Raptor Population Inventory

and

Management Planning

(North Slope)

NOGAP Project G-17

Fish and Wildlife Branch

Yukon Department of Renewable Resources

D. Mossop

R. Ward

D. Talarico

Interim Report

1986

INTRODUCTION

Initial inventory and planning for the management of raptors on the Yukon North Slope has been an ongoing project since the early 1970's. In the interim, much of the area drained by streams of the Beaufort Sea have been covered in initial intensive surveys (see Platt 1975; Mossop and Hayes 1976, 1977, 1978, 1979, 1980). As well, various management options have been investigated including reintroduction of an extirpated species (see Peregrine Falcon Recovery project, this report) and harvest of the gyrfalcon , primarily for commercial reasons (Mossop and Hayes, 1981). The remaining task has been to complete the inventory but more importantly, to draw together all the work that has been done into a comprehensive analysis of raptor populations and an overall management plan for the future of these birds. A grant from Northern Oil and Gas Action Plan (NOGAP), a federal/territorial funding agreement has made the present task possible.

Difficult accessibility of the Yukon North Slope has been the factor limiting human use in the area. With the development of the North Yukon National Park and the Herschel Island Territorial Park, more human activity is expected in the North Slope area. Other options for this area include wilderness tourism, industrial site development and corridor transportation development. In the near future, activities associated with the oil and gas industry (both exploration and production) are the most likely industrial developments to occur.

Although management planning recognizes all North Slope activities, it has prioritized petroleum development activities as its main concern.

The Raptor Species

The Yukon North Slope supports numbers of 12 raptor species. Of these, breeding records exist for 8 species:

	Breeding Records
gyrfalcon (*Falco rusticolus*)	Yes
peregrine falcon (*Falco peregrinus tundrius*)	Yes
merlin (*Falco columbarius*)	Yes
northern harrier (*Circus cyaneus*)	Yes
rough-legged hawk (*Buteo lagopus*)	Yes
Swainson's hawk (*Buteo Swainsonii*)	Probable
golden eagle (*Aquila chrysaetos*)	Yes
bald eagle (*Haliaetus leucocephalus*)	Probable
osprey (*Pandrion haliaetus*)	No
hawk owl (*surnia uluta*)	Probable
short-eared owl (*Asio flammeus*)	Yes
snowy owl (*Nyctea scandiaca*)	Yes

The large falcons, the eagles and the osprey have been priorized for inventory throughout the Yukon. Because of their size, and in most cases because they display specialized aspects in their breeding ecology which makes them intuitively "vulnerable" to interference, management in the immediate future will likely be directed at this group. Breeding data on the other species is gathered incidentally but is catalogued and treated similarly where feasible.

The Area

The rivers of the Beaufort Sea in Yukon drain an area of 17,940 km^2. The area is somewhat diverse, although due to vegetative similarities, fall totally within one ecoregion as described by Oswald and Senyk (1971).

Three identifyable mountain groups rising to 1500 m include the Richardson Mountains, Barn Mountains and the British Mountains. They grade in the north through foothills to the flat coastal plain of the Arctic Ocean. Unifying features are the generally tundra vegetation underlain by mostly sedimentary rocks which give way to increasingly metamorphic rock in the British Mountains of the western portion (Figure 1).

For the purpose of discussing raptor populations, the area is divided into its major drainage basins. Drainages cutting through the generally soft rocks of the region have created a super-abundance of nesting habitat for cliff nesting raptorial birds. The drainages thus form, as is often the case in the Yukon, a natural search route for inventory and population monitoring.

Administrative boundaries which will conceivably affect raptor management include a proposed Yukon Territorial Park on Herschel Island and the designation of lands west of the Babbage River as a National Park (Figure 1). All of the area in question falls within the land settlement area of the C.O.P.E. Agreement and subsequent Act of the Canadian Parliament (quote).

METHODS

(a) Terminology

The term "nest site" is used to describe the location of a nest and its immediate area. It relates most to the concept of a nesting territory, and in the case of cliff nesting raptors usually refers to a cliff or series of cliffs.

An "occupied" or "active" site means a nest site with signs of occupation by adults such as fresh excrement, new nesting material or the presence of one or more adults in the area.

A "productive" site means the site supports a nest where eggs and/or nestlings were observed or where adults showed incubating or brooding behaviour.

(b) Inventory and Population Monitoring

All initial inventory and the majority of revisits for the purpose of monitoring the progress of sites have been accomplished by helicopter. A variety of helicopter types have been used but with all, a standard procedure has emerged. Two observers flew on all surveys. One recorded data on prepared coding forms compatible with a data storage system designed for the Yukon Government computer (Hayes and Mossop 1982). The other navigated and supplied data to the recorder. The pilot, recorder and observer were normally interconnected by intercom.

Initially, search was conducted throughout all acceptable nesting habitat. As nesting sites and alternate acceptable nesting habitat became known and mapped, subsequent searches became more limited. During revisits, careful effort was expended to locate nests within nesting territories where previous years' nests were found unoccupied. A feature of raptor ecology on the Yukon North Slope was that the overwhelming proportion of birds use cliff nesting sites. Survey technique was thus mostly cliff survey. A helicopter flying a single pass across most cliff faces at reduced air speed allowed all standard observations. Field procedures recognized the vulnerability of birds of prey to prolonged and/or sudden disturbance. In instances where all observations necessary could not be taken from the air, the site was approached on foot from below, although this has been a rare occurrence in this particular nesting habitat.

(c) Data Storage and Retrieval

Hayes and Kale (1982) describe the data handling process that has evolved from the ongoing Yukon raptor population inventory projects. Since 1982 the process has been somewhat streamlined although the basics have remained unchanged.

