior years a few selected "trend maps" were surveyed to monitor trends in swan population and production. On the Koyukuk refuge, there was a decline in numbers of young produced, numbers of paired, flocked, and single birds, and mean brood size between 1989 and 1990 (Figures 4 and 5). The decline, however, did not dip below the levels observed in 1985. In the Kaiyuh Flats between 1989 and 1990 there was a slight increase in cygnet production, mean brood size and breeding effort, but a major decrease in non-breeding swans (flocked and singles) (Figures 6 and 7).

Goose production surveys were conducted on Dulbi River, Dulbi Slough, Kateel River, and the Nowitna River in 1990.

Totals of 460 adults and 157 cygnet swans were counted on the first-ever refuge-wide aerial census. Trend maps indicated that numbers of pairs, non-breeders, and young were lower than 1989, however, the population has been growing steadily since 1985. Both trumpeter and tundra swans occur on the Koyukuk.

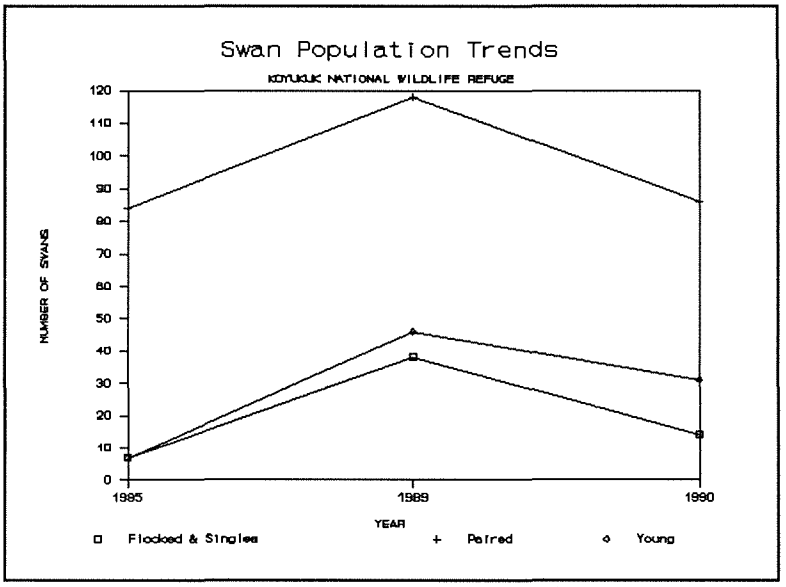


Figure 4. Swan numbers observed during late summer or fall aerial surveys of the Kateel River A2, C1, D1, and D3 trend maps.

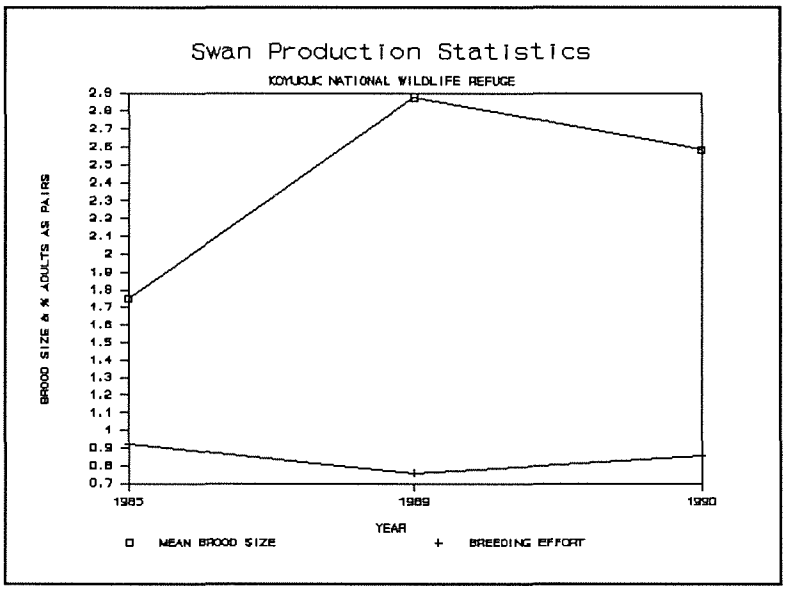


Figure 5. Swan production statistics based on late summer or fall surveys of the Kateel River A2, C1, D1, and D3 trend maps.

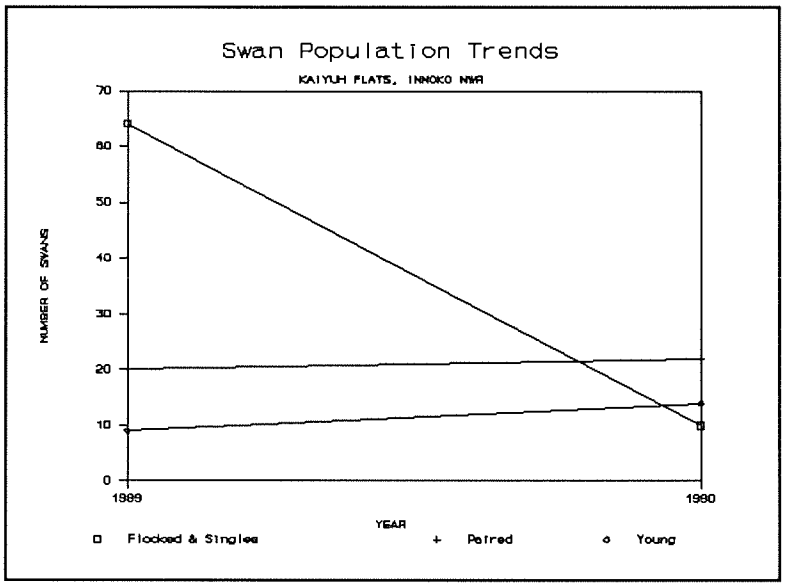


Figure 6. Swan numbers observed during late summer or fall aerial surveys of the Nulato B4 and B5 trend maps.

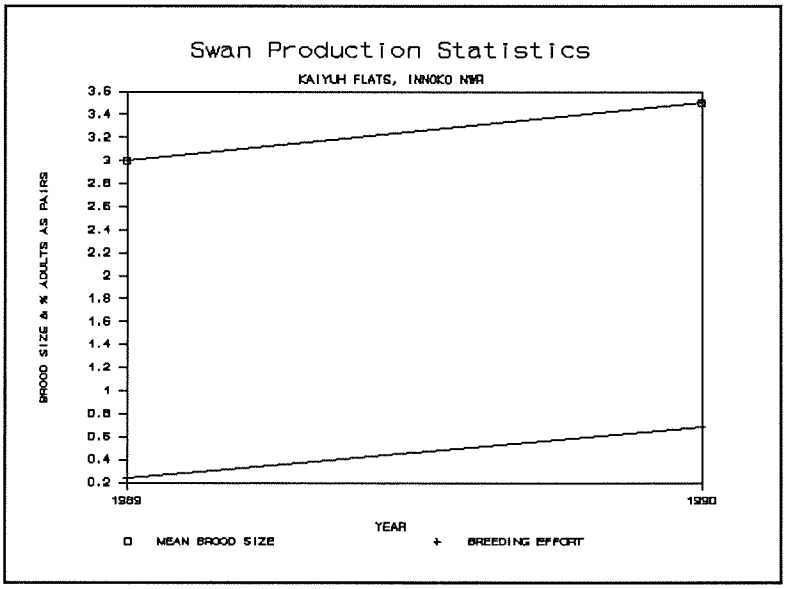


Figure 7. Swan production statistics based on late summer or fall surveys of the Nulato B4 and B5 trend maps.

Waterfowl Related Studies

A. Sightability Study

For the second consecutive year a sightability study was continued with the objective of developing a correction factor for the number of undetected broods in the standard brood surveys. To accomplish this teams of two people observed waterbodies up to 12 hours and enumerated all broods prior to the initiation of standard brood surveys.

Sightability correction data were collected from 16-27 July. Waterbodies varied in size, hydrological characteristics, and waterfowl productivity. All were selected from existing waterfowl plots. Existing waterfowl production plots contained waterbodies in the following sizes: less than 40 acres=84%, 40 acres to 120 acres=11%, and over 120 acres=5%. Sightability plots were chosen based on the proportion and size of waterbodies in riverine and non-riverine habitats (including bog and non-bog). A total of 13 plots were selected, 8 from riverine and 5 upland habitats. Alternate waterbodies were selected to replace those waterbodies which allowed brood movement, i.e., waterbodies connected to other waterbodies, rivers, or streams.

At each study wetland, sightability observations were made between noon the day before and 10 AM the day of the standard duck brood survey. In most cases, two observers were placed on each waterbody. If more than one waterbody (not large waterbodies) were to be observed at a study site the observation team would split up for the evening shift. The following day the team would switch observation sites and later compare and finalize data for each waterbody observed. Observations were made from the ground at the best vantage points which were usually elevated banks. Two of the larger waterbodies were observed from a 12 foot elevated platform. Spotting scopes and binoculars were also used.

Results in 1990 suggested that broods are indeed being missed during standard brood surveys. About 43% more broods were observed in both riverine and non-riverine habitats prior to brood surveys. About 37% more young were observed in riverine habitats, and 50% more young observed in non-riverine habitats prior to brood surveys. Due to limited sample size n=25 broods, (n=6 wetlands) and other problems (see below) we do not feel that a correction factor for sightability can be derived from these data.

Overall a total of 25 broods and 101 young were observed prior to standard brood surveys on 6 waterbodies. Standard brood surveys observed 14 broods and 51 young. Four of the waterbodies were dropped from the sample because they adjoined other waterbodies or streams. Three waterbodies had no observed broods on them. Combined observation time ranged from 4 to 13 hours per waterbody with a mean of 7.2 hours. Waterbody size ranged from 0.8 ha to 36.0 ha with a mean of 12.2 ha. Seventy-eight percent of waterbodies were classified as bog and the remaining were non-bog.

A total of 12 broods and 54 young was observed prior to standard brood surveys on two waterbodies in the riverine habitat. Standard brood surveys observed 7 broods and 34 young. Three of the eight waterbodies selected in the riverine habitats had adjoining waterbodies or streams and were removed from the sample. Three of the eight waterbodies had no brood observations in both surveys. Combined observation time ranged from 4 to 13 hours per waterbody with a mean of 6.8 hours. Waterbodies ranged from 0.8 hectare (ha) to 60.0 ha with a mean size of 13.0 ha. Sixty percent of waterbodies were classified bog and 40% non-bog based on ground observations of plant species and surrounding terrain.

Thirteen broods and 47 young were observed prior to standard brood surveys on four waterbodies in the non-riverine stratum. Standard brood surveys observed 7 broods 17 young. One waterbody selected was connected to a slough and had to be dropped from the sample due to possible brood movements. Combined observation time ranged from 4.25 to 12.0 hours per waterbody with a mean of 7.8 hours. Waterbody size ranged from 1.0 ha to 36.0 ha with a mean of 11.8 ha.

Study design was altered in 1990 in an attempt to develop a more precise method to measure the number, if any, of broods being missed during the standard brood survey. It was observed in 1989 that dense shoreline vegetation provided excellent brood rearing cover and many of these broods remained undetected until flushed during the standard brood surveys. It was recommended that observation time prior to brood surveys be increased in 1990 to overcome this problem. Observation time prior to brood surveys was increased from a mean of 4.2 hours in 1989 to 7.2 in 1990. It was also found that it was impossible to adequately identify or detect young on waterbodies greater that 50 ha. Mean waterbody size decreased from a mean of 20.8 hectares (ha) to 12.2 ha in 1990. In addition an observation tower was used to increase our ability to spot broods on large waterbodies.

Broods observed in the two surveys were compared in an attempt to identify possible brood identification errors. Only four broods (comprised of four species) were identified exactly by number, age, and species in both surveys. Seven broods (four species) nearly matched in the two surveys but differed slightly by age or number. Thirteen broods were seen prior to but not during standard brood surveys. Five of these thirteen broods were mallards. Five broods were observed during the standard brood survey but not seen during the preliminary survey.

In spite of favorable nesting conditions in 1990 the number of broods observed prior to surveys was only 25. It was not felt that a correction factor could be developed from such a small sample size. This study has had several inherent unknown problems in its design which has limited us from developing a correction factor. There is documented overland brood movement in lower 48 wetlands but very little is known about brood movement between waterbodies in Alaska. It is possible that although we tried to disturb the waterbody as little as possible prior to the standard brood survey we may have pushed some broods away from each study area. We observed and heard many broods and broody hens in 1989-90 that were never detected prior to brood surveys because they never left protective cover, mainly horsetail, during extended observations. They were only detected by canoe during standard surveys. There are no plans to continue the study in 1991.

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 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.

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, 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. The refuge staff participated again this year with the ADF&G and local Galena residents in the annual Christmas bird count (Table 14).

Table 14. Results of the Galena Christmas Bird Count, 1982-90.

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

[1] cw=seen during count week

8. Game Mammals

Moose

Moose are presently 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.

Two major projects concerning moose populations were conducted during the year. A hunter check station was operated on the lower Koyukuk River during the September hunting season and a moose calf mortality study was initiated in May. 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 indicate similar calf:cow ratios, signifying adequate reproduction on both refuges. It is hoped that the inclusion of the Koyukuk in this study will enable biologists to address questions designed to compare moose calf mortality rates between the the Koyukuk, with a healthy population, and the Nowitna, with a struggling yearling population component.

As was observed on the Nowitna Refuge, preliminary 1990 results on the Koyukuk Refuge have identified high rates of calf mortality (61%), principally attributable to black bear predation (Table 15) (Figure 9). Of the 62 collared calves only about 39% were alive by the end of the year (Table 16). The causes and periods of mortality are similar between the two refuges. Analysis of fall moose trend data indicate that adequate numbers of calves are being produced annually on both refuges. Expected annual rates of adult moose mortality, reported from 0.07 to 0.26 would suggest that calf mortality is not limiting population growth on either refuge.

Usually the signs left at a moose calf kill location by a predator were sufficient to determine the cause of death. Black bears often eat everything but the hooves and a few bone pieces, and left more sign on the ground such as broken brush, scats and hair.

Wolves usually dismembered the calf and dragged pieces of the body in different directions from the kill site before consuming.

Table 15. Causes of mortality for moose calves of known fate on the Nowitna (1988 and 1989) and Koyukuk National Wildlife Refuges, (1990) Alaska.

Mortality cause	Year	Nowitna NWR 1988 (n=42)[1]	1989 (n=47)	Koyukuk NWR 1990[2] (n=64)
Black bear		14 (33%)	20 (42%)	26 (41%)
Brown bear		1 (2%)	1 (2%)	3 (5%)
Wolf		6 (14%)	4 (9%)	3 (5%)
Unknown predator		2 (5%)	5 (11%)	5 (8%)
Drowning		2 (5%)	0 (0%)	1 (1%)
Unknown cause		1 (2%)	2 (4%)	1 (1%)
Total		26 (62%)	32 (68%)	39 (61%)

[1] Number of calves at start of each monitoring session is in parentheses.

