New Zealand Falcon (*Falco novaeseelandiae*) in Pine Plantations in the Hawke's Bay*

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Abstract

The New Zealand falcon (*Falco novaeseelandiae*) is a rare, endemic species. Its range has been substantially reduced due to destruction of its historical habitat. In recent years, however, the bush form of the New Zealand falcon has been found nesting in clear-cuts in pine plantations in the Central North Island. This study investigated whether or not New Zealand falcons utilise pine plantations in the Hawke's Bay in a similar way. In addition, experts familiar with the breeding and distribution of New Zealand falcons were surveyed to gain a better understanding of the behavioural attributes of the species. From the results, it is evident that New Zealand falcons are utilising clear-cut areas in Hawke's Bay forests and it appears the behaviour of breeding pairs is similar throughout New Zealand. The findings of this study will allow forestry companies to make informed decisions on the management of New Zealand falcon in their forests given the increased understanding of the relationship between breeding New Zealand falcon and pine forests.

Introduction

The bush form of the New Zealand falcon (*Falco novaeseelandiae*) has historically nested in tall lowland podocarp forests in the North Island. Habitat loss through logging, coupled with the effects of introduced predators, has severely reduced population numbers (Stewart & Hyde, 2004). This form of the species has been listed as "nationally vulnerable", indicating that existing threats could further the decrease in population numbers (Hitchmough 2002; Department of Conservation 2006). The species is under threat without some form of intervention (Barea *et al.*, 1997).

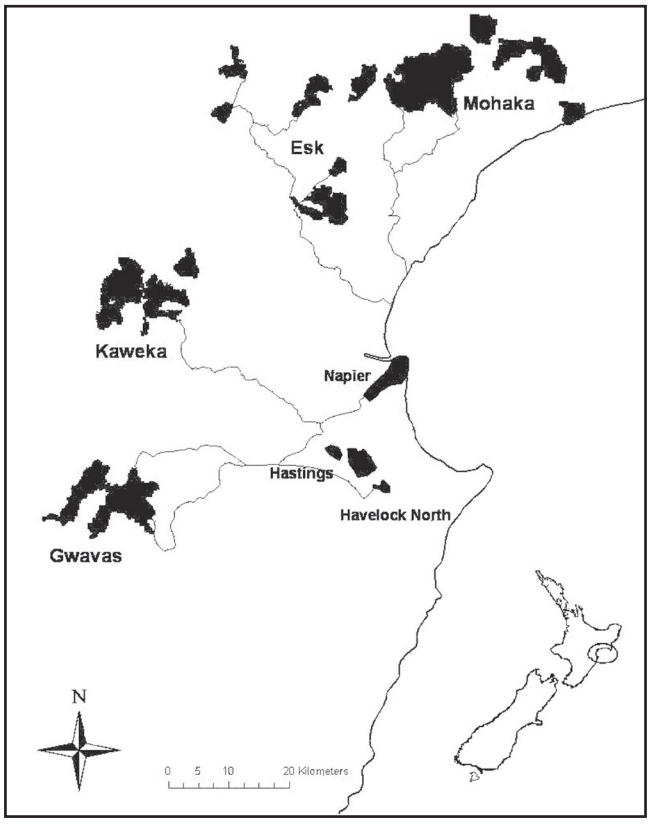
The first report of falcons targeting pine plantations for nesting purposes was a tentative one in 1948 by a forestry worker in Kaingaroa Forest (Ryder, 1948). More recently this has been confirmed through research undertaken by the Massey University Falcon Research Programme - notably the work of Richard Seaton (pers. comm., 2005), and Stewart & Hyde (2004). The largest known population of New Zealand falcons is currently in Kaingaroa forest (R. Seaton pers. comm. 2005). There is a strong association between falcon sightings and clear-cut areas in plantation forests (Stewart & Hyde, 2004). Unconfirmed sightings from around New Zealand suggest that falcons can be found in other plantation forests (Maunder *et al.* 2005).

