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A SURVEY FOR CLIFF NESTING BIRDS OF PREY
OF THE
NORTH FORK OF THE KOYUKUK RIVER
IN
GATES OF THE ARCTIC NATIONAL PARK AND PRESERVE
ALASKA

Compiled Field Notes of
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INTRODUCTION:

Gates of the Arctic National Park and Preserve was established in 1980, in part, "...to protect habitat for and populations of fish and wildlife, including...raptorial birds." (ANILCA; Public Law, 96-487; 1980). Through ANILCA, the National Park Service is designated as a primary agency responsible for maintaining natural and healthy populations of raptors within the Park.

In addition, the Gates of the Arctic General Management Plan/Land Protection Plan/ and Wilderness Suitability Review (1986), outlines management directives for research, protection and management of wildlife including birds of prey. Under this plan, objectives are listed for identifying critical areas for raptorial birds and "identifying and protecting threatened or endangered species" which includes the arctic peregrine falcon (Falco peregrinus tundrius). The arctic peregrine falcon is currently listed as federally threatened.

The peregrine falcon has been known to occur within Gates of the Arctic National Park and Preserve during the breeding season (Garber 1987, 1988a, 1988b; Kline and Brown 1986). A lack of documented breeding records of the peregrine falcon, and general lack of knowledge on the distribution and occurrence of all raptors occurring in the Park led to this survey. This survey was part of an on-going inventory of raptor populations in Gates of the Arctic National Park and Preserve.

This survey was the first ground survey conducted for raptors on the North Fork of the Koyukuk river. This area was chosen to assess it's suitability for conducting long-term monitoring of raptor populations in the southern half of the Park and Preserve. The North Fork was chosen since it is a typical representative of river valley habitats encountered on the south side of the Park and Preserve.

This North Fork is also one of the most accessible areas of the park, an important factor when surveying costs and future human impacts are considered. Since this area is easily accessible it is one of the more heavily used areas of the Park and Preserve. Concerns about adverse impacts from visitor use and possible disturbance to peregrine nest sites were also reasons for selecting this drainage as a monitoring area.

STUDY AREA:

The North Fork of the Koyukuk River begins in the northeastern section of the park (Figure 1.), and then runs south through the Endicott Mountains of the Brooks Range.

As the river winds southward, it passes through the "Gates of the Arctic"- a narrow valley between Boreal Mountain and Frigid Crags. At river mile 126/203km, the river joins the Middle Fork of the Koyukuk, and then exits the southern boundary of the park at river mile 138/221km. The river valley is approximately 1.6km (1 mile) wide at the headwaters of the river, widening to approximately 8km (5 miles) at the southern end of the mountains, just prior to exiting the park.

The Endicott mountains line both sides of the river valley, rising up to elevations of 2,446m (7,457'). The predominant rock substrate appears to be metamorphic. Most of the mountains in the valley had rock structure which appeared to be suitable for use by cliff nesting raptors. Our observations indicated that the most suitable rock structure (in the survey area) may occur from the Bombardment Creek area south to the "Gates".

The entire basin of the "North Fork" is north of the arctic circle and is at the northern limits of the tree line. We found that the flora and fauna are characteristic of sub-arctic and arctic alpine environments.

The upper reaches of the river, and the higher elevations of the river valley above 918m (2,800') are treeless. The primary habitat is alpine tundra, characterized by mats of various heathers Cassiope spp., Dyras spp. and tussock forming sedges including Eriophorum spp. and Carex spp.

From our starting point at Bombardment Creek (river mile 28/45km), throughout the remainder of the valley, the habitat is predominantly mixed deciduous/ coniferous forest. This habitat is characterized by white spruce Picea glauca and aspen Populus tremuloides. Dwarf woodlands are also represent a major habitat type and are characterized by dwarfed black spruce (P. mariana) interspersed with tussock grass Eriophorum spp., dwarf birch Betula nana and willows Salix spp. Open habitats of tundra/ tussocks/ wetlands and stands of willows also occur.

