RAPTOR SURVEYS IN THE KITIKMEOT AND BAFFIN REGIONS, NORTHWEST TERRITORIES, 1983 AND 1984

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ABSTRACT

Raptor surveys initiated in 1982 were continued and expanded in the Kitikmeot and Baffin regions in 1983 and 1984. Surveys were specifically designed for investigating gyrfalcon densities, productivity and production. Those censuses conducted by snowmachine during the spring covered 1,350 km^2 in 1983 and 6,540 km^2 and 3,650 km of coastline in 1984. Aerial surveys by helicopter covered 17,522 km^2 and 14,951 km^2 in 1983 and 1984, respectively.

Spring phenology was about 10 days advanced in 1984 over 1983 and 1982. Density of territorial pairs was quite low in 1983 (1 pair per 604 km^2), particularly in the Baffin Region survey areas (1 pair per 1,333 km^2), compared to 1984 (1 pair per 253 km^2 overall, 1 pair per 233 km^2 in Baffin). Productivity of territorial pairs was stable, but total production of young was 62% higher in 1984 (55 young) than in 1983 (34 young) for those areas surveyed both years.

A comparison of estimates of productivity based upon spring and summer surveys, versus summer surveys only was made. The comparison indicated that if only summer surveys (July) were conducted, the rate of productivity of gyrfalcons could be over estimated by 50%. Two surveys are thus required to estimate productivity of territorial pairs; one during incubation and one during the nestling period. The incubation survey can be used to estimate population sizes, and the nestling survey can yield production information.

Reoccupancy rates of territorial gyrfalcons were high, indicating a high degree of traditional use of territories. This can be important in designing long term monitoring studies of the species.

Density of territories of Peregrine Falcons varied from 1 per 278 km^2 in 1983 to 1 per 156 km^2 in 1984. As with Gyrfalcons, the increased density may have been partly in response to early spring phenology. Productivity of peregrines averaged 2.8 and 3.0 eggs and/or young per pair in 1983 and 1984, respectively. Since peregrines initiate nests much later than Gyrfalcons, productivity measurements were made much earlier in their nesting chronology than for Gyrfalcons.

Data on production and reoccupancy rates are presented for Common Ravens and Golden Eagles. Nesting observations of Rough-legged Hawks, which rose to a population peak in 1984, are also presented.

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INTRODUCTION

This report is the third in a series on raptor work being conducted by the Department of Renewable Resources, Government of the Northwest Territories (GNWT) (Bromley 1983, Poole and Bromley 1985). Emphasis is placed on Gyrfalcons (Falco rusticolus) because of the recent interest by residents in selling juvenile Gyrfalcons on the world market (see Bromley 1983 for background). Extensive surveys were initiated in 1982 to investigate the status of the species in order to determine if capture quotas could easily be sustained by the population. Although an annual NWT quota of 20 juvenile Gyrfalcons is available, only four Gyrfalcons have been exported from the NWT since 1981. In 1985, the North American population of Gyrfalcons was placed on Appendix I of the Conference on the International Trade of Endangered Species of Fauna and Flora (CITES), thereby removing the possibility of exporting Gyrfalcons from Canada at the present time.

Objectives of the survey were to:

1) document densities of territorial pairs of Gyrfalcons,
2) determine annual productivity of Gyrfalcons and production of other raptors,
3) measure annual variation in densities and production, and
4) colour band a sample of nestling Gyrfalcons to monitor dispersal of individual birds to breeding sites in subsequent years.

Although emphasis was placed on Gyrfalcons, observations were also recorded on Tundra Peregrine Falcons (Falco peregrinus tundrius), Golden Eagles (Aquila chrysaetos), Rough-legged Hawks

(Buteo lagopus) and Common Ravens (Corvus corax). The definitions of territory, nest site, active territory, occupied nest, successful nest, production, and productivity, follow Poole and Bromley (1985). As in previous reports, specific locations of eyries are not given in order to protect these sites from disturbance by irresponsible people. Surveys were conducted in spring and summer 1983 and 1984.

SURVEY AREAS

Surveys were conducted in 1983 and 1984 from the communities of Cambridge Bay, Coppermine, Fort Ross (abandoned), Holman and Spence Bay in the Kitikmeot Region; and from Broughton Island, Cape Dorset, Frobisher Bay, Lake Harbour and Pangnirtung in the Baffin Region (Fig. 1).

Survey areas have been described for Cambridge Bay, Spence Bay, Cape Dorset, Lake Harbour and Frobisher Bay (Bromley 1983, Poole and Bromley 1985). Descriptions of the remaining survey areas follow.

Kitikmeot Region

Coppermine

The Coppermine survey area lies largely within two broad ecosystem categories termed sparsely-vegetated tundra and lush vegetation tundra, and to a small extent within the forest-tundra transition wildlife zone (Jacobson 1979). Similarly, the area is encompassed by Porsild and Cody's (1980) fourth phytogeographical province (mainly wide-ranging, low arctic tundra plants) and to a small extent their fifth province (low-relief, wooded western portion of the Canadian Shield).

Physiographically, most of the survey area is part of the Bear-Slave Upland which is composed of igneous rock with some stratified rock, forming rounded, rocky hills and exhibiting a relief of about 100 m. Small lakes are numerous.

