Falcon Research in Greenland, 1973

INTRODUCTION

During the summer of 1972 a research team initiated the first in-depth study of the peregrine falcon *(Falco peregrinus)* in West Greenland[1]. Eight eyries (nests) of this endangered species were located in an inland sample area of 700 sq. mi. Detailed observations were taken of peregrine breeding behaviour at one eyrie. Seven of the eyries produced young, containing an average of 2.57 young per successful eyrie. This high reproductive rate indicates a healthy population, but analyses of 2 addled eggs revealed high p,p'-DDE as well as polychlorinated biphenyl (PCB) residues[2] and eggshell fragments from 9 eggs showed a 14 per cent decrease in thickness compared with 42 eggs collected in Greenland before the introduction of DDT into the environment[3]. This combination of factors suggests that the population of peregrine falcons in West Greenland is nearing the critical point at which organochlorine insecticide residues concentrating within the birds are sufficient to cause eggshell thinning and resultant reproductive failure.

While the organochlorines are not used in Greenland, banding returns indicate that Greenland peregrines migrate down the east coast of North America to winter in Central and South America, and the Caribbean Islands[4]. On this migration and in its wintering area the peregrine is exposed to chlorinated hydrocarbon chemicals as well as to other pollutants. When it returns to its summer nesting grounds in Greenland, the peregrine feeds on small birds that migrate from Europe, North America and Africa. In this way the peregrine is also exposed to the pollutants found in those areas of the world.

West Greenland provides the opportunity to observe a peregrine population which still appears healthy but which nears the crucial point where reproductive failures begin. Furthermore, the few bird species present in Greenland make this an ideal area for studying interactions between the peregrine population and populations of other species. Finally, the peregrine's sensitivity to organochlorine pollutants makes the species a good indicator of the effect of human activities even on the remote tundra of Greenland. For these reasons plans were formulated for a long-term study of the peregrine in Greenland.

FIELD METHODS

The 1973 research began at the University Zoological Museum, Copenhagen, Denmark, where the peregrine falcon skin collection was examined to obtain data on collecting locations and dates, immature and mature plumage diversity, and structural measurements.

After arrival in West Greenland on 17 May, the first weeks were devoted to establishing a time-lapse photographic study on gyrfalcon *(Falco rusticolus)* behaviour at the eyrie. Observations were also made on the early arrival of peregrine falcons at nesting cliffs and activities of ravens *(Corvus corax)*, as well as other birds nesting within the study area. On 12 June, the research team began a resurvey and expansion of the 1972 survey area. Traverses of the area consisted of backpacking trips lasting 3 to 8 days, with limited use of a rubber raft and occasional helicopter support. Part of the area was first viewed from a light aircraft.

From 6 to 14 July an exploratory trip was made to the Angmagssalik District of East Greenland to obtain information from native inhabitants on falcon sightings and nesting.

Upon each visit to the nesting sites of both peregrines and gyrfalcons, pellets as well as feathers and bones from prey remains were collected for analysis. Descriptive data were taken from both old and occupied eyries of the peregrine, gyrfalcon, and raven to determine nesting requirements for these possibly competing species. The team banded all young peregrines with metal and plastic colour bands. Eggshell fragments, one addled egg, and bacterial cultures from mouth and cloaca were collected at the peregrine eyries.

During the whole study period, breeding birds were censused to establish relative abundance of prey species available for peregrines and gyrfalcons. The small passerines were counted in varied areas on 1000-pace traverses of the tundra. All birds appearing within 15 m. of the observer were recorded. One geographical location in the survey area was used as a standardization base so that fluctuations in population numbers due to young leaving nests and other influencing factors could be detected. Several other traverses were repeated throughout the season to obtain data on local fluctuations in prey numbers. Notes were taken on distribution of ducks and other large birds that had much lower breeding densities. Four ravens, 7 gyrfalcons, 25 Lapland longspurs *(Calcarius lapponicus)*, and 5 redpolls *(Carduelis flammea)* were banded. Specimens of prey species were collected for pesticide analysis.

The time-lapse photographic study of the

gyrfalcon's breeding behaviour began prior to egg hatching at 2 nesting locations 9 km. apart and continued through fledging at the first site. The photographic study of the first eyrie was combined with 75 hours of observation from a blind 20 m. from the nest and over 200 hours of non-blind observations. A total of 86,000 frames of super-8 movie film was exposed at the 2 eyries. The cameras took 1 frame every minute at the blind eyrie and every 3 minutes at the non-blind eyrie, but the camera at this eyrie failed after one week. Selected sequences of behaviour were also photographed at regular movie speed from the blind. Periodic collections of prey remains were made at each gyrfalcon cliff, and at the first site tail and tarsal measurements were taken from each young bird during the period of growth.