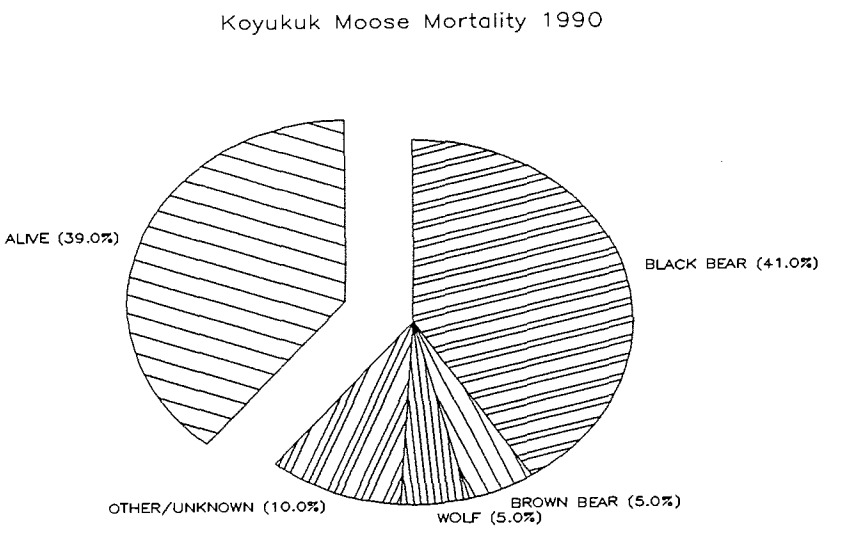
[2] as of 1 February 1991.

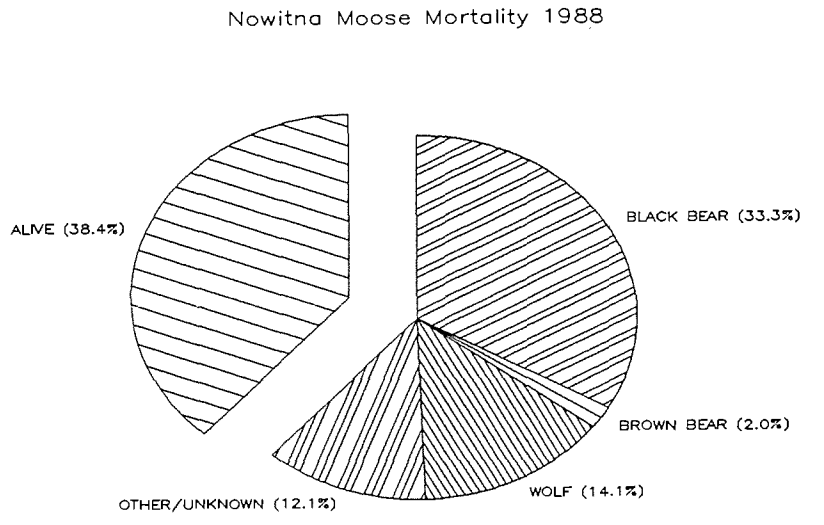
Table 16. Proportion of moose calves surviving to the end of three intervals during their first year of life on the Nowitna (1988 and 1989) and Koyukuk (1990) National Wildlife Refuges, Alaska.

	Nowitna 1988	Nowitna 1989	Koyukuk 1990
collaring (birth) dates	22-26 May	21-30 May	21-25 May
calves collared	42	47	62
Interval	percent alive at end of interval		
I. 21 May - 1 June	78	72	68
II. 2 June - 10 July	60	38	44
III. 21 May - 11 July	38	30	39[1]

[1] as of 1 February 1991

This year repeated attempts were made by the local State Area Biologist to conduct aerial surveys of the Three-Day-Slough trend areas but they were precluded by cold weather.





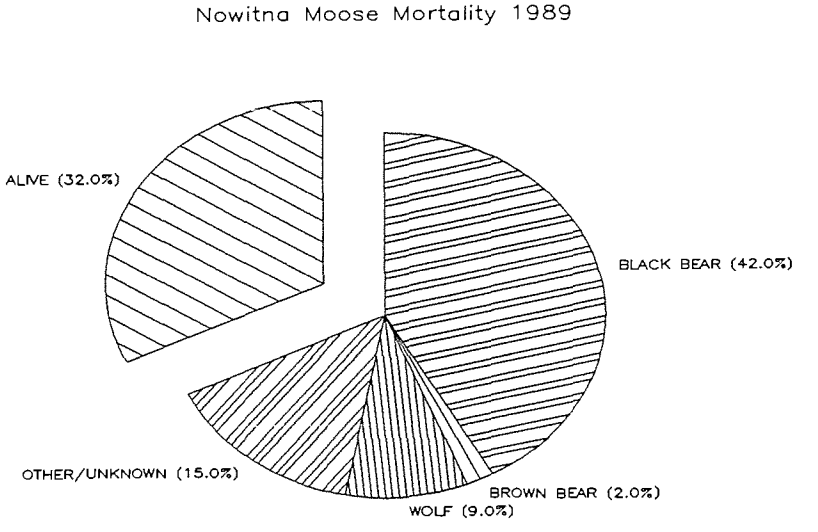


Figure 9. Results of moose calf mortality study.
(Note: Koyukuk data for partial year,
May 1990 through February 1991)

Caribou

The ranges of two caribou herds include portions of the refuge. The Galena Mountain Herd, a small herd of 500 that calves in the mountains of the Melozitna River drainage, winters on the southern Koyukuk flats. Currently a small portion of the winter range of the Western Arctic herd, the largest caribou herd in Alaska, also includes the same area and other northern and western sections of the refuge. The Western Arctic herd has been growing steadily since its crash in the 70's, and is presently estimated at about 420,000. In early 1989 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 Galena Mountain Herd. Current distribution patterns may change if the herd size continues to increase. Figure 10 displays recent caribou distribution of both herds.

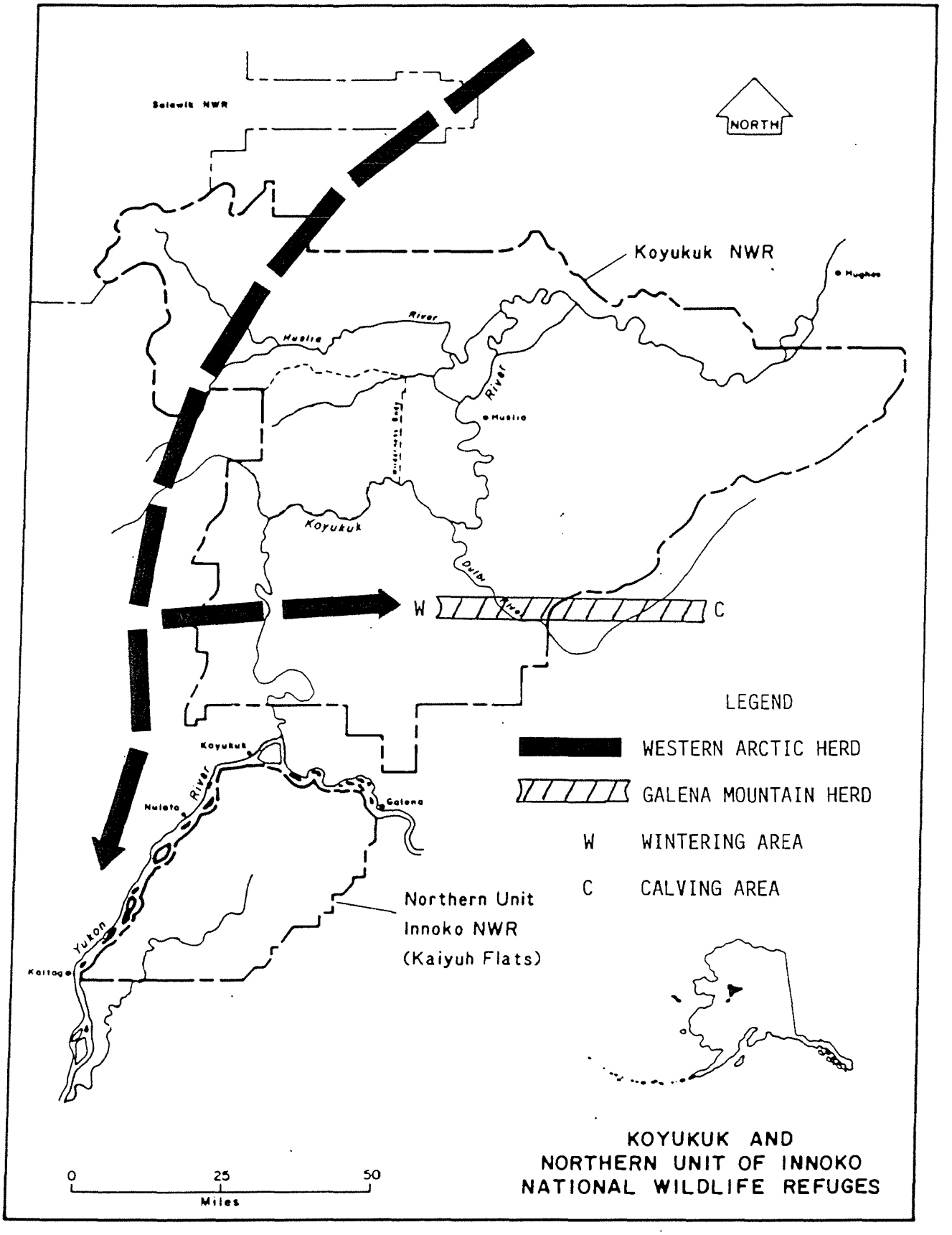
As follow-up to a cooperative Galena Mountain Herd study with the Bureau of Land Management, refuge staff made several caribou relocation flights in January. Four caribou, of the original nine collared from the Galena Herd in 1986 and 1987, were suspected to still be on the air. Repeated relocation attempts in January failed but one caribou was finally picked up on the air January 24, 1989 at the base of Galena Mountain.

By early December the Western Arctic Herd had migrated southeast through the Nulato Hills to Kaltag and into the Natlaratlen River drainage on the refuge. The Alaska Department of Fish and Game announced an "emergency" opening of the caribou season on December 17 which would allow local residents the opportunity to harvest caribou from the Western Arctic Herd during this eastern shift in migration patterns. Initially we had concern about the mixing of the two herds and the possible overharvest of the Galena Mountain Herd. Harvest was mostly away from the Galena Mountain Herd winter range. Further collaring and blood I.D. will be done in 1991 and 1992.

Bears

Black bears are abundant in the forest, lowland habitat of the refuge. Hunting pressure is low and habitat quality is excellent. About 40% of the classified land cover types on the refuge are 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 by the staff on the refuge in 1990. 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 10. Recent migration patterns of the Galena Mountain Caribou Herd and the Western Arctic Caribou Herd.



Muskox

A single muskox was sighted 20 miles south of Huslia standing on a sandbar in the middle of the Koyukuk River in September. This is the third sighting of this attractive species made on the drainage in recent times. The nearest viable herd is on the Seward Peninsula.

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. The wildlife inventory plan will focus our attention on obtaining baseline data starting in 1991.

Beaver

Beaver populations in much of Interior Alaska are presently high. They are common throughout the refuge and are frequently seen during the summer. Beaver is an important source of fur and food for local resource users and accounts for a large portion of the fur harvest. Pelts sold for approximately $50 in 1990. The fur is used locally for hats and as trim on gloves 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.

Wolverine

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

Lynx, Mink, Red Fox, and River Otter

The population status of these furbearer species have not been determined on the refuge. Population fluctuations are known to occur in accordance with fluctuations in prey species populations, primarily microtine rodents and/or snowshoe hare. All are occasionally harvested by 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 for food. Consequently, wolf numbers are often highest where moose and/or caribou are abundant. Another factor that effects wolf populations is harvest intensity. Presently, healthy populations of wolves and moose occur on the Koyukuk NWR and Kaiyuh Flats Unit. An inventory 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 was amended in 1989 to include the entire Complex. 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 north. The amended study plan called for the deployment of up 20 transmitters in areas of known moose densities throughout the refuge complex.

Between March 14 and 22 of 1990, twenty wolves were captured and fitted with radio collars. Weather conditions were excellent during most of the week with fresh snow and good lighting affording excellent tracking and darting conditions. Three to four spotter planes (PA-18) were used to locate wolf packs and one helicopter was used for darting and collaring. Twelve wolves were collared from 5 packs on the Koyukuk and 8 wolves were collared in three packs on the Nowitna. At time of capture, three packs were in an area of high moose density, three in medium, and two in low. Twelve wolves were males and their average weight was 48.0 kg (106 lb, range 92-132 lb). The average weight of the eight female wolves was 38.4kg (84.5 lb, range 74-96 lb). Packs were located every two weeks until snow cover began to diminish (May) and once a month over the course of the summer. With the return of snow cover in October we hoped to locate the packs bimonthly, however, weather and darkness hindered the efforts. We averaged a location every three weeks. Of the twenty wolves originally collared, 15 are active, 1 slipped its collar shortly after capture, 3 were shot, 2 have been trapped, and the fate of one wolf is unknown (Table 18). Plans for week-long relocation bouts during winter and spring 1991 will hopefully

A majority of the Koyukuk and Nowitna wolves feed on moose, however, caribou are taken when present. Some lone or paired wolves we have tracked fed mostly on caribou and small game. Many of the interior wolves are black or tan/grey.

This wolf was nicknamed "Gumbie" because of lost teeth and gums showing. It was probably alpha male of the lower Nowitna wolf pack until it was caught in a trapper's snare in March 1991. Estimated wolf population is 150 on Koyukuk and 80 on Nowitna with annual harvest by hunters and trappers estimated at 30%.

provide enough locations to delineate territories and determine the spatial relationships of packs during the period.

Table 18. 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	Status Unknown - 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	Active - 3 Day Slough Pack
W26	3/18/90	Dead - 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	Active - Lower Dulbi Pack
W14	3/16/90	Dead - Trapped - Nayuka Pack
W15	3/16/90	Active - Nayuka Pack
W16	3/17/90	Active - Lone Wolf
W17	3/17/90	Active - Ham Island Pack
W18	3/17/90	Active - Ham Island Pack
W19	3/17/90	Active - Monzonite Pack
W20	3/17/90	Active - Monzonite Pack
W21	3/17/90	Active - Monzonite Pack
W22	3/17/90	Dead - Trapped - Novi Pack
W27	3/22/90	Active - Novi Pack

11. Fishery Resources

Significant anadromous species found in the Koyukuk River include chum, chinook and coho salmon. Chum salmon, summer and fall runs, and chinook salmon are the primary subsistence fish for the villages near the refuge. Coho and sockeye are occasionally taken while pinks are rarely harvested. We assisted the Fairbanks Fisheries Office in their sampling of Yukon River salmon, and provided support during their attendence at the Yukon River Salmon meeting in December.

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, but they had to be delayed due to limited funding. Main concerns are identification of spawning and rearing sites, and proper allocation of harvest for subsistence.

16. Marking and banding

A successful banding effort this year resulted in the banding and collaring of 478 greater white-fronted geese. Nylon drive nets were used on the Dulbi and Koyukuk rivers and on Boat Lake to capture molting white-fronted geese 2-5 July. Nets were positioned on the inside of river oxbow bends or in lake shores. They were attended by at least three people with one or two canoes. The capture sites were carefully chosen from the air and positioned about 1-2 miles downstream from flocks of molting white-fronted geese. All drive attempts involved seven to eight people and two aircraft. A circling PA-18 was used to slowly push birds downstream toward the trap site. As birds became cautious and stopped in front of the drive nets both the PA-18 and a C-185 landed and pushed the geese up the bank into the drive nets. Ground based personnel then pushed the birds into the holding pen. Four drive attempts resulted in 478 geese which were sexed, aged, banded, and collared (Table 17). Sex ratios of adult geese were 50 M : 50 F, while the age class was 94 ASY : 6 SY. Morphological measurements were taken from 60 geese and blood samples from 20.

Table 17. Sex and age ratios of Greater white-fronted geese banded and collared on the Koyukuk National Wildlife Refuge, 2-5 July 1990.