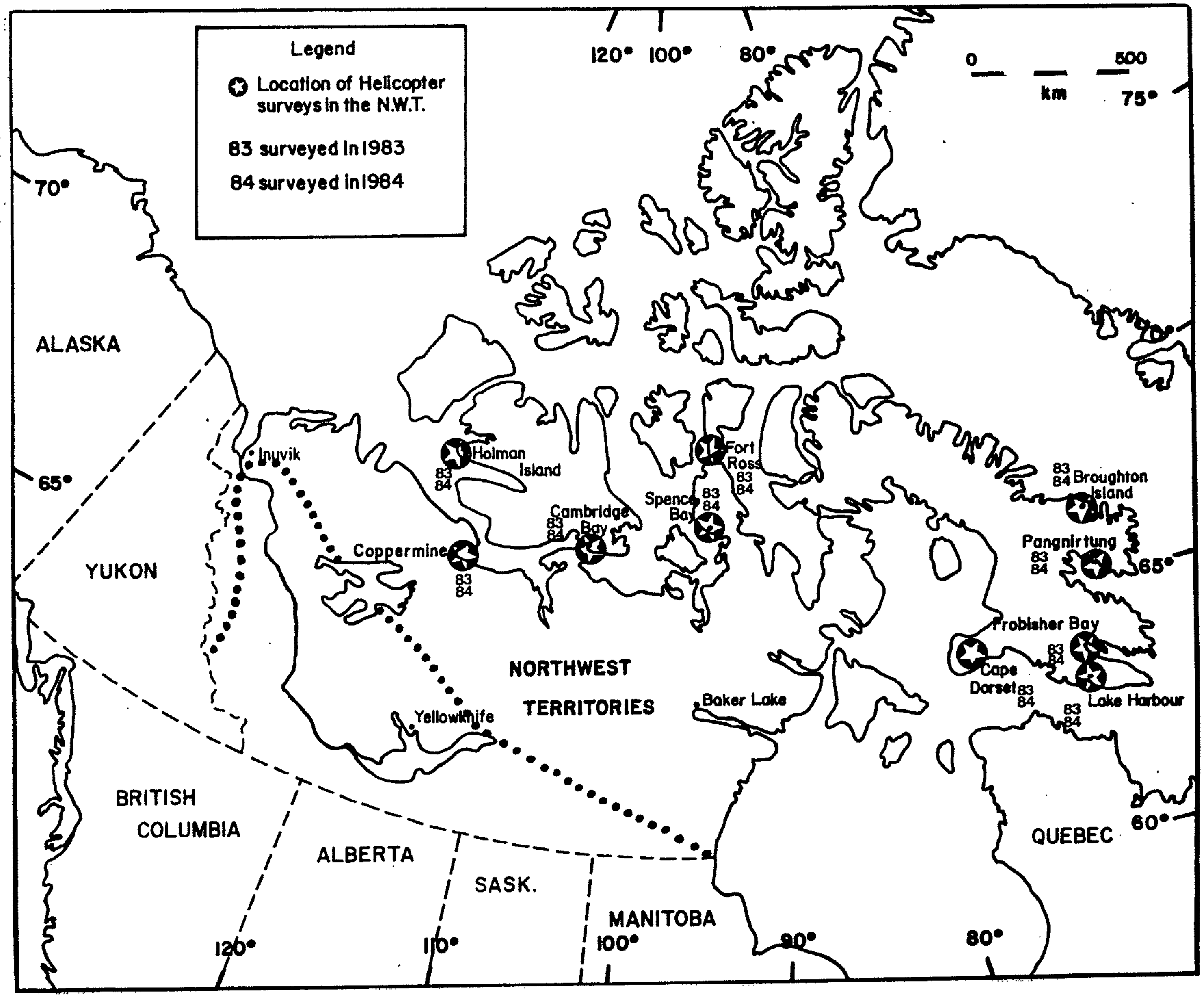

Figure 1. The location of communities from which surveys were conducted in 1983 and 1984.

The Coronation Hills, part of the study area, are formed by gently northward-dipping sediments intruded by sills and dykes. They reach elevations of 250 m (Douglas 1972). Soils are poorly developed and shallow.

The Coppermine area has a Polar Continental climate with short, cool summers and long, cold winters (Table 1). The mean annual total precipitation is 22 cm in the community of Coppermine (Devine 1984) and increases going inland (Canada Department of the Environment 1978).

Subjectively, the area appears to be excellent raptor habitat, consisting of broad open stretches of well-vegetated tundra studded with an optimal interspersion of cliffs 10 to 40 m high and of variable aspect. Southerly and easterly cliff aspects are the most common. Ptarmigan (*Lagopus* spp.), Arctic Ground Squirrels (*Spermophilus parryii*), waterfowl and passerines are common to abundant.

Fort Ross

The Fort Ross survey area is on Boothia Peninsula and adjacent Somerset Island, in the mid-Arctic Ecoregion (Canada Department of the Environment 1981). This region is characterized by areas of discontinuous tundra vegetation of perennial herbs, trailing or low shrubs, lichens and mosses, with continuous vegetation cover in the valleys and sheltered lowlands. The soils are poorly to moderately weathered.

A north-south belt of Precambrian upland spans the length of central Boothia Peninsula (Blackadar 1967). The north of the

Table 1. Climatic characteristics of new study areas surveyed in 1983 and 1984 (from Maxwell 1980).

Study area	Annual Precipitation (cm)	Temperatures (°C)				Time of snow loss	Average number of days without snow
		July $\bar{x}$ high	July $\bar{x}$ low	January $\bar{x}$ high	January $\bar{x}$ low		
Coppermine	22	13	5	-26	-33	first 2 weeks of June	110-115
Fort Ross	15	8	3	-30	-35	late June-early July	55-85
Holman	16	11	4	-26	-33	mid- to late June	90
Broughton	31	8	2	-21	-27	early to mid-July	65-75
Pangnirtung	35	11	4	-26	-38	late June-early July	90-95

peninsula is characterized by rugged, rocky hills, with some peaks nearly 600 m in elevation. The central portion of the peninsula is a smooth, rolling plateau. This upland area is bounded to the northeast and southwest by well-vegetated Paleozoic lowlands, which are mostly flat and consist mainly of limestones (Thompson 1980). These lowlands have many small lakes and ponds with poor drainage (Blackadar 1967).

Climatically the area is subject to cold, dry winters and cool, dry summers (Table 1). During the survey in early July 1983, the southern uplands of Somerset Island had extensive areas of over 60% snow cover.

Our impressions of the survey area were that Gyrfalcon prey abundance (ptarmigan and waterfowl) was low, except for the presence of many gull (*Larus* spp.) colonies along Bellot Strait. Cliffs were often of "gravelly" loose rock and situated in narrow shaded canyons. As a result, we concluded that they comprised a particularly cold microclimate.

Holman

In 1984, areas of Victoria Island were surveyed from Holman. The study area is located in the M'Clintock Plains and Shaler Mountains Ecoregions (Canada Department of the Environment 1982).

The M'Clintock Plains Ecoregion is dominated by rolling to undulating plains comprised of calcareous and often drumlinized moraine underlain by sedimentary rock (Thorsteinsson and Tozer 1962). Outcrops generally have mean elevations below 150 m. The numerous lakes and streams are poorly drained. There are large areas of sparse vegetation. Discontinuous to continuous vegetation cover of moss-sedge-herb subformations are typical of the lowlands (Canada Department of the Environment 1982).

The Shaler Mountains bisect Victoria Island, forming a band of tilted beds of Precambrian sedimentary and volcanic rocks, capped by basalt flows or diabase sills (Thorsteinsson and Tozer 1962). Escarpments up to 500 m high are common, intermixed with rolling plains.

The vegetation in the rocky uplands is a sparse to discontinuous cover of crustose lichens on frost-shattered bedrock and outcrops. The morainal lowlands have a sparse cover of herb-shrub associations. Lakes are few at high elevations and fairly numerous at lower elevations (Canada Department of the Environment 1982).

The climate of Holman is similar to that of Coppermine though slightly cooler and drier (Table 1).

The Holman study area was considered fairly good raptor habitat. Cliffs of assorted heights up to 100 m are present in high densities, but often with northerly aspects. Although no ptarmigan were seen in this area, Arctic Hares (*Lepus arcticus*) were more abundant than in any other survey area. Judging from the number of Rough-legged Hawk nests with lemming (*Lemmus* sp. or *Dicrostonyx* sp.) carcasses covering the rims, a high in the numerical cycle of lemmings was occurring during the year of the survey. Small herds of muskoxen (*Ovibos muschatus*) were observed in occasional valleys which supported lush sedge meadows.

Baffin Region

The areas surveyed from Broughton Island and Pangnirtung are located in the Davis physiographic region (Sempels 1982). This region, which is part of the Canadian Shield, has been influenced by erosion of overlying sediments and glaciation which caused scouring and deposition (Sempels 1982).

Broughton Island

The Broughton Island survey area includes parts of Penny Highland and the Home Bay Upland physiographic subdivisions. The Penny Highland is characterized by steep-sided mountains, long narrow fiords and valleys with glaciers present inland (Sempels 1982). Generally the coastline is very rugged with tall, sheer cliffs, large talus slopes and occasional gravel beaches. Sheer cliffs often exceed several hundred meters in height.

The Home Bay Upland is largely a blocky plateau dissected by deep valleys and fiords. The coast includes little flat ground except islands and at the headlands of larger peninsulas. The vegetation is typical of the mid- to high Arctic, being predominantly a rock desert or fell field of lichens-avens-saxifrage (*Saxifraga* sp.). Intermittent patches of lichen-heath comprised of lichens, labrador tea (*Ledum* sp.) and heather (*Cassiope* sp.) also characterize the area (Maxwell 1980).

The east coast of Baffin Island offers suitable cliffs for nesting raptors as well as seabirds (Fulmar [*Fulmarus glacialis*], Common Murre [*Uria aalge*], Black Guillemot [*Cepphus gyrlle*], and gulls. The seabirds may form an important part of the diet of nesting Gyrfalcons.

