

Nest site characteristics of New Zealand Falcons (*Falco novaeseelandiae*) in a forested habitat

LAURENCE P. BAREA^{1,2}, JOSEPH R. WAAS¹ and KEITH THOMPSON¹

¹Department of Biological Sciences, University of Waikato, Private Bag 3105, Hamilton, New Zealand; ²Department of Conservation, Bay of Plenty Conservancy, P.O. Box 1146, Rotorua, New Zealand.

ABSTRACT

Six nest sites of New Zealand Falcon (*Falco novaeseelandiae*) breeding in a mixed podocarp/hardwood forest are described. All nest scrapes were located in *Collospermum bastatum* epiphytes on emergent. Nest height was about twice the height of the surrounding canopy. All but one nest trees were alive and appeared to be in good health. The large diameter (mean at breast height: 105 cm) and the height of nest trees (mean 36 m) indicated that falcons selected older trees in the forest. Nests tended to be located mid-slope or towards a gully and of northerly aspect. Management of New Zealand falcon habitats should involve the maintenance of adequate emergent trees in forests, from which falcons can select appropriate nest sites.

KEYWORDS: New Zealand Falcon, *Falco novaeseelandiae*, nest site, forest

INTRODUCTION

Fox (1977, 1988) described three forms of the endemic New Zealand Falcon (*Falco novaeseelandiae*) differing in their morphology, distribution and ecology. The South Island high country is inhabited by the large pale eastern form, while the forests of the North Island (mainly south of 37°S) and the forests of the West Coast of the South Island and around the Nelson region are the habitat of the small dark bush form. The southern form, intermediate in size and coloration to the eastern and bush forms inhabits the forests of Fiordland and the Auckland Islands. New Zealand Falcons also inhabit Stewart Island, and have been reported on Codfish Island, off the coast of Stewart Island.

The New Zealand Falcon is categorised as a class B threatened species by the Department of Conservation (Tisdall 1994), and is classified as a near threatened species under IUCN criteria (Collar *et al.* 1994). An essential step in understanding the ecology of a threatened species is to develop a knowledge of particular habitat requirements.

Nest site availability can be a limiting factor for raptors (Newton 1979). Fox (1977) cited the forest inhabiting bush form of the New Zealand Falcon as being most vulnerable to habitat modification. The purpose of this study was to gain an understanding of nest site requirements of this form of the New Zealand Falcon.

METHODS

Nest location

Nests were searched for between the summers of 1989 and 1993 in the Mapara Wildlife Management Reserve central King Country, North Island, New Zealand (38°34'S, 175°17'E). Observations of falcons were plotted onto a 1:10 000 aerial photo, areas of high falcon activity were identified and searches focused in these areas. The position of each nest in its tree was determined during incubation when the females often left the nest to receive prey from the males. To avoid disturbance, measurements at the nest site were taken after the young had fledged and left the nest area.

Nest sites were found for eight of the nine breeding attempts that were known to occur in the reserve. Two sites were used twice so there were six nest sites in total. Because including data twice from these sites would bias the results (Mosher *et al.* 1987), data are only included once from the two sites where breeding occurred twice.

Nest site sampling

Vegetative and physical characteristics around six known nest trees in the Mapara Wildlife Management Reserve were measured and described.

The following was recorded at each nest site: tree species, tree "status" (emergent, canopy or sub-canopy); aspect of the slope; nest tree position on slope (ridge, mid-slope, or gully); tree height (m); diameter at breast height of nest tree (DBH, cm); nest height (m); nest aspect; height of nest above canopy (m); height of surrounding canopy (m); habitat (unlogged or logged forest).

RESULTS

All nest scrapes were among leaves of the epiphyte *Collospermum hastatum* growing high up in emergent trees. Five trees were alive and appeared to be in good health. One nest was located in a dead rata tree (*Metrosideros robusta*). Nest site variables are shown in Table 1.

Nest site descriptions

Nest A: This nest was active during the summer of 1993/94. The nest scrape was in the base of the largest of four *C. hastatum* plants attached to the main trunk of a live emergent tawa (*Beilschmiedia tawa*) tree. The nest tree was growing in a forest habitat about 100 m from disturbed forest and was situated mid-slope with a northerly aspect.