The process consists of two basic types of data: mapped data and various stored alpha numeric information. Maps used are 1:250,000 topographic sheets and they are used to record area of search and field locations of observations. A series of master maps with all basic site information of nesting raptors is hand prepared, updated annually and held in confidential files at Whitehorse. The other information collected includes: a description of the nest site, its surrounding habitat, obvious alternate nests at the site, productivity data including occupancy, number of eggs and/or young, age of young and visible response of the adults to the survey disturbance. All the latter data are coded and stored in the Y.T.G. computer system at Whitehorse as a S.A.S. data set.

(d) Management Options

Experiments with management options have included: exploring non-consumptive use options, experimenting with harvest for commercial reasons, and developing criteria to mitigate against disturbances. These efforts are all documented in annual reports and published documents since 1978: Harvest options: Mossop 1980, Mossop and Hayes 1981, Mossop 1982. Tundra Peregrine Reintroduction: Mossop *et al*. 1979, 1980, 1981, 1983, 1984, 1985. General Inventory and Non-Consumptive Value: Mossop and Hayes 1975, 1976; Hawkings and Mossop 1984; Ward and Mossop 1985. Mitigation against Disturbance: A considerable body of information has been gathered in the area and elsewhere in the Yukon relative to disturbance by industrial (and other) activity near raptor nests. Mitigative management criteria for various disturbances are becoming fairly well established (Platt 1975; Mossop et *al* 1978).

The remaining task was to complete experiments with management options and incorporate them into a comprehensive package for long term application to the North Slope area.

RESULTS

State of the Resource

Sufficient numbers of five species were found breeding to allow analysis of population parameters (Table 1). Of these, the large falcons (peregrine falcon, gyrfalcon) are of high priority for management primarily due to their perceived high social, ecological and commercial values. The golden eagle is perhaps of next significance due to their apparent high numbers and productivity. Golden eagles at high density can be expected to be exerting a considerable influence on the ecosystems of the area in general. The rough-legged hawk also apparently occurring in high density, tends to nest in highly accessible locations and could pose management concern related to disturbance. Merlin data must be considered incidental and our analysis of raven numbers is mostly as a result of the interrelationships between them and the cliff nesting raptors.

Table 1. Bird species for which North Slope raptor surveys 1974-86 produced population data showing sample sizes.

Species	Total Site Visits	Proportion Occupied	Proportion Productive	Mean Young Per Productive Nest	(n)
Gyrfalcon	630	0.72	0.52	2.74 ± 0.9	(261)
Peregrine falcon	129	0.40	0.24	2.24 ± 0.7	(8)
Golden eagle	198	0.80	0.63	1.37 ± 0.5	(86)
Merlin	4	1.00	--	--	
Rough-legged hawk	94	0.96	0.89	2.76 ± 1.1	(25)
Raven	23	0.87	0.81	3.36 ± 1.2	(12)
TOTAL:	1078	0.72	0.55	2.45 ± 1.1	(392)

(a) Peregrine Falcon

Early surveys in the 1970's quickly identified a good population of peregrine falcons occupying all of the major drainage basins of the slope. It has always been assumed that this population was of the tundra geographic race (*Falco peregrinus tundrius*). No specimens were collected at that time, although early explorers to the area are known to have taken specimens sporadically (Nat. Museum, Can. collections). Generally, this peregrine is described as somewhat darker in colour than its eastern arctic counterpart and apparently somewhat smaller than peregrines of other races (White 1968). It occurred across the whole of the western North Slope presumably from the Mackenzie River to the western coast of Alaska (Cade 1960)

Numbers:

As the Yukon government standardized surveys were established, it became apparent that the tundra peregrine was declining rapidly (Table 2). By 1979 only one pair was known in the region and in 1981 the last evidence of a lone bird at a former nesting cliff was recorded. A concurrent decline occurred across the Alaska range although there, population monitoring was not as standardized (Rosseneau 19 _).

At present, the bird does not exist as a breeder in the Yukon. Sporadic records of birds are made by various observers although all recent records have been made after the breeding season and can most easily be interpreted

Table 2.

Year	Total Territories Known	Number Checked	Number Occupied (pairs or single)	Number Productive
1975	14	12	5	--
1976	15	14	2	3
1977	15	15	3	3
1978	15	13	3	2
1979	15	14	2	0
1980	*15	16	2	0
1981	16	15	1	0
1982	16	13	0	0
1983	16	6	0	0
1984	16	13	0	0
1985	16	9	0	0

*Includes one N.W.T. site not normally checked.

as movements through the area. Recently, the bird's numbers have apparently stabilized in its Alaska range and good evidence now exists that its numbers are beginning a recovery (Ambrose 1986). This, as well as initial successes at reintroduction to the Yukon (see management options below), are encouraging speculation for a happier future to this species on the North Slope.

Use of Habitat:

Nesting habitat of Yukon's tundra peregrines was typically river cliffs in the open tundra. Some nests were known well within the mountains inland but always situated on cliff faces overlooking a river. No nests were known above 700 meters (a.s.l.). Nests were rarely situated below an overhang and were often found on the tops of cliffs or on the tops of promenances associated with cliffs. Old nests of ravens and especially rough-legged hawks were apparently used regularly when available in the nesting territory. Unlike gyrfalcons, peregrines regularly nested successfully on unstable clay and loose rock cliffs. Fidelity to a nesting cliff from year to year seemed from the limited observations possible, to be complete. The actual nest seemed to be relocated regularly between years on the same nesting cliff.

Prey Utilization:

Very little information exists on the use of prey by the Yukon's tundra peregrine population. Two nest sites from which prey remains were collected in 1976 yielded shorebird remains exclusively.