Date	Site	# banded and collared	ASY		SY		L		Recaps	
			M	F	M	F	M	F	M	F
2 July 1990	Dulbi River	23	16	7					3	1
3 July 1990	Boat Lake	93	36	41	6	10			2	
4 July 1990	Dulbi River	173	82	81	2	5	1 (2 unknown)		5	9
5 July 1990	Three-Day-Slough	183	88	89	2	4			6	
Total		472	222	218	10	19	1 (2 unknown)		16	10

Total Males	= 233	Total ASY	= 440
Total Females	= 237	Total SY	= 29
Unknown	= 2	Total L	= 1
Ratio M/F	= 50:50	Ratio ASY/SY	= 94:6

A total of 478 white-fronted geese were banded and neck collared in early July 1990. We banded geese by driving them on oxbow lakes using circling aircraft, taxing aircraft and people stationed at strategic locations near the net.

Swallowtail butterflies were the primary cause of moose mortality on the Koyukuk NWR in 1990 - at least for this photo. Actually, most (41%) moose calves were taken by black bears in 1990. Brown bears and wolves also killed a few of the 64 calves that were collared and monitored. Dead calves were necropsied in the field if necessary to determine the cause of death.

We attempted to band pintails the first two weeks of August but recurring smoke problems precluded access to the banding site, thus ending our chances for 1990.

H. PUBLIC USE

1. General

The main public use of the Koyukuk and Northern Unit of the Innoko Refuges is subsistence hunting, fishing, trapping, and gathering. This ranges from putting meat, fish, and berries on the table to cutting house logs and firewood. Recreation and other uses are minor compared to subsistence.

A considerable portion of refuge staff time in 1990 was spent on addressing the ramifications of the McDowell court decision, which in brief, transferred from ADF&G to the Service the responsibility for subsistence management on federal lands.

A sampler of our involvement with subsistence: WB Bodkin and WB Johnson attended the Middle Yukon Fish and Game Advisory Committee meeting in Galena on February 17 and discussed results of the Koyukuk moose census completed in the fall of 1989. WB Bertram and ARMP Spindler attended the Koyukuk Fish and Game Advisory Committee meeting in Hughes on February 24 and 25. Presentations were made on results of the Kanuti and Koyukuk moose censuses and the proposed prescribed burns planned for the summer of 1990. ARM Liedberg and WB Bertram attended the Ruby Fish and Game Advisory Committee meeting on March 13. The board supported liberalization of black bear harvest regulations, including baiting and season length, and an increased take of the Western Arctic Caribou Herd. The committee also voted to support a decrease in length of both sport and subsistence moose seasons in the Nowitna area. Spindler, DeMatteo, Bertram, and H. Johnson represented the Service at K'eelough Dohootaa' (Hurry up and get started!) the Athabascan Values conference held in Galena April 27-30. Most of the speeches about native cultural ties to the land were very informative. ARMP Spindler attended the Subsistence regulation review panel meeting in Fairbanks on May 14. No major changes were proposed. A few minor adjustments were discussed but deferred beyond the interim regulation process. ARM Liedberg attended a Subsistence meeting at Alyeska, June 14-15. RM Stearns attended the Interior Regional Council meeting in October. Spindler attended the Middle Yukon Advisory Committee meeting in Galena on December 12. A permanent solution to the Western

Huslia elder and leader Steven Attla builds sleds from local birch wood. Steven subsistence traps, hunts, and fishes. The village of Huslia has one of the highest per capita consumption of wild fish and game in Alaska.

Fishweels on the Yukon River are operated for a commercial chum salmon roe fishery in July and September and a king salmon fishery in June. Galena was the site of an organizational meeting for the Yukon River Drainage Fisherman's Association in December 1990.

Education Specialist Heather Johnson made a display of Earth Day at the Galena School.

Wildlife Biologist Mark Bertram presented an environmental education talk at Kaltag. Area schools are very receptive to guest presentations and demonstrations.

meeting in Galena on December 12. A permanent solution to the Western Arctic Caribou Herd harvest west of the Galena-Huslia trail was proposed but later over-turned by the R.O.

Three Federal Subsistence meetings were held in the region in October: Galena, Tanana, and Kaltag. These meetings were conducted jointly by refuge staff and the Federal Subsistence Staff to gather input on the existing public involvement process and current regulations. At the request of the Regional Office, comments were prepared regarding the effectiveness of the Fish and Game Advisory Committee and Regional Council system for input to subsistence management. We recommended utilizing the existing structure to the fullest extent possible. One of the limiting factors is that there simply are not enough qualified leaders and spokespersons from each village to have two separate Advisory Committees. Comments were also prepared on the temporary subsistence regulations.

6. Interpretive Exhibits/Demonstration

Volunteer Heather Johnson set up an Earth Week and Waterfowl Population/Spring Hunting display in the Galena School Library. She also worked with elementary teachers to make a litter control poster.

7. Other Interpretive Programs

Assistant Manager Liedberg and FMO Granger attended a meeting in Fairbanks on 17 January to outline goals for the "Teach About Wildfire" meeting. Hopefully, "Teach About Wildfire" material will be available prior to the 1991 fire season. In July refuge volunteer Heather Johnson was selected by the Regional Office ERI program to work as an Education Specialist. In August she and refuge Biological Technician Pamela Nelson began working on curriculum materials for "Teach About Fire." Heather is a former Outdoor Rec. Planner, and Pam is a former bush teacher. A draft curriculum should be ready in August. The refuge was pleased to provide support for these individuals since the project is very timely and will be an important follow-up after such a record fire season.

Refuge staff presented Wildlife Week and Earth Week activities to regional schools during the week of April 23-27. A total of 16 programs were presented in seven villages. In most locations a K-3, and 4-6 presentation was given. In Galena separate K, 1-2 and 4-6 programs were given. In Huslia and Kaltag a 7-12 presentation was also made. In Nulato 6-7 and 7-12 presentations were made. The programs were well received and we were pleased to find out that several villages are planning recycling drives.

Mark Air has agreed to transport aluminum cans from the villages to Anchorage free or at minimum cost.

Educational games, prize buttons, displays, and a newsletter were presented by the refuge staff at the second annual Koyukon Jamboree in Galena in October. The games were a solid hit with over 30 kids visting our booth and almost that many adults. We also had lots of dialogue that surely will help understanding of items such as waterfowl identification, habitat, and radio telemetry. Prizes given to the winnning kids were a newly designed and manufactured refuge button, complete with a unique wildlife logo.

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, 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.

A large portion of the refuge including most of the Koyukuk River corridor is contained within a controlled use area established by the State 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 1990. Only one guide has been issued permits over the last few years and he was inactive in 1990 because he felt permit conditions were too restrictive. The entire system of allocation of guide use areas was being reviewed by the Alaska legislature. Our part in helping with this effort included mapping potential guide/outfitter use areas on and near the refuges in cooperation with the ADF&G Area Game Biologist. The information from land managers, the State biologists, and other interest groups was to be compiled by the Anchorage ADF&G office. Were it not for major changes in subsistence managment due to the McDowell decision, we would probably be looking at a system of state-permitted guiding areas with periodic lease renewal periods.

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 ADF&G 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 the Western Arctic caribou left about March 1. WB Johnson met with Galena Air Force Base Commander Albers, ADFG Area Biologist Osborne, and Alaska Fish and Wildlife Protection Officer Piepgras to discuss Air Force participation in the hunt.

Tanana Chief's Conference (TCC) was contacted to assist us in making village contacts to determine this year's moose harvest. Usually the officially reported harvest to ADF&G is much below actual harvest because most village residents do not send in their harvest reports. As it turns out an estimated 1,316 moose were harvested on or near the three refuges. The Koyukuk and Nowitna hunter check station data will increase this figure by 150-200. This represents a total harvest of about 1500 moose from a population of about 13,000, or about 11.5%.

Hunter Check Station

ADF&G Area Game Biologist Tim Osborne has conducted a hunter check station on the Koyukuk River just south of the refuge boundary since 1983. Because the entire Koyukuk River within the Refuge boundary is part of a controlled use area barring aircraft access for moose hunting, the check station provides a good source of harvest information for the majority of refuge hunters who gain access from the Yukon River. This includes many of the local residents and virtually all hunters who do not reside in the local area. This year the Alaska Department of Fish and Game included in their regulations a requirement for hunters to stop and report to personnel at the check station.

Hunters checked 183 moose (177 bulls and 6 cows) through the station this year. This compares to totals of 158 moose and 181 moose in 1989 and 1988, respectively. There has been, however, a substantial increase in the number of non-local hunters in recent years (Table 19). Of the 306 hunters, 137 were local game management unit (GMU) 21D residents, 133 were non-local state residents, and 36 were out of state residents. The breakdown of GMU moose hunter residency is given in Table 20. Although the increased hunting pressure is probably not currently affecting growth of the moose population, a moose management plan is being considered to address future management considerations.

Table 19. Number of moose hunters by residency class checked through the Koyukuk River Check Station[1].

Year	Non-Local	Non-Res.	Unit Res.	Total Hunters
1983	29	3	132[2]	164
1984	67	9	92[2]	168
1985	74	4	117[2]	195
1986	80	9	140[2]	229
1987	92	21	151	264
1988	121	17	158	299
1989	125	23	154	302
1990	133	36	137	306

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

[2] includes every trip made by hunter

Table 20. Number of moose hunters from local villages (Unit Residents) checked through the Koyukuk River Check Station, 1987-1990.

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

*Most Huslia hunters do not pass thru the check station, but hunt near the village.

One transporter (K2) was permitted to fly clients into the Koyukuk - primarily for moose hunting. He had not submitted a report on the number of clients transported by years end.

Wolf Hunting

Wolf hunting in the complex is done both with the use of snowmachines and airplanes. The season runs from August 10 through April 30 with a hunting limit of 10 wolves. Most wolf hunting with the use of aircraft 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 "land-and-shoot" hunting possible.

Aerial hunting of wolves was historically done as a state sanctioned population control method or as a legal sport hunting method. This activity is under the 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 forest 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 method (illegal) is the use of snow machines to "run down" the wolves just before they are shot. This traditional method was proposed to become a legal method by several villages and two advisory committees. The number of wolves taken with the use of aircraft in 1990, legal or illegal, is not known; however, some illegal activity is suspected (see H.7). Total wolf harvest by hunting is estimated to be between 30 and 50 per year.

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 21. These figures provide a conservative estimate of harvest since some skins, especially beaver, 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. When disputes do occur; however, 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 although a few trappers still use dogs for transportation on their lines. Some trappers use airplanes for access and a few simply walk their traplines. 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. Some are run over or run down (illegally) with snow machines.

Table 21 Furbearer harvest on the Koyukuk NWR and Northern Unit of the Innoko NWR (Kaiyuh Flats) during the 1989-90 trapping season.[1]

Area	Species				
	Beaver	Lynx	Otter	Wolf	Wolverine
Kaiyuh Flats	88	3	0	4	0
Koyukuk-Kateel	0	0	0	3	0
Lower Koyukuk	2	0	0	0	0
Koyukuk Island North	9	0	0	2	0
Nikolai	21	0	0	2	0
Bear Creek	22	0	0	1	0
Huslia West	12	2	1	0	0
Huslia East	104	2	1	1	2
TOTALS	258	7	2	13	2

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

17. Law Enforcement

The Complex had no more than two commissioned refuge officers at any time during 1990. With the departure of manager Nunn in February, WB Johnson gained the dubious distinction of being the only federal law enforcement officer in town. With the arrival of RM Stearns in July our contingent returned to two. All officers attended required training sessions; refresher at Marana, Arizona in March and handgun requalification in Fairbanks.

The revised closed season migratory bird enforcement policy was reviewed by all staff and implemented appropriately for this region. Meetings and/or informal visits were conducted in Huslia, Hughes, Kaltag, Nulato, Koyukuk,

and Ruby. Posters were placed in conspicuous public places and handouts were distributed during the visits. The effort was a positive experience with most folks understanding the plight of the birds and agreeing that local people should do their part to help. A 10 minute radio program on the subject was recorded on April 20th and was aired by KIYU at least five times during the latter half of the month. Spindler and Liedberg met with Game Board member Sidney Huntington to discuss the Closed Season Policy and other refuge management matters. Efforts to monitor spring waterfowl harvest were undertaken near Huslia at the end of April when WB Johnson and WB Bertram spent the 3 days and two nights camped in a bird hunting area. Probably the greatest harvest in the region occurred near Huslia.

Throughout the year opportunistic patrols were made in conjunction with other field activities. One case involving possible violations of the Airborne Hunting Act occurred while refuge personnel were capturing and collaring wolves. The incident was reported to Special Agents in Fairbanks and is still under investigation. WB Johnson assisted Trooper John Harmon in investigation of wanton waste of caribou 30 miles west of Nulato. He also assisted Special Agent Mark Webb and Trooper John Harmon with carrying out a search warrant in Galena in connection with a pending aerial wolf hunting case. In December refuge staff met with SRA Crane, SA's Webb and Eicher to discuss the Airborne Hunting Act provisions. We decided to work cooperatively on a news release to educate the public about the legal means of take.

WB Johnson inspected a tree cutting site in the Koyukuk Wilderness Area during the summer. It turned out to be an individual gone astray from an adjacent allotment who was cutting house logs. The "concept" of Special Use Permits was discussed and no citation was issued. A defense of life and property bear killing at a fishing guide's camp on the Kaiyuh Flats Unit was investigated by WB Bodkin and Pilot Brown on August 29. The matter was referred to ADF&G, Galena.

During the moose season we worked in close cooperation with the new Alaska Fish and Wildlife Protection Officer Ken Piepgras. Several cases, one involving wanton waste and cows taken during a bull only season were investigated. Considering the large numbers of hunters in the complex during this period, the season was largely uneventful.

18. Cooperating Associations

During December the Alaska Natural History Association Outlet for Galena was approved for operation and will be started in 1991.

I. EQUIPMENT AND FACILITIES

1. New Construction

The Complex headquarters offices received a much needed sidewalk in September. In addition, outside electrical outlets were installed along the building and sidewalk for hook-up of vehicle heaters during the winter. Spruce trees were also planted in the front yard to "spruce up" the appearance and two small storage sheds were moved to the equipment yard. The "new look" is much more appealing. We are still short of shop space, office space, and winter storage for our trucks and planes.

Gravel was hauled to the fuel tank site at the floatpond, and the access drive to the floatpond was widened. A bulk AV-Gas storage tank was installed at the floatplane dock in Galena and two AV-Gas tanks have been ordered to be placed in Ruby and Huslia.

3. Major Maintenance

The obstacles one must overcome to maintain a refuge in such a cold dominated region of Alaska is almost mind boggling and, at times, very frustrating. Almost six weeks of -40 to -60 degree weather at the beginning of the year wreaked major havoc on all of the vehicles, heating systems and the sewer and water systems at the office and bunkhouse. The last two years the pipes beneath the office froze and in February 1990 the refuge spent $8,000 getting them thawed and repaired. Currently, we're installing electrical heating tape inside the sewer lines to prevent further freezing. Because of the freezing problem caused by permafrost-rich soils, the City of Galena does not have a piped sewer and water system. Water and sewer trucks fill and empty holding tanks from within each quarters on a weekly basis at a cost that averages $300-$400 per month per quarters.

The cold is very destructive to vehicles as well. Since all of our vehicles are parked outside, tires blow out, belts break, oil gels, shocks discharge, plastic breaks (a major component of all new vehicles) and batteries freeze despite being plugged in nightly. If a vehicle can make it to 40,000 miles it's used up!

Sensaphones have been placed in all quarters and on several occasions have called us in the middle of the night to notify us that the temperature was low. This advance warning of pending doom has saved the refuge a considerable amount of money, allowing for early repairs or standby heat to prevent freeze-ups. Each quarters has been outfitted with a 3,500 watt

standby generator that can power the furnace, as well as an oil-fired space heater.

