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A SURVEY OF THE BREEDING FALCONS OF EQALUNGMIUT NUNAAT, WEST GREENLAND IN 1984

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ABSTRACT.—A survey of Peregrine Falcons (*Falco peregrinus*) in continental West Greenland 120 km north of the Arctic Circle found a higher breeding density than reported elsewhere in Greenland. Casual observations of Gyrfalcons (*Falco rusticolus*) during early spring suggested a larger population than was later found. Peregrine hatching dates and productivity were similar to other West Greenland studies, although nest aspect in the present study was less predictable. Interspecific competition for nesting cliffs, asynchronously-hatched broods and the possibility of renesting and 'alternative' nesting sites are discussed.

As a member of the 1984 Greenland White-fronted Goose Study Expedition, I spent the period 1 May–13 August in low arctic Western Greenland. The falcon project arose from a personal interest in raptors and was part of a general ecological investigation of the study area. The aim was to gather information on the location, occupation and breeding success of Gyrfalcon (*Falco rusticolus*) and Peregrine Falcon (*Falco peregrinus*) eyries.

STUDY AREA

Eqalungmiut Nunaat is an essentially triangular area of upland tundra adjoining the western edge of the Greenland ice sheet (Fig. 1) bounded on two further sides by broad (1–3 km), flat, melt-river valleys which join at its western extremity to form the southern arm of Nagsuggtoq (Nordre Strømfjord). Central co-ordinates of 50°30'W, 67°30'N, place the area approximately 120 km north of the Arctic Circle, and 65 km north of Kangerlussuaq (Søndre Strømfjord).

Eqalungmiut Nunaat is a region approximately 750 km^2 of often bare gneissic plateau with whaleback ridges, small, broken crags, lakes and damp gullies rising from sea level to a maximum altitude of 631 m. The region is part of a tract of apparently similar terrain stretching far to the north and south, intersected by valleys, minor and major, sometimes flanked by high cliffs, and occasionally forming deep gorges with sheer, rocky sides. The glacial melt-rivers are particularly cliff bound in places, with sheer rock dropping up to 250 m from the plateau.

METHODS

The survey period was between 23 May and 10 August 1984. Visits were made to sites occupied by falcons in 1979 (Fox and Stroud 1981) as time and weather conditions allowed. Reports of calling falcons were followed up, and speculative visits were made to previously unknown areas. A cliff thought suitable for an eyrie was observed from a distance until the presence or absence of falcons was confirmed. Signs such as old stick nests, patches of 'whitewash' and orange lichen (*Caloplaca* sp.) were useful in locating potential nest sites, but the exact location of the scrape was confirmed only after use by falcons was seen.

On each visit the stage in the breeding cycle was assessed, and an attempt was made to count and age young when present. Hatching dates were estimated by backdating from the estimated age of nestlings (see Anderson and Hickey 1970). Nesting ledges were not visited, nor were prey remains collected. Time constraints restricted the area which could be covered, but the survey is thought to be complete over an area of 560 km^2. The study area can conveniently be regarded as an island for determining mean territory size.

RESULTS

Peregrine Falcon. Thirteen Peregrine territories were found, one of which was later deserted, and another of which held just a single adult; eleven pairs were thought to have reared young (Table 1). However, distribution was by no means uniform, and a large (125 km^2) discrete area appeared to be unoccupied by Peregrines. At least one pair held territory in the unoccupied area in 1979, but a recent rock fall on the then occupied cliff may have destroyed the nesting ledge; however, no sign of occupancy was found on numerous, apparently suitable, cliffs nearby. Other sheer rockfaces were discovered in the 'empty quarter' which were apparently unoccupied during incubation. Eyries may have been missed during this, the 'quiet' period at these latitudes, but the nature of the cliffs suggested that nesting sites were not numerous there. Any additional eyries would, of course, increase the breeding density given below.