Breeding Season:

Tundra peregrines are thought to be highly migratory, moving further south to winter than any of the other North American peregrine races (Fyfe 1985). No band returns are available from the Yukon population although returns from Alaska bandings seem to be confirming this idea (Ambrose, pers. comm.) Timing of return to the breeding habitat is unknown. The more southerly (anatum) race of peregrines in the Yukon returns to its breeding habitat in mid-late April. The tundra birds likely arrive somewhat later. Estimated nesting chronology of the few nests which were monitored in the Yukon is shown in Figure __.

(b) Gyrfalcon

Early surveys identified an apparently large population of gyrfalcons on the North Slope. The gyrfalcons breeding in the area are virtually all of the grey colour phase. Approximately 2% of observations of adults in the area are of birds which could be classified as white or partially white. No "black" or very dark coloured adults have been noted.

Numbers:

The North Slope supports the largest gyrfalcon population known in the Yukon Territory. Nesting density is open to some minor interpretation. Overall, nesting territories are spaced regularly at a minimum of about one per 167 to 211 km^2. Territories often contained more than one nest site. Occasionally, two nest sites would be recorded as occupied in a territory in one year because of fresh wash at both sites but within a 'territory' as we define it, no more than one nest site was ever productive (producing eggs or young) in any one year. Small segments of the North Slope remain unsurveyed, but it is not likely density will increase appreciably beyond the 85 permanent and 107 maximum nest sites now known.

The density of nesting territories within individual river drainages range from one pair per 68.3 km^2 in Anker Creek to one pair per 561.3 km^2 in the Blow River drainage (Table 3). The Anker and Blow drainages were significantly higher and lower than other drainages on the North Slope (Chi squared test with Yates correction $P < 0.05$). Without more knowledge about the gyrfalcons' use of habitat in total, it is difficult to interpret these differences. The Anker drainage is a very small area and the Blow a very large area. The apparent clumping and spacing respectively is probably an anomaly of the analysis. As larger regions are compared - for example the eastern and western halves of the slope - no signficant differences in density are evident.

Table 3.

Drainage	Area km^2	Minimum/Maximum Nesting Terr.	Density (km^2/Terr.)
Anker	410	6-11	68.3 - 37.3
Babbage	3795	12-17	316.3 - 223.2
Blow	2245	4-5	561.3 - 449.0
Fish	975	8-8	121.9 - 121.9
Rapid	1630	7-9	232.9 - 181.1
Firth	3800	24-29	158.3 - 131.0
Malcolm	1985	9-9	220.6 - 220.6
Trail	3100	15-19	206.7 - 163.2
Eastern Drgs	9055	37-50	244.7 - 181.1
Western Drgs	8885	48-57	185.1 - 155.9
Total Area	17940	85-107	211.1 - 167.7