Contractors painted the interiors of all six quarters during the year. Everyone agrees that white walls are much more appealing than the previous drab yellow. We continue to experience numerous maintenance problems and design flaws with all six quarters but all in all, they make living in Galena much easier.

The field season proved to be very hard on the riverboats. Outboards on both riverboats quit enroute to Ruby on the same day. Fortunately this was near the end of summer after most of the field work had been completed. The 200 HP motor on the Nowitna riverboat (SS Equivalent) required major engine repair which prompted us to go ahead and transfer the boat to Togiak NWR. The original acquisition was for a boat "Equivalent" to the Koyukuk's flat bottomed river boat that former RM Nunn designed after consultation with local boat builders. What the Nowitna received was an enormous V-hulled ocean-going boat with 200 hp outboard motor that was a gas hog and always broken at the most inopportune times. On top of that, the boat was so heavy and drafted so much water that it was practically useless. Hopefully the "Equivalent" will be better suited for the deep ocean waters near Togiak than on the shallow Yukon River. The jet-boat was sent into Fairbanks for engine repairs, new control panels
and a new canopy and arrived back in Galena by summer's end.

The Koyukuk-Hog River and Lower Nowitna Administrative cabins received several days of badly needed clean-up and fix-up work.

4. Equipment Utilization and Replacement

Nowitna's Chevy Suburban (1980) was sold to the highest bidder ($1,000) early in the year and was replaced with a Chevy Crew Cab Pickup. Also, several items (mostly old appliances) that had been "sitting around" for quite some time were sold by sealed bids to local residents. As previously mentioned, the Equivalent was transferred to Togiak NWR.

Contacts are under way for local supply of a hanger, storage, and repair building. Hopefully, we can work out an inexpensive arrangement with a local vendor.

Refuge aircraft N4343, a super cub, is used for observation, wildlife surveys, radio tracking, and patrols. A Cessna 185 is used for personnel transport, logistics, and surveys. The station pilots flew over 1,250 hours in 1990. In addition we had close to 100 hours of charter aircraft use. During summer staggered shifts for the pilots make optional use of our aircraft.

A bulk aviation fuel storage tank and pump was installed at Alexander Lake, the Galena floatplane pond and winter ski-strip. We also added electrical plug-ins and new gravel to the access drive.

Who designed this one? Actually the new sidewalk at the headquarters office was poured properly. We added a non-slip steel grate stairway for safety. We also added electrical plug-ins for vehicle heating around the office and along the parking area.

The service has spent over $250,000 on radio systems for Koyukuk and Nowitna Refuges and after 4 years of work, we were still without a radio system that worked even 50% of the time. Storms damaged the antennas on Totson Peak, and ice accumulated over the solar panels, allowing batteries to discharge, break, and leak. A radio technician in March 1991 said we should start over. In the meantime, we went back to using HF - signal sideband.

5. Communications

A new phone system was installed in the office which seems to be smarter than we are, for initially we didn't even know how to answer it. We're slowly getting up to speed. Learning to program the system was quite complicated. Another drawback is that since we didn't purchase it from the local vendor (Interior Telephone Co.) they won't service it! For the sake of saving a few dollars on the initial purchase we'll end up paying thousands of dollars during the useful life of the system to have someone from Anchorage or Fairbanks fly to Galena to repair the phones.

The refuge radio system is working no better than in previous years and still needs revision. Maintenance costs are high. We had to pay for three helicopter trips to do the needed maintenance work in 1990. To save money initially, cheap low quality radios were installed in the BLM site on Totson Mtn. We used their antenna towers, solar panels, and batteries, all of which failed in 1990. This represents over $10,000 of helicopter time that if wisely spent on high quality radios and batteries, could reduce maintenance trips from three times a year to once a year. We are planning on re-building the Totson site in 1991 to include independent shelter, antennas, solar panels and batteries. Hopefully we will be able to afford better quality radios to go in the site.

6. Computer Systems

Two AST 386 (IBM compatible) computers were purchased during 1990 bringing the office computer total to ten. A HP Laser printer was also purchased, along with Bitstream Fontware. Software packages now in use include DBASE III & IV, WORD PERFECT 50 & 51, SYSTAT, MYSTAT, LOTUS 1-2-3, BITCOM and SIGMA PLOT. It seems like we spend more time behind these computers than in the field! We have a feeling this is the norm instead of an exception. Whatever happened to down in the muck, grit in your teeth, field work?

8. Other

The Complex uses two aircraft extensively in our operations: A Cessna 185 N714KH, primarily for logistics and crew transport; and a Piper PA-18 Super Cub, N4343, primarily for aerial surveys and short field work. With all the additional field work this year we began looking for a third aircraft. Moose census, wolf collaring, moose collaring, brood-surveys, vegetation sampling, the furbearers study, subsistence supervision, fire management, and other administrative tasks have all required another ship. In the past we have borrowed cubs, chartered cubs, 185's and 206's and

attempted to lease another plane. All of these arrangements helped but were less than desirable. We are looking for another arrangement.

We obtained approval to mount an aerial ignition device (ping pong ball machine) in N714KH. The setup should allow us to ignite prescribed burns using the C-185 instead of a helicopter, which would be much more convenient and cost considerably less.

The floatplane dock was installed but is in need of repair. It is scheduled for replacement in 1991. The City of Galena has done two things which render Alexander Lake, our floatpond, dangerous. The first item is to put a new power line 10-15 ft. higher then the old one at one end of the lake. Also, to add to the problems the city crews have pumped water out of the lake for several days to compact fill at the new power house. This reduced the usable length of this pond even more. We are attempting to mitigate both problems. The long-term solution is to work with the airport planners to ensure that a new floatpond is built when the airport is reconstructed in the next 20 years. We are also working to obtain rental hangar space until one can be constructed. New grounding cables and fire extinguishers were ordered by Pilot Brown for our aircraft fueling system at Alexander Lake.

The problems we have had with aircraft maintenance (see section E.6) in 1990, including one engine change, two cylinder changes, two magneto changes, and three forced landings, all due to mechanical difficulties, make this staff question OAS maintenance standards. Our aircraft were much more trouble-free 2-3 years ago--what has happened? Have the aircraft aged or have top standards been lowered.

J. OTHER ITEMS

4. Credits

Sections F and I were written by FMO Granger. Section G. was coauthored by WB Bertram and WB Johnson. Section H8, H10, and H17 were written by WB Johnson. Sections A, B, C, E, and the remainder of H were written by ARMP Spindler. RM Stearns wrote Sections D and K. Spindler and Stearns edited the report. Secretaries Honea and Williams typed, proofed, and helped finalize and assemble the report.

5. Literature Cited

This section includes articles and papers the staff have published during the year.

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K. FEEDBACK

The Year 1990 continued the education of Alaskan refuge staffs in the "new" eons old phenomenon - "subsistence". Notwithstanding that in 1980 the law laid out the related guidance, some viewed this "new" regional program as a way to expand FWS influence at the expense of public support for resource management programs. In the bush regulations of any kind, even simple ones, are slow to be understood by local people and even slower to be translated into compliance. The prospect of two or maybe three sets of harvest regulations on refuge lands causes many " Maylox Moments." Add to this the prospect of a highly polarized "professional" wildlife management community and new Self Determination Act players and we have all the ingredients for a very challenging time. It is our hope the final outcome of all this will be responsive to the law and more importantly stay within resource limitations. In the scramble to be "legal" and maintain regulatory integrity it seems prudent in the long run to not forget who the major players in all this are: resource users; They must support, understand, and comply with the regulatory outcome. The KIS system is not without value! To be 100% legally correct without compliance or public support is a questionable goal.

On a more positive note, the maturation of the Interagency Fire Management Plans and their implementation is at hand. During the hot, fiery summer of 1990 Interior Alaska had lots of fire, lots of limited action fire suppression and in our Complex essentially no controversy concerning "our" smoke or the minor property losses. This system is saving taxpayers millions of dollars in suppression costs on these natural and largely beneficial events. It has taken almost ten years to reach this point in "our" thinking. Hopefully the road ahead does not hold many potholes to derail this well run and accepted program!

ANNUAL NARRATIVE REPORT

1990

NOWITNA NATIONAL WILDLIFE REFUGE

Galena, Alaska

REVIEW AND APPROVALS

F. Dan Stearns 4/29/91

Complex Manager Date Associate Manager Date

Regional Office Approval Date

NOWITNA NATIONAL WILDLIFE REFUGE

The mouth of the Nowitna River, where it meets the Yukon River, with the Kokrines Hill in the background. The Nowitna River is the centerpiece of the refuge and extends 223 miles across the refuge.

The Nowitna Canyon water is a gentle (Class I-II) run through rounded hills about halfway between the headwaters and the mouth. Formally travelled by gold prospectors, it is now used as a travel corridor for trappers, moose hunters, and a few river floaters.

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INTRODUCTION

The Nowitna National Wildlife Refuge was created on December 2, 1980 with passage of the Alaska National Interest Lands Conservation Act. Purposes of the refuge 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 wildlife 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, a Piper Super Cub and a Cessna 185, as well as a several riverboats and snowmobiles provide transportation for the staff. Refuge headquarters are located in Galena, a village of approximately 1000 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, therefore items common to both refuges are presented in detail under the Koyukuk report.

A. HIGHLIGHTS

A study to determine the effects of fire on furbearers and their habitats in Interior Alaska, long proposed and awaited by several agencies, was funded by the Regional Office and assigned to the Koyukuk/Nowitna Complex. The first year of field work will begin on the Nowitna NWR in spring 1991. So far the study has produced a literature survey including a computerized bibliography that will eventually be published.

An estimated 17,549 ducklings were produced on the refuge in 1990, which was similar to the 1988 production and represented a recovery of the flood-affected minimal production in 1989.

A study to determine the relationships of wolf home range and predation study in areas of known prey density was initiated in 1990. A total of 20 wolves in 8 packs were collared.

B. CLIMATIC CONDITIONS

Specific climatological recordings for the Nowitna NWR area are not taken. Refer to the Koyukuk section for general conditions in the Galena area.

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 in the Nowitna NWR. Even though the ranking process was mandated by Congress, at present there are no acquisition funds designated for the Nowitna NWR.

A. PLANNING

1. Master Plan

The CCP (Master Plan) was written in 1986 and is due for revision but will be 1992 before it is started. The subsistence issue will prompt critical review of this document.

2. Management Plan

At the direction of the Associate Manager, the Complex has drafted an operational plan for the next 5 years.

5. Research and Investigations

The following are a summary and brief description of approved refuge studies.

The relationship of wildfire to furbearers and their habitats in Interior Alaska.

This study will determine the response of marten, lynx, and small mammals to differing stages of habitat succession following wildfire. This project was originally proposed by Ted Bailey of Kenai NWR and was to be undertaken in cooperation with Yukon Flats NWR. The study was transferred to this station in August 1990 because of the high staff interest and existence of an ideal study site. The project was assigned to Wildlife Biologist Walter Johnson, who had submitted the following two furbearer study proposals in 1989: a) Numerical response of marten to prey availability and their implications to analysis of annual harvest statistics in the Nowitna NWR; and b) Movement patterns and dispersal of marten and their implication to analysis of annual harvest statistics on the Nowitna NWR. These detailed project proposals will be revised to include the fire work, and a lynx and small mammal proposal will also be written. The work will be coordinated with other Alaska NWR's, notably Tetlin and Kanuti, as well as ADFG, USFS, UAF.

Seasonal Movements and Home 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 the Spring of 1990. Primary objectives of the study are to determine pack sizes, location, home ranges, and general age class of three wolf packs on the Nowitna Refuge, determine seasonal habitat use, and

develop an estimate of wolf/prey ratios in an area of known prey density. Results from this year 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, however, 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 are 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. Results of this study can be found in section G.8.

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

Several volunteers served the refuge in 1990. Heather Johnson assisted with Environmental Education, public information, and Nowitna moose hunter check station duties. She organized and presented several school programs, coordinated the Galena Nature trail cleanup, and assisted with other refuge field work. Kevin Lynch assisted in operation of the moose check station and the moose census on the Nowitna. Alice Stearns assisted at the moose check station and "other duties as assigned". Anne cain helped build an equipment storage shed at the lower Nowitna Administrative Cabin.

5. Funding

Even though Koyukuk and Nowitna refuges were complexed in August 1989, the budgets were kept separate in FY90. The budget for Nowitna NWR is shown in Table 1.

Table 1. Nowitna National Wildlife Refuge Funding

Program	FY86	FY87	FY88	FY89	FY90
1230					10,000
1260	375,000	430,000	440,000		
1261				273,000	285,000
1262				190,000	165,500
8610	22,000	40,000	39,100	20,589	16,853
Totals	397,000	470,000	479,100	483,000	477,353

Funding for the Nowitna has been stable, which allowed the staff to perform needed administrative and maintenance work around the office and bunkhouse as well as continue important wildlife inventories and studies, and initiate a few others.

6. Safety

Refer to the Koyukuk section of this report.

7. Technical Assistance

Refer to the Koyukuk section of this report

8. Other Items

Administration and monitoring of Special Use Permits has become an increasingly significant duty on this station. The complex issued a total of 13 permits in 1990, including seven on the Nowitna NWR. It takes a considerable amount of time to research a permit application and make necessary compatibility and subsistence determinations. Sometimes a trapping cabin permit applicant will try to get the refuge manager to resolve or mediate a trapline conflict. Finally after the permit is issued, it is important to monitor the activity to ensure that the special conditions on the permit have been complied with. This latter aspect has taken an increasing amount of time and effort.

Permits issued on Nowitna:

2/7/90 Ron Inlow	House Logs
2/7/90 John Quirk	House Logs
2/7/90 Stan Gurtler	House Logs
2/26/90 Mark Freshwaters	Trapping Cabin
4/4/90 Tundra Air	Air Taxi
6/5/90 Denali West Lodge	Guided float trip
8/6/90 Denali Hunt Consultants	Air Taxi

The Mark Freshwaters permit and subsequent correspondence has taken considerable time in 1990. ARMP Spindler, ARM Liedberg and RM Stearns have met with the applicant at his cabin and in Ruby, and discussed several issues. Permitted cabin size, additions, shared cabin permits, neighboring trappers, and multiple cabins per trapline were discussed. In February a permit was issued to Mark to construct a 16 x 20 ft. addition onto his existing pre-ANILCA trapping cabin along the Nowitna River. This resulted from his appeal to the Regional Director and State legislator John Binkley regarding cabin size restrictions and additions. The new Cabin Policy with the 200 ft^2 cabin size limit is perceived by Mark and others as too restrictive for professional/subsistence trappers, but may be adequate for part time or amateur trappers. We are concerned about the density of trappers and permitted cabins along the lower Nowitna River corridor. There is plenty of area available away from the river, however, poorer access make these areas less desirable.

The resource impact of Air Taxi Special Use Permits is also of concern. On all three units managed out of the Galena office the single most common permit category (5 of 14) in 1990 was for Air Taxi. Of the Air Taxi operators, the primary (99%) use is transport of fly-in moose hunters. A few rare air taxi trips are for other purposes, e.g. for a river floaters, etc. We issue the Air Taxi permits as per policy, almost routinely, yet they are one of the main factors in determining moose harvest on the refuges. A future Public Use Management Plan may have to be written to plan allocation of Air Taxi permits or limitation on numbers of clients for hunting.

F. HABITAT MANAGEMENT

1. General

The Nowitna NWR is characteristic of Interior Alaska. A majority of refuge lands are forested and belong to three major plant associations. Extensive bottomland spruce poplar forests are found along the Nowitna River drainages, and to a lesser extent, along smaller streams and tributaries. This type 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, and resin and dwarf birch. Sedges, rushes, and cottongrass, as well as mosses and lichens, are also present. The largest plant association on the refuge is the lowland spruce-hardwood forest. This community 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.