ROUTE/LOGISTICS:

We were dropped off by Piper Super-cub on 6 July 89 at the gravel airstrip located at the confluence of Bombardment creek and the North Fork of the Koyukuk river (See Figure 1.). We then surveyed cliffs on both sides of the river as we traveled down-river between camps. We continued the survey outside of the park until we reached our take-out site at Bettles.

The survey route covered approximately 134 river miles/ 215km. Approximately 15 river miles/ 24km of river was surveyed south of the park boundary, prior to reaching our take-out point at Bettles. Foot surveys from our base camps along the river covered an additional 39km (24 miles).

Table 1.
Summary of Route/Logistics:

<u>DATES</u>	<u>KILOMETERS FLOATED/ SURVEYED</u>	<u>CAMP</u>	<u>LOGISTICS</u>
6 July 89	0/0	1	Left GAAR ranger station and arrived at Bombardment creek at ~2100 after 2 loads of gear and Eben Paxton had arrived. Pilot Buster Points took the first load of gear in leaving at 1500. Chief ranger/pilot Bruce Collins took the second two loads of gear/personnel in.
7 July 89	2/0	1	Hiked north across river and returned to camp.
8 July 89	0/3	1/2	Packed up and moved to camp 2.
9 July 89	8/0	2	Hiked north and returned to camp.
10 July 89	12/0	2	Crossed river and hiked area south of camp, then headed east to Bombardment creek and then returned to camp 2.
11 July 89	0/12	2/3	Packed up and moved to camp 3.
12 July 89	0/0	3	Rained in
13 July 89	0/0	3	Rained in
14 July 89	0/0	3/4	Rain continues, move camp from our rapidly disappearing island and head downstream to escape the rain
15 July 89	2.4/21	3/4	Set up camp 4.
16 July 89	0/19	4/5	Move to camp 5
17 July 89	0/42	5/6	Move to camp 6
18 July 89	0/16	6	Set up camp 6; then return to Bettles

METHODS:

This is the first ground survey for raptors on the North Fork of the Koyukuk River. The survey was focused on locating cliff nesting raptors. The survey area was limited to cliffs within a day's hike of the main river valley. The area was surveyed by both foot and canoe.

Maps and aerial photographs of the proposed survey area were studied and a route was chosen which would transect what appeared to be suitable habitat for cliff nesting raptors. Sightings of possible nest structures contained in the GAAR nest record files (from past incidental observations and limited aerial surveys) were also taken into consideration when planning the survey route.

An overflight of the proposed route was conducted enroute to our drop off point. Areas with white-washing (excrement) and large patches of orange crustose lichens* were marked noted on a map. Areas which appeared to contain suitable cliff structure were also noted. Priority was given to cliff elevations below 1,312m (4,000'). The survey route was then modified to include areas of what appeared to be optimal habitat.

Cliffs which appeared to be suitable for nest sites were checked for raptor use. Binoculars and a 15-60 power spotting scope were used to identify raptors and look for nest sites. Cliffs with white-washing and large patches of orange lichens were examined thoroughly for raptor nests. Ground nesting raptors were noted when encountered, and were essentially incidental observations. Detailed notes were kept on all observations.

Along the survey route, an effort was made to check all known nests within 5.6k (3.5 miles) of the river. However, due to unforeseen difficulties (time constraints due to weather and hiking conditions) many of these sites were not thoroughly checked. Only three days were spent hiking from the river to cliffs suitable for raptor nesting due to inclement weather.

Consequently, most of the survey consisted of scanning cliffs for raptor nests using a spotting scope from the river shore (weather permitting). Most of the cliffs in upper reaches of

*-In the arctic, lichen growth is often associated with raptor nests on cliffs; due to enhanced growth from the nutrients provided by excrement from the raptors (Thomson 1979).

the river (above the "Gates") were close enough to the river to give a cursory examination using a spotting scope from the river's edge. Further to the south, as the valley widened, this became difficult due to the greater distance.

We felt as if we covered suitable habitat between Bombardment Creek and Ernie Creek fairly well, but had poor coverage during the remainder of the trip (due to inclement weather).