The climate is strongly influenced by Davis Strait and the extent of sea ice or open water (Table 1).

Pangnirtung

The survey areas are all located in the Baffin Upland physiographic division (Semples 1982). This division includes the Cumberland Fiords and the Nettilling Upland. The former is part of a blocky plateau dissected by deep valleys and fiords. The steep cliffs along the coast offer ideal nesting habitat for raptors.

The Nettilling Upland is a dissected plateau dominated by linear scarps that form the sides of numerous islands, inlets and lakes. Inland, the undulating surface has a mean elevation of 250 m often with steep sided valleys formed by erosion along structural lineaments (Sempels 1982). The upland area is also characterized by a variety of suitable cliffs of variable height and aspect.

The vegetation in the survey area is typical of the mid-Arctic. Dwarf shrubs and sedges are common as are areas of shrubby birch (Betula nana) and willow (Salix spp.), sedges (Carex spp.), blueberry (Vaccinium spp.), crowberry (Empetrum sp.) and labrador tea (Maxwell 1980).

Pangnirtung is characterized by relatively high precipitation and a moderate length snow-free period (Table 1).

Gull colonies of a few to several hundred pairs were frequently observed along coastal cliffs. Occasional Black Guillemot colonies also provided a ready source of prey for Gyrfalcons.

METHODS

Two methods of surveying for raptors were employed; snowmobile surveys and helicopter surveys.

Snowmobile Surveys

Spring surveys by snowmobile were conducted in the Cambridge Bay area in 1983 and 1984 (Poole and Bromley 1985). In the Baffin Region in 1984, spring snowmobile surveys were conducted from Broughton Island, Frobisher Bay and Pangnirtung (McLean 1984). The southern Baffin Island survey was completed for the Baffin Regional Council (BRC) and the Baffin Region Inuit Association (BRIA) on contract.

Dates of surveys were 10 May to 10 June 1983 and 9 May to 3 June 1984 for the Cambridge Bay area; 14 May to 10 June 1984 for the Frobisher Bay, Pangnirtung and Broughton Island areas. Logistics (distance from town) and accessibility by snowmobile influenced the areas chosen to be surveyed.

The survey technique was essentially the same in the various areas although identity and experience of observers varied, as did the number of observers (from two to seven). All suitable cliffs in the survey area were examined for evidence of nesting raptors. Such evidence consisted of whitewash, orange lichen (*Xantheria elegans*) or presence of raptors. Using standardized data cards and maps, the location of a site or potential nest was given a unique number, marked on the map and nest site characteristics were recorded. Presence or absence of birds at a nest site, number of adults, colour phase (Gyrfalcon) and behaviour of the birds were noted. The survey route was also marked on the maps. The exact route taken and speed of travel varied considerably as dictated by local topography.

Observers remained in the area ot a nest as briefly as possible (usually less than 10 minutes) in order to minimize disturbance (Fyfe and Olendorff 1976).

Aerial Survey

Sample areas were subjectively selected, as in 1982, using the criteria that they be; (1) near an aircraft fuel source, and (2) within the regions which might be expected to support a harvest of Gyrfalcons. Aerial surveys in Baffin were also designed to overlap with areas surveyed by snowmobile in 1984.

Surveys were conducted in the Kitikmeot Region in 1983 from Cambridge Bay, Coppermine, Fort Ross and Spence Bay, and in 1984 from Cambridge Bay, Coppermine and Holman. In the Baffin Region, surveys were conducted in 1983 from Cape Dorset, Frobisher Bay and Lake Harbour, and in 1984 from Frobisher Bay, Pangnirtung and Broughton Island.

Surveys were conducted with a Bell 206B Jet Ranger helicopter on floats, carrying a pilot and usually two observers, one in the co-pilot seat and one in the rear. Although an effort was made to examine all cliff faces within an area, some cliffs were likely missed.

Where young were present, an attempt was made to band them, provided that it was feasible to descend or climb into the nest and that the nestlings were of an appropriate age.

The ages of nestlings were estimated by comparing photos of them to photos of young of known ages. Dates of nest initiation, hatching and fledging were calculated by back dating or forward dating as in Bromley (1983). Each nestling was banded with a standard United States Fish and Wildlife Service (USFWS) lock-on type leg band and most also received an anodized, coloured, riveted band on the opposite leg. Colours were assigned according to geographic areas (Table 2). A part of the 5th secondary feather from one wing of older young (greater than 25 days) was collected. The feather samples will be analyzed for trace elements (c.f. Parrish et al. 1983) in an attempt to identify unique signatures for different geographic areas. This work will be discussed in a subsequent report. The colour phase and sex (when known) of the nestlings was recorded and any unhatched eggs that were not viable (i.e., addled, infertile, or with dead embryo) were collected, wrapped in tin foil and stored for contaminant analysis.

Sightings of Gyrfalcons not associated with nests were recorded, as they were for Rough-legged Hawks, Golden Eagles, Peregrine Falcons, ravens, and any active or inactive nests associated with these species.

Each survey flight was given a unique number and the flight path of the helicopter traced on 1:250,000 topographic maps. All observations of raptors and nest sites along the flight path were assigned sequential numbers, and the numbers were plotted on the maps.

Table 2. Colour marking scheme for nestling Gyrfalcons in the NWT.

East and south Baffin (all of Baffin south of 70° Latitude)	Black band, Left leg
High Arctic (above 70° Latitude)	Red band, Left leg
Central Arctic (below 70°, west of Baffin Island to 120° west except for:	Red band, Right leg
Central Arctic (intensive study area)	Blue band, Right leg
Western NWT (below 70°, west of 120°W)	Blue band, Right leg
Keewatin (south of Arctic Circle, west of Hudson Bay to 105°W)	Blue band, Left leg

Surveys were conducted in the Kitikmeot Region from 30 June to 14 July 1983 and 5-17 July 1984. In the Baffin Region the dates were 27 July to 5 August 1983 and 14-25 July 1984. A total of 89 h (Table 1) and 83 h of survey were flown by helicopter in 1983 and 1984, respectively (Table 3), with an additional 45 hrs and 47 h of ferrying time used in 1983 and 1984, respectively, to position the aircraft (Appendix I).

Except where noted, data reported in subsequent sections of this report are combined observations from both the snowmobile and helicopter surveys.

Calculation of Nesting Density

Survey areas were censused for nesting raptors with an attempt to examine every cliff within each area. Density for each nesting species was calculated by dividing the number of nests in each area by its areal extent, as measured by planimeter.

Table 3. The number of survey hours flown by helicopter in each area and region during the 1983 and 1984 raptor surveys in the NWT.

Survey area	Survey time (hours) 1983	1984
Kitikmeot Region		
Coppermine	17	15
Cambridge Bay	21	15
Spence Bay	9	-
Fort Ross	7	-
Holman	-	15
Sub-total	54	45
Baffin Region		
Frobisher Bay	8	19
Lake Harbour	14	-
Cape Dorset	13	-
Pangnirtung	-	13
Broughton Island	-	6
Sub-total	35	38
Total	89	83

RESULTS AND DISCUSSION

Area Surveyed

In spring 1983 and 1984, the same Cambridge Bay study area was surveyed by snowmobile (Table 4). In the Baffin Region, survey areas were measured either by area or, where appropriate, by coastline distance (Table 4, and McLean 1984). A total of 1,350 km^2 was surveyed in 1983 and 6,540 km^2 and 3,650 km of coastline was surveyed in 1984.