The purpose of this study is to examine the density and behaviour of New Zealand falcons in Hawke's Bay forests and to provide information to forest managers that may be of value to the conservation of the species. Research in the Hawke's Bay forests provides an opportunity to compare the behaviour of New Zealand falcons there with their counterparts in the Kaingaroa Forest, and to determine whether Hawke's Bay falcons also occupy and breed within the clear-fell areas of pine plantations. If New Zealand falcons are found to occupy and breed in the Hawke's Bay pine plantations in the same manner as they do in Kaingaroa Forest, they may use other New Zealand plantation forests in a similar way.

Study Area

The pine plantations used in this study are located in the Hawke's Bay region of New Zealand and are owned by Pan Pac Forest Products Limited. This is a Japanese owned, fully integrated forestry company that manages five forests in the Hawke's Bay. Because of logistical constraints only four forests, Gwavas, Kaweka, Esk and Mohaka, were included in the study (Figure 1).

Figure 1: Pan Pac Forestry Products Limited study site location map.



Pan Pac's forests are characterised by rolling to steep hill country and are mostly surrounded by Department of Conservation land to the west and farmland for the remainder. In these forests, compartment size is dictated by the landscape and thus tends to be variable but typically small to moderate. The total area of all of Pan Pac's forests is 32,500 Ha.

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Table 1: Falcon Behaviour Derived from Survey of Falcon Experts

Based upon their experience, falcon 'experts' were asked to comment on:	Consensus of 'experts'
Areas where most sightings occur	Bay of Plenty, Otago, Marlborough, Wairarapa, Wellington
Frequency of months falcons are most often sighted in the wild (% of sightings)	October: 16% November: 36% December: 32% January: 10% February: 6%
Average distance from nest before falcon responds (previously disturbed & undisturbed nests)	170m & 160m respectively
Furthest distance from nest before falcon response (disturbed and undisturbed)	400m & 325m respectively
Sex of bird most likely to react first to human presence near the nest	Female
Female's reaction to humans approaching the nest	Aggressive to very aggressive
Male's reaction to human approaching the nest	Uncommitted to moderately aggressive
Behaviour of adult birds when the nest contains eggs	Uncommitted to moderately aggressive
Behaviour of adult birds when the nest contains nestlings	Aggressive to very aggressive
Behaviour of adult birds when the nest contains fledglings	Uncommitted to aggressive
Nestlings response to human approach	No noise, remain still, vocalise, curious, move/fly away

Methods

Two surveys were conducted for the study. The first summarised the knowledge acquired by New Zealand falcon experts over the years. The second comprised of field observations to identify falcon location and behaviour.

Survey of falcon experts. Long-standing and active members of the Raptor Association of New Zealand were surveyed via a mailed questionnaire to learn from their experience of working with falcons for many years. These participants were chosen based on the merit of their extensive experience with the species. In particular, the survey was aimed at retrieving data about the breeding behaviour of falcons so that the authors could interpret falcon behaviour with greater confidence.

Field survey of New Zealand falcons. The field component of this study was carried out from November 2004 to January 2005, consistent with the New Zealand falcons' breeding season (Heather & Robertson, 1996). Pan Pac sponsored the programme and provided logistical and financial support. This included forest maps showing the locations of all zero- to three-year-old compartments and information on previous falcon sightings. Compartments aged zero- to three-years-old were surveyed on foot to locate breeding pairs of New Zealand falcons. This is based on information from forestry workers, who have been reporting falcon nests for some time and the majority of these are coming from clear cuts and compartments aged three-years-old and younger. Richard Seaton in Kaingaroa Forest established that the majority of New Zealand falcon nest in younger-aged stands (R. Seaton, pers. comm., 2005). Forestry workers were given falcon identification and behaviour information (talks, posters and letters) and were encouraged them to report all sightings.

For each compartment in which a falcon was sighted (either flying over, or nesting in the compartment), details were recorded of all falcon behaviour and habitat characteristics. The geolocation of the birds was logged using a Global Positioning System unit and the information transferred to a forest map.

From field sightings of falcons, breeding pair density estimates were made (pairs per hectare) for each forest block, and then compared those to breeding pair densities for Kaingaroa Forest. Kaingaroa Forest densities were obtained from field researchers working there (R. Seaton, pers. comm., 2005). The territorial characteristics of the New Zealand falcon made this possible because pairs stay in the same area over the breeding season (Holland & McCutcheon, in prep).