Due to the inclement weather/ poor coverage of the area, some of the historic nest sites immediately adjacent to the river were checked by aircraft (Piper Super-cub) on 4 August 89 (8 records, 3 of which had not been checked from the ground).

RESULTS:

The North Fork of the Koyukuk river was chosen to assess the suitability of the area for conducting long-term monitoring of raptor populations and document the presence of peregrine falcons. This survey was part of continuing baseline surveys for locating nesting raptors in Gates of the Arctic National Park and Preserve.

One of the primary objectives for conducting this survey was to locate peregrine falcons. No peregrine falcons were observed during the survey. Although there have been reports of nesting of peregrine falcons along the North Fork, they are unconfirmed. A single record is contained in the Raptor Nest data base files in which observers found evidence of what they believed may have been nesting peregrines in the vicinity of Richmond Creek (1986). Also, a lone defensive raptor believed to be a peregrine was also recorded in the same area earlier this summer prior to this survey. This area should be checked next year, and in following years, to determine if peregrines do nest at this site.

A total of 11 species of raptors were recorded in the study area during this survey (see Table 2 below). Past records in the study area also exist for both the peregrine falcon and osprey (both unconfirmed). A total of 10 new nesting areas were found during the survey which represented 7 species of raptors.

Table 2.
Summary of Raptor Observations

SPECIES	#OBSERVED ADLT/YNG	#ADULTS (ESTIMATE)	----- LOCATED NESTS AND STATUS -----		
			ACTIVE	INACTIVE (OCCUPIED)	INACTIVE
Golden eagle	8 / 1	5	1	0	4
Bald eagle	1 / 0	1	0	1	0
Northern harrier	4 / 0	3	1 ?	0	0
Northern goshawk	3 / 0	3	0	0	1
Red-tailed hawk	3 / 0	3	1	0	0
Rough-legged hawk	1 / 0	1	0	0	0
American kestrel	19 / 0	14	1	0	0
Merlin	6 / 5	6	1	0	0
Great-horned owl	2 / 3**	2	0	0	0
Northern hawk-owl	2 ? / 3	2?	1	0	0
Common raven	8* / 0	8	3 ?	0	0

*- of these 8, 3 were belived to be recently fledged young

** - all recently fledged

These figures are subjective and by no means definitive.

Nest status terminology-

Active:

- young were seen
- eggs or eggshells were in the nest from current year
- an adult was seen in incubation posture
- two adults were seen in or near a nest
- one adult and one immature were seen near a nest and mating behavior was observed

Inactive (occupied):

- fresh vegetation was seen on nest, and/or molted body feathers from current year were observed on or in immediate vicinity of nest
- One adult was observed at a nest and molted body feathers from this year were found.

Inactive:

- None of the above were observed

Prior to this survey, a total of 14 species of raptors have been recorded within the Park and Preserve. Seven of these species have been recorded as breeding in the Park and Preserve (Garber 1989). An additional 2 species of raptors were belived to be present within the park based on observations just south of the park boundary. Two "new" species were confirmed as breeding within the park during this survey: the great-horned owl and northern hawk owl. This brings the total number of species of raptors recorded as breeding within the Park and Preserve to nine.

In addition, a bald eagle was found attending a nest indicating a possible breeding attempt, the first record for the Park and Preserve.

Historical nest records:

Of 22 historic nest records within the survey area, 15 were checked (See Table 3- below). Of these records, it was apparent that several were duplicates of the same nest record. In several incidents, the location of the nest site was not mapped correctly (sometimes there was no cliff in the area!); resulting in the same nest being duplicated several times.

Of the 22 records, 17 were golden eagle nest sites. Of these 17, 9 were not checked during the ground survey, due to their distance from the river and our time constraints. These 9 records represented 6 nest sites. Of the 9 nests which were not checked, 2 were remnants last year, indicating little current use. Two additional records were checked in a later (4 August) aerial survey; both were found to be active.

Most of the golden eagle nests along the river were re-classified as common raven nests due to their construction (very small twigs), placement on small bluffs next to the river (atypical for this area), and historical use of similar nests by ravens.

For a complete summary of the status of each nest, see Appendix 3: Nest Record Status.