Surveys conducted by helicopter in July covered those areas surveyed by snowmobile plus additional areas in both the Kitikmeot and Baffin regions (Table 5). Some survey areas had also been covered in 1982 (Bromley 1983 and Table 5).

Gyrfalcons

Density and Distribution

In the Kitikmeot Region the density of active Gyrfalcon territories ranged from 1/142 km^2 to 1/2,253 km^2 in 1983 (Table 6). The average density for all areas in the region was 1/452 km^2. In 1984 the overall density was 1/275 km^2 (Table 7). No gyrfalcons were observed in the Holman survey area. This was similar to 1980, when L.G.L. Environmental Consultants and Canadian Wildlife Service, during more than 17 h of flying, recorded only one incidental observation of a gyrfalcon (McLaren and Alliston 1981).

The Baffin Region study areas had an average density in 1983 of 1 territory per 1,333 km^2 and in 1984 of 1/233 km^2.

Table 4. Area or coastline surveyed in spring 1983 and 1984 from Cambridge Bay (Poole and Bromley 1985) and in southern Baffin Island (McLean 1984).

Location	1983 Area surveyed (km^2)	1984 Area (km^2) surveyed	1984 Coastline (km)
Cambridge Bay	1,350	1,350	--
Broughton Island	--	--	2,110
Frobisher Bay	--	2,400	785
Pangnirtung	--	2,790	755
Total	1,350	6,540	3,650

Table 5. A comparison of areas surveyed by helicopter in 1982, 1983 and 1984.

Location	Years surveyed 198__	Area surveyed: Once only	Twice	Three times	At least once (total)
Kitikmeot					
Cambridge	2,3,4	2,122	1,015	1,272	4,409
Coppermine	3,4	2,466	1,584	--	4,050
Spence Bay	2,3	--	3,724	--	3,724
Fort Ross	3	2,253	--	--	2,253
Holman	4	2,624	--	--	2,624
Pelly Bay	2	1,742	--	--	1,742
Sub-total		11,207	6,323	1,272	18,802
Baffin					
Broughton Island	4	1,275	--	--	1,275
Cape Dorset	2,3	--	2,952	--	2,952
Frobisher	2,3,4	2,140	1,187	834	4,161
Lake Harbour	2,3	--	1,661	--	1,661
Pangnirtung	4	2,728	--	--	2,728
Sub-total		6,143	5,800	834	12,777
Total		17,350	12,123	2,106	31,579

Table 6. Areas surveyed, number of Gyrfalcon territories and density of territories by survey area and region in 1983.

Survey area	Area surveyed (km^2)	Number of active territories	Density of territories (km^2/territory)
<u>Kitikmeot Region</u>			
Coppermine	2,328	3	776
Cambridge Bay	2,554	18[a]	142
Spence Bay	3,724	2	1,862
Fort Ross	2,253	1	2,253
Sub-total	10,859	24	452
<u>Baffin Region</u>			
Frobisher Bay	2,050	1	2,050
Lake Harbour	1,661	1	1,661
Cape Dorset	2,952	3	984
Sub-total	6,663	5	1,333
Total	17,522	29	604

a Two of these territories were active in May 1983 but not at the time of the aerial survey in July 1983.

Table 7. Areas surveyed, number of Gyrfalcon territories and density of territories by survey area and region in 1984.

Survey area	Area surveyed (km^2)	Number of active territories	Density of territories (km^2/territory)
Kitikmeot Region			
Coppermine	3,350	14	239
Cambridge Bay	2,000	15[a]	133
Holman	2,624	0	0
Sub-total	7,974	29	275
Baffin Region			
Frobisher Bay	2,974	13	228
Pangnirtung	2,728	12	227
Broughton Island	1,275	5	255
Sub-total	6,977	30[a]	233
Total	14,951	59	253

a These figures include active territories which were located during a May snowmobile survey. Nine of 23 territories were inactive or not found during the July helicopter survey and would have been missed without the spring work.

Observed densities of active territories were much greater in 1984 than in 1983 in both the Kitikmeot (164%) and Baffin (572%) regions. Differences in locations of study areas influenced estimates of average densities within each region's area surveyed. For example, in the Kitikmeot Region, two relatively low density study areas (Spence Bay and Fort Ross) were surveyed in 1983 and only one low density area was surveyed in 1984 (Holman), while two relatively high density study areas were surveyed both years.

Direct indications of differences between years were observed in the three study areas surveyed both years. Both higher numbers of successful pairs and greater production of young in 1984 in the Coppermine, Cambridge Bay and Frobisher Bay study areas confirmed differences between 1983 and 1984 (Table 8). Similarly, one low density study area (Spence Bay) surveyed in 1982 (Bromley 1983) averaged 1 pair per 931 km^2 compared to 1 pair per 1,862 km^2 in 1983. In the Baffin Region, a similar and more dramatic decline from 1982 to 1983 was observed in the same Frobisher Bay area, from 1 pair/683 km^2 in 1982 (Bromley 1983) to 1 pair/2050 km^2 in 1983. Thus, the data indicate that the lower measure of territorial pairs in 1983 was real, rather than simply an artifact of different study area locations.

One factor in Baffin in 1983 which contributed to the extremely low density of territorial pairs was the timing of the survey. During that year, surveys did not occur until 27 July to 5 August. By this date, a few young have fledged already although most would still be in the nest (Bromley 1983). Of greater importance as a source of error is that many unproductive pairs

Table 8. Density and production of Gyrfalcons in 1983 compared to 1984 for three study areas in the Central and Eastern Arctic, NWT.

Location	Year	Number of territorial pairs[a]	Density of pairs (km^2/ territory)	Production of young
Coppermine	1983	3	776	7
	1984	14	254	30[b]
Cambridge Bay	1983	18	142	25
	1984	15	133	31
Frobisher Bay	1983	1	2,050	2
	1984	13	228	25[b]

a Number of territorial pairs and thus also density of pairs in Frobisher Bay (1983) are underestimates due to lack of spring snowmobile surveys, which did occur in Cambridge Bay and Frobisher Bay (1984).

b Since the Coppermine and Frobisher Bay survey areas were expanded in 1984, figures for total production of young are not directly comparable. For Coppermine, the same area surveyed in 1983 and 1984 produced 7 and 16 young, respectively. For Frobisher Bay, the same area surveyd in both 1983 and 1984 produced 2 and 8 young, respectively.

have abandoned their territories by that date, whereas observers in earlier surveys such as in 1982 (early July) and 1984 were more likely to have recorded pairs before the falcons left the vicinity of unproductive nests.

Finally, spring surveys by snowmobile were not conducted in 1983 in the Baffin Region, while they were in 1984. Nine of 23 active territories located in the spring in the three Baffin study areas were inactive by the time of the helicopter survey in mid-July. These nine sites may represent nesting attempts which failed or, in the cases of four nests, were not relocated in July (McLean 1984). Such information would serve to accentuate differences between 1983 and 1984 in Baffin. Since spring surveys were conducted on the Cambridge Bay study area in both years, differences in the Kitikmeot Region were probably not over emphasized.

In summary, despite differences in the location of some study areas and the absence of spring snowmobile surveys in some areas, a real decline in density of territorial pairs was documented in both regions in 1983 from 1982 numbers with a subsequent increase to beyond even 1982 densities in 1984.

Bromley (1983) discussed the density of territorial pairs surveyed in 1982 and compared those values with the literature. In reiteration, the areas selected for survey were chosen partly because they had some cliff habitat suitable for nesting. Therefore, the densities should not be extrapolated to a large part of the regions concerned or to the NWT as a whole. The NWT Department of Renewable Resources is developing a system of classification for raptor habitat, from which extrapolation of density data may occur.

