

TERRITORIAL SPACING OF THE NEW ZEALAND FALCON (*Falco novaeseelandiae*)

By N. C. FOX

ABSTRACT

142 nesting sites in five study areas totalling 7 800 km² around Marlborough, Kaikoura, North Canterbury, Cass and Fox Glacier were used to measure local densities of New Zealand Falcons. Adult falcons are considered to be sedentary. The spacing of nesting territories in each study area is illustrated. Territories in Marlborough and North Canterbury averaged 3.80 and 3.95 km apart. Six territories near Fox Glacier averaged 13.7 km apart but some pairs had probably been overlooked. Falcon pairs in open country probably had home ranges of about 15.0 km², and those in forest areas ranges of less than 189.0 km².

INTRODUCTION

The New Zealand Falcon (*Falco novaeseelandiae*) appears to have several territorial boundaries and in this respect follows closely the model postulated for the Peregrine (*Falco peregrinus*) by Cade (1969: 199). Around the nest itself is a nesting territory defended against all intruders while the nest is in use. Males defend a larger nest territory than females (Fox 1978). Beyond this central territory is the home range or hunting range which is undefended except intermittently against other falcons. Additionally, favoured spots such as roost sites, hunting perches and temporarily disused alternative nest sites may be defended occasionally.

Contrary to Moncrieff's (1929) suggestion that the falcon is a partial migrant, my observations indicate that it is sedentary and that adults live and roost in the same area all the year round. Ten recoveries from 37 birds banded showed a mean distance travelled of 4.4 km (max. 10.0 km). Certain gullies have been inhabited by falcons throughout living memory (at least 30 years) (see also Harrow 1965), and the uric acid deposits at some roosts (Fox 1977a) indicate that occupation has extended for decades, if not centuries. Trained falcons flown in occupied home ranges during April 1976 elicited a territorial response on five occasions and it appears that resident falcons are to some extent territorial all the year round.

METHODS

As New Zealand Falcons tend to nest in the same place each year and have a noisy nest defence, people such as farmers and rangers often know if falcons are present. By talking to such people it was easy to establish the presence of many pairs. About 120 high-country

stations were visited. Sheep runs were the most rewarding as musterers are often dive-bombed during the tailing muster in November and also most of these stations are now well supplied with tracks, giving easy access by trail-bike. There is less chance of falcon nests being found on cattle runs such as Molesworth and Clarence Reserve which are mustered only once or twice a year. By establishing a network of informants I had, in effect, several hundred people each year covering the areas for falcons during mustering. This also gave me an unexpectedly high number (27%) of banding recoveries (cf Shor 1976).

Five areas in South Island were studied (Fig. 1). These contained 142 known pairs of falcons. Two of the areas, A (Marlborough) and C (North Canterbury) received much more attention than the others. The salient data on the study areas are shown in Table 1. The sheep farming sections of study areas A-D were similar but area E was predominantly lowland temperate rainforest. The flora and fauna of these areas, and the nesting histories and success of the falcons in them, have been described by Fox (1977b).