Table 3.
Summary of Nest Records

<u>SPECIES</u>	<u># Old records</u>	<u># Old checked</u>	<u># Changed to raven</u>	<u># New records</u>	<u># Current records</u>
Golden eagle	17	10	7	2	12
Bald eagle	0	0	0	1	1
Northern harrier	0	0	0	0	0
Northern goshawk	1	1	0	1	2
Red-tailed hawk	0	0	0	1	1
Rough-legged hawk	2	2	0	0	2
American kestrel	0	0	0	1	1
Merlin	0	0	0	1	1
Northern hawk-owl	0	0	0	1	1
Common raven	1	1	0	0	3
Unidentified nest	1	1	0	0	1
Total-	22	15	7	8	25

CONCLUSION:

Based on the limited observations recorded during this survey, the North Fork appears to be a suitable choice for study area which is a typical representative of river valley habitats encountered on the south side of the Park and Preserve. Since this is a major river valley, it may contain a large enough population of raptors to monitor long-term changes in populations. However, there is still little known on raptor populations in the valley.

Although peregrines have been reported in the survey area, no sightings were made during this survey. No confirmed nesting of peregrine falcons have been documented along the North Fork. Peregrine falcons have been documented as breeding just to the south, outside of GAAR, on the John River, and to the north within the Castle/Fortress Mountain area and just to the west along the Noatak River. Other sightings of peregrines have been made in other areas of the park. Considering this evidence, peregrine falcons may breed along this river. The area in which peregrines have been sighted should be checked next year, and in following years, to determine if peregrines do nest at this site.

Due to poor coverage of the survey area this year, it is recommended that this area be surveyed again to document the presence and breeding status of raptors occurring in the area. This river is one of the most accessible areas of the park, an important factor when survey costs and future human impacts are considered. It is recommended that surveys of this area continue to be conducted in the future for these reasons. During subsequent surveys, historic nest records should be checked, and new areas should be surveyed.

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Appendix 1.
Raptor Species Account Summaries

A brief summary of our raptor sightings including nesting activity is listed below. For more information, see Appendix 3- Nest Record Status or see the Gates of the Arctic Raptor Nest Inventory files (Fairbanks, AK).

1. Golden eagle (Aquila chrysaetos)-

During the ground survey, one occupied* nest was located, containing 1 young. An additional 4 unoccupied nest structures were located (excluding several old eagle nest records in which the status was changed (i.e. nests which were re-classified as raven nests).

A total of 4 territories were located. Two of these territories showed signs of occupancy; one of which contained young, the other of which a pair was observed several times in the area, but this nest was not located.

Six sightings of flying eagles were recorded; most of these were in association with known occupied territories.

During a later aerial survey, 2 additional territories were checked, a nest with a single feathered young was found at each site.

2. Bald eagle (Haliaeetus leucocephalus)-

One nest was located; it was attended by one adult eagle. Feathers from an adult and a sub-adult were found at the nest. An aerial check revealed that the nest was empty. This is the first nesting record for the park.

3. Northern harrier (Circus cyaneus)-

Four observations were made. One series of observations indicated a possible nest in the area.

4. Northern goshawk (Accipiter gentilis)-

Three individuals were observed (2 adults and one sub-adult) and one unoccupied nest was located. An area which had a old nest record was checked and the nest was not located.

5. Red-tailed hawk (Buteo jamaicensis)-

Observations were made of a defensive pair at a probable nest site. A ground survey and a later aerial survey did not reveal a nest. A lone adult was also observed. All red-tailed hawks observed were of the "Harlan's" variety.

*-See Table 2 for nest status terminology.

6. Rough-legged hawk (Buteo lagopus)-

One individual was observed just north of the "Gates". Two historic nest areas were checked. Neither nest structure was located.

7. Osprey (Pandion haliaetus)-

A defensive pair was reported along the river at Winnie Creek last year. This area was checked this year and a defensive pair of red-tailed hawks were located. A ground survey and a later aerial survey did not reveal any nests.

From observations at this site, several possibilities were considered which may explain why ospreys were not at this site:

-The red-tailed hawks were here last year and were misidentified as osprey.