In Table 2 the mean territory size and mean inter-eyrie distance are given for Eqalungmiut Nunaat and compared with those for several parts of the Arctic and of the British Isles. The use of the term 'territory size' does not imply an area defended or used exclusively by one pair of falcons. The density of breeding Peregrines in Eqalungmiut Nunaat is similar to that in 'prime' British habitat (i.e., an area thought by Ratcliffe (1980) to have abundant prey

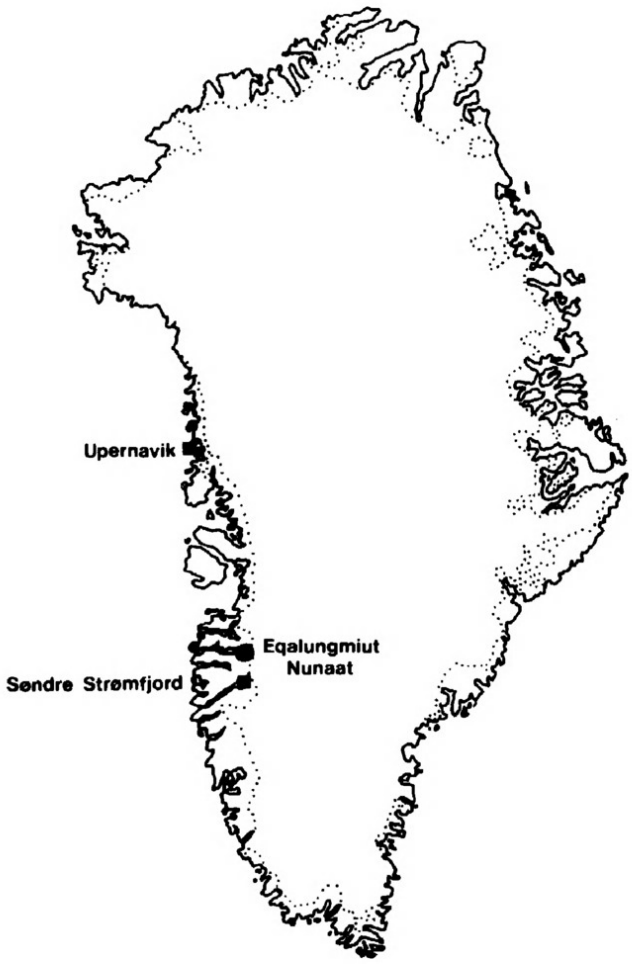

Figure 1. Map of Greenland showing approximate location of Eqalungmiut Nunaat study area.

and nesting places), higher than that in the Søndre Strømfjord area (Burnham and Mattox 1984) and considerably higher than that for Southern Greenland (Falk and Moller 1986). In Table 3, I have given densities for Eqalungmiut Nunaat as a whole (A), and the area actually occupied (B). It is recognised that the latter may be, to some extent, an arbitrary measurement, given that Peregrines nesting there may have hunted in the unoccupied area. Nevertheless, some idea results of the high density reached there. I have compared these figures with densities discovered in the Søndre Strømfjord area (Mattox 1984). Density in area (B) approaches that in Northwest England in recent years but is considerably lower than that found in the Canadian tundra west of Hudson Bay (Court et al. in press).

High Peregrine breeding density in Eqalungmiut Nunaat is not easy to explain. Basic requirements would be an abundance of suitable nesting sites and of prey. All prey items seen being taken to an eyrie were small in size; Peregrine diet is likely to have been similar to that discovered by Burnham and Mattox (1984) in their nearby study area—more than 90% Lapland Longspur (*Calcarius lapponicus*), Snow Bunting (*Plectrophenax nivalis*), Wheatear (*Oenanthe oenanthe*), and Redpoll (*Carduelis flammea*). Mattox (pers. comm.) has found that Peregrine density is lower towards the West Greenland coast as reflected in the density calculations for his larger study area. Likely, an increase in Peregrine density had taken place since 1979, but the 1984 survey was very much more thorough, rendering a meaningful comparison difficult. This study confirms the finding of high productivity of young Peregrines in West Greenland (Burnham and Mattox 1984).