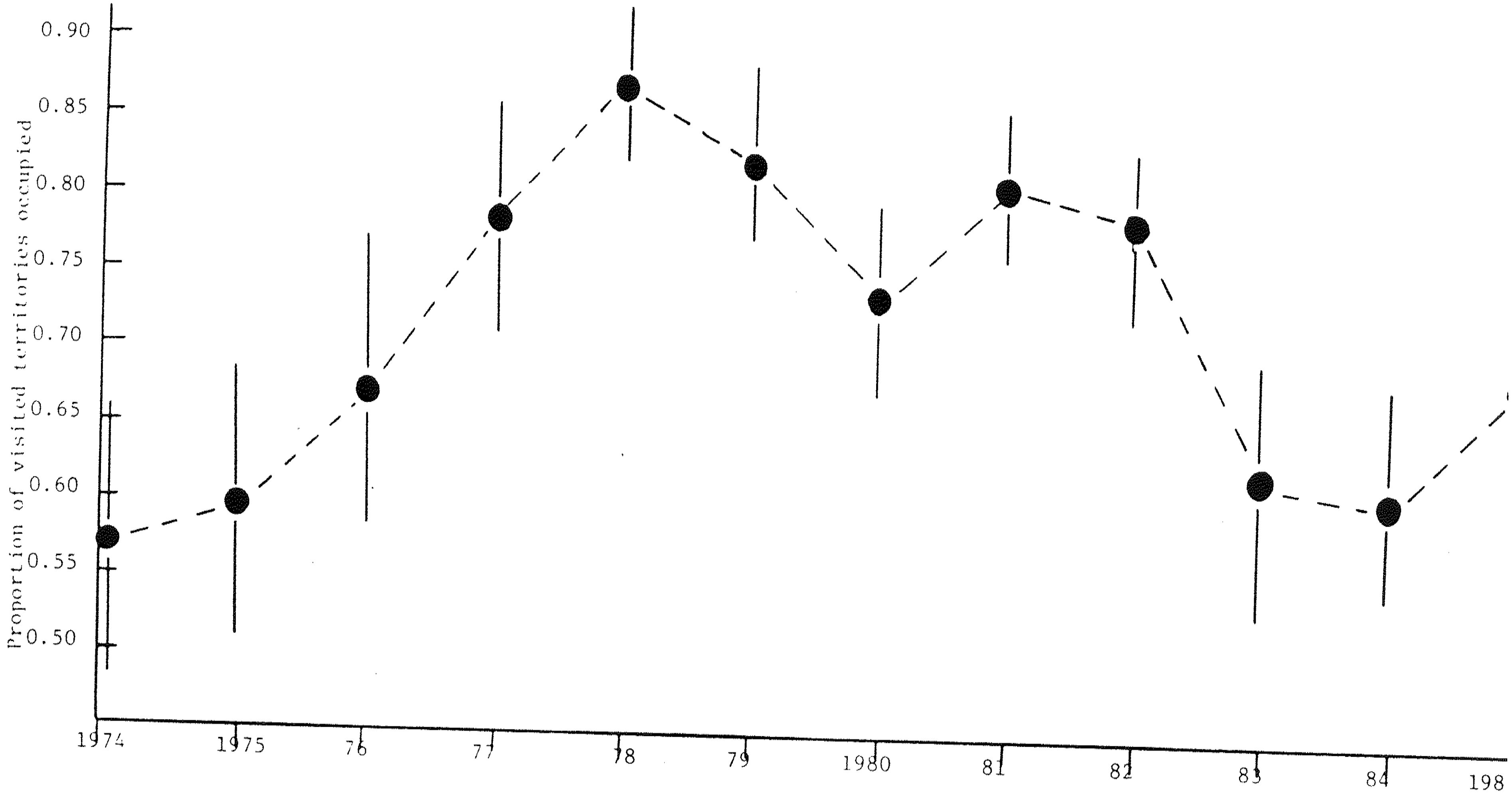

Figure 1. Gyrfalcon territory occupancy rates, proportion of visited territories occupied, Yukon North Slope 1974-85, shown are standard errors.

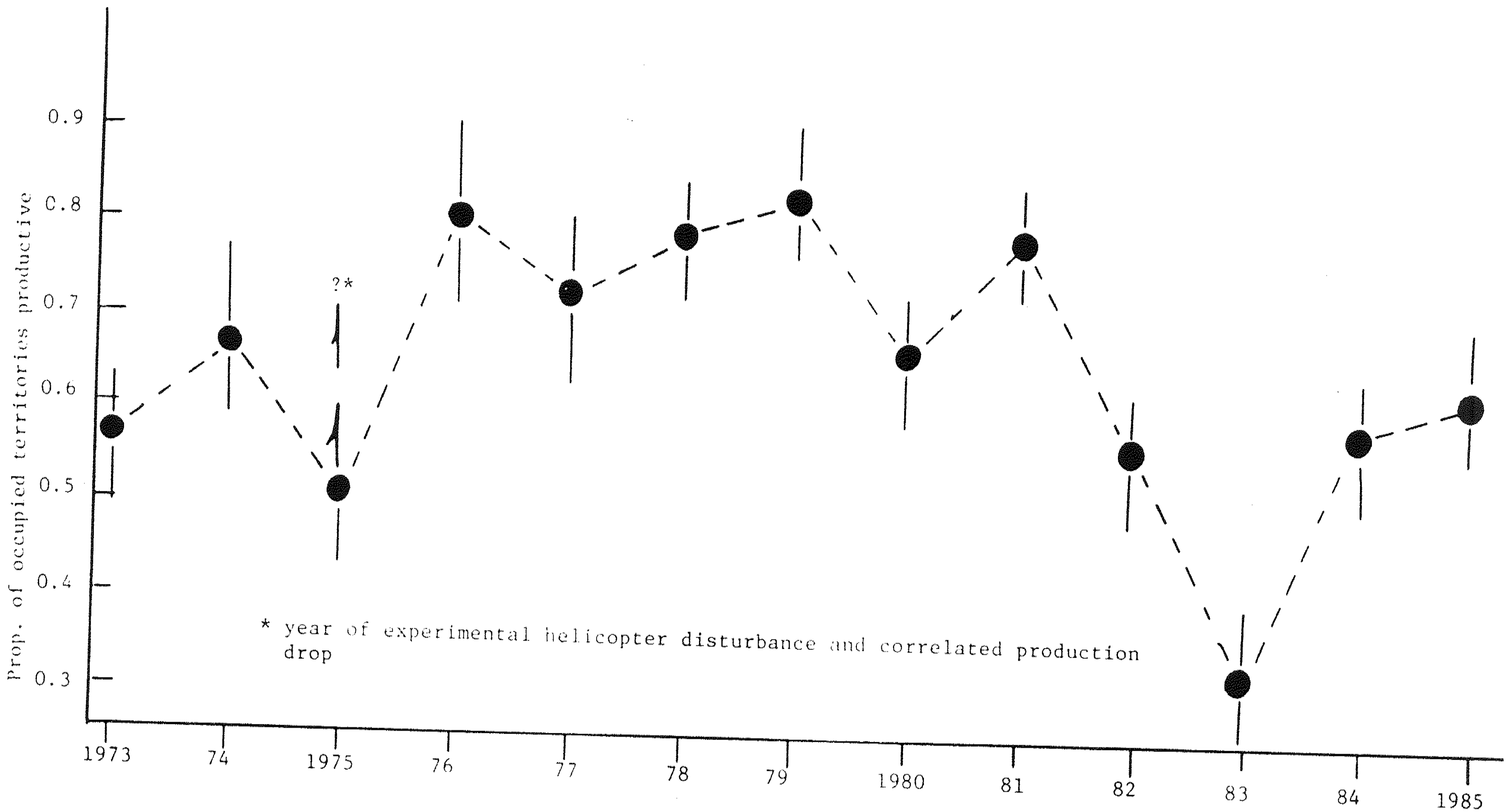

Figure 2. Gyrfalcon productivity rates, proportion of occupied territories productive, 1983 - 85 standard errors.