Even though the time-lapse cameras had to be set up in sub-freezing temperatures, both nests had 100 per cent hatching success. Installation of equipment and other time-consuming operations were conducted as quickly as possible to prevent egg-chilling. At one eyrie the eggs were placed in a heated container when technical difficulties arose.

To continue our study of peregrine breeding behaviour begun in 1972, a second eyrie was observed for 93 hours from 26 July to 5 August. The 3 young in the nest were 1 week old at the beginning of this 11-day period. Notes were taken on development and care of young, intra- and interspecific behaviour of the adults, feeding, hunting, weather conditions, and the daily cycle of activity. These observations, when compared with our record of another peregrine family in 1972, reveal consistencies and variations in behaviour among peregrine pairs. Results from these detailed studies have been written up for publication.

The time-lapse photographic study ended on 28 July and the peregrine survey and banding were completed on 6 August. The entire team departed from West Greenland on 8 August.

RESULTS

The survey area consisted of 900 sq. mi. (2,330 sq. km.), including ice-cap, lakes, fjords, and other unsuitable habitat totalling about 150 sq. mi. (388 sq. km.). We found 10 occupied peregrine falcon nesting cliffs in the survey area in 1973. At one of these the pair displayed territorial behaviour and the female made a nest scrape but no eggs were laid, and both adults had departed by 21 July. The other 9 eyries produced young. Of these 9, 7 were also successful in 1972, while another was occupied throughout the season by an aggressive pair, and at the ninth a lone female mildly defended the cliff. Of the 9 producing eyries in 1973, 1 contained 4 young, 5 contained 3 young each, 2 had 2 young each, and 1 held 1 young. This gives a total of 24 young peregrines and a production rate of 2.4 young per occupied eyrie, or 2.67 young per successful eyrie. These young were counted at advanced ages varying from 2.5 weeks to just before fledging. It is believed that all or almost all fledged. We found 1 occupied eyrie per 90 sq. mi. (233 sq. km.), or 1 successful eyrie per 100 sq. mi. (260 sq. km.).

All young were banded with a metal band on the left tarsus and a red plastic band on the right. A white number on the red plastic band can be read with hand-held binoculars at 60 ft. (18 m.) and with a supported spotting scope at 300 ft. (91 m.). The colour bands signify the beginning of an international peregrine colour banding system established for quick geographical identification of banding locality[5].

During the 2 summers, 9 gyrfalcon nesting cliffs were located in the survey area. We believe that at least 6 of the 9 locations were occupied in 1972. In 1973, 8 of the 9 cliffs were checked. Young were found at 4 sites. A fifth was observed from an aircraft and appeared to be active. Lone adults were observed at 2 other locations. Seven young gyrfalcons were banded out of 10 young found.

TABLE 1. Results* of 1972 and 1973 research.

PEREGRINE FALCONS	1972	1973
Number of producing nests found	7	9
Number of young assumed to have fledged	17	24
Number of sq. miles per producing pair	100	100
Number of sq. miles per occupied site	90	90
Mean number of young fledging per occupied site	2.57	2.67
GYRFALCONS	1972	1973
Number of producing nests found	3	4
Number of young assumed to have fledged	8	10
Mean number of young fledging per occupied site	2.67	2.50

*Information gained from local inhabitants has been omitted from this table. More sites may have been occupied as new locations were found and some 1972 sites were not checked in 1973.

One nest site was inaccessible and the young were not banded, accounting for the difference in number located and banded. The production rate per producing pair of gyrfalcons was 2.50 young. See Table 1.