Spring Phenology and Nesting Chronology

Phenological conditions on the Cambridge Bay study area were 10 to 14 days advanced in 1984 compared to 1983 (Poole and Bromley 1985). According to local accounts mild spring temperatures and snow melt also came early to other study areas in 1984 in both the Kitikmeot and Baffin regions. This was confirmed by climatological data (Table 9), though to a much lesser degree for the Baffin than for the Kitikmeot Region.

Concomitant with phenological differences were differences in the chronology of reproductive activities of Gyrfalcons. In the Kitikmeot Region, the average date of initiation of egg laying was 10 days earlier in 1984 than in 1983; egg laying was also approximately 10 days earlier in the Baffin in 1984 than for the few nests recorded in 1983 or 1982 (Table 10). Poole and Bromley (1985) discussed in greater detail how phenology might affect the timing of reproductive activities of the falcons, through the availability of ptarmigan at a critical time in the spring.

Timing and Accuracy of Productivity Measurements

Measurements of productivity of Gyrfalcons, or average number of young per territorial pair, can be biased according to the timing and frequency of surveys. July helicopter surveys yield over estimates of productivity when spring surveys have not been conducted, because at least some pairs that attempted to nest and

Table 9. Climatic variables from Cambridge Bay, Coppermine and Frobisher Bay in 1983 and 1984[a].

	Mean daily temperature (°C)				Difference (°C) from normal			
	1983		1984		1983		1984	
Community	May	June	May	June	May	June	May	June
Cambridge Bay	-14.9	+3.6	-6.2	-4.6	-5.5	+2.1	+3.2	+3.1
Coppermine	-13.3	+5.0	+0.3	+4.9	-8.0	+1.2	+5.6	+1.1
Frobisher Bay	-6.1	+3.8	-5.1	+3.6	-2.9	+0.4	-1.9	+0.2

a Data from Climatic Perspectives, Canada Department of the Environment 1983 and 1984.

Table 10. Reproductive chronology of Gyrfalcons in the Kitikmeot and Baffin regions during the 1983 and 1984 surveys compared to 1982[a].

Location	Number of nests		Initiation of egg-laying		Hatch		Fledging	
	1983	1984	1983	1984	1983	1984	1983	1984
Kitikmeot Region								
Coppermine	2	7	14 May	3 May	18 June	7 June	4 August	24 July
Cambridge Bay	10	11	16 May	5 May	20 June	9 June	6 August	26 July
Spence Bay	2	--	25 April	--	30 May	--	16 July	--
Fort Ross	1	--	7 May	--	11 June	--	8 July	--
Average dates			12 May	4 May	16 June	8 June	2 August	25 July
1982 dates			>18 May		>22 June		>8 August	
Baffin Region								
Frobisher Bay	1	6	11 May	6 May	15 June	9 June	1 August	26 July
Lake Harbour	1	--	18 May	--	22 June	--	8 August	--
Cape Dorset	3	--	18 May	--	22 June	--	8 August	--
Pangnirtung	--	8	--	10 May	--	14 June	--	31 July
Broughton Island	--	2	--	16 May	--	14 June	--	31 July
Average dates			17 May	9 May	21 June	13 June	7 August	30 July
1982 dates			>20 May		>24 June		>10 August	

a Based on estimated age of young when found, and assuming 35 day incubation period beginning immediately with first egg laid; and 47 day nestling period.

failed are likely to depart their territories by July. The number of territorial pairs is, therefore, lower in July than in May/June.

To investigate the extent of this bias, we summarized productivity data for territorial pairs observed or checked during both spring and summer surveys compared to productivity data for summer surveys only. We found that over all areas and both years, summer surveys overestimated productivity by 50% (2.4 young compared to 1.6 young, Table 11). This was largely due to abandonment of territories (13 out of 16 cases, Table 12) prior to the summer survey. Thus, we highly recommend that for estimates of productivity of falcons at least two visits to survey areas, one during incubation and one during the nestling period, should be undertaken each year to provide accurate and comparative information between areas and years. If only one survey can be conducted, the early survey should be done if population information is most important, or a late survey if measuring production of young is the primary objective.

<u>Regional Productivity and Production</u>

Productivity of successful pairs was similar to those rates reported in the literature, as reviewed by Poole and Bromley (1985). The 1983 rates were moderate in both the Kitikmeot and Baffin regions (2.6 and 2.4 young per productive pair, respectively, Table 13) and slightly higher in both regions during 1984 (2.8 and 2.6, respectively, Table 14). Nest success was similar between years, but did reflect the same trend as shown in

Table 11. A comparison between measures of productivity of Gyrfalcons in the NWT based on the results of spring (snowmobile) and summer (helicopter) surveys combined versus results based on summer surveys only.

	Active territory				Productivity[a] based on		
Location/Year	Spring	Summer	Common to both	Total number of unique territories	Total number of young	Summer only	Spring and summer
Cambridge Bay 1983	14	9	9	14	21	2.3	1.5
Cambridge Bay 1984	15	11	11	15	31	2.8	2.1
Frobisher Bay 1984	10	8	7	11	18	2.3	1.6
Pangnirtung 1984	9	7	6	10	13	1.9	1.3
Broughton 1984	5	2	1	6	4	2.0	0.7
All areas and years	53	37	34	56	87	2.4	1.6

a Number of young per territorial pair.

Table 12. The July status of nest sites located during surveys by snowmobile in the Kitikmeot (1983, 1984) and Baffin regions (1984)[a].

Survey area	Active territories located in May/June	Status in July Survey			
		Occupied	Active but unproductive	Inactive	Unconfirmed (not found)
Cambridge Bay					
1983	15	10	--	5	--
1984	14	11	--	3	--
Baffin Region 1984					
Broughton Island	4	1	--	3	--
Frobisher Bay	10	5	2	1	2
Pangnirtung	9	5	1	1	2
Total	23	11	3	5	4

a Nests which were found in new areas during the helicopter survey or were missed during the snowmobile survey were not included in this comparison.

Table 13. Productivity of Gyrfalcons measured during the nestling period, 1983 in the Kitikmeot and Baffin regions.

Area	Number of territorial pairs	Number of productive pairs (%)	Calculated minimum clutch size $\underline{x}$ (n)	Number of young per productive nest	Productivity (number of young/ territorial pair)
<u>Kitikmeot</u>					
Coppermine	3	2(67)	3.5(2)	3.5	2.3
Cambridge Bay[a]	18	11[b] (61)	2.8(12)	2.3	1.4
Spence Bay	2	2(100)	3.5(2)	3.5	3.5
Fort Ross	1	1(100)	2.0(1)	2.0	2.0
Sub-total	24	16(67)	2.9(17)	2.6	1.7
<u>Baffin</u>					
Frobisher Bay	1	1(100)	2.0(1)	2.0	2.0
Lake Harbour	1	1(100)	2.0(1)	2.0	2.0
Cape Dorset	3	3(100)	2.0(3)	1.7	1.7
Sub-total	5	5(100)	2.0(5)	1.8	1.8
Total	29	21(72)	2.7(22)	2.4	1.7

a Cambridge Bay was the only survey area that was also surveyed by snowmobile during spring 1983.

b One nest was treated as productive with two young, but the nest actually failed due to disturbance by investigators.

productivity data, of higher success in 1984 for the Kitikmeot Region (Tables 13 and 14).

Total production of young varied considerably more between years than did either nest success or productivity. ʟy examining those study areas surveyed during both 1983 and 1984, it is evident that production of young increased dramatically in 1984 from the previous year. Those portions of the Coppermine and Cambridge Bay areas surveyed in both years produced 32 young in 1983 and 47 young (up 47%) in 1984; that part of the Frobisher Bay survey area censused in both years produced two young and eight young (up 30%), respectively.