The *Collospermum* foliage screened the nest scrape on all sides except to the north-west, and was open from above. A branch on the west side of the nest was used by the parents as a perch when approaching the nest from that side only. The nest tree was 50 m from a 'dead topped' tawa in which the adult female spent much of her time when not incubating or brooding chicks. This tree was also used for courtship, copulation and food transfers.

TABLE 1 - Nest site variables, their means and standard errors of the mean, of six pairs of New Zealand Falcon (*Falco novaeseelandiae*) breeding in the Mapara Wildlife Management Reserve between the summers of 1989/90 and 1993/94.

Feature	Nest site						\bar{x}	$s_{\bar{x}}$
	A	B	C	D	E	F		
Tree height (m)	30	22	59	32	37	40	37	5
DBH (cm)	80	43	157	145	106	100	105	17
Nest height (m)	25	9	44	26	32	30	28	5
Canopy height (m)	20	6	11	17	20	15	15	2
Height of nest above canopy (m)	5	3	33	8	12	20	14	11
Nest height as a percentage of tree height	83	44	75	80	87	75	74	15
Nest height as a percentage of canopy height	125	158	400	148	162	200	200	101
Nest aspect	N	N	NE	NE	N	N	-	-
Nest tree slope aspect	N	NE	E	E	SE	W	-	-
Nest tree position on slope	mid	mid	gully	mid	mid	mid	-	-

Nest B: This nest was used twice: during the summers of 1990/91 and 1992/93. The nest scrape was at the base of a *Collospermum* in the centre of the crown of a live emergent hinau (*Eleocarpus dentatus*). The nest tree was on a steep mid-slope with a north-easterly aspect in a logged habitat. The nest had a northerly aspect. The parents entered and left from the north-west, using a branch of an epiphyte (*Griselinia lucida*) growing on the nest tree. The nest tree was sheltered from the west by a ridge about 50 m away, and from the south by the slope. When not incubating eggs or brooding chicks, the adult female often perched on an emergent tawa about 100m from the nest.

Nest C: Nest C was used during the 1993/94 breeding season. The nest scrape was in a *Collospermum* growing on a side branch of an emergent rimu (*Dacrydium cupressinum*) which was growing near the base of a forested gully. The nest tree slope faced east. The nest scrape was screened by the foliage of the *Collospermum* from above and all sides, except the north-east from which the parents entered and left the nest via an open platform. The adult female spent most of her time, when not incubating or brooding, perched in emergent rimu trees about 100 m from the nest tree.

Nest D: This nest was used during the 1990/91 breeding season. The nest scrape was in a *Collospermum* growing against the trunk of a live emergent rimu located mid-slope in forest habitat. The nest tree slope had an easterly aspect and the nest faced north east. The nest scrape was screened by *Collospermum* on all sides and from above. Access to the nest was through a tunnel in the foliage on the upper side of the nest. Two rata spars were present about 100 m from the nest and were used as perches by the adult female when not at the nest.

Nest E: Nest E was used twice: first during the 1989/90 breeding season and during 1990/91. The nest scrape was in a *Collospermum* growing against the trunk of a live emergent rimu in forest habitat. The nest tree grew on the mid-slope and had a south-easterly aspect. The nest scrape was screened from above and on all

sides by *Collospermum* foliage. The nest was accessed from behind, between the tree and the slope, through a short tunnel in the *Collospermum*. The nest aspect was north and faced the nest slope. A bare branch of a large tawa, 30 m from the nest, was used by the adult female as a perch when not attending the nest.

Nest F: This nest was used during the 1992/93 breeding season and was at the base of a *Collospermum* growing against the trunk of an emergent rata spar, in mid-slope forest habitat. The nest tree had a westerly aspect and the nest faced predominantly north. The nest was exposed from above and from all sides, except from the south, which was screened by the trunk of the nest tree. Emergent rimu trees and spars were used as perches about 100 m from the nest tree by the adult female.