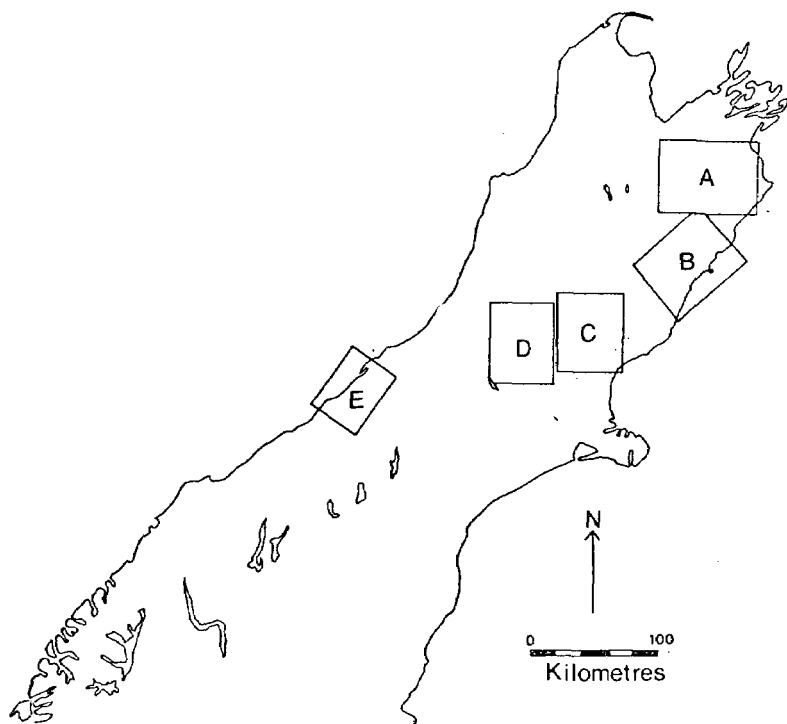


FIGURE 1 — Location of Study Areas in South Island.

	A	B	C	D	E
Location	Marlborough	Kaikoura	N. Cant'y	Arthur's Pass	Westland
Longitude	173°40' E	173°20' E	172°20' E	171°45' E	170°00' E
Latitude	41°45' S	42°25' S	43°00' S	43°05' S	43°20' S
No. documented Falcon pairs	80	11	27	17	7
Approximate area (sq. km)	3000	1240	1060	1250	1250
Max. height (m) A.S.L.	2883	1830	1290	1920	1218
Min. height (m) A.S.L.	100	0	306	650	0
Height of most pairs (m) A.S.L.	610	610	610	980	460
Angle of slope	30°	35°	30°	30°	0°-40°
Mean annual rainfall (mm)	890	1270	890	1270	3810
Mean annual temp. (°C)	7.8	9.2	9.2	7.8	8.9
Dominant rock type	Greywacke	Greywacke	Greywacke	Greywacke	Garnet Zone Schist
Land use	Extensive sheep farm	Extensive sheep farm	Extensive sheep farm	Sheep/Nat. Park	Nat. Park
Major vegetation cover	95% Grassland 5% Bush	90% Grassland 10% Bush	95% Grassland 5% Bush	40% Grassland 40% Bush 20% Alpine	80% Bush 15% Alpine 5% Grassland
Main river catchments	Wairau Waihopai Awatere Flaxbourne	Kahutara Conway	Hurunui Waipara Okuku Ashley	Wainakariri	Waiho Cook

TABLE 1 — Data on the Study Areas.

An arbitrary 4.0 km diameter circle, approximating the size of most home ranges, was drawn on the map around each falcon nest site in each study area. Where a pair was known to use two or more sites, the centre was taken as equidistant between them unless one site was rarely used. The distance between pairs was measured by drawing lines between all adjacent pairs. No line was drawn if this entailed cutting the circle of a third pair or crossing another line; thus where four pairs were placed in a roughly square formation only one diagonal, the shortest, was drawn. If two pairs were widely separated by suitable nesting habitat, known to be untenanted by falcons, a line was drawn connecting the pairs. This was not done for area E, since the terrain between pairs was not definitely known to be untenanted.

RESULTS

The spacing of pairs in each of the 5 study areas is shown in Figures 2-6. The frequency of inter-pair distances is shown in Figure 7.

DISCUSSION

Spacing of pairs

The results showed that the spacing was markedly consistent, indicating that in these areas nest sites are less important in limiting the populations of the New Zealand Falcon than in most Peregrine populations (Hickey 1942). Pairs were a mean distance apart of 3.80 km and 3.95 km in areas A and C respectively, the majority of pairs being between 2 and 5 km apart. By contrast, pairs in E averaged 13.7 km apart.