Cliff aspect was estimated for each eyrie, and in contrast with the findings of Burnham (1975), both north- and northwest-facing cliffs were occupied. Burnham discovered a mean aspect of almost due

Table 1. Comparison of Peregrine Falcon breeding success in Western Greenland and Great Britain.

AREA	PAIRS HOLDING TERRITORY	SUCCESSFUL PAIRS	BREEDING SUCCESS	BROOD SIZE ($\bar{x}$)	YOUNG/ PAIR
Eqalungmiut Nunaat (1984)[a]	12	11	92%	2.3	2.1
West Greenland (1972–84)[b]	—	—	83%	2.8	2.3
West Greenland (1984)[b]	30	22	73%	3.2	2.3
Great Britain (1976–80)[c]	—	—	56%	2.3	1.3

[a] Mean brood size (and therefore young/pair) may have been under-estimated as nesting ledges were not visited. Note also small sample size—7 broods.

[b] From Mattox (1984).

[c] From Ratcliffe (1984). Young/pair in an increasing but non-migratory population.

Table 2. Comparison of mean inter-eyrie distance and mean territory size (all pairs) for some Peregrine Falcon populations.

AREA	MEAN INTER-EYRIE DISTANCE (km)	MEAN TERRITORY SIZE (km^2)[f]
Eqalungmiut Nunaat (A)[f] (1984)	5.2	46.7
Eqalungmiut Nunaat (B)[f] (1984)	5.2	36.2
West Greenland (1984)[a]	7.7	86.3
South Greenland[b]	—	240
Northwest Territories, Canada (west coast of Hudson Bay)[c]	3.3	17
Inland Northwest England (1930–60)[d]	5.0	42.3
Inland Northwest England (1982)[e]	4.6	32.0

[a] Figures from Mattox (1984) but see also Burnham and Mattox (1984).
[b] See Falk and Moller (1986).
[c] See Court (1986) and Court et al. (1987).
[d] An inland area thought by Ratcliffe (1980) to have abundant nesting places and prey, and therefore maximum Peregrine density.
[e] Increased density since recovery from pesticide crash (Ratcliffe 1984).
[f] See text.

Table 3. Mean territory size of Peregrine Falcons in West Greenland 1984.

AREA	MEAN TERRITORY SIZE (km^2)[a]		
	SUCCESSFUL PAIRS	PAIRS IN TERRITORY	TOTAL TERRITORIES
Eqalungmiut Nunaat A[a]	50.9	46.7	43.1
Eqalungmiut Nunaat B[a]	39.5	36.2	33.5
West Greenland[b]	117.3	86.3	66.4

[a] See text.
[b] From Mattox (1984).

south, while that for the present study was approximately 240°, or west-southwest. One north-facing eyrie in Eqalungmiut Nunaat had a late hatch date of 22 July. The majority of nesting cliffs were high and sheer, and at medium elevation. Eyrie elevation was between 150 m and 500 m, with a mean of 340 m. Eight successful cliff eyries were on sheer faces 60–120 m high, while a ninth was on a 20 m face at the bottom of an 80 m broken rocky slope. Two unsuccessful eyries were on 150 and 180 m sheer faces. Cliff height above the surrounding area was usually accentuated by a steep talus slope, which in many cases effectively doubled the height. The majority of eyries overlooked areas of flat terrain, often a lake or melt-river valley, with two exceptions: one eyrie on the sheer side of a deep (150 m) and narrow gorge was enclosed by the opposite wall, while a second pair nesting in another gorge had a limited view over the lower eastern wall.