DISCUSSION

Six falcon nests found at Mapara were in emergent trees. All nest scrapes were located in perching *Collospermum* high above the forest canopy. Emergent trees appeared to have more prolific *Collospermum* growth than canopy trees and it is possible that this feature was attractive for falcons selecting nest sites.

Nesting above the canopy gives easier access to the nest and provides a better view than below the canopy. A panoramic view of the surrounding area would enable the falcons to detect and evict potential threats such as Australasian Harriers (*Circus approximans*), which were common in the area.

Most nest trees were in mid-slope. These sites were less exposed to the elements than nest trees located on ridges. Fox (1977) also stated that there was water suitable for bathing within 50-100 m of all nests he located. At Mapara, the mean distance from nests to streams was 113 m (range 20 m - 230 m) which was similar to the distance found by Fox (1977).

Fox (1977) classified falcon nests he found and those in the Ornithological Society of New Zealand's (OSNZ) Nest Record Scheme. Most of the nests were of falcons belonging to the eastern form. Nests were in a range of sites ranging from cliffs to the ground in forest. Four of the nests in the OSNZ scheme were definitely nests of falcons of the bush form (i.e., they were from the North Island) and all of these were on emergent forest trees. Three of these were in epiphytes.

The nests at Mapara all faced between north-west and north-east, with nest slope between north and south-east. In contrast, Fox (1977) found considerable variation in nest slope and aspect but both most often faced between south and east. Fox (1977) suggested that nests tended to face away from the hot noonday sun, and persistent north-west and south-west winds. Reynolds *et al.* (1982) stated that *Accipiter* species nesting in forests in Oregon tended to prefer nest aspects that were protected.

The forests of the Mapara Wildlife Management Reserve were often wet. North aspects receive more sunshine than other aspects, and nest sites with these aspects may stay drier than nests with a more southerly aspect. Nests facing north-east would also be less exposed to the prevailing westerly or southerly winds. This may account for the difference between our data and those of Fox (1977).

The nests found during this study varied in the degree of shelter from the elements. Three were almost totally exposed on all sides, and were exposed from above, with only small clumps of *Collospermum* growth forming a rim around the nest (nests A, B & F). Others were more or less protected. The nests in Fox's (1977) study also varied in the amount of screening around and above the nest. Cliff nests were often screened above by a rocky overhang and by vegetation on all sides, leaving a narrow entrance. Ground nests were only screened from above, usually by a log, and offered little protection from the elements.

The range of nests used by falcons in Mapara was less than that for falcons in general (Cade 1982), though the bush form have been known to use sites other than emergent trees elsewhere in the North Island. A cliff site was used for at least three consecutive years by a pair of the bush form near Te Haroto (L. Barea pers. obs.). Another pair nested on the top of a sedimentary rock stack in the Wairapa (N. Hyde pers. comm.). A record exists of a pair of the bush form nesting in a scrub covered hill face (presumably on the ground), in the Kaimanawa mountains (J. Leathwick pers. comm.). Another nest site, found in the Kaimanawa mountains during December 1994, was located on the ground beneath a fallen beech (*Nothofagus* sp.) trunk (A. Hansen pers. comm.). Two pairs of the bush form nested on the ground (both failed to fledge young) in a *Pinus radiata* plantation in the Kiangaroo Forest during 1994 (D. Stewart-Badger pers. comm.). In all these cases, the nesting habitat differed significantly (i.e., the absence of emergent trees with epiphytes) from the lowland mixed podocarp/hardwood forest at Mapara.

Emergent trees and epiphytes are common in podocarp/hardwood forests. In these forests, emergent trees are probably the most commonly chosen nest site. While falcons in beech forests have been known to nest on the ground, nest site preference remains to be investigated in this type of forest. Fox (1977) reported that ground nests were less productive than cliff nests. Predation by introduced mammals is a likely explanation.

While the bush form can nest on the ground, they appear to prefer to use emergent trees when they are available. Falcons may persist following logging of a forest, but the retention of some emergent trees may be necessary to guarantee their long-term survival.

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