KEY TO FIGURES 2 - 6

Complete 4.0 km circles indicate known, frequently occupied Falcon nesting areas. Broken circles indicate marginal sites not now in use. Black dots mark known harrier nest areas. Narrow, continuous lines indicate sea-coast.

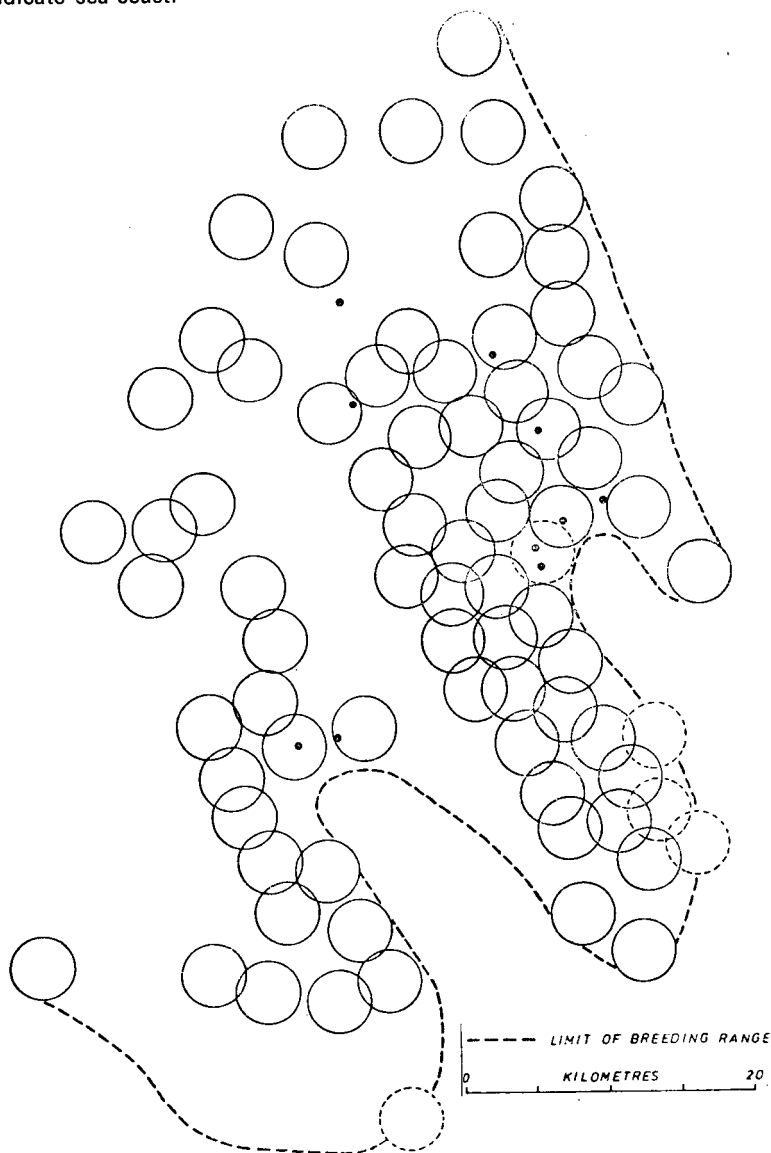


FIGURE 2 — Study Area A — Marlborough.