Hatching took place between 2 and 22 July (8 broods) with a mean hatch date of 9 July compared with Mattox's (1984) mean for the same year of 7 July and a 1983 mean of 12 July (Burnham and Mattox 1984). The two day difference in 1984 mean hatch dates cannot be adequately addressed in view of this study's small sample size and different method of estimation. At one eyrie with a late hatch date (18 July), a Peregrine pair had been present since at least 23 May. Behaviour of the pair on that date, including courtship feeding and the sluggish behaviour of the female in particular, suggested that egg-laying was about to take place or had perhaps even commenced (the first casual sighting of a Peregrine in the area had been on 5 May). Activity took place at both the cliff eventually used (a 20 m face), and a sheer 120 m face with a Common Raven (*Corvus corax*) nest and copious white-wash, facing northwest, about 1 km away. The late estimated start of incubation (18 June) suggests that renesting may have taken place. Inclement weather during late May could have led to the loss of an unusually early first clutch at a more exposed but more secure alternative nesting site within the same territory. The larger cliff was occupied by Peregrines in 1979. Replacement clutches and the use of alternative cliffs are well-known phenomena at lower latitudes (in the British Isles, for example), but have not been proven in the Arctic, to my knowledge. W. G. Mattox (pers. comm.) believes that a 're-lay' may have taken place on one occasion in the Greenland Peregrine Falcon Survey area.

Gyrfalcon. Two successful pairs were found, rearing two and three young, while a third pair

deserted territory during or after incubation. All three occupied eyries were on south-facing cliffs, one at 450 m, two at 200 m. One additional eyrie occupied by Gyrfalcons in 1979 was used by ravens in 1984.

A large number of casual Gyrfalcon sightings during May and early June suggested a larger population than was eventually found. On the evidence of this survey, it is difficult to agree that numbers of Gyrfalcon and Peregrine nesting sites are similar in inland West Greenland (Burnham and Mattox 1984). It is known, however, that Gyrfalcon breeding populations fluctuate widely according to the availability of prey (Burnham and Mattox 1984). Late winter and early spring were exceptionally severe in central West Greenland which may have had a direct or indirect effect on Gyrfalcon numbers.

Seven unused eyries (identified by white-wash on cliffs), were found, mainly on lesser (<40 m), medium to high elevation (300–500 m) cliffs of varying aspect. Possibly Gyrfalcons occupied a proportion of perhaps less than ideal sites in more favourable years, or in fact some cliffs that were later occupied by Peregrines. At one south-facing 150 m cliff, nesting attempts by both Gyrfalcons and Peregrines took place. Observations at the cliff on 1 and 3 June suggested that Peregrines had recently arrived, evicted a pair of ravens and established a territory. Gyrfalcons were incubating about 600 m away and were driven off violently by the Peregrines when approaching too closely. Peregrine courtship displays and copulation were observed; there was no evidence of egg-laying, although this may have taken place elsewhere. Both pairs subsequently deserted the cliff, although the male Gyrfalcon was seen at the cliff in early August (interestingly, an identically plumaged male Gyrfalcon was seen on three occasions in mid-July at another cliff about 15 km away, and not previously or subsequently). Possibly inter-specific aggression contributed to the desertion of the cliff by both species. The two species were not known to have bred on the same cliff in Greenland until 1984 but do so in Alaska (White and Cade 1971). In 1984 two cliffs in the Søndre Strømfjord area held successful pairs of both species (Mattox 1984). However, unsuccessful attempts such as the one under discussion may have taken place on other occasions.

Asynchronously-hatched broods of both Peregrines (one brood of four) and Gyrfalcons (one brood of three) were recorded. The last-hatched in each brood had survived into the final third of the nestling period, and seemed healthy and vigorous in each case, despite appearing at least one week younger than its siblings. Burnham and Mattox (1984) have found small 'odd-age' young in several West Greenland eyries, but the smallest nestling has never survived to fledging. Court (1986) found that the last hatched Peregrine chicks in broods of four grew at the same rate as the first, second and third hatched chicks—if they survived the first week.

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