The mechanisms by which production of Gyrfalcons is regulated in the central and eastern Canadian Arctic are not understood. In the western arctic, such as the Yukon, there is a strong correlation between Willow Ptarmigan (Lagopus lagopus) numbers and Gyrfalcon production (Barichello and Mossop 1983). There the Willow Ptarmigan population apparently fluctuates in a cyclic manner over 10-year intervals. Gudmundsson (1960) also states that Rock Ptarmigan (L. mutus) in Iceland exhibit 10-year cycles. To date there have been few attempts in the NWT to monitor Rock Ptarmigan numbers, other than our program on a central arctic study area initiated in 1983 (Poole and Bromley 1985). Detailed studies of Rock Ptarmigan population dynamics in the central and eastern arctic of the NWT are required.

Perhaps more important than numbers of ptarmigan is simply the presence and availability of these prey to Gyrfalcons at a critical point in early spring. This theory is supported by the

Table 14. Productivity of Gyrfalcons measured during the early nesting and nestling period, in the Kitikmeot and Baffin regions, 1984.

Area	Number of territorial pairs	Number of productive pairs (%)	Calculated minimum clutch size[a] $\bar{x}$ (n)	Number of young per productive nest	Productivity (number of young/ territorial pair)
Kitikmeot					
Coppermine	14[b]	11(79)	2.9(11)	2.7	2.1
Cambridge Bay	15	11(73)	3.6(11)	2.8	2.1
Holman	0[b]	0	0	0	0
Sub-total	29	22(76)	3.3(22)	2.8	2.1
Baffin					
Frobisher Bay	13	8(62)	3.3(8)	3.1	1.9
Pangnirtung	12	8(67)	2.5(8)	2.1	1.4
Broughton Island	5	2(40)	2.0(2)	2.0	0.8
Sub-total	30	18(60)	2.8(18)	2.6	1.6
Total	59	40(68)	3.0(40)	2.7	1.8

a Minimum clutch size was determined by adding the number of eggs (alive or dead) and young (alive or dead). Since some eggs and young were missing from nests without our knowledge of their existence, this figure is smaller than actual clutch size.

b Little or no survey work was conducted in the Coppermine and Holman areas during spring (early nesting season) 1984, compared to intensive spring work in all other areas.

results of a study in the Yukon (Barichello pers. comm.). Newton and Marquiss (1981) have demonstrated a relationship between food availability, laying dates and clutch size of accipiters. If such is the case for Gyrfalcons, the chronology of the late winter/early spring migration of Rock Ptarmigan may be a limiting factor influencing Gyrfalcon production on our survey areas. This possibility implies the need to study the chronology of early spring movements of Rock Ptarmigan to and/or through the nesting areas of Gyrfalcons in relation to timing of reproductive activities and reproductive success of the falcons.

Although there is no information available on abundance of ptarmigan in south Baffin Region, there has been a study of the monthly harvest of ptarmigan by resident Inuit since 1981 (Pattimore pers. comm.). We reviewed the estimated ptarmigan harvest for March, April and May for the period for which data are available, and compared it to Gyrfalcon production in the years 1982 to 1984 (Table 15). Although based on preliminary harvest data for ptarmigan, it is apparent that the year of exceptional Gyrfalcon production in south Baffin occurred when the human harvest of ptarmigan was considerably higher early in the spring (April) rather than late (May). Presumably the early harvest indicated an early influx of ptarmigan into the region. Long term studies are necessary to test whether or not this relationship holds and can be used to predict production of Gyrfalcons from year to year. It may be that the timing of the influx of ptarmigan onto gyrfalcon nesting grounds may be more critical than their abundance.

Table 15. Total estimated ptarmigan harvest from four south Baffin communities[a] for March through May, 1982 through 1984.

	1982	1983	1984
March	403	154	0
April	238	990	2,831
May	3,808	4,610	672
April/May ratio	0.06	0.21	4.21
Gyrfalcon[b] reproductive success	444	740	148

a Communities for which estimates of ptarmigan harvest were available for all 3 years were Cape Dorset, Frobisher Bay, Pangnirtung and Broughton Island.

b This figure (km^2 of area per young produced) was calculated by dividing the area surveyed in south Baffin in 1983 and 1984 (Tables 5 and 6) by the number of young produced (Tables 12 and 13). Similar calculations were made for 1982 from Bromley (1983).

Further confounding the factors influencing production are the food habits of Gyrfalcons on the eastern arctic survey areas. Preliminary analysis of prey remains collected at nest sites during surveys and banding indicate heavy use of seabirds, including Black Guillemots and gulls by nesting Gyrfalcons. Nevertheless, spring food habits are poorly known, and might still indicate a dependency on ptarmigan during the early part of the breeding season. Seabirds are typically considered fairly stable (numerically), k-selected species with low rates of productivity and long lives. Thus, if Gyrfalcons in the eastern arctic rely solely on seabirds, the degree to which food limits falcon production should vary minimally from year to year with one exception. As with ptarmigan, the timing of seabird arrival on their nesting grounds could still effect initial reproductive efforts of the Gyrfalcons.

Reoccupancy Rates of Territories

Reoccupancy rates of Gyrfalcon territories between consecutive years were generally high (Table 16). One exception was the Baffin Region from 1982 to 1983, where reoccupancy was only 22%. This figure is likely biased downwards due to the timing of the 1983 survey (late summer after some birds, which were territorial in the spring, had been reproductively unsuccessful and abandoned their territories). Since reproductive success in that area was particularly low in 1983, a greater proportion of pairs had been unsuccessful, and thus were likely to

Table 16. Reoccupancy of Gyrfalcon territories in the Kitikmeot and Baffin regions, NWT for 1982 to 1984.

Years of comparison	Kitikmeot Region n	(%)	Baffin Region n	(%)
1982/1983	12/17	(71)	4/18	(22)
1983/1984	13/19	(68)	1/1	(100)

leave their territories, than occurred in 1982. Similarly, the small sample size common to both 1983 and 1984, and the dramatic rise in reproductive activity in 1984 in the Baffin, account for the inflated estimated of 100% reoccupancy based on the single nest site checked and active in both 1983 and 1984.

The Kitikmeot Region surveys provided a more rigorous measure of reoccupancy rates of Gyrfalcon territories (Table 16). The similar rates of 71% and 68% probably reflect the benefits of survey effort common in both timing and in area covered throughout the 3 year period studied. These reoccupancy rates indicate a fairly high degree of traditional use of territories by Gyrfalcon. Mossop (1980) came to a similar conclusion in a study of Gyrfalcons on the north slope of the Yukon Territory.

Peregrine Falcons

Although the surveys were timed to maximize observations of Gyrfalcons, opportunistic records of territorial and nesting Peregrine Falcons were noted regularly. Few peregrines had returned to survey areas during the early spring snowmobile surveys, so most observations were made during helicopter surveys in July. At the time of the July surveys peregrine nests contained eggs and/or small young. Characteristic behaviour of adult females at this time was to sit tightly on the nest, not flushing even when the helicopter passed within 15 to 20 m of the nest. Such behaviour by peregrines often resulted in no opportunity to document the number of eggs or young in the nest. Occasionally the nest itself could not be located.