CONCLUSIONS

Our sample survey indicates that in 1973, as in 1972, the peregrine falcon reproduced normally in West Greenland. The slightly higher production rate in 1973 can possibly be attributed to warmer temperatures during the nesting period, as the summer of 1972 was unseasonably cool. However, the 1972 data on eggshell thinning and high DDE and PCB residues reveal that this population is precariously balanced, and severe reproductive failure threatens. Analysis of the 1973 addled egg and measurement of the additional eggshell fragments will supplement the 1972 results to provide a larger data base. The number of peregrines which fledge from the nest may be substantially greater than the number that actually leave the nesting area and migrate south. In 1973 we found the remains of 2 immature peregrine falcons from 1972 broods. In one case feathers from a peregrine approximately 5 weeks of age were found at the 1972 nesting ledge. The remains of the second immature peregrine were found below a nesting cliff; it was at least 8 weeks old at the time of death. The areas below the majority of the nesting cliffs were not checked for falcon remains and more dead young may have been present. Both young were at an age where they could have been flying and thus were considered as fledged in the 1972 count. Thus at least 2 out of 18 eyasses died before beginning their migration. A third eyass from the 18 had died before fledging.

FUTURE RESEARCH

Information gained from preliminary data suggests that prey availability is a major factor governing peregrine nesting. The Greenland peregrines are somewhat selective in their diet and where low passerine populations occurred, even in the presence of suitable nesting cliffs, no peregrines were present. Some cliffs appeared to have been used previously but were not used during 1973. This factor will be investigated in the 1974 research.

The 1973 trip produced considerable data but analysis, especially the photographic record, will take time. However, the research has already established productivity of peregrine falcons and gyrfalcons in the study area, nesting density, eggshell thickness and pesticide levels in the peregrine eggs, prey species for peregrines and gyrfalcons, time of arrival of adult peregrines to nesting cliffs and dates of egg laying, hatching and fledging. Studies on brooding behaviour of peregrines and a small bird census has shown hunting areas and relationships of raptors to available prey species.

Many aspects of peregrine behaviour at the eyrie still need to be described. We lack observations during courtship and post-fledging periods, and we do not know how activities and diet of coastal pairs differ from those of inland peregrines we have studied. Continuation of the behavioural study, as well as the population survey in Greenland, will allow correlation of changes in peregrine behaviour and production with altering levels of pesticide contamination. Disturbances in behaviour may appear, possibly a key factor in the reproductive failures noted elsewhere. For the same reason detailed observations should be taken of arctic peregrines from an already declining population, and these results compared with our data.

Coastal peregrines of the Greenland population may experience different exposures to organochlorines than do the inland peregrines we have studied. The survey area should be expanded to include coastal areas contiguous to our inland survey area. But most importantly, the present status of the Greenland peregrine population suggests that rapid changes may occur in reproductive success and breeding density. For this reason our sample area should be resurveyed annually.

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The Alaska Highway Development

Thirty-one years ago, in November of 1942, the Alaska Highway was opened for use as a military road. Built as a long-range defense measure [1:221], it was assumed that improvements would continue following World War II. Since that time, there have been many proposals to pave the road, but they have been blocked by political and economic considerations.

The resulting highway had a good gravelled driving surface, but was rough and uneven. After the responsibility for the highway was transferred from the United States Army to the Royal Canadian Engineers, the terms of reference under which operations were carried out did not permit major road relocations. Although temporary structures were replaced by more permanent ones and some hazardous areas were reconstructed, the alignment of the highway is essentially the same today as it was in 1943[2:5].

The highway is Alaska's only land link with the lower forty-eight States and a major road serving the Yukon, yet of the nearly 1,525 miles of road, to date less than 400 miles are paved. The remaining 1,100 odd miles are at best a dusty and difficult ordeal for both men and machines.

With both United States and Canadian interest increasing toward the growth and development of the northwest, there can be little doubt that a paved road would be of substantial value to both countries. The present reaction to the issue of paving is somewhat a mirror of past negotiations. The federal governments of the United States and Canada are cool toward the issue, while local interest in both Alaska and the Yukon is quite high.

RECENT ISSUES

Measures to improve the Alaska Highway have been periodically brought before the Canadian Parliament and the United States Congress, but a growing disparity of interests beginning in the 1950's, has made negotiations very difficult.

The Conservative victories in the elections of 10 June 1957 and 31 March 1958, which installed the Diefenbaker government, led to a major re-examination of Canadian government policies with significant implications for the entire spectrum of Canadian-United States relationships. As the United States Ambassador to Canada, the Hon. Livingston T. Merchant, observed [3:637]:

> . . . The disparity in population and power between Canada and the United States has understandably created a defensive reaction on the part of Canadians which takes the form of sensitivity to any real or fancied slight to Canadian sovereignty.

During that period, a United States bill was found objectionable in Canada in that the quality and the standards of construction for the improved road would have been placed under the direction of the United States' Secretary of the Interior. The bill was subsequently withdrawn in Congress, but