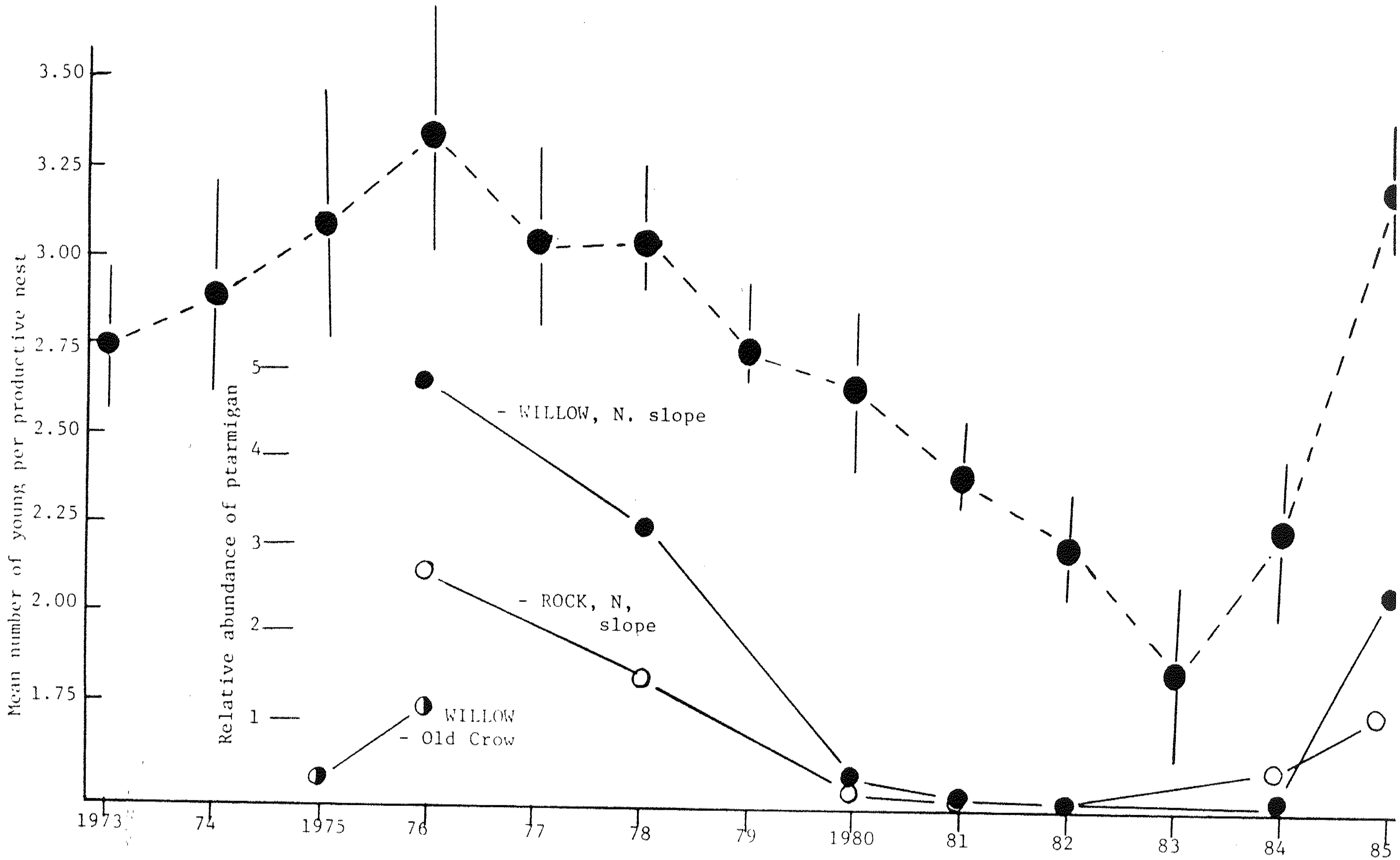

Figure 3. Mean annual production of young per productive gyrfalcon nest, Yukon North Slope 1973 - 85, with standard errors, and the relative abundance of ptarmigan in the northern Yukon, 1975-85.

Complicating density interpretation is a regular cycle in gyrfalcon production and abundance, apparently tracking prey abundance in a 10-year cycle (Figure 1). In years of peak gyrfalcon abundance, occupancy began to occur at what are best interpreted as "intermediary" sites apparently between established nesting territories. If these are included, density would be found to be slightly higher; our interpretation of a "minimum" adult breeding density emphasizes the necessity of long strings of population data to accurately assess density in these northern cyclic populations.

Production of young of this population has shown wide swings. Several parameters have been tracked over a minimum of ten years giving a good picture of changes. No significant differences were found in any of the productivity parameters between the various sub-drainages where comparisons were possible (Chi squared $P > 0.05$). Occupancy itself is in a sense a productivity parameter (Figure 1). Significant differences between this measure on various years' data occurred only between the extreme years: the high in 1978 and low 1983, 1984. Once nest sites were identified as occupied, the subsequent production of young followed a variation over the years closely resembling occupancy (Figure 2). Significant difference again was only demonstrated between the extreme years (1976 and 1983). The average number of young produced at successful nests likewise showed regular variation (Figure 3). It is important to note that in 1975 production is known to have been artificially depressed (Platt 1975).

Prey Utilization:

The explanation for the cycle in productivity and hence gyrfalcon abundance in general is proposed to be induced by prey availability (Barichello and Mossop 1983). The prey hypothesized as critical to understanding Yukon gyrfalcon abundance are the species of ptarmigan, in particular the two: rock and willow (Lagopus mutus and L. lagopus). The correlation of the various productivity parameters and ptarmigan population cycles is the subject of major research in the central Yukon (Barichello, in prep.). On the Yukon North Slope, overall ptarmigan breeding abundance has been monitored over the years of raptor surveys. The measure of abundance correlates very closely with gyrfalcon performance (Figure 3).

Collections of prey remains have been taken on most survey visits to gyrfalcon nests. Although analysis of these collections is not complete, initial cataloguing of material shows a high dependance on ptarmigan species and later in the breeding season, on ground squirrels (Spermophilus parryii) and larger migratory birds. A feature of prey utilization needing further analysis is an apparent shift indicated by preliminary cataloguing toward small and (presumably) non-preferred prey during periods of low ptarmigan abundance.