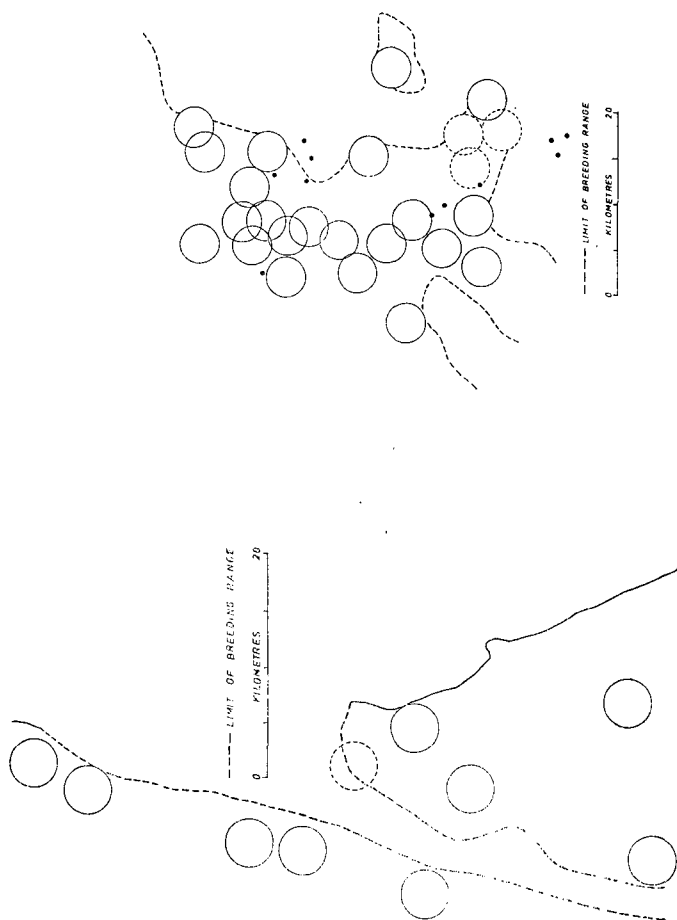
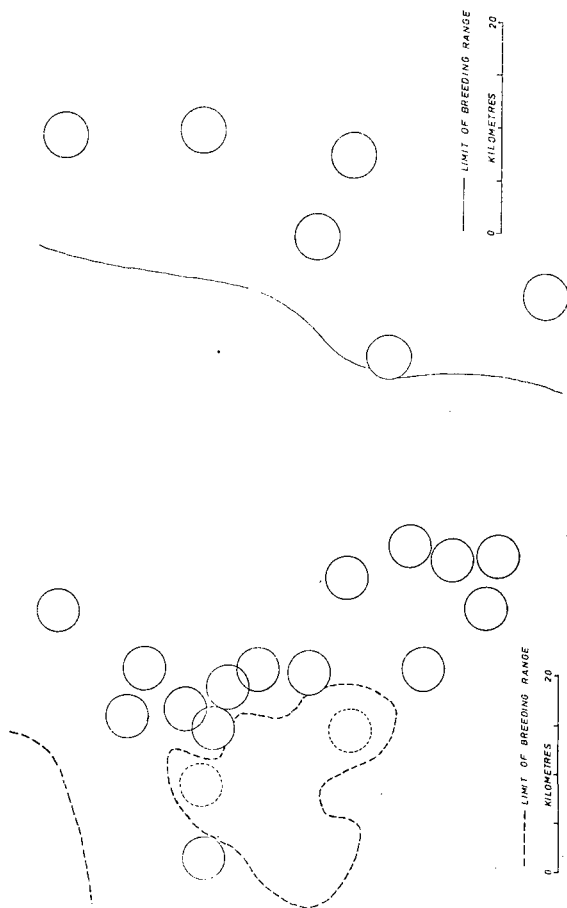


FIGURE 3 — Study Area B — Kaikoura.

FIGURE 4 — Study Area C — North Canterbury.