-The osprey returned but did not stay in the area since this site was occupied by red-tailed hawks this year.

-The osprey did not return this year.

-If the osprey were here last year, they may not have bred or did not construct a nest. If they did construct a nest, we either did not find it or it was blown down.

8. American kestrel (Falco sparverius)-

Fifteen individuals were observed at 13 locations. Five territorial interactions were recorded; all but 2 were between male kestrels. All kestrels seen were believed to be males, and one female was heard with a male. At this site, an area was located at which a nest site is believed to be located (in spruce forest). Kestrels were the most commonly encountered raptor during the survey.

9. Merlin (Falco columbarius)-

Five observations of six adults were made at five locations. Two adults were observed at a nest site. The nest site was located at the base of a willow on the ground, just above treeline. Five young were observed in the nest.

10. Peregrine falcon (Falco peregrinus)-

Two records were checked. One of these observation records was from earlier this year. A "possible nest" record from 1986 was also checked. No peregrines or obvious nest sites were observed during our survey.

11. Great horned owl (Bubo virginianus)-

Four observations of five individuals total. This includes three recently fledged young; one of which was observed with an adult. No nest sites were located; but one young was observed in the vicinity of an old goshawk nest (although it did not appear to have been used).

12. Northern hawk-owl (Surnia ulula)-

Observations were made at one site where three young and at least one adult was observed; the actual nest site was not located. No other hawk-owls were seen or heard.

13. Common raven (Corvus corax)-

Six observations of eight ravens were made. A group of 4 ravens were observed at one location; 3 of these appeared to have been recently fledged young. Five nests were located which were believed to have been constructed by ravens. No active nests were observed, but 3 of the nests had white-wash sprayed in the rear, indicating that ravens may have used them this year.

Appendix 2.

Travel Conditions and Survey Recommendations

Travel conditions:

Hiking conditions were also much more difficult than we expected. From Bombardment creek to the "Gates", the hiking was not difficult, and was very good at higher elevations. However, south of the "Gates", at lower elevations, the hiking becomes extremely difficult due to the combination of tussocks, brush and trees. South of the "Gates", the river valley widens, and it is usually a difficult two-three mile hike to the base of the mountain. In these areas, it is impractical to hike to the mountains on day trips from the river.

We used an 'Ally Pak' folding canoe for this survey and feel that it is a suitable craft for floating this and other slow moving shallow rivers. It draws very little water, and is relatively easy to set up. However, in the event of a major collision with a rock, the frame could be destroyed. Considering this, a complete repair kit should be brought along, including materials to repair broken aluminum ribs. Alternatively, a small raft (Redshank, etc.) may be also be suitable.

We had to line the canoe from our drop-off point at Bombardment Creek downstream for 1.6km (1 mile) and then on and off for the next 4.8km (3 miles). A few "sweepers" were present along the upper reaches of the river; rafters should be on the look out in these areas. We floated the remainder of the river with little problem.

Survey Recommendations:

Since the area is difficult to survey due to its large size and difficult travel conditions, a substantial amount of time will be required to cover the area. If a general river-based survey of this area is conducted again, it should be considered that it may be impractical to check nests more than 3.2km (2 miles) from the river due to width of the river valley and the rough terrain. It is recommended that at least 3 weeks are spent surveying the river. The length of time conducting the survey will depend on what species are to be the focus of the survey. For a general survey of both cliff and ground nesting species, a short ground survey could be conducted in conjunction with an aircraft survey for cliff nesting raptors. This may be the most time and cost effective method of surveying this area.

After it is decided what species are high priority, certain areas of the river valley will have to be selected to survey since it is unrealistic to survey the entire area. From our findings, it is feasible to hike the areas from Summit Lake downstream to the "Gates"-these areas are relatively easy to hike in. The remainder of the river could be floated, and bluffs along the river could be checked for cliff nesting raptors. Also, ground and forest nesting species can be located during the river survey. For cliff nesting raptors, it is recommended that they are surveyed using a Piper Super-cub since access is difficult to these sites, especially in the lower sections of the valley.