The Breeding Season:

Yukon gyrfalcons occupy the breeding habitat year round. Winter occupancy in the high latitudes of the north slope has been confirmed (Platt 1976), but good evidence also exists that winter occupancy is dependent on high ptarmigan numbers (Barichello 1983). The location of gyrfalcons, both adults and subadults, in winters of low prey abundance is a major gap in our understanding of their total ecology.

Breeding activity at the nesting territory can be expected underway on the North Slope in most years on fine days in March. Our analysis of estimated hatch dates suggests an earlier breeding season in years of good production and late hatch when production drops. This result, which amounts to a two week variation, is only really significant in the recent decline from approximately 1979 - 1982 through the current recovery indicated by the 1985 data. Overall mean hatch date has been June 5 (Figure 4). Incubation can be expected to be about 32 days with egg laying lasting about 8 - 10 days. The laying of the first egg is expected about April 25. The courting period prior to this is probably criticqal to the eventual success of the nest.

Young were found at the nest site through to about their 60th day of life. The breeding activity at the nesting territory thus occupies virtually the whole year with the intensive activity of courting, incubating and rearing young occupying the months of March through July.

c) Golden Eagle

Breeding Population:

A summary of golden eagle nest sites and densities for North Slope river drainages is presented in Table 4. A total of 92 golden eagle nest sites were identified during the ten years of surveys. Nest density ranged from one nest per 82.0 km^2 on the Anker River drainage to one nest per 325 km^2 on the Fish River drainage and averaged one nest per 195 km^2 for the entire region. The Anker and Firth River drainages had significantly higher nest densities than other drainages (CHi Square $P<0.05$).

One hundred and ninety eight visits were made to golden eagle nest sites on the North Slope between 1976 and 1985. Annual sample sizes were not sufficiently large to compare annual productivity rates on a drainage by drainage basis, however. Drainages were therefore lumped into eastern and

Table 4. Summary of nest site numbers and densities for North Slope River drainages.

Obs.	River Drainage	Area (km^2)	Number of Nests	Nest Density (km^2/nest)
1	Anker	410	5	82.000*
2	Babbage	3795	15	253.000
3	Blow	2245	7	320.714
4	Firth	3800	29	131.034*
5	Fish	975	3	325.000
6	Malcolm	1985	9	220.556
7	Rapid	1630	13	125.385
8	Trail	3100	11	281.818
9	North Slope	17940	92	195.000

*Significantly higher than expected nest density (CHi Square: $P<0.05$).

western North Slope subregions. (The Anker, Babbage, Blow, Fish and Rapid River drainages were grouped as the east subregion and the Firth, Malcolm and Trail River drainages were grouped as the west subregion.

No significant differences were found in the proportion of visited nest sites that were occupied or productive or mean number of young per productive nest between subregions in any year (CHi Square test with Yates correction P>0.05). Annual sample sizes were not sufficiently large to test for significant differences in the mean annual number of eggs per productive nest between subregions. The data for the two subregions are therefore lumped in subsequent analysis.

Annual nest site occupancy rates ranged from 0.53 and 0.95 and averaged 0.80 over all years (Table 5). The years 1979, 1981 and 1983 had significantly higher occupancy rates than 1977 or 1984 (Mann Whitney U Test: P>0.05). Annual nest site productivity rates ranged from 0.35 to 0.90 and averaged 0.63 over all years (Table 5). The years 1976 and 1979 had significantly higher productivity rates than 1977, 1983 or 1984 (Mann Whitney U Test: P<0.05).

As stated above, annual sample sizes were not sufficiently large to draw any conclusions about annual fluctuations in number of eggs per productive nest. Based on the limited data however, mean number of eggs per productive nest remained relatively constant between years. Mean annual clutch size ranged 1.0 to 1.5 eggs/nest and averaged 1.2 +- 0.42 over all years (+- 1 SD: N=10). The maximum observed number of eggs per nest was two (Table 5).

Table 5. Golden Eagle Occupancy and Productivity 1974 - 1985.

Year	Proportion occupied	Proportion productive	Eggs per nest	Young per nest
1974	1.00	-	-	-
1975	-	-	-	-
1976	0.90	0.90	1.3 ± 0.6	1.0 ± ?
1977	0.60	0.40	1.0 ± 0.0	1.3 ± 0.5
1978	0.78	0.68	1.0 ± -	1.6 ± 0.5
1979	0.92	0.76	1.0 ± -	1.4 ± 0.5
1980	0.81	0.68	1.5 ± 0.7	1.3 ± 0.5
1981	0.95	0.77	-	1.4 ± 0.6
1982	0.86	0.62	-	1.5 ± 0.5
1983	0.92	0.35	1.0 ± -	1.1 ± 0.4
1984	0.53	0.40	-	1.2 ± 0.4
1985	0.80	0.70	-	1.0 ± -
All Years	0.80	0.59	1.2 ± 0.4	1.4 ± 0.5

Annual mean number of young per productive nest was not significantly different between years (Kruskal Wallis Test: $P<>0.05$). Mean annual brood sizes ranged from 1.0 to 1.6 young per nest and averaged 1.4 over all years (Table 2). The maximum number of young observed in a nest was three. The fact that the mean and maximum number of young per productive nest tended to be as high or higher than the mean and maximum number of eggs per productive nest may indicate a weakness in our data on clutch sizes. It may also be, however, that early clutches tend to be larger than later ones. The clutches recorded during these surveys would therefore be smaller than those that produced the broods recorded. In any event, it would seem likely that hatchling survival is high.