Table 2. Habitat types derived from LANDSAT, Nowitna NWR.

Habitat Type	Acreage	PerCent
Forest	1,735,847	84.1
Scrub (willows, poplar & alder)	132,881	6.5
Dwarf Scrub (sedge tussocks, blueberry, Ledum, and dwarf birch)	58,881	2.9
Herbaceous (grasses - includes bogs and grass lakes)	47,063	2.3
Scarcely Vegetated (floodplains and scree)	1,765	0.1
Water	62,528	3.1
Unclassified (shadow)	20,109	1.0

2. Wetlands

The principal rivers on the refuge include the Yukon, Nowitna, Sulatna, Big Mud, Little Mud and Grand Creek. Most of these rivers carry a heavy sediment load. The Yukon 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. Its most notable characteristic is its meandering, which 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 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 has grown dramatically in the past decade, stimulated by the lifting of Federal restrictions on gold prices in the early 1970's. In 1983, more than 300 placer mines were in operation throughout the state, producing an estimated 169,000 ounces of gold. Because large amounts of overburden were removed to reach the gold in alluvia, frequently active streams were used to wash the site. This technique makes placer mining a major source of aquatic and riparian habitat destruction in Alaska.

Although most placer mining activities are taking place outside refuge boundaries, the impacts on refuge lands are significant due to the large amounts of sediment transported downstream into the refuge. Studies of placer mining impacts on downstream sites elsewhere in Alaska have demonstrated adverse effects on biological productivity such as fish abundance, growth, and reproduction. It is reasonable to assume heavy metals and sediment impacts may be occurring on the refuge. In fact, results of samples collected in 1987 indicate that northern pike from the Sulukna River immediately above the confluence with the Nowitna River contained elevated mercury concentrations (See Koyukuk, Wetlands)

A plan to remove an estimated 200 empty and partially full fuel drums was submitted to the Northern Alaska Ecological Services office in February.

The plan was to pay cooperators $50.00 for each barrel returned to Ruby. By summer's end, 110 barrels had been removed from the refuge. The program worked quite well considering we couldn't send a crew out, locate all of the barrels and haul them back to Ruby for less than what was paid out in "bounties". To alleviate future problems, signs were ordered to be placed at the moose hunter check station. If accumulations of barrels continue, a special regulation may be needed.

3. Forest

The Nowitna is unusual among Alaskan refuges in that over 80% of it is 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. However, approximately 36% of the refuge is dominated by black spruce. The primary use by local residents of this timber is for house logs and firewood, although small commercial sawmills have operated in Tanana, Ruby and Galena. Most of the highest quality timber on the refuge grows along the Nowitna River, whose Wild River designation precludes commercial timbering. Local interest in commercial logging operations on the islands in the Yukon has been expressed. This activity is addressed in the Nowitna Comprehensive Conservation Plan for the refuge which does not allow commercial timber harvesting.

9. Fire Management

Unlike the extreme burning conditions experienced on the Koyukuk, the Nowitna had an average fire season in 1990. Three fires burned approximately 3000 acres. The first fire was reported on June 25 and the last fire was declared out on July 26 (See Koyukuk, Section F.9., Tables 2-3). Because of local weather patterns, wildfires occur less frequently and usually burn smaller acreages on the Nowitna when compared to the remainder of Alaska's Interior.

All of the lands within the Nowitna NWR are covered by the Alaska Interagency Fire Management Plan (Tanana/Minchumina Planning Area). The plan was completed in 1982 and is subject to annual revision.

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 but this is a far bigger project than the present staff can handle. A full time position is needed for this work to be done correctly.

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 that has a few remote homesteads.) The Nowitna is a beautiful river which is accessible to the general public only by boat or airplane. A management plan, soon to be written, 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 birds, 20 fishes and 1 amphibian are known to occur on or near the refuge. See Appendix A for a listing of species occurring or thought to occur on the refuge.

2. Endangered Species

Although not seen in 1990, the peregrine falcon regularly occurs here. Suitable nesting areas have been located on the refuge along water courses.

3. Waterfowl

Wetlands within the Nowitna and Yukon river floodplain support large numbers of waterfowl. Principal duck species include American wigeon, northern pintail, mallard, green-winged teal, white-winged scoter, common and Barrow's goldeneye, and lesser scaup. Other breeding ducks include northern shoveler, red-breasted merganser, greater scaup, canvasback, 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 occur along the rivers during the spring and fall migrations. Waterfowl inventories conducted on the Nowitna NWR in 1990 included duck production and spring breeding surveys, goose production, and swan production surveys.

Duck production was up in 1990, matching levels observed in 1988 and greatly exceeding the poor production observed in 1989. We estimate that 3,199 broods totalling 17,549 young ducklings were produced on the refuge in 1990. Wigeon were the most abundant dabbler, followed by green winged teal, pintail, shoveler, and mallard. Pictured above is a shoveler hen.

Young great horned owls along the bank of the Nowitna River. Great horned owls are common in the riparian forests of the river corridor.

Weather Conditions and Waterfowl Migration Chronology

Break-up on the Nowitna River in 1990 occurred sometime during late April or early May. Flooding was minimal and by mid-May all but the largest lakes were ice free. As a result of favorable breakup conditions waterfowl nesters fared well in 1990.

Duck Production Survey

Waterfowl brood surveys have been conducted on the refuge each year since 1983. Sampling scheme and methods have varied from year to year in an attempt to produce the most precise production estimate. In 1987, a systematic brood survey was introduced which divided waterfowl habitat into five geographic strata. In 1988, helicopters were first used to survey inaccessible parts of the refuge and two separate brood surveys were conducted. In 1989, only one survey was conducted in an attempt to sample peak dabbler and diver production periods while minimizing effort. Several major changes were made to waterfowl inventory design again in 1990 to include the statewide production survey method. (See the Koyukuk Refuge waterfowl section for a more detailed description of the new approach.) According to the new statewide methods, the Nowitna Refuge was placed in the Tanana-Kuskokwim Unit or Production Unit 3 (See Koyukuk, Fig. 3).

The same stratification technique used by the Koyukuk Refuge was adopted by the Nowitna Refuge in 1990. Color infra-red photos were used to classify waterfowl habitat into three strata of expected waterfowl density - low, medium, or high - based on the amount of water and the presence or absence of bog habitat. A random selection of waterbodies was made in each stratum using optimal allocation (Table 3). Over 50% of the refuge was classified non-habitat (1,775 mi^2), the remaining 1,497 mi^2 was classified as habitat and stratified as follows: low density stratum - 1,403 mi^2, medium density stratum - 76 mi^2, and the high density stratum - 18 mi^2. The totals of 6, 14, and 18 plots sampled from the low, medium, and high density strata, respectively, included a total of 99 waterbodies.

A Cessna 185 and Piper PA-18, both equipped with floats, and a 16 foot river boat with a 50 hp. engine, 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.

Table 3. Strata size and sampling effort for waterfowl production surveys, Nowitna NWR, Alaska-1990.

Stratum sampled	Size (mi^2)	mi^2 sampled	% stratum
Low	1,403	6	<1%
Medium	76	14	18%
High	18	18	100%
Total	1,497	38	3%

Three hundred and seventeen broods were observed during waterfowl production surveys between July 10-14 (Table 4). Dabbling duck broods accounted for 80% of the observations. As in past years the most commonly observed dabbler brood was American wigeon and the principal diving duck species was scaup. Average brood size for most dabblers and diver species exceeded 1989 refuge figures and 1990 statewide averages. It should be noted that production in 1989 was below average due to heavy spring flooding. Mean dabbler and diver brood sizes as well as the total production estimate were more comparable to 1988 figures when spring flooding had a negligible effect on production.

There was an estimated 3,199 duck broods produced on the refuge in 1990 (Table 5). The coefficient of variation (or CV = variation relative to the means of the sample) for this estimate was 0.39. Brood estimates were highest for American wigeon (n=1,005, CV=0.33), surf scoter (n=483, CV=0.97), bufflehead (n=393, CV=1.00), and green-winged teal (n=318, CV=0.74). Estimated broods for dabblers were 1,994 (CV=0.32) and for divers 718 (CV=0.87).

The total production estimate for all species in 1990 was 17,549 ducklings (Table 6). Production estimates were highest for American wigeon (5,071), surf scoter (2,936), scaup spp. (2,174), green-winged teal (1,567), and mallard (1,430). Dabbler production was estimated at 10,016 and diver production at 5,230. Relative abundance in 1990 of dabbler

broods was similar to that recorded during annual production surveys from 1983-89.

Table 4. Number, average brood size, and age distribution of observed broods, Nowitna NWR, Alaska-1990.

Species State	Class 1		Class 2		Class 3		Broody	Total	Total	1990
	N	Size	N	Size	N	Size	Hens	Broods	Avg.Size	Avg.Size
Wigeon	67	5.1	16	4.8	0	0.0	28	111	5.0	4.8
G-W Teal	23	5.3	14	4.4	0	0.0	8	45	4.9	4.2
N. Pintail	7	5.7	13	3.9	4	4.0	8	32	4.5	4.4
N. Shoveler	4	6.9	9	6.1	0	0.0	13	29	6.4	4.6
Mallard	18	4.4	7	5.4	1	2.0	11	37	4.6	4.5
DABBLERS	122	5.2	59	4.8	5	3.5	68	254	5.0	4.5
Canvasback	0	0.0	1	6.0	0	0.0	0	1	6.0	5.6
Scaup spp.	27	7.6	0	0.0	0	0.0	0	27	7.7	6.2
Ring-necked	5	6.8	0	0.0	0	0.0	0	5	6.8	5.2
Goldeneye spp.	6	8.2	2	6.0	0	0.0	0	8	7.6	5.7
Bufflehead	1	4.0	2	3.0	0	0.0	0	3	3.0	4.5
Redhead	3	7.0	0	0.0	0	0.0	0	3	7.0	11.0
DIVERS	42	7.4	5	4.9	0	0.0	0	47	7.3	5.6
Surf Scoter	13	6.1	0	0.0	0	0.0	0	13	6.1	5.2
Unknown	2	5.3	1	5.9	1	2.0	0	4[a]	4.3	3.7
TOTALS	179	5.8	65	4.8	6	3.2	68	317	5.5	4.7

[a] Total includes broods of unidentified species and age class

Table 5. Estimated broods by age class with coefficient of variation, Nowitna NWR, Alaska-1990.

Species	Class (C.V)			Broody Hens	Total Broods
	1	2	3		
Wigeon	187 (0.30)	723 (0.43)	0 (0.00)	94 (0.58)	1,005 (0.33)
G-W Teal	45 (0.33)	260 (0.90)	0 (0.00)	12 (0.52)	318 (0.74)
N. Pintail	25 (0.52)	26 (0.40)	243 (0.96)	12 (0.52)	307 (0.77)
N. Shoveler	16 (0.73)	18 (0.64)	0 (0.00)	22 (0.64)	56 (0.39)
Mallard	40 (0.34)	244 (0.96)	1 (1.00)	24 (0.39)	310 (0.76)
DABBLERS	313 (0.25)	1,272 (0.44)	244 (0.96)	165 (0.39)	1,994 (0.32)
Canvasback	0 (0.00)	1 (1.00)	0 (0.00)	0 (0.00)	1 (1.00)
Scaup spp.	282 (0.83)	0 (0.00)	0 (0.00)	0 (0.00)	282 (0.83)
Ring-necked	9 (0.66)	0 (0.00)	0 (0.00)	0 (0.00)	9 (0.66)
Goldeneye spp.	19 (0.62)	6 (0.86)	0 (0.00)	0 (0.00)	26 (0.49)
Bufflehead	1 (1.00)	392 (1.00)	0 (0.00)	0 (0.00)	393 (1.00)
Redhead	7 (0.75)	0 (0.00)	0 (0.00)	0 (0.00)	7 (0.75)
DIVERS	319 (0.74)	399 (0.98)	0 (0.00)	0 (0.00)	718 (0.87)
Surf Scoter	483 (0.97)	0 (0.00)	0 (0.00)	0 (0.00)	483 (0.97)
Unknown	2 (0.78)	1 (0.85)	1 (1.00)	0 (0.00)	4 (0.63)
TOTALS	1,117 (0.44)	1,672 (0.51)	245 (0.95)	165 (0.39)	3,199 (0.39)

Direct statistical comparisons are not possible between 1990 and previous years because of the different sampling scheme initiated in 1990 but overall trends are apparent. Production has certainly rebounded from the low production total of 4,209 documented in 1989. Estimated production of 17,549 in 1990 appears comparable to 1988 (17,140) and 1987 (15,823).

When scheduling only one survey in 1990 it was our intent to survey the bulk of the class two dabbler ducklings and the majority of the class one divers. Over 68% of ducklings observed in 1990 were class one while 30% of observed ducklings were class two. Diver age class one composition was 93%. Although surveys were initiated at about the same time as in previous years (Approximately July 10), nesting chronology was apparently late in 1990 and we started about a week too early.

Table 6. Number and age distribution of observed young and estimated young production, Nowitna NWR, Alaska-1990.

	Class									Estimated Young[1]		
Species	1A	1B	1C	2A	2B	2C	3	Total	% of Total	1990	1989	1988
Wigeon	44	135	164	50	25	2	0	420	30.84	5,071	1,427	4,720
G-W Teal	26	58	37	36	20	5	0	182	13.36	1,567	108	2,424
N. Pintail	5	19	16	21	15	14	14	104	7.64	1,364	153	2,623
N. Shoveler	9	11	28	26	24	5	0	103	7.56	358	354	716
Mallard	25	22	34	10	11	17	2	121	8.88	1,430	205	3,204
DABBLERS	109	245	279	143	95	43	16	930	68.28	10,016	2,247	13,687
Canvasback	0	0	0	6	0	0	0	6	.44	6	0	9
Scaup spp.	115	90	0	0	0	0	0	205	15.05	2,174	859	1,977
Ring-necked	34	0	0	0	0	0	0	34	2.50	64	0	0
Goldeneye sp	0	14	35	5	7	0	0	61	4.48	196	240	637
Bufflehead	0	4	0	5	0	0	0	9	.66	1,178	40	553
Redhead	12	9	0	0	0	0	0	21	1.54	52	151	35
DIVERS	161	117	35	16	7	0	0	336	24.67	5,230	1,290	3,211
W.W. Scoter	0	0	0	0	0	0	0	0	0	0	140	0
Surf Scoter	30	43	6	0	0	0	0	79	5.80	2,936	10	163
Black Scoter	0	0	0	0	0	0	0	0	0	0	0	3
Unknown	1	6	1	0	1	6	2	17	1.25	16	522	76
TOTALS	301	411	321	159	103	49	18	1,362	100.00	17,549	4,209	17,140

[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.

Table 7. Estimated broods with coefficient of variation and estimated young production by stratum for waterfowl production surveys, Nowitna NWR, Alaska-1990.

Stratum/ Species	Estimated Broods	Coefficient of Variation	Estimated Young
Low			
Dabblers	1,403	0.45	5,144
Divers	626	1.00	2,503
Sea ducks	468	1.00	2,806
Unident.	0	0.00	0
Total	2,496	0.49	10,485
Medium			
Dabblers	421	0.32	1,837
Divers	60	0.55	440
Sea ducks	5	1.00	33
Unident.	0	0.00	0
Total	486	0.33	2,372
High			
Dabblers	170	0.31	921
Divers	33	0.49	247
Sea ducks	10	0.57	61
Unident.	4	0.63	16
Total	217	0.25	1,264
Total All Strata			
Dabblers	1,994	0.32	10,016
Divers	718	0.87	5,230
Sea ducks	483	0.97	2,936
Unident.	4	0.63	16
Total	3,199	0.39	17,549

In 1990 the estimated dabbler brood coefficient of variation (CV) was 0.32, the diver CV was 0.87. Table 7 displays the amount of variation contributed by each stratum to the overall coefficient of variation and the estimated number of young per stratum. Much of the variation in dabbler and diver broods observed can be attributed to the low density stratum; the CV was 0.45 in dabblers and 1.00 in divers. Because the low density stratum contains over 1,400 mi^2 of habitat (94% of available waterfowl habitat) and less than 1% of the stratum was sampled, the variation observed in this stratum was weighted heavily in determining overall variation in broods. We will increase our sampling of the low density stratum in 1991 with the intent of reducing variation in this stratum.