The hiking conditions in this area have two implications; first that the average hiker is not going to spend much time hiking up to the mountains from the river and as a result, disturbance to cliff nesting raptors from hikers is likely to be minimal. However, successful monitoring of raptors in this river valley should be conducted irregardless of the effects of hikers- there are other potential disturbances; i.e. airplane traffic and loss of wintering habitat.

When conducting future surveys, it should be decided what species will be the focus of continuing monitoring efforts so survey efforts are concentrated on those habitats. There are three major nesting habitat types along the river valley. These habitats include cliffs, forested areas of the river valley and bluffs along the river banks. When deciding which of these habitats to survey, nesting habitat selection of the raptors found in the survey area should be considered.

Of the thirteen species of raptors recorded as occurring in the survey area, eight are forest nesting species. Four raptor species are also recorded as nesting on river bluffs. Ground nesting raptors are also accessible from the river (2 species). Cliff nesting raptors (4 species) are a high priority, but access is difficult due to the hiking conditions and distances involved.

As a percentage of total raptors in the survey area, most of the raptors occur in the river valley lowlands, either in forested areas, along river bluffs, or on the ground. Eleven out of thirteen species have been recorded as nesting in lowland habitats. Since the majority of raptor species in the area nest in lowlands of the river valley, it may be easier and more cost effective to survey for cliff nesting raptors using a Piper Super-cub. Raptors in the vicinity of the river could be surveyed for using a raft and hiking short distances from the river.

If the emphasis of future river-based surveys are on forest and ground nesting species, it should be considered that they are difficult to detect. Without a standardized survey method (i.e. use a randomly selected transect or survey block method- both of which may be time consuming and expensive), it will be difficult to detect changes or locate nests of these species.

Since this was the first survey of the North Fork, emphasis was placed on what species were present and what areas would be the best to survey. For future surveys it should be decided which species will be monitored and develop a survey technique which will produce meaningful data.

**Appendix 3.
Nest Record Status**

SPECIES	TERR#	MAP#	STATUS
Golden eagle	053-1	011	Located nest, inactive
Golden eagle	053-2,	060	2 new nests, 1 with single feathered young
Golden eagle	075-1		Changed to C. Raven-003-01,02; map #053
Golden eagle	005-1		Changed to C. Raven-002-01; map #039
Golden eagle	003-1		Changed to C. Raven-004-01; map #002
Golden eagle	004-1		Changed to C. Raven-005-01; map #001
Golden eagle	084-1		Changed to C. Raven-005-01; map #001
Golden eagle	085-1		Changed to C. Raven-004-01; map #004
Golden eagle	058-1		Changed to C. Raven-003-01; map #053
Golden eagle	017-1	005	Not checked, not visible from river — all in same terr.
Golden eagle	018-1	006	Not checked, not visible from river
Golden eagle	019-1	007	Not checked, not visible from river
Golden eagle	020-1	008	Not visible from river, checked from air; 1 feathered YNG
Golden eagle	021-1	009	Not visible from river, checked from air; 1 feathered YNG
Golden eagle	074-1	026	Not visible from river, not checked; remnant last year
Golden eagle	083-1	031	Not visible from river, not checked; remnant last year
Golden eagle	095-1	051	Not visible from river, not checked — all in same terr.
Golden eagle	096-1	052	Not visible from river, not checked
Golden eagle	106-1	059	New nest; good condition; inactive
Bald eagle	001-1	062	New nest, first record for the park; one adult at nest; feathers from adult and sub-adult at nest; no YNG obs. on ground (7/4) or aerial survey (8/4)
Osprey	013-1	030	Area located, occupied by red-tailed hawk; nest not located; aerial survey on 8/4, nest not located
Northern goshawk	001-1	027	Not located
Northern goshawk	002-1	063	Probable nest in crown of birch tree; did not appear to have been used this year
Red-tailed hawk	002-1	061	Pair of defensive adults; nest not located from ground or aerial survey; supposedly occupied by osprey last year (see above); new territory
Rough-legged hawk	010-1	034	Area located, nest not found, presume destroyed
Rough-legged hawk	003-1	028	Area located, nest not found, presume destroyed
American kestrel	001-1	064	Potential nest site; first record for park (M. Britten saw a family group on Alatna river last summer); heard food soliciting calls of female, male's alarm calls; obs. male several times, including obs. of diving at a northern harrier