<u>Breeding Season</u>

Estimated mean, modal and median annual hatch dates were similar (Table 6) and strongly correlated ($R>.95$: P of $> R <0.005$). Mean annual hatch date ranged from June 1 to June 22, but was not significantly different between years. Mean hatch date over all years was June 12 (Table 3). Hatch date data are obviously incomplete, however, as some nests still contained eggs when the surveys were conducted. The range of hatch dates would be larger than reported in Table 6, but it appears that most broods do hatch in mid-June.

Using these bench marks, the breeding season for golden eagles on the North Slope can be constructed (Figure __). The birds are migratory, no winter records exist for the area.

Prey Utilization:

Though non-breeding eagles are known to take caribou calves, golden eagle prey utilization strategies are poorly known. Required is an understanding of the role caribou calves play in the over all reproductive strategy of eagles on the North Slope. A study of breeding and subadult food habits has been proposed as a future part of the raptor management plan (Mossop and Ward 1985). Through the collection of prey remains and pellets from nesting and roosting sites, additional data can be added to the existing 10 years of sporadic prey collections previously collected.

Table 6. Average hatch date - Golden Eagle - North Slope, 1974 - 1985.

Year	(n)	Mean hatchdate (June)	Modal hatchdate (June)	Median hatchdate (June)	Earliest hatchdate (June)	Latest hatchdate (June)
1976	1	1	1	1	1	1
1977	2	15	11	15	11	19
1981	16	11	12	12	3	17
1982	6	8	6	7	6	12
1983	3	22	22	22	22	22
1984	7	13	12	12	11	18
1985	7	16	18	18	10	20
All Years	42	12	12	12	2	22

d) Rough-legged Hawk

Breeding rough-legged hawk (*Buteo lagopus sancti-johannis*) populations exist throughout the North Slope region, with especially high numbers on Herschel Island. Written records of Rough-legged Hawks on the North Slope date to the late 1800's when explorers and whalers first travelled along the coast near Herschel Island (Rand, 1946). Between the years of 1974 to 1986, rough-legged hawk nesting sites have been recorded during the north slope raptor surveys. However, search for this species unfortunately cannot be considered complete. A concentrated search of Herschel Island, between the years of 1984 to 1986 to determine breeding density on the island.

Numbers:

Between the years of 1974 to 1985, 69 rough-legged hawk nesting sites have been identified on the North Slope (excluding Herschel Island). During this time period 25 were found to be active (Table 1). Habitat use, prey utilization, and breeding season data for these North Slope nests are awaiting further analysis.

Herschel Island:

Between the years of 1984 to 1986 a maximum of 28 nesting territories have been identified on Herschel Island. Of the known sites, 19 and 22 were productive in 1984 and 1985 respectively. In 1986, 26 sites were classed as occupied and 24 of these were productive. This repesents an increased breeding density of one nest per 5.56 km2 in 1984, one nest per 4.56 km2 in 1985, and one nest per 4.12 km2 in 1986. The lower density in 1984 has been attributed to the fact that only partial survey of the island was conducted.

Prey Utilization:

During the years 1984, 1985 and 1986, collared lemmings (Dicrostonyx groenlandicus), brown lemmings (Lemmus subericus), tundra voles (Microtus oeconomous), juvenile rock ptarmigan and passerines were found near or on nest sites. Rough-legged hawk castings were collected for future analysis.

Breeding Season:

Rough-legged hawks have been seen on Herschel Island during the first week of June. In 1985 and 1986, clutches were complete and being incubated by mid June. In both years the number of eggs ranged from 3 to 5 per nest. The average clutch size in 1985 was 3.9 ± .3 n=16 and in 1986 it was 4.1 ± .5 n=21 (Table 7).

Table 7. Rough-legged hawk breeding density and average reproductive success on Herschel Island in 1984, 1985 and 1986.

Year	Density of Breeding Pairs	Average Number of Eggs Per Nest	Average Number of Young Surviving 10-14 Days
1984	1 pair/5.56 km^2 n=19	--	--
1985	1 pair/4.56 km^2 n=22	3.9 ± .3 n=16	2.7 ± 1.1 n=15
1986	1 pair/4.12 km^2 n=24 25 occ./24 Prod.	4.1 ± .5 n=21	2.0 ± 1.7 n=12

Hatching occurred in early to mid July, after an approximate 30 day incubation period. The average number of young surviving past 10-14 days in 1985 was 2.7 ± 1.1 n=15 and 2.0 ± n=12 in 1986.

h) Other Species:

Population analysis of the less common raptor species is not possible with the data base available. Their presence is a contribution to the diversity of the area and incidental sightings and breeding records will continue to enhance the understanding of status.

MANAGEMENT OPTIONS

a) Assumptions: Three documents give some direction in determining management assumptions that should guide raptor management on the North Slope:

- Yukon Territorial Government 19__. A model etc.
- Yukon Department of Renewable Resources 1983. A policy etc.
- Inuvialuit Final Agreement 198_.

Of these, the latter is potentially the most powerful document from which policy questions can be suggested for the specific area in question. All, however, are in harmony on the major initial assumptions in determining a raptor management strategy.

MANAGEMENT OPTIONS

a) Assumptions:

b) Raptor management zones - North Slope:

- National Park
- Territorial Park
- Protected Areas
- Integrated Resource Areas

c) Peregrine recovery plan

d) Non-consumptive management options

e) Mitigative, protection criteria

f) Harvest potential

g) Population monitoring needs

h) Research needs:

- golden eagle prey utilization
- gyrfalcon post-fledging strategies

LITERATURE CITED

APPENDIX:

YUKON NORTH SLOPE BIRDS OF PREY

MANAGEMENT OPTIONS

a) **Assumptions**

1. It is assumed that the birds of prey of the North Slope will remain essentially unharvested; any harvest will be a very closely controlled, rare event.