Costs for the production surveys are summarized in Table 8.

Table 8. Summary of cost and effort for the waterfowl production surveys, Nowitna NWR, Alaska-1990.

Aircraft	Hours	Hourly Charges	Fuel	Total Cost
		(@$234.00/hr)	($33/hr)	
C-185 (Charter)	22.59	4,838.54	745.47	5,583.94
		($52/hr)	($18/hr)	
PA-18	19.70	1,024.40	354.60	1,379.00
subtotal	42.29	5,862.94	1,100.07	6,962.94
Effort (13 different personnel and 33 person days)				
Personnel costs (includes salary, overtime, and benefits)				4,149.32

Goose Production

A sixty mile stretch of the upper Nowitna River within the refuge was surveyed by canoe from June 26-28 to assess goose production in this area and to record observations of other wildlife. All geese observed were tallied and recorded by species, sex, and age-class when possible. One

hundred eighty-five adult and 182 gosling Canada geese and 41 adult and 108 gosling white-fronted geese were observed (Table 9). Age class estimates were difficult to make because of the evasive action of the broods once encountered but all broods were class 1. Most brood observations were class 1B.

Table 9. Observations of geese, upper Nowitna River, Nowitna NWR, 26-28 June 1990, Alaska.

		Age Class Young			Unid.
Species	Adult	1A	1B	1C	1
Canada Geese	185		39	12	57
White-Fronted Geese	41	5	35	8	134
Total Geese	226	5	74	20	191

To survey goose production in past years, a mix of both aerial and float surveys of the Nowitna River have been conducted. A July 1988 float from the refuge boundary to the mouth included 281 geese, of which 207 were Canada's, indicating higher densities in 1990 since only the upper portion was floated. In fall 1990 groups totalling over a thousand Canada geese were seen in mid-September, apparently using the Nowitna corridor as a migration stop. Interestingly, spring aerial surveys of the river corridor in 1986-88 produced a majority of white-fronted geese (range, 273-323).

Swan Production

A swan census of the entire refuge was conducted in August 1990 by refuge staff using standardized methods. The survey was the refuge's contribution to the five-year statewide trumpeter swan survey that was coordinated by the Migratory Birds office in Juneau. On the Nowitna a clear majority of swans identified to species have been found to be trumpeter swans, although tundra swans occur very infrequently (Loranger and Lons 1987). A total of 292 swans, including 76 juveniles, was counted on 19 USGS quadrangle maps during the census. Analysis of seven trend maps surveyed over the past five years indicated that the adult population has increased, and that production in 1990 was lower than the record year of 1988, but higher than 1985 and 1987 (Figures 1 & 2).

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. Eight red-necked grebe broods, and one common loon brood were observed during the 1990 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 are being conducted to assess population distribution or status of the species.

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, peregrine falcon, and snowy owl. Swainson's hawks and gyrfalcons are occasional visitors. No active assessment program is underway for these species.

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 belted kingfisher and downy and hairy woodpeckers.

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

Trumpeter swans have been surveyed on the refuge since 1985, and the population of breeding pairs has increased steadily. In 1990 production dropped from 1989 levels. A total of 292 swans, including 76 cygnets, were counted on the first survey of the entire refuge, completed in August 1990.

The fire/furbearer study was initiated in August 1990 with a literature review and detailed study planning. In September the plywood floor of the base camp at Round Lake was painted to weatherproof it and ready it for winter use. Marten collaring was scheduled to begin at Round Lake in March 1991.

Refuge staff again 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. Incidental observations by refuge personnel and reports from trappers indicate that the refuge snowshoe hare population is increasing.

Moose

Moose are present throughout the refuge, their highest densities occurring along the lower Nowitna river drainage. The refuge moose population is an important subsistence resource for local residents and an important recreational resource for non-local Alaskans. Moose hunting during September represents the greatest portion of the refuge's public use.

In 1980, 1986, and 1990 censuses were conducted on the refuge to estimate the total moose numbers and the sex and age composition. In addition, since 1980 annual surveys of trend areas have been conducted to assess the relative abundance and demographics of the population.

A telemetry study to determine the extent, timing, and causes of mortality in calves was initiated in the spring of 1988. Additional objectives of this study were: 1) to determine the relative importance of various sources of moose calf mortality, including predation, disease/malnutrition, and accidents; 2) to assess the effects of varying snow conditions on overwinter survival of refuge calves; and 3) to determine habitat use, movements, and seasonal distribution of calf-cow pairs.

A. Moose Census

In 1980, 1986, and 1990 the entire refuge was censused to describe the distribution, abundance, and demographics of the Nowitna moose population. These surveys were based on standardized techniques and procedures described by Gasaway et al. (1986). In 1980, 1982, 1983, and 1985 through 1990 aerial trend surveys were used to describe relative abundance and composition of the herd. The quantity of habitat surveyed in the annual trend area surveys varied from year to year and was dependent upon survey conditions (primarily snow cover). A

comprehensive analysis of the 1990 census and trend information collected since 1980 was completed, and a report entitled "1990 Moose Census--Lower Nowitna and Sulatna River Drainages" was drafted by WB Mark Bertram. The following is a summary from that report.

The 1990 moose census was conducted November 15-28 and was a cooperative effort by the U.S. Fish and Wildlife Service and the Alaska Department of Fish and Game. Snow cover was complete, however, weather conditions were less than ideal for most of the survey. Temperatures ranged from 20^0 to -50^0 F. Low ceilings and poor visibility grounded survey crews four of the first eight days of the census. Following this period of low pressure systems, temperatures plummeted and extremely cold weather again interrupted surveys.

The study area (Figure 3) encompassed 2,700 mi^2 and is approximately 55 miles east and 65 miles south of Ruby, Alaska. It included two study units, the Nowitna/Sulatna Rivers Unit and the Lower Nowitna River Subunit, a subset of the former. The Lower Nowitna River Subunit included mainly the west half of the Nowitna National Wildlife Refuge. The remaining discussion will deal solely with the Lower Nowitna River Subunit, which is entirely within the refuge.

Nearly 53% of the study area (821.8 mi^2) was stratified low density and included 67 sample units. The medium density stratum contained 34% of the study area (533.0 mi^2) and included 41 sample units. Over 13% of the study area (205.4 mi^2) was classified high density and contained 16 sample units (Table 10).

Four hundred and forty-four moose were observed during the standard survey (Table 11). Average density of observed moose for all strata was 0.70 moose per mi^2. Within strata, moose density averaged 0.14 moose/mi^2 in the low, 0.84 moose/mi^2 in the medium, and 2.58 moose/mi^2 in the high density stratum. Sightability correction flights were flown in 15 of 25 sample units in all three strata. Nine additional moose were observed during intensive searches for a sightability correction factor estimate of 1.15.

The 1990 moose population estimate, corrected for sightability, for the Lower Nowitna River Subunit was 1,262 +/- 18% at the 90% confidence level (CL) (Table 12). The 1980 and 1986 estimates for the same unit were 1,390 +/- 27% and 783 +/- 24% at the 90% CL, respectively.

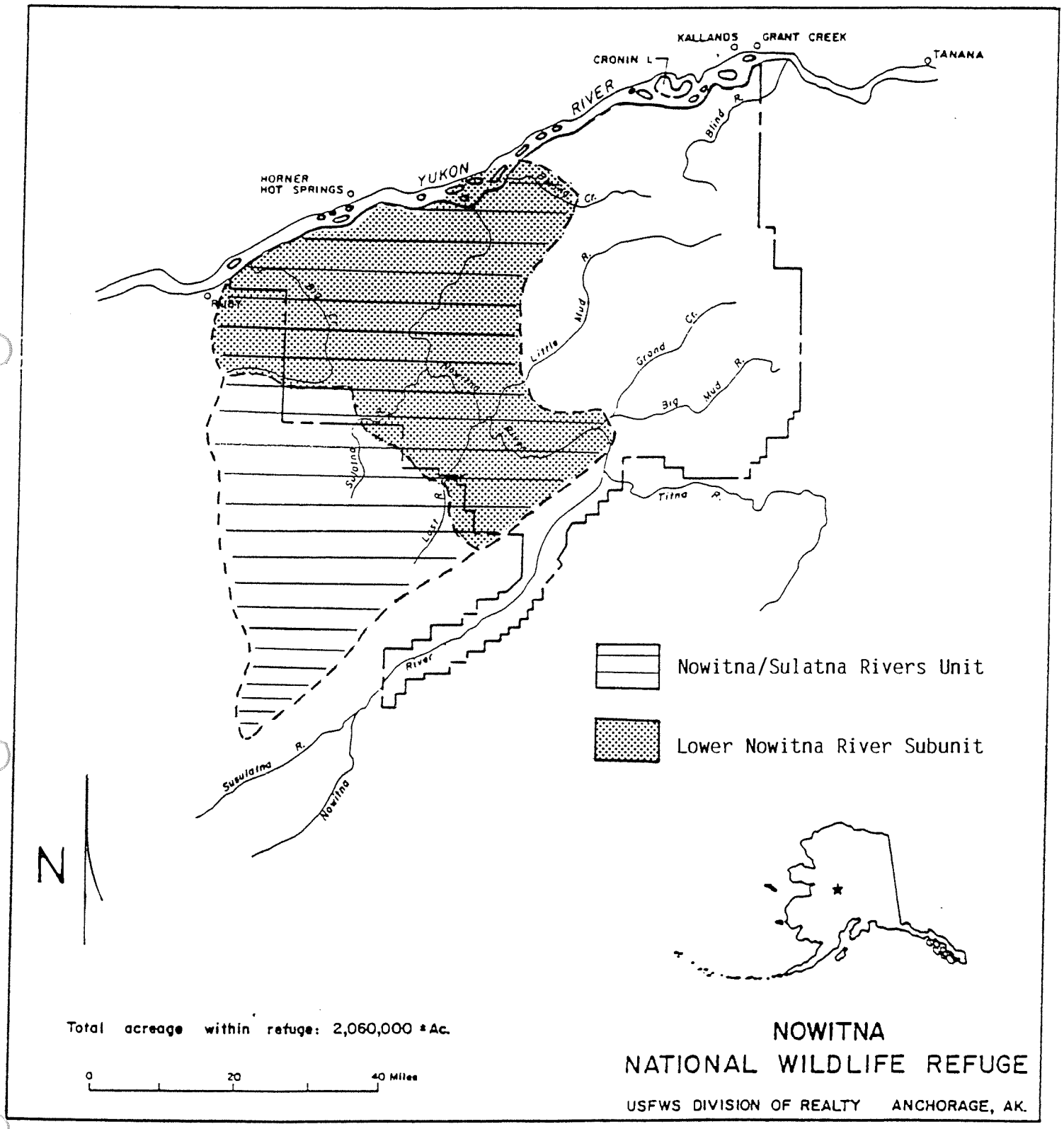


Figure 3. Location of moose census units surveyed in 1990.

Table 10. Stratification results, sampling effort, and average search intensity, by stratum, during 1980, 1986, and 1990 aerial surveys of the Lower Nowitna River Subunit, Alaska.

Year/ Stratum	Total S.U.	S.U. Surveyed	Total Area(mi^2)	Area Surveyed	Search Intensity[2] (min./$mi.^2$)
1980					
Low	42	9	531.0	112.5	
Medium	56	11	712.9	133.1	
High	23	7	312.1	86.2	
Total	121	27	1,556.0	331.8	
1986					
Low	82	6	1,018.8	78.6	2.72
Medium	35	17	448.5	225.8	4.22
High	7	7	88.7	88.7	4.98
Total	124	30	1,556.0	393.1	
1990					
Low	67	6	821.8	73.1	4.62
Medium	41	9	533.0	114.8	5.86
High	16	10	205.4	130.5	4.87
Total	124	25	1,560.2	318.4	

Table 11. Observed and estimated numbers of moose and average density, by stratum, during 1980, 1986, and 1990 aerial surveys of the Lower Nowitna River Subunit, Alaska.

Year/ Stratum	# Moose Observed[1]	Stratum Estimate[2]	Average Density (moose/mi^2)[3]
1980			
Low	28	132	0.25
Medium	97	525	0.74
High	149	539	1.73
Total	274		0.77
1986			
Low	2	29	0.03
Medium	219	446	0.97
High	191	191	2.15
Total	412		0.43
1990			
Low	10	112	0.14
Medium	97	450	0.84
High	337	530	2.58
Total	444		0.70

[1] Does not include additional moose observed during intensive SCF surveys.
[2] Indicates point estimate, does not include sightability correction factor.
[3] Average density = Total Moose Observed/Total Area Surveyed

Table 12. Moose population estimates from 1980, 1986, and 1990 aerial surveys of the Lower Nowitna River Subunit, Alaska.

Year	Observable Pop. Estimate	SCR[1]	Expanded Pop. Estimate[2]
1980	1,197	1.16	1,390 +/- 27%
1986	652	1.20	783 +/- 24%
1990	1,093	1.15	1,262 +/- 18%

[1] SCR = sightability correction factor [2] 90% Confidence Interval

A comparison of 1980 and 1986 surveys indicated a 7.4% annual (year to year) decrease while a 1986 and 1990 comparison indicated an 8% annual (year to year) increase. The annual increase from 1986 to present was further supported by trend survey information collected from 1987-90 which indicated an increase in total moose density from 2.0/mi^2 (1980-86) to 2.7/mi^2 (1987-90).

Sex and age composition data from population censuses in 1980, 1986, and 1990 for the Lower Nowitna River Subunit are presented in Table 13. Included in this table are comparison data from Koyukuk NWR trend surveys conducted at Three-Day-Slough from 1981-89. This information is included for comparison because it, like the Lower Nowitna River Subunit, contains a hunted moose population. Tables 14 and 15 compare herd density, composition, and age structure collected in annual trend surveys in the Lower Nowitna River Subunit since 1980. Interpretation of the trend survey data is difficult because of missing data (in 1981 and 1984) and sample size differences, but some general trends are evident. Similar patterns for some aspects of sex and age structure are exhibited in both the population censuses and annual trend surveys. Most inferences regarding the population status will be drawn from the more comprehensive population censuses conducted in 1980, 1986, and 1990.

Calf:adult cow ratios indicated adequate calf survival during the summers of all years except 1985. The 1990 calf component of 23% exceeded that of the Koyukuk Refuge (19%) which included a population that has been described as "vigorous and healthy" (Bodkin et al. 1990) (Table 13).

Table 13. Observed sex and age composition during 1980, 1986, and 1990 moose surveys of the Lower Nowitna River Subunit, Alaska, with included comparison to Koyukuk NWR moose surveys, 1987-89, Alaska.

		Lower Nowitna River			Koyukuk
		1980	1986	1990	1981-89[2]
Twins	: 100 adult cows	2	5	2	10
Calves	: 100 (all) cows	34	40	38	33
Calves	: 100 adult cows	39	42	41	37
Yrlg Male	: 100 adult cows	13	6	7	13
Yearlings	: 100 adult cows	25	13	14	25
Adult Bulls	: 100 adult cows	41	34	24	36
Large Bulls	: 100 adult cows	16	8	2	----
% Calves	in population	19	22	23	19
% Yearlings[1]	in population	12	7	8	13
% Adult Cows	in population	49	53	56	53
% Adult Bulls	in population	20	18	13	15
% Large Bulls	in population	8	8	1	11

[1] % Yearling males = % Yearlings/2

[2] Koyukuk data consists of mean values from 1981-89 November trend surveys of Three-Day-Slough.