Density and Distribution

Regional densities of territorial pairs of Peregrine Falcons varied from 1 pair per 498 km^2 in Baffin in 1984 to 1 pair per 97 km^2 in the Kitikmeot during the same year (Tables 17 and 18). Increased survey effort in the Cambridge Bay area in 1984 resulted in a higher and more accurate record of peregrines than had been obtained in 1983 (Poole and Bromley 1985). The low densities recorded in the Spence Bay area were down from earlier observations of 1 pair/413 km^2 in 1982 (Bromley 1983). South Baffin densities were higher in 1983 (1 pair /202 km^2) than in 1982 (1/303 km^2, calculated from Bromley 1983). Adding two new study areas and dropping two old ones in Baffin render 1983 and 1984 incomparable, except for Frobisher Bay which had a higher density in 1983 (1/205 km^2) than in 1982 (1/2050 km^2, Bromley 1983) or 1984 (1/330 km^2).

McLaren and Alliston (1981) conducted 17 h of raptor surveys in the Minto Inlet/Holman area of the Kitikmeot Region from 3 to 14 July 1980. They observed 17 Peregrine Falcon sites (1 site per h), including two occupied nests and eight sites with territorial birds which were suspected to be nesting. During our July 1984 surveys in an area which overlapped at least 50% with McLaren and Alliston's survey area, we observed 24 active territories of peregrines (Table 18) in 15 h (1.6 sites per h) of flying (Table 3). In nine of the 24 territories we spotted the nest with eggs, small young or the females in an incubating position. Six sites had territorial pairs but no nest was located, while single birds were observed at nine sites.

Table 17. Density of territorial pairs of Peregrine Falcons in Kitikmeot and Baffin regions in 1983.

Survey area	Area surveyed (km^2)	Number of active territories	Density of territories (km^2/territory)
Kitikmeot Region			
Coppermine	2328	16	146
Cambridge Bay	2554	8	319
Spence Bay	3724	5	745
Fort Ross	2253	1	2253
Sub-total	10,859	30	362
Baffin Region			
Frobisher Bay	2050	10	205
Lake Harbour	1661	14	119
Cape Dorset	2952	9	328
Sub-total	6663	33	202
Total	17,522	63	278

Table 18. Density of territorial pairs of Peregrine Falcons in Kitikmeot and Baffin regions in 1984.

Survey area	Area surveyed (km^2)	Number of active territories	Density of territories (km^2/territory)
Kitikmeot Region			
Coppermine	3350	30	112
Cambridge Bay	2000	28	71
Holman	2624	24	109
Sub-total	7974	82	97
Baffin Region			
Frobisher Bay	2974	9	330
Pangnirtung	2728	5	546
Broughton Island	1275	0	---
Sub-total	6977	14	498
Total	14,951	96	156

Previous survey work in south Baffin has yielded conflicting results on the densities of Peregrine Falcons. Soper (1946) observed few birds in that region, while MacPherson and McLaren (1959) recorded the species as common. Fyfe (1969) classified south Baffin as optimal habitat for peregrines. During the 1970 North American Peregrine Survey, J. Weaver and J. Crier checked seven eyries located in south Baffin during 1200 miles (1920 km) of travel by boat (Cade and Fyfe 1970). Five eyries were occupied. In 1980, G. Court checked five of those seven eyries and found no birds, while he located one new site occupied by a pair and three young (White and Fyfe 1985). As noted, Bromley (1983) reported 22 territorial pairs during a helicopter survey in 1982 ($1/303\ km^2$).

The wide variation in findings of various investigations probably reflect two factors. First, survey methods and intensity have varied considerably from one study to another. Secondly, findings may well represent a wide variation in nesting activities of Peregrine Falcons over a number of years. Weaver and Grier (in Cade and Fyfe 1970) mentioned the extremely inclement weather conditions during the reproductive season in 1970. Temperatures were considerably below normal and snowfall during June and July was well above normal. Bromley (in press) discusses the status of peregrines in Baffin Region from 1982 through 1985 in more detail.

Productivity

Productivity was measured at the late incubation-early nestling stage, and reported as the number of eggs and/or young per successful pair. As indicated previously, productivity data was gathered for relatively few pairs, in order to minimize disturbance at nests and to conserve helicopter time.

In 1983 and 1984, peregrines had an average of 2.8 (n=22) and 3.0 (n=26) eggs/young per successful pair (Tables 19 and 20). Ratcliffe (1980) noted that peregrines generally lay three to four eggs per clutch. In northern Alaska, Cade (1960) reported an average of 2.5 young per successful pair. Other researchers in the NWT have documented productivity of 2.5 young/successful pair (n=19, Alliston and Patterson 1978), 2.5-2.9 young/pair (n=89, Calef and Heard 1979) and 2.8-3.0 young/pair (n=14, Court and Gates 1982, 1983). Figures from this study are similar to those reported in the literature, particularly since some mortality between the time of our observation and fledging was likely (Ratcliffe 1980, Pruett-Jones et al. 1981). A reduction of 29% between the egg stage and fledging (Ratcliffe 1980) and of 15% between hatching and fledging (Pruett-Jones et al. 1981) were recorded in those studies.

Nesting Chronology

Peregrine Falcons in the survey areas tended to begin nesting slightly earlier in the central arctic than in the eastern areas (Table 21). Due to the timing of surveys, particularly in the Kitikmeot Region, nests often contained eggs only, thereby preventing back dating to determine dates of nest initiation. For intensive studies of nesting Peregrines at these latitudes, we recommend a nesting pair survey in mid- to late June, followed by production surveys in early August.

Table 19. Tundra Peregrine Falcon site occupancy and production in the Kitikmeot and Baffin regions, 1983.

Location	Number of active territories	Sites with: 0 adults	1 adult	2 adults	Number of sites where number of eggs/young known	Total eggs/young	$\bar{x}$ number of eggs or young per productive site[a]
Kitikmeot							
Coppermine	16	0	8	8	2	7/0	3.5
Cambridge Bay	8	0	7	1	3	11/0	3.7
Spence Bay	5	0	3	2	–	–	
Fort Ross	1	0	1	0	–	–	–
Sub-total	30	0	19	11	5	18/0	3.6
Baffin							
Frobisher Bay	10	2	7	1	5	0/13	2.6
Lake Harbour	14	3	8	3	7	0/18	2.6
Cape Dorset	9	0	6	3	5	0/13	2.6
Sub-total	33	5	21	7	17	0/44	2.6
Total	63	5	40	18	22	18/44	2.8

a In the Kitikmeot Region survey peregrines had eggs only, while during the Baffin survey, only young were present.

Table 20. Tundra Peregrine Falcon site occupancy and production in the Kitikmeot and Baffin regions, 1984.

Location	Number of active territories	Sites with 0 adults	Sites with 1 adult	Sites with 2 adults	Number of sites where number of eggs/young known	Total eggs/young	$\bar{x}$ number of eggs or young per productive site[a]
Kitikmeot							
Coppermine	30	0	17	13	10	32	3.2
Holman	24	0	16	8	3	9	3.0
Cambridge Bay	28	0	14	14	12	33	2.8
Sub-total	82	0	47	35	25	74	3.0
Baffin							
Frobisher Bay	9	0	6	3	1	4	4.0
Pangnirtung	5	0	3	2	0	--	--
Broughton Island	0	--	--	--	--	--	
Sub-total	14	0	9	5	1	4	4.0
Total	96	0	56	40	26	78	3.0

Table 21. Nesting chronology of Tundra Peregrine Falcons in the Baffin Region, 1983 and the Kitikmeot Region, 1984.

Region	Year	n	$\bar{x}$ laying date	$\bar{x}$ hatching date	$\bar{x}$ fledging date
Baffin	1983	16	19 June	21 July	29 August
Kitikmeot[a]	1984	12	4+ June	6+ July	14+ August

a Since 8 nests in the Kitikmeot Region in 1984 had eggs only when last observed, the dates reported are average minimums rather than actual averages. The true average dates were undoubtedly later than those presented here.