Nest Record Status:

<u>SPECIES</u>	<u>TERR#</u>	<u>MAP#</u>	<u>STATUS</u>
Merlin	005-1	057	New nest; pair of adults and 5 young about 10 days old; ground nest
Peregrine falcon		002	Nest reported in area in '86, sighting on 6/27 reported; no falcons observed in area on 7/15 or overflight on 8/4
Northern hawk-owl	001-1	058	New nest, first record for park; at least one adult and 3 young
Common raven	001-1	039	Located, may have been active this year; golden eagle nest site-005-01 is probably a duplicate of this site; changed
Common raven	004-1	002	Located, formerly golden eagle nests-#003-01 and #085-01
Common raven	005-1	001	Located, may have been used this year, lone raven obs., at roost; formerly golden eagle sites- #004-01 and #084-01
Unidentified nest	002-1	041	Unidentified raptor nest; no nest or raptors observed in area

Appendix 4.

Summary of Bird Observations:

A survey form was used to record observations on abundance and distribution of birds. While conducting raptor surveys or while floating downriver, population densities of birds were noted mentally and recorded at the end of the day. Although this is a crude method and does not give a realistic portrayal of species density, it does give an idea of relative abundance.

Abundance designations:

(Adapted from A guide to the birds of Alaska; Armstrong, R.H., 1980)

A= Abundant; Species occurs repeatedly in proper habitats, with available habitat heavily utilized, and/or the region regularly hosts great numbers of the species.

C= Common; Species occurs in all or nearly all proper habitats, but some areas of presumed suitable habitat are occupied sparsely or not at all and/or the region regularly hosts large numbers of the species

U= Uncommon; Species occurs irregularly in only some of the proper habitats, and large areas of presumed suitable habitat are occupied sparsely or not at all; not observed regularly even in suitable habitat

R= Rare; Species occurs rarely in proper habitat; in very small numbers.

A total of 7 survey forms were completed. A form was filled out in the vicinity of camp, and during hikes, reflecting the abundance of birds within the vicinity of each camp. Some species are not well represented, particularly alpine species including wheatear, rosy finch and water pipit. These species are probably more common than indicated below; due to the fact that little time was spent in these habitats.

A total of 48 species of birds were seen.

Habitat types encountered were recorded on the survey forms. These designations were also recorded and used on raptor survey cards.

The following habitat types were encountered:

- River
- Stream
- Lake
- Cliff
- Wet meadow
- Unvegetated ground/gravel bar
- Grass meadow
- Dwarf shrub mat (shrubs < 0.4 m high)
- Dwarf shrub meadow (tundra dominated by grasses or sedges)
- Low shrub thicket (shrubs 0.5-1.1 m high)
- Medium shrub thicket (shrubs 1.2-2.4 m high)
- Tall shrub thicket (shrubs 2.5-5.0 m tall)
- Mixed deciduous-coniferous forest
- Scattered woodland and dwarf forest