Table 14. Observed moose density based on trend surveys of the Lower Nowitna River Subunit, 1980-90, Alaska.

Year	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
1981		No surveys conducted					
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
1984		No surveys conducted					
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
means	96	226	0.49	0.25	1.3	0.27	2.3

Table 15. Herd composition and adult age structure of the Lower Nowitna River Subunit, 1980-90, Alaska.

Year	Composition (% of herd) Ad. Bulls	Ad.Cows	Yrlgs	Calves	Adult Sex Ratio Bulls/100 Cows
1980	16	53	13	19	37
1981		No surveys conducted			
1982	8	57	21	12	28
1983	17	50	7	26	38
1984		No surveys conducted			
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	24
Means	12	56	11	21	28

A comparison of mean calf to yearling composition from the 1980-90 Nowitna trend data indicated a 10% annual loss of calves (21% to 11%). Mean annual losses on the Koyukuk NWR averaged 6% from 1981-89. This suggested that a 6% loss may not be limiting growth on the Koyukuk moose herd but what specific influence the 10% annual loss has on the Lower Nowitna River Subunit herd is unknown, although the population is growing.

The 1990 population census indicated yearling composition was 8%, a slight increase from 7% in 1986. Generally, yearling composition under 10% is not typical of high density moose populations in interior Alaska. Population census data suggests yearling composition in this subunit is indicative of a low density moose population. Trend data, however, indicated a 1990 and ten year average yearling component of 11%. Yearling composition data were further analyzed by comparing duplicate sample plot information (n=3) from 1986-90 annual trend surveys; this also indicated an 11% yearling component.

The bull:cow ratio has steadily decreased in each population census since 1980 (41:100 - 34:100 - 24:100); this compares to a 36:100 bull/cow ratio on the Koyukuk NWR (1981-89 data, Bodkin et al. 1990). The highest bull:cow ratio recorded in trend surveys was 40:100 in 1987; in the last three years it has averaged 24:100. Bull:cow ratios in this subunit are among the lowest recorded in interior Alaska in recent years. The percentage of adult males has also decreased in each population census (20%, 18%, 13% for 1980, 1986, and 1990, respectively). Only 1% of adult

bulls were identified as large (>50"). This is a significant decrease from 1986 estimates of 8%.

Table 16. Moose harvest for the Lower Nowitna River Subunit, 1990, Alaska.

	Pre-harvest population	1990 Harvest[1]	Harvest Mortality
All Moose	1262	56	4%
Yearling Male[2]	50	9	18%
Adult Male	164	42	26%
Unknown age		7	
Total (males only)	214	56	26%

[1] Based on 1990 hunter check station data of the Nowitna and Sulatna river drainages. Also note, that actual harvest is probably somewhat higher since check station data do not include hunters who flew in and boat hunters who failed to stop at check station.

[2] Yearling males were classified based on examination of cementum annuli of lower incisor.

Harvest on the Nowitna Refuge was 56 male moose in 1990 based on hunter check station data (Table 16). Actual harvest is estimated to be about 10% higher due to fly-in hunters and boat hunters who fail to stop at the check station (Osborne pers. comm. 1991). Based on 1990 population census figures and assuming little movement of adult bulls between hunting season and November surveys, this harvest represents a 4% population mortality, and a 26% mortality of the yearling and adult bull pre-hunt population (bulls available to harvest). A minimum of 18% mortality occurred in the yearling bull pre-hunt population and a 26% mortality to the adult bull pre-hunt population.

The sex and age structure of the Lower Nowitna River Subunit moose population describe a population that is slowly increasing. The recent population growth of this herd is likely explained by the increase in the abundance of females. However, further analysis depicts a population with low recruitment rates, low yearling and adult bull components, and a decreasing male proportion of the population. The structure of this population suggests a male and/or juvenile biased source of mortality.

The decline of the proportion of males in this herd is reason for concern, especially for subsistence and sport hunters utilizing the lower Nowitna drainage. If the percentage of harvestable yearling and adult males

continues to decrease it could reduce hunter success. To identify the causes of the decline of the male components of the Lower Nowitna River Subunit population we made the following recommendations:

1.) When fiscally possible, implement the study proposal entitled, "Extent, Causes, and Timing of Non-Calf Moose Mortality on the Koyukuk/Nowitna National Wildlife Refuges, Alaska." This study has been approved at the Regional level of the U.S. Fish and Wildlife Service and now awaits funding. Data collected from this study will supply much needed information on bull movement and availability to hunters during the hunting season. In addition this study, when combined with existing information on herd population structure, calf mortality, and annual hunter harvest, might be used to develop a population model to predict acceptable levels of annual human harvest.

2.) The current yearling bull moose harvest of 18% of the pre-hunt population may be high. By slightly reducing hunter harvest, bulls in the population may be allowed to recover. In 1990 the Unit 21B moose season for nonresident hunters was reduced by 5 days for just this reason, however, both yearling bull and overall moose harvest increased in 1990. We recommended shortening the season in Unit 21B from Sept. 5-25 to Sept. 5-20 for all hunters in 1991.

3.) Trend area surveys are valuable management tools and should continue to be conducted annually in the future. All plots sampled in previous years should be reexamined and a core selection of eight high density strata plots made. These eight plots should contain four plots from each of the two high density areas (the Yukon River and Lower Nowitna River) currently being sampled. In addition, four medium density plots should be sampled to enhance the ability to detect changes in the population since the 1986 decline in the moose population was not evident from trend information. These four plots should be selected from previous population census plots with a sampling history. Once the trend sample is stabilized and we are committed to doing the same ones each year, population analysis will not be limited to ratios and densities. Comprehensive population censuses should be scheduled every 10 years.

Table 17 outlines the costs to complete the census and Table 18 includes a summary of effort. Time and cost of preparation for the census is not included. This survey required five PA-18's, a Cessna 185, and 14 personnel. To reach the desired confidence interval of +/- 15% of the population estimate, over 20% of the land area within the Lower Nowitna River Subunit was sampled. Additional sampling would have been needed to attain the desired 15% confidence interval.

Table 17. Summary of cost for 1990 Nowitna Moose Census.

Aircraft	Hours	Hourly Charges	Fuel	Total Cost
PA-18:(includes survey and ferry time, $52/hr avail. $18/hr fuel)				
1364P	14.6	759.00	262.80	1,021.80
4343	25.5	1,326.00	459.00	1,785.00
N2497B	16.0	832.00	288.00	1,120.00
724	15.5	806.00	279.00	1,085.00
91251	35.9	1,866.80	646.20	2,513.00
C-185:(includes survey and ferry time, $75/hr avail. $33/hr fuel)				
714KH	20.4	1,530.00	673.20	2,203.20
total	127.9	7,119.80	2,608.20	9,728.00
Additional fuel charges				
barge fuel				963.00
barrel deposit				640.00
total				1,603.00
Additional transportation				
2 persons-Mark Air				84.00
1 person-Tanana Air				95.00
2 persons-Frontier				296.38
total				475.38
Room and Board (110 person days @ $50/day plus other services rendered)				6,081.50
Transportation (12 days @ $50/day)				600.00
Per diem expenses (3 people)				795.80
Subtotal				19,283.68
Subtotal without aircraft hourly costs				12,163.88
Personnel salary costs (only Koy/Novi staff, does include benefits*)				10,083.39
Grand total				29,367.47

* (Benefits include FICA, HEALTH, LIFE INSUR., FERS, THRIFT, CSR)

Table 18. Summary of effort for 1990 Nowitna Moose Census.

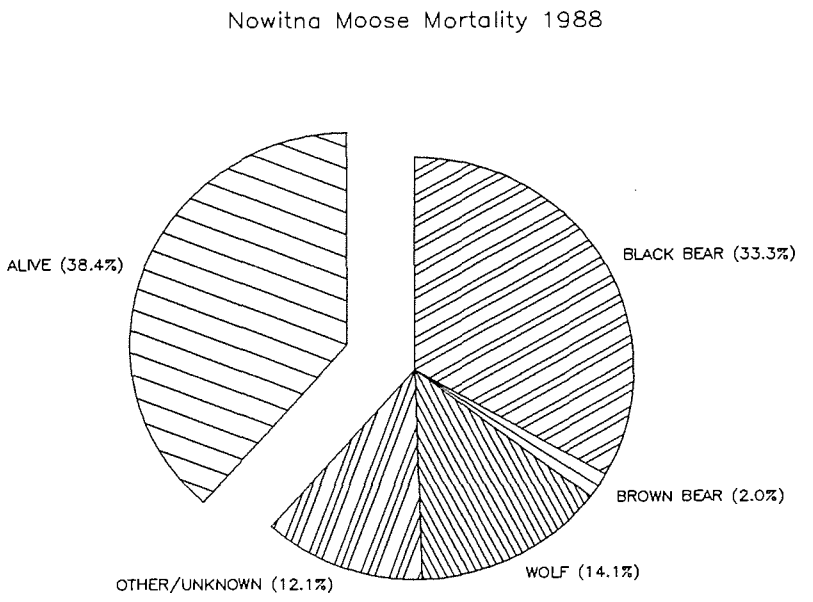
Total Area (mi^2)	2,700.8
Surveyed (mi^2)	446.2
Total Sample Units	221
Surveyed Sample Units	36
Hours to Stratify (Actual start/stop time = 14.1)	17.1
Hours to Survey	86
Person Days to Stratify	16
Person Days to Survey	36

B. Moose Calf Mortality

In response to the observed decline in the Nowitna moose population in 1986, the refuge initiated a 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. Studies of the dynamics of moose populations have described several factors capable of affecting moose abundance. Brown bears, back bears, and wolves have been identified as predators capable of limiting population growth. Human harvest has been identified as a source of mortality capable of limiting moose populations. Environmental conditions and habitat quality have also been identified as variables affecting moose populations (usually in the absence of large predators).

Results of this study from 1988-89 have identified high rates of calf mortality (62%-68%), principally attributable to black bear predation (Figure 4, Table 19). However, analysis of annual fall moose trend area data indicate that adequate numbers of calves (8 year average = 20% calves in the fall population) are entering the adult (non-calf) moose population. Expected annual rates of adult moose mortality, reported from 0.07 to 0.26 (Mytton and Keith 1981, Hauge and Keith 1981, Larsen et al. 1989 and Bangs et al. 1989), would suggest that calf mortality is not limiting growth in this population.

Several known sources of mortality are removing moose from the Nowitna population. Immediately upon parturition, predation (principally, black bear) begins removal of about 22%-28% during the first two weeks (Table 20). Overwinter mortality, principally by wolves, may remove an additional 10% of that years calf production. We presently have no data indicating a sex bias in calf mortality. Human harvest begins removing about 18% of



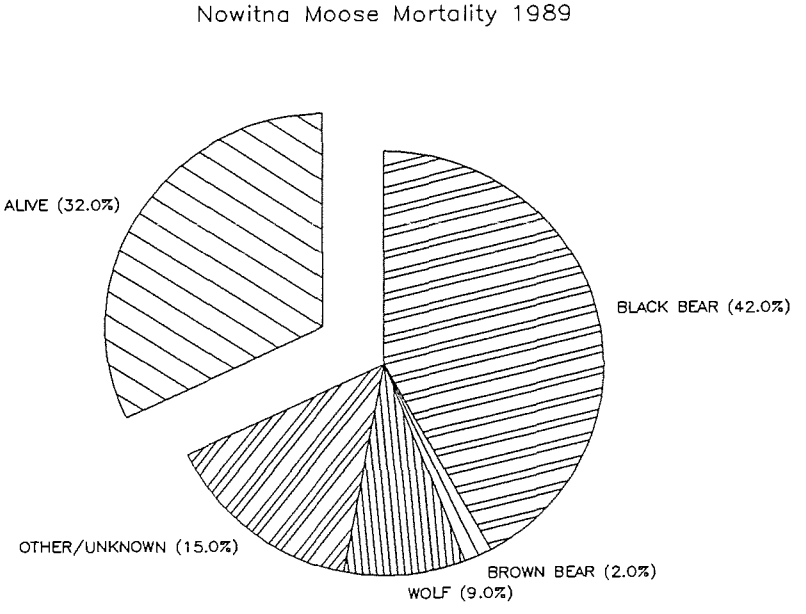


Figure 4. Mortality of radio-collared moose calves in 1988 and 1989.

the males out of that same cohort each year. Clearly, several mortality factors are acting in concert to reduce the size of each cohort to a level where population growth could be limited. The recent increase in the abundance of moose on the Nowitna Refuge can be explained only as a result of an increase in the abundance of females. Sources of non-human mortality in age classes other than calves have not been identified or quantified.

Table 21 provides preliminary estimates of annual survival. Overall survival was similar for both years. Male calves had a higher survival rate than females both years, but differences may not be significant (statistical tests not yet performed). Single calves had substantially higher survival than twin calves in 1989, although twins had slightly higher survival in 1990.

This study was amended in 1990, after the complexing of the two refuges, to include the Koyukuk Refuge in the study area. Annual moose surveys on both refuges indicated similar calf:cow ratios, signifying adequate reproduction on both refuges. However, sex and age composition data on the Koyukuk suggest a healthy growing population in all age classes. Preliminary results from calf mortality on the Koyukuk in 1990 indicate similar sources and patterns of mortality compared to the Nowitna. Calf mortality data collected from both refuges indicate calf mortality is not limiting population growth on the Nowitna Refuge. A source of male biased mortality may exist in the yearling male class.

Table 19. Causes of mortality for moose calves of known fate on the Nowitna (1988 and 1989) and Koyukuk National Wildlife Refuges, Alaska.

Mortality cause	1988 (n=42)[1]	1989 (n=47)	1990[2] (n=64)
Black bear	14 (33%)	20 (42%)	26 (41%)
Brown bear	1 (2%)	1 (2%)	3 (5%)
Wolf	6 (14%)	4 (9%)	3 (5%)
Unknown predator	2 (5%)	5 (11%)	5 (8%)
Drowning	2 (5%)	0 (0%)	1 (1%)
Unknown cause	1 (2%)	2 (4%)	1 (1%)
Total	26 (62%)	32 (68%)	39 (61%)

[1] Number of calves at start of each monitoring session is in parentheses beneath date.

[2] as of 1 February 1991.

Table 20. Annual survival estimates[1] for moose calves on the Nowitna NWR, Alaska, during 1988 and 1989. 95% confidence limits in brackets.

	1988	1989
All calves	0.34 [0.22, 0.52] n=35	0.29 [0.18, 0.45] n=45
Males	0.42 [0.25, 0.70] n=21	0.32 [0.16, 0.63] n=16
Females	0.23 [0.09, 0.62] n=14	0.26 [0.14, 0.49] n=29
Singles	0.27 [0.10, 0.73] n=14	0.56 [0.33, 0.93] n=12
Twins	0.35 [0.21, 0.58] n=28	0.20 [0.10, 0.39] n=35

[1] estimates derived from MICROMORT software (Heisley and Fuller 1985)

Table 21. Proportion of moose calves surviving to the end of three intervals during their first year of life on the Nowitna (1988 and 1989) and Koyukuk (1990) National Wildlife Refuges, Alaska.