Common Ravens

Ravens begin nesting at approximately the same time as Gyrfalcons; however, with an incubation period of 20-21 days and a nestling period of 35-42 days (Harrison 1978), the young fledge 2-3 weeks before Gyrfalcon young.

Production of ravens varied from 1.7 young per nest in the Baffin 1984 to 3.3 young per nest in the Kitikmeot Region in 1983 (Table 22), similar to production in 1982 (Bromley 1983). Although the number of active nests dropped by 33% in the Baffin Region from 1983 to 1984, and reoccupancy rates dropped similarly (Table 23), there were no active raven nests in 1983 that were occupied by Gyrfalcons in 1984. In general, reoccupancy rates of raven nests from year to year (Table 23) were considerably lower than that observed for either Gyrfalcons or Peregrine Falcons.

Golden Eagles

Golden Eagles nest in the Kitikmeot Region but not in the Baffin Region. A total of 25 active nests were located in 1983 and 25 active nests in 1984 (Table 24). The mean number of young per nest was 1.5(±0.8, n=11) in 1983 and 1.3(±0.4, n=15) in 1984. Gyrfalcons have been observed using nests previously built by Golden Eagles (Bromley 1983, Poole and Bromley 1985) and competition for nest sites between the two species is likely. Golden Eagles were productive at four nests in 1983, which had been occupied in 1982 (Table 25). In 1984 a total of six sites which had been occupied by Golden Eagles in 1983 were productive

Table 22. Production at Common Raven nests in 1983.

Region	Year	Number of active nests	Number of known productive nests	Number of nests where young counted	Number of young	Number of young/nest x (SD)
Kitikmeot	1983	20	14	8	26	3.3(0.7)
	1984	22	14	14	38	2.7(0.9)
Baffin[a]	1983	18	14	1	3	3.0 -
	1984	12	3	3	5	1.7(0.9)

a Data is based on evidence of (1) occupancy and (2) duration of occupancy (whitewash, prey remains) at nest sites. The 1983 and 1984 surveys occurred after most ravens had already completed the nesting cycle. Only one nest still contained young in 1983 and three in 1984.

Table 23. Reoccupancy of Common Raven nests in 1983 and 1984 in Kitikmeot and Baffin regions, NWT.

Region	Year	Proportion of previous year's site checked n(%)	Occupancy of sites occupied in previous year n(%)	Number of previous sites inactive n(%)	Number of previous year's sites occupied by Gyrfalcons n(%)
Kitikmeot	1983	7/16(44)	0(0)	4(57)	2(29)
	1984	18/26(69)	3(17)	12(67)	3(17)
Baffin	1983	14/19(74)	5(36)	9(64)	0(-)
	1984	6/9(67)	1(17)	5(83)	0(-)

Table 24. Golden Eagle observations in the Kitikmeot Region, NWT, in 1983 and 1984.

Year and Location	Number of active territories	Number of active territories with 0 adults	1 adult	2 adults	Number of known productive nests (%)	Number of nests where young observed	Average number of young per nest (SD)
1983							
Coppermine	6	0	3	3	5(83)	4	2.0(1.0)
Cambridge Bay	18	7	8	3	7(39)	6	1.2(0.4)
Spence Bay[a]	1	0	1	0	1(100)	1	2.0(-)
Total	25	7	12	6	13(52)	11	1.5(0.8)
1984							
Coppermine	10	1	4	5	6(60)	6	1.3(0.5)
Cambridge Bay	15	2	6	7	9(60)	9	1.2(0.4)
Total	25	3	10	12	15(60)	15	1.3(0.4)

a The nest near Spence Bay contained 1 egg and 1 newly hatched young.

Table 25. Reoccupancy of Golden Eagle nests in 1982/83 and 1983/84 and comparison of production in the Kitikmeot Region, NWT.

Year	First year sites surveyed in second year n(%)	First year sites productive in first year n(%)	Reoccupancy of first year sites productive in second year n(%)	Production of young at sites in first year n(SD)	Production of young at sites in second year n(SD)
1982/83	11(100)	10(91)	4(36)	1.9(0.6)	1.3(0.4)
1983/84	27(90)	13(48)	6(22)	1.4(0.6)	1.2(0.4)

(Table 25). Production at individual sites was slightly lower in the second year of the two-year comparison.

Rough-legged Hawks

Rough-legged Hawk numbers have varied from high numbers in 1980 (McLaren and Alliston 1981) to relatively low numbers in 1982 (Bromley 1983), to highs in 1983 and 1984 in the Kitikmeot Region (Tables 26 and 27). The species is known to fluctuate numerically in a cyclic manner coincident with microtine numbers (Baker and Brooks 1981). Presumably the oscillations documented here reflect changes in lemming and vole populations, although we have no direct evidence of this. The average number of eggs or young per nest observed was 3.5 or greater during 1983 and 1984, indicating that availability of food was probably high.

On the Holman survey area in 1984, 160 Rough-legged Hawk nests (Table 27) were observed during 15 h of flying (10.7 nests per h of survey). Clutch size averaged 3.8 at 99 nests (Table 27). McLaren and Alliston also observed high densities of Rough-legged Hawks in that area during 1980 with 91 nests recorded during 17 h of surveys (5.4 nests per h). Clutch size in 1980 averaged 3.4 (n=14). Lemmings, generally considered to be the principle prey of rough-legs on Victoria Island are known to cycle in numbers over 2-5 (frequently 4) year periods (Banfield 1977).

Few Rough-legged Hawks were observed in the Baffin Region. According to Godfrey (1966), the species is at the limit of its natural range in south Baffin, so large numbers would not be expected. Possibly low availability of prey, including lack of

Table 26. Nesting observations of Rough-legged Hawks in the Kitikmeot and Baffin regions 1983.

Location	Number of occupied nests	Number of adults at nests	Number of eggs at nests (number of nests)	Mean clutch[a] or brood size
Kitikmeot Region				
Coppermine	91	124	93(23)	4.0
Cambridge Bay	13	15	7(2)	3.5
Spence Bay	8	9	-	-
Fort Ross	17	19	-	-
Sub-total	129	167	100(25)	4.0
Baffin Region				
Frobisher Bay	4	4	5(3)	1.7
Lake Harbour	2	1	6(2)	3.0
Cape Dorset	0	-	-	-
Sub-total	6	5	11(5)	2.2
Total	135	172	111(30)	3.7

a During surveys in the Kitikmeot Region, Rough-legged Hawk nests contained only eggs, while in the Baffin Region nests contained only young.

Table 27. Nesting observations of Rough-legged Hawks in the Kitikmeot Region, 1984.

Location	Number of occupied nests	Number of adults at nests	Number of eggs at nests (number of nests)	Mean clutch[a] or brood size
Coppermine	79	85	138(42)	3.3
Cambridge Bay	32	31	89(30)	3.0
Holman	160	120	375(99)	3.8
Total	271	236	602(171)	3.5

a Most nests contained young during the time of the survey.

alternate prey such as ground squirrels and passerines, limits the number of nesting Rough-legged Hawks in this region.

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Appendix I. Breakdown of helicopter survey time (h) and ferry time by region in 1983 and 1984.

Positioning of the helicopter for survey work in the arctic can be costly. In 1983 and 1984, actual survey hours accounted for 66% and 64%, respectively, of the total charter time. The remaining time was used to ferry the helicopter from community to community, since few, if any, helicopters are based in northern settlements.

Region	Year	Survey	Ferry	Total
Kitikmeot	1983	54	30	84
	1984	45	22	67
Baffin	1983	35	15	50
	1984	38	25	63
Total	1983	89	45	134
	1984	83	47	130