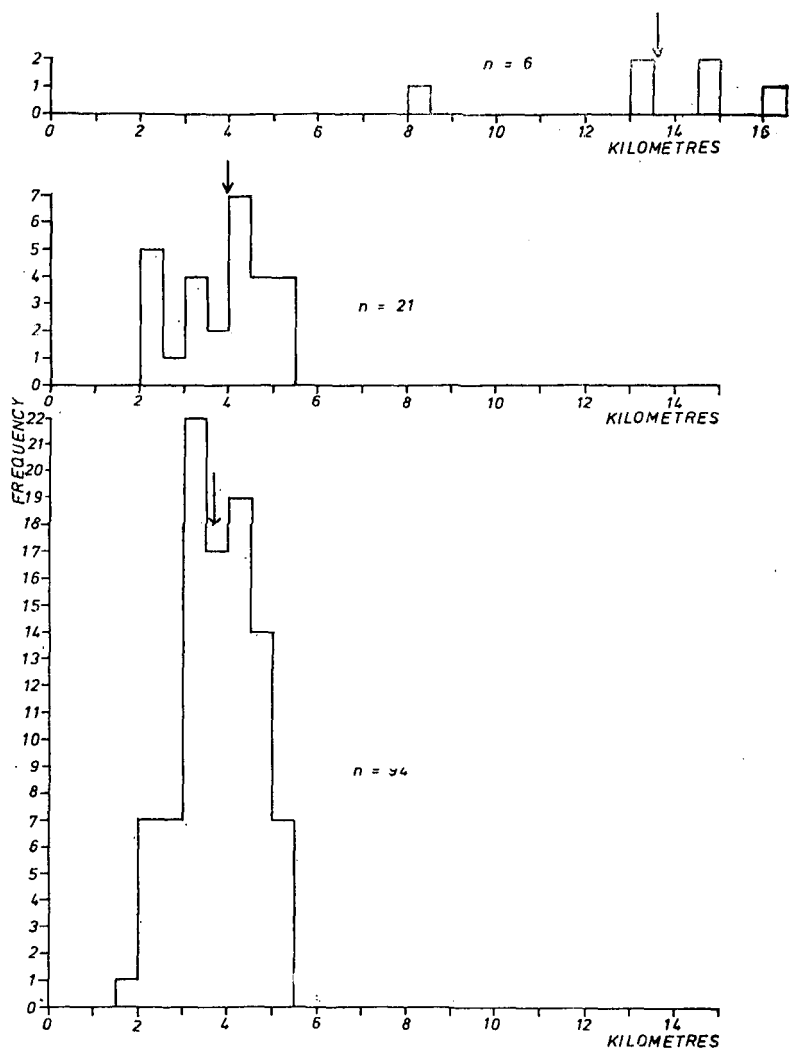


FIGURE 7 — Frequency histograms showing distances (km) between adjacent pairs. Arrows mark mean values. Top: study area E (Fox Glacier). Middle: study area C (North Canterbury). Bottom: study area A (Marlborough).

Either there were intermediate, unlocated pairs in area E, or pairs were further apart in E than in A and C, or there was a combination of both possibilities. Southern & Lowe (1968) found that Tawny Owls (*Strix aluco*) are much more efficient hunters and require

smaller territories in open forest than in dense forest with heavy undergrowth. Also, Lay (1938) found that margins of clearings had 95% more birds than comparable areas inside the adjacent woodlands. It seems probable that a similar situation exists here and that falcon pairs were more widely spaced in the forested area E than in the other areas.

Where the forest has been partially felled, creating margins and clearings, the density of falcons and their prey may be higher. John Powell (pers. comm.) found two falcon pairs 3.2 km apart in partly logged Rimu/Beech forest in the southern Ureweras. Guthrie-Smith (1927) recorded that in 1921, 5-6 pairs of falcons were present on his 20 000 acre runholding. Pairs must have been about 4.3 km apart. However at this time the area was being cleared from virgin bush, exposing prey and creating optimal hunting conditions for falcons. The falcons were probably temporarily superabundant — Guthrie-Smith noted that only one pair had a permanent breeding site — and by 1927 when most of the run had been cleared no falcon nests were found.