	1988	1989	1990
collaring (birth) dates	22-26 May	21-30 May	21-25 May
calves collared	42	47	62
Interval	percent alive at end of interval		
I. 21 May - 1 June	78	72	68
II. 2 June - 10 July	60	38	44
III. 21 May - 11 July	38	30	39[1]

[1] as of 1 February 1991

B. Black Bear

Black bear densities on the refuge are believed to be high. They are commonly observed along rivers and in lowland areas. Black bears were the major predator on moose calves on the refuge, killing 34 of the 49

radio-collared calves in 1988-89. Of all losses due to predation, 83% were attributed to black bears.

Black bears are occasionally harvested in the spring and summer by local residents, especially in the vicinity of fish camps. Most harvest occurs in September, coincidentally with moose hunting.

C. Brown Bear

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, and salmon runs in 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 occurs during the summer months and during the September moose season. Alaska Fish and Game reported that no brown bears were legally harvested on the Nowitna during 1990.

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, shorttail weasel, coyote and wolf. All species are harvested by refuge trappers however marten and beaver are by far the most economically important. Arctic ground squirrels and least weasels, species trapped in other parts of Alaska, are present on the refuge but are not harvested by local trappers.

Fire/Furbearer Project

A broad-based investigation of lynx and marten ecology in interior Alaska was initiated this year on the refuge complex. Basic information regarding fire and furbearers is needed to adequately address the growing concerns of resource users and to better predict the results of management policies and actions involving fire. The purpose of the project is to provide baseline ecological data on marten and lynx habitat relationships, seasonal distribution and home range characteristics, population parameters, prey relationships, and to examine the relationships between wildfire and furbearer populations in interior Alaska.

The project encompasses several tasks and individual studies. An extensive literature review and development of a relationship model was contracted to Audrey Magoun, a furbearer consultant in Fairbanks, and should be completed by March 1991. Plans have been made to begin a marten study on the Nowitna Refuge in the spring of 1991. A companion study involving small mammals would be initiated during summer. Both studies would focus on two burns; one 35,000 acre - 6 year old burn and one 52,000 acre - 22 year old burn. Projects involving lynx are tentatively planned for the fall of 1991.

Marten

The Nowitna region is considered by many to be some of interior Alaska's premier marten habitat. Marten harvest on the refuge has ranged from approximately 500 to 1000 animals annually. As many as 18 trappers, most from Ruby and Tanana, have active traplines on the refuge, though not all may trap in a given year. Because there are no sealing requirements for marten in interior Alaska, only limited information is available on annual harvests. 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 animal. Trapper questionnaires are providing estimates of annual trapping effort. This information will be used in concert with ongoing marten studies 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.

Marten skulls from the 1989-90 harvest were purchased from four trappers who regularly trap on the refuge. One of the trappers used an airplane to access remote lakes and then 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 to attach a corresponding numbered tag to each marten skull. In addition, trappers were asked to complete a questionnaire at the end of the trapping season.

Initial aging of each skull was done using a field technique based on cranial muscle development (Magoun et al. 1988). The technique is still being refined but 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, Montana) for sectioning and age

determination by cementum analysis. Radiographs were used to identify juvenile animals prior to tooth sectioning.

Refuge trappers provided 294 skulls during the 1989-1990 trapping season. Trapline harvest among cooperating trappers ranged from 16 to 95 marten (Table 22). Trapper assessment of environmental conditions ranged from poor to excellent. Despite some extremely cold periods most trappers were able to run their lines throughout the entire season.

The age distributions of marten harvested during the 1989-90 season are presented in Table 23. The oldest animal caught was one 12 year old female which established a new record for Matson's Lab. It should be noted however that the accuracy of aging older marten is questionable. Juveniles accounted for most of the harvest (53%) and yearlings accounted for another 30%. The overall sex ratio (M:F) was 1.7 : 1 and trapline ratios ranged from 1.0 to 2.1 (Table 22). The ratio of juveniles to female > 2.5 years old was 12.8 : 1 and the ratio of juveniles to females > 1.5 years old was 3.6 : 1.

Table 22. Total number and sex-and age ratios of marten harvested by four trappers during the 1989-90 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	16	1.0	2.0	0.0	5.0	63
05	93	1.4	1.8	9.6	3.0	52
06	90	1.8	2.2	26.0	4.3	58
10	95	2.1	2.8	8.8	3.4	47
Combined Total	294	1.7	2.3	12.8	3.6	53

Table 23. Age distributions of marten harvested by four trappers during the 1989-90 trapping season, Nowitna NWR, Alaska.

Trapper Number	Age Class 0	1	2	3	4	5	6	7	8	9	10	11	12	13	Total
Males															
01	4	3	0	0	0	0	0	0	1	0	0	0	0	0	8
05	26	19	5	0	0	1	0	0	3	1	0	0	0	0	55
06	32	17	3	2	1	0	2	0	0	0	1	0	0	0	58
10	28	18	5	1	2	1	1	3	2	2	0	1	0	0	64
Total	90	57	13	3	3	2	3	3	6	3	1	1	0	0	185
Females															
01	6	2	0	0	0	0	0	0	0	0	0	0	0	0	8
05	22	11	4	0	0	1	0	0	0	0	0	0	0	0	38
06	20	10	0	1	0	0	0	0	0	0	0	0	1	0	32
10	18	8	0	1	0	1	2	1	0	0	0	0	0	0	31
Total	66	31	4	2	0	2	2	1	0	0	0	0	1	0	109
TOTAL	156	88	17	5	3	4	5	4	6	3	1	1	1	0	294

The use of sex and age ratios as indices of harvest intensity has been reviewed by Strickland and Douglas (1987). These investigators suggested that a harvest containing a low proportion of juveniles and a high proportion of adult females may be indicative of overharvest. Typically, the number juveniles harvested will be highest early in the season and then taper off. This was not the case on the Nowitna where the proportion of juveniles remained relatively high throughout the season (Table 24). The juveniles per female > 2.5 years old ratio of 12.8 in the Nowitna NWR 1989-90 sample seems to indicate that harvest intensity was not excessive during this period. However, these ratios are difficult to interpret without information on the fecundity rate for the same period. During the 1990-91 trapping season carcasses will be collected in connection with an on-going marten study. Reproductive information obtained from this effort will greatly enhance the interpretation of sex and age ratios.

Table 24. Sex and age distribution of marten harvest by month of capture by all trappers on the Nowitna NWR, 1989-90.

		Month of Capture			
		November	December	January	February
Juveniles (both sexes)	%	53	56	42	63
	n	(60/113)	(57/101)	(25/59)	(12/19)
Females ≥ 1.5 yrs	%	12	17	14	16
	n	(14/113)	(17/101)	(8/59)	(4/19)
Males ≥ 1.5 yrs	%	35	27	44	16
	n	(39/113)	(27/101)	(26/59)	(3/19)

Archibald and Jessup (1984) suggested that a harvest in which the sex ratio is nearly equal or dominant to females probably indicates overharvest. The sex ratio from the traplines in our sample was 1.7 males to 1 female. This is somewhat higher than last year and falls within the expected range for an exploited population (Loranger 1989). Given the observed age and sex ratios, the harvest intensity within the sampled areas is probably moderate.

Wolves

Aerial wolf surveys conducted on the Nowitna in 1985, 1987, 1988, and 1989 generated estimates ranging from 52 to 74 wolves in 6 to 9 packs. These estimates are believed to be conservative and we feel that the wolf population is either stable or increasing.

Because of limited time and higher priorities, a wolf survey was not completed on the Nowitna in 1990. During the normal survey period a wolf collaring project was initiated on the refuge complex (see Koyukuk Sect. G.10.). Presently, it appears as though we collared wolves from three packs previously identified as the Middle Nowitna/Sulatna, Lower Nowitna/Yukon, and Big Creek/Beaver Creek packs (Figure 5). Preliminary information suggests that the packs are more dynamic than expected. The continued collection of data over the winter should increase our knowledge of the spatial relationships of packs which will facilitate future survey work.

Beaver

Beaver populations in much of interior Alaska are presently high. They are common throughout the refuge; active beaver lodges were observed in the

Aerial wolf surveys have been conducted annually on the Nowitna since 1988. Under good tracking conditions packs can be located and counted. There are an estimated 80 wolves on the refuge.

A brown "grizzly" bear den located at the edge of the forest and alpine terrain. Grizzlies accounted for only 2% of moose calf predation on the Nowitna, but 5% on the Koyukuk.

majority of wetlands surveyed during the 1990 duck production survey. Beaver is an important source of fur and food for local resource users. Pelts sold for approximately $50 in 1989, and beaver meat is highly prized and is a welcome change from moose in the diet of local residents.

Wolverine

Relatively little is known about the status of the refuge wolverine population. They are occasionally harvested by refuge trappers but rarely seen. WB Johnson was fortunate enough to get a close look at a wolverine this spring as it swam across the Nowitna River.

Lynx, Mink, Red Fox, and River Otter

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

11. Fishery Resources

No field work was completed in 1990, however, contacts were made with the Fairbanks Fisheries office and budgetary planning began for baseline fisheries surveys. We provided logistical support to the Fairbanks Fisheries office as they sampled Yukon River salmon at the "Big Eddy" just north of the Refuge.

H. PUBLIC USE

1. General

The main public uses of the Nowitna Refuge are subsistence hunting, fishing, trapping, and gathering. This ranges from putting meat, fish, and berries on the table to cutting house logs and firewood. Sport hunting for moose is another major public use on the refuge, however, recreation uses are minor compared to subsistence.

6. Interpretive Exhibits/Demonstration

Refer to the Koyukuk section of this report.

7. Other Interpretive Programs

Refer to the Koyukuk section of this report.

8. Hunting

Subsistence and recreational hunting for moose in 1990 once again comprised a substantial portion of the Nowitna NWR's public use. The refuge is a popular hunting area for Fairbanks residents who access the refuge by boat or floatplane. Three air taxi operators were permitted to transport hunters to the Nowitna during the 1990 season. One of the operators (Tundra Air) transported five moose hunters who harvested four moose and one black bear.

A moose hunter check station at the mouth of the Nowitna River was operated again this year in cooperation with ADF&G Area Biologist Tim Osborne. The check station was staffed primarily by BT Tom Paragi and ADF&G local hire Kevin Lynch and was open from September 3-28. The majority of hunters accessing the refuge do so via boat on the Nowitna River and consequently the check station is a natural place to contact hunters and obtain harvest estimates. This summer a major effort was made to remove discarded fuel drums along the Nowitna River corridor and hunters were reminded on their way in to leave behind a clean camp.

A storm front brought clouds and high winds during the first week of the season but the rest of the month was generally clear and cool. Although, relatively dry during most of the month, water levels were high at the start of the season facilitating access to the upper Nowitna. Some moose hunters reported that bulls were not responding to calling until the latter part of the season. One hundred thirty hunters were tallied at the station and 54 bulls were checked (Table 25). Two cows were also taken (illegally) and a hunter involved in one of the incidents turned himself in. Most of the hunters came from the Fairbanks area (52%) and accounted for most of the harvest (Table 26).

Table 25. Nowitna NWR hunter check station data 1988-90.

	Harvest	#Hunters(Total)	Success rate	Parties
1988	56	178	31.1%	66
1989	49	234	21.0%	74
1990	54	130	42.0%	46

Table 26. Residency (N) and success (n) of moose hunters stopping at the Nowitna NWR hunter check station 1988 and 1990[1].

	Local Villages		Fairbanks		Other Resident		Non-resident		Unknown		Total	
	N	n	N	n	N	n	N	n	N	n	N	n
1988	33	9	103	40	14	5	11	5	9	0	178	56
1990	23	7	67	32	26	12	14	4	0	0	130	54

[1] residency data not available for 1989 hunt.

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, 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).

9. Fishing

Northern pike and sheefish are the most sought after non-anadromous species by recreational fishermen 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 do not allow easy contacts with refuge staff. 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 and provides an important source of supplemental income for many residents in the villages of Ruby and Tanana. The reported harvest of furbearers (sealing records) on the Nowitna is shown in Table 27. These figures provide a conservative estimate of harvest as some fur, especially beaver, is often kept for personal use or barter by some trappers. 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 of some sort. At least one trapper on the Nowitna uses an airplane to reach remote lakes and then traps their periphery. Most trappers use snowmobiles for transportation and a few occasionally use dog teams. Marten 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 examining several aspects of marten ecology and refuge trappers have been very cooperative in our efforts (see Sect. G.10).

Table 27. Furbearer harvest on the Nowitna NWR during the 1989-90 trapping season.[1]

	Species				
Area	Beaver	Lynx	Otter	Wolverine	Wolf
Deep Creek	20	0	0	0	0
Lower Nowitna	4	0	0	0	0
Boney Creek	0	1	0	0	0
Yukon-Blind River	0	0	0	1	1
Titna	12	5	0	0	0
TOTALS	36	6	0	1	1

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

The Palisades Bluff or "Boneyard" where pleistocene mammoth and other bones are washed out of an eroding bank of the Yukon River. In 1990 we investigated reports of individuals robbing fossil ivory and other items from the site, however, further surveillance will be required.

Most (51%) of the moose hunters using the Nowitna Refuge in 1990 were from Fairbanks, while 5% were from the local area.

17. Law Enforcement

A majority of the enforcement activities on the Nowitna were in coordination with the Koyukuk NWR and the Alaska Fish and Wildlife Protection Division (See Koyukuk, H.17). We have felt the hunter check station at the Nowitna mouth is best used by us to provide the using public with information and represents an opportunity for us to gather harvest information from the public. We therefore have minimized enforcement activities at the check station and have focussed enforcement activities on patrolling elsewhere on the refuge.

Shortly after breakup, WB Johnson and ARM Liedberg investigated a tip that someone was excavating fossilized ivory along a section of the Yukon know as the Palisades. This area, called the "Boneyard" by locals, is located within the Nowitna Refuge boundary and poses a reoccurring problem each spring as high water uncovers a seemingly perpetual supply of fossils. The site was visited a couple of times during the spring but no one was present. It will probably be difficult to apprehend anyone without a period of continued surveillance. We will be soliciting assistance from Law Enforcement/Fairbanks next year.

18. Cooperating Associations

Refer to the Koyukuk section of this report.

I. EQUIPMENT AND FACILITIES

1. New Construction

A snowmobile and equipment shed was constructed at the Lower Nowitna Administrative cabin. Some supplies were barged to the Nowitna Mouth, and the remainder sent by small boat from Galena. BT George Wholecheese and Volunteer Anne Cain did an excellent job assembling the 12 ft. by 12 ft. shed on a rainy long weekend in September. The shed will be used to safely and securely store flammable fuel containers, outboard motors, and snowmobiles. Hopefully the bears will have a harder time snacking on the plastic fuel jugs and snowmobile seats.

3. Major Maintenance

The field crew spent several days cleaning up and winterizing the Lower Nowitna River Administrative Cabin.

A single engine Dehavilland Otter was used to haul field supplies to the Nowitna Refuge. Oversize things like drums of jet fuel, sleds, and snowmobiles are easily hauled by this aircraft.

A helicopter used for capturing moose calves during the mortality study is being fueled by the pilot in Galena. ADF&G area biologist Tim Osborne looks on. Jet fuel cached out on the refuge by the otter is necessary during most collaring projects.

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 Systems

Refer to the Koyukuk section of this report.

8. Other

Refer to the Koyukuk section of this report.

J. OTHER ITEMS

4. Credits

Sections F and I were written by FMO Granger. Section G. was co-authored by WB Bertram and WB Johnson. Section H8, H10, and H17 were written by Johnson. Sections A, B, C, E, and H were written by ARMP Spindler. RM Stearns wrote Sections D and K. Spindler and Stearns edited the report. Secretaries Honea and Williams typed, proofed, and helped finalize and assemble the report.

K. FEEDBACK

Refer to the Koyukuk section of this report.