Summary of Bird Observations

SPECIES	Camp:1	2	3	4	5/6	Notes:
Canada goose					R	
Northern pintail				R		2 total
Green wing teal					R	
Bufflehead					R	1 female
Red-breasted merganser					R	
Lesser yellowlegs			R	U	R	
Spotted sandpiper	C	C	C	C	C	
Common snipe		R				Nest distraction display
Upland sandpiper	C	C	C			Locally common
Mew gull			U	U	U	
Arctic tern				R	U	3 pairs total; breeding
Northern goshawk		R				
Northern harrier			R	U		
Rough-legged hawk						
Red-tailed hawk					U	
Golden eagle	R	U	R			
Bald eagle					R	
Merlin	U			U		
American kestrel	U	U	U	U		
Rock ptarmigan	R		R			
Willow ptarmigan		R				
Great horned owl				U	R	
Hawk owl	R					
Belted kingfisher				R		
Northern flicker				R	U	
Say's phoebe	U					Nest with young
Olive-sided flycatcher					C	
Alder flycatcher					C	
Violet-green swallow				R	U	
Bank swallow				C		
Gray jay		U	U	C	U	Young fledged
Common raven	U	R	U		R	Young fledged
Black-capped chickadee					R	
Boreal chickadee	C	R		U		
Townsend's solitaire		U				Some young fledged
Swainson's thrush				U	U	
American robin	C	U	C	C	C	
Northern wheatear	C		C			Young fledged
Water pipit			R			
Yellow-rumped warbler	R					
Wilson's warbler			R			1 pair
American tree sparrow	C	R	R			
Dark-eyed juncos		U		C	U	Young fledged
White-crowned sparrows	A	C		A	U	Young fledged
Song sparrow						
White-winged crossbill					R	
Redpoll spp.	U			U	U	
Rosy finch			R			

Appendix 5.
Summary of Mammal Observations

SPECIES	DATE	#OBS	LOCATION	COMMENTS
Dall sheep	7/9	7	NW1/4 S17 T36N R14W	7 rams
Grizzly bear	7/10	1AD/2YNG	SW1/4 S28 T36N R14W	Sow and 2 cubs of the year
Dall sheep	7/11	6	NW1/4 S17 T36N R14W	6 rams
Ground squirrel	7/8		Area of Camp 1 & 2	Very few along river, most at higher elevations
Moose	7/16	1AD/1YNG	SE1/4 S5 T28N R14W	Cow and calf on gravel bar
Black bear	7/17	1	SW1/4 S23 T27N R15W	Smaller adult. We were about 100' upriver from the bear at the water's edge on a gravel bar when we first observed it from the canoe. As we approached within 80' the bear, it began to swim across the river. We changed our course to avoid running it over and passed by it. It exited on the opposite shore, ran for about 100' shook itself off, looked at us and ambled on into the woods.
Red fox	7/18	1	SW1/4 S24 T25N R15W	Red phase, along river

Appendix 6.
Aircraft Observations

For approximate locations consult trip schedule of logistics.

Date	Time	Comments
7/6	2200	E>W; 10,000'; 4 prop transport plane
7/7	1250	E>W; 6,000'; silver Beaver on floats
7/7	1345	W>E; same plane returning
7/7	1545	W>E; Silver w/ blue stripe; on floats (185?)
7/9	1045	E>W; Helicopter; grey and black?; across river valley, circled back and appeared to land in the vicinity of Bombardment Creek. Shortly thereafter flew to NE.
7/9	1530	Distant plane heard near confluence of Ernie Creek and N.F. Koyukuk River.
7/9	1732	E>W; Helicopter-white w/red trim #N58337; landed ~3/4 mi upstream from river on Bombardment creek; took off about 3 minutes later and headed upstream toward Marshall Lake
7/9	1907	W>E; Helicopter-White with slashed red trim; Bell 206; 3,000'
7/10	1140	S>N; Headed up main river valley; White with red trim 180 series

Date	Time	Comments
7/10	1245	N>S; Helicopter-distant-appeared to be flying into, then out of Bombardment Creek-not positive if it landed
7/10	1400	S>N; 3,500'; High wing single with tricycle gear; white with red trim
7/11	1210	W>E; NPS- Buster checks on us with Super cub
7/11	1230	N>S; 5,000'; High wing single up main river valley
7/11	1503	Distant jet; no visual
7/11	1927	N>S; 10,000'; DC-3?; silver; over main river valley
7/12	1940	N>S; 500'; Silver 185? on floats; flew over camp and headed down main river valley
7/13	1240	S>N; 500'; NPS 185 on floats-Buster flying
7/13	1443	N>S; 750'; NPS 185 on floats-Buster flying
7/13	1622	S>N; 800'; NPS 185 on floats-Buster flying
7/14	2250	N>S: 500'; Yellow 185 on floats; probably Brooks Range Aviation
7/18	----	Can hear aircraft flying into Bettles field; on our trip into town, saw a Bell 206 (NPS contract), and contacted Buster in the Supercub