Home range sizes

The size of the hunting range of a pair of falcons can be answered at this stage only by making some more or less unsubstantiated assumptions. The subject needs to be investigated more thoroughly, possibly using radio-telemetry. If it is assumed that the hunting range of a pair of falcons is hunted by that pair alone, then the maximum hunting area of a pair of nesting falcons in Marlborough is about 14.4 km². The corresponding figure for North Canterbury (area C) is 15.6 km² and for Westland (area E) 189 km². The scanty data available thus suggest that falcons in bush may use hunting ranges about 13 times as large as in open country. Possibly only about 10% of this bush area is actively hunted by the falcons. I believe that if study area E were investigated more thoroughly, more pairs of falcons would be located and that densities approaching one pair per 75 km² would be found.

The way in which home range is measured and calculated is important. In this study the area occupied by one pair of falcons was taken as the square of the mean distance between adjacent pairs. No extra allowance was made for margins of breeding ranges; field work indicated that such areas tended to be occupied by non-breeders.

Craighead and Craighead (1956) based their figures on visual observations of unmarked birds and their data may be subject to error. They found that home range sizes for any one species varied by a factor of over 100% between pairs. Ratcliffe (1962) found 26 pairs of Peregrines nesting contiguously with a mean distance between adjacent pairs of 4.7 km. He enlarged the hypothetical territorial area around the periphery of the population so that the boundary extended 4.7 km from each outside pair, rather than 2.35 km (half the mean

inter-pair distance) applied to the central pairs. This increased the area taken into consideration by a factor of 2.3, so that, instead of reaching a figure of 22.1 km² per pair for a continuous population density, by allowing for a big periphery he obtained a figure of 50.5 km² (19.5 square miles). Because this latter figure is proportional to the size and distribution of the population it cannot be used for comparisons with other populations. Rowan (1921) found that Merlins (*Falco columbarius*) had ranges of about 13 km².

Schoener (1968) stated that territory size increases with raptor size. Thus one would expect the New Zealand Falcon's home range to be intermediate in size between that of the Merlin and of the Peregrine. In open country the home ranges were slightly smaller than anticipated, possibly because the Australasian Harrier (*Circus approximans gouldi*) is the only competing species. In temperate rainforest the areas appeared to be about 13 times larger than expected. Because food supply affects breeding densities (Moore 1957, Mebs 1964, Nelson & Myers 1976, Newton 1976) it is probable that falcons breed at lower densities in the alpine and sub-alpine valleys than they do in the lower-lying hill country.

Spacing mechanisms

Since falcons are not affected by ecological factors, such as available nest sites, they are probably spaced out by their behaviour. If display flights and calls are the mechanism, as is frequently the case in raptors, an intruding falcon, on seeing a resident falcon, would leave the area or at the least would not breed. To investigate this, two pairs of falcons were artificially established about 150-200 m apart so that normally one pair would be within the nesting territory of the other. One pair was in an aviary with an open netting roof. The other pair was free. The free falcons could thus space themselves by any means except physical violence. The free pair frequently flew over the aviary, and each morning the two males called loudly. Yet both pairs laid eggs and it appeared that, if anything, these displays, by promoting pair-bonding, enhanced breeding. One can conclude tentatively that breeding pairs of New Zealand Falcons are spaced out by physical attack. Territory size would therefore be limited by the area which the resident birds were capable of patrolling or by the area which the residents had to patrol to obtain sufficient food. Although the mechanism of spacing would be territorial behaviour, the ultimate density-controlling factor would be food supply.

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SHORT NOTE

WELCOME SWALLOW IN MID TASMAN SEA

On 10 May 1978, a Welcome Swallow (*Hirundo neoxena*) was seen fluttering around the DSIR ship R.V. *Tangaroa* in the mid Tasman Sea, at 36°07'S 163°24'E. The bird was clearly identified as it flew close to the ship, briefly landing several times. No other ships came in sight on the cruise. A few days later the swallow was seen again, looking rather weak, sheltering under a tarpaulin. A brief search was made on returning to Wellington but it was not found.

For about a week before the sighting a large anticyclone had been moving slowly eastwards across the Tasman, giving light winds. By 10 May this had moved off and most of the Tasman was having northerly winds; 15-20 knots at our position.

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