2. The birds of prey are most valuable for their non-consumptive values; they rank very high as wild creatures which visiting naturalists value to see.

3. The birds of prey are valued quite highly locally for cultural and aesthetic purposes and will always by a valued part of the natural community.

4. As top-of-the-foodchain predators and ones that have demonstrated catastrophic crashes due to environmental degradation, they are very valuable as ecosystem indicators, in particular of the presence of pesticides in the food chain.

b) **Partnerships**: Raptor management "zones": Four regions of the North Slope are recognised:

Ivvavik National Park
Herschel Territorial Park
(Proposed) Protected areas
Integrated Resource management areas

Because of the unique status of raptors as unhunted wildlife the management of the birds across all the zones of the slope are not anticipated to be different. In effect the only differences will be dictated by the operational budgets affecting the different areas. In that sense the responsible staff and partnerships necessary to implement management will be a combination; **the partners should work together on this task**. Operational budgets for the two parks and the operational budgets of the Yukon Government Fish and Wildlife Branch will be the chief sources of personnel and resources. Clearly the co-ordinating body for these partners will be the Wildlife Management Advisory Board set up pursuant to the IFA.

c) **Non-consumptive management options**: Visitors to the Slope will seek minimal aids in enjoying the raptors of the area:

1) **Access to the slope** --a) air access to designated points (eg: Herschel Island) and must be closely controlled to avoid random air disturbance.

--b) boat access to the coast will be valuable if available at the air access points.

--c) foot access to view specific raptor species will be possible; guiding service will be important (eg: Herschel Island for Snowy Owl, Rough-legged hawks, Peregrine Falcon).

The major issue in providing access to the raptors of the slope for viewing will be protection of the resource from excessive disturbance. A strict code of ethics and guiding service will help to alleviate.

2) **Written material**: A good brochure of the birds of prey of the slope should: a) introduce the species diversity.
b) lay out the code of ethics required for viewing breeding raptors.
c) give general aids in helping visitors locate the species in which they have most interest.

3) **On-going monitoring/research**: A most important component feeding into safe visitor enjoyment will be knowledgeable on-site personnel. An on-going program of research will keep local personnel (notably in the two parks) current in this regard. The process of judging the effectiveness of an interpretive program will also require the information generated.

d) **Peregrine Falcon Recovery**: The slope's peregrines are recognized as the 'tundra' race; its status as a species at 'risk'(COSEWIC) and the recommendations pursuant to that listing require close population monitoring and management to effect recovery. The existing plan for the Yukon (1979) recognizes the need to:

a) Monitor regularly
b) Explore the possibility of captive breeding and cross-foster release (to gyrfalcon parents)
c) Work co-operatively with the Alaskans who share the population with the Yukon.
d) Provide complete protection for the species.

e) **Mitigative, Protection criteria:** The slope's various birds of prey all nest either on the ground or on cliff faces with the exception of the few Bald Eagles tree-nesting. All species are tied to **very critical nesting sites** and it should be these sites which are the focus of protective land-use decisions. Within 2 km of a site, land use permitting decisions should be contemplated.

The criteria developed for most nesting raptors is that **within 1 km of a nest** site all activity will be seriously disruptive and should be avoided unless very detailed mitigative management by the management authority can be designed.

Within 2 km of a nest site the management authority should be alerted and an on-site inspection considered depending on species.

Activities needing control include all disruptive activities and include repeat aircraft overflights, campsites and simply people in the area for periods beyond an hour.

f) **Harvest potential**: The only species for which harvest can be conceivable will be the gyrfalcon. Access for harvest will be the central concern. For this reason **free flying young birds** of the year should be the only birds contemplated for permitted capture. A process of access to the coast under close scrutiny of a local guide with a very conservative limit of **2-3 birds a year in good years** will be sustainable.

An essential element in any harvest scheme will be a **population monitoring** program. Harvest should be limited to years when the birds are producing an excess of young.

g) **Population Monitoring**: This is probably the most basic and potentially valuable of the management option elements. It feeds to all other elements of the plan. One of the most valuable roles birds of prey play in **ecosystem monitoring** is their proven sensitivity to disturbance in the whole food chain. A sample of breeding pairs should be selected and as **a matter of operational requirement**, the staff of the two parks in cooperation with the Yukon Territorial government should carry out minimal annual monitoring. The good data bases already in place make this effort especially valuable for the long term.

Gyrfalcon: probably the most valuable for monitoring because it is a year round resident completely dependant on the tundra ecosystem.

Peregrine Falcon: as a species at risk should be monitored. Cooperartion with the Alaskan researchers will be essential.

Golden Eagle: by far the most common bird of prey with very close association with the mammal populations of the slope (including caribou).

Rough-legged hawk: The densest breeding population ever recorded lives on Herschel Island. Monitoring it is relatively easy and should be considered an operational priority.

Snowy Owl: One of the most valuable bird to visiting birders; its numbers are also relatively easy to monitor especially on Herschel Island.

h) **Research options**: Three pieces of basic research are identified:

Golden Eagle: The second most important predator of calf caribou on the slope the species displays a very interesting breeding and population strategy for utilizing this resource. It is basically unstudied, the data base in place now would be a valuable first step in this research.

Gyrfalcon post-fledging strategies: The migration and survival of yearling (and possibly female adult) gyrfalcons is a large unknown in their ecology.

Peregrine Falcon recovery: The tundra peregrine will predictably return to the slope. Its recovery will be valuable to research closely mostly to understand the habitat/species interactions in recovering populations but also to help develop criteria to prevent any future collapse. Research into the effectiveness of past effort (mostly the cross-fostering effort) is important.