Results

Falcon expert survey. Results of the falcon expert survey are summarised in Table 1. Most breeding pair sightings occur

during November and December. Previously disturbed birds are slightly more responsive than undisturbed birds when approached. The average undisturbed pair reacts when an observer approaches within 160m, with some reacting to an intruder 325m distant. Previously disturbed birds generally react to intruders about 170m away and, on occasion, up to 400m away.

Female New Zealand falcons generally react more vociferously to human presence near the nest than their male counterparts. The behaviour of nesting females is characterised by attacks on the intruder resulting in direct hits or repeated dive-bombing. The reaction of the male is less aggressive, with the male less likely to strike an intruder.

The behaviour of both adults depends upon whether the nest contains eggs, chicks or fledglings. When the nest contains eggs, behaviour is generally characterised by dive-bombing and vocalising. Breeding pairs are most aggressive when the nest contains dependant chicks, and direct hits are more common. Parental behaviour becomes more variable after chicks fledge and can range from direct strikes to no observable reaction from either the male or female.

When approached by a human, nestlings normally remain still and quiet and only occasionally move away or vocalise. Fledglings are more vocal as humans approach. They are more curious and will often approach an intruder and then move away. Non-breeding pairs can be vocal and 'kek' for a time and then become quiet. They mainly avoid or ignore humans, but on occasion they may be curious enough to fly over people or dive-bomb them.

Field survey of New Zealand falcons. The principal findings of the study are that falcons are commonly seen in Pan Pac forests. Individual birds, breeding pairs and young fledglings were sighted. Over the entire study period, the weather made falcon viewing difficult and it is unlikely that all birds were identified. Gale force NW winds especially in November and December made the detection of any birds particularly difficult.

During the field survey, all but one pair of falcons were located in clear-cuts. A summary of the field survey data is presented in Table 2. Several breeding pairs were found but very few nests were located due to the timing of the survey, which coincided with the end of the breeding season for many of the birds, particularly in Mohaka Forest. Most of the juveniles located had fledged and were no longer using nests.

In Gwavas Forest, a nesting pair was sighted in a one-year-old compartment, and the nest located on a cliff face over a small stream. A single bird was seen flying over a two-year-old compartment.

In the main Kaweka block, one nesting pair was seen attacking a harrier hawk on the forest boundary. A single falcon was seen flying over a one-year-old clear cut and continuing over older stands of trees. In another section of Kaweka Forest (the smaller Te Kowhai block), one male falcon was seen attacking harrier hawks, but a nest was not found in the area. Another falcon, judged to be non-breeding, was sighted in a zero-year-old compartment in the Te Kowhai block.

Table 2: Summary of Field Observations

Forest	Date	Falcons identified	Compartment age (yrs.)	Behavioural Observations
Gwavas	24/11/04	Pair	1	Vocalisation, dive-bombing, food passes
Gwavasz	25/11/04	Individual	2	
Kaweka	01/12/04	Individual	1	
Kaweka	07/12/04	Pair	Native Bush	Aggressive behaviour towards harrier hawk
Kaweka *Te Kowhai*	19/01/05	Individual	0	Aggressive behaviour towards harrier hawk
Kaweka *Te Kowhai*	19/01/05	Individual	0	Avoidance of humans
Esk *Ohane Block*	12/12/04	Individual	1	
Esk *Glenfalls Block*	13/12/04	Juvenile	1	
Esk *Glenfalls Block*		Non-breeding pair	2	Vocalisation but no aggression, avoidance
Esk *North Block*	15/12/04	Pair + juvenile	35	Vocalisation, some dive-bombing
Mohaka	14/12/04	Pair + two juveniles	1	As above. Curiosity from fledged juvenile
Mohaka	19/12/04	Individual	3	
Mohaka	20/12/04	Pair + juvenile	0	Whining from juvenile, "curiosity" from adults
Mohaka	12/01/05	Pair + juvenile	2	Anxious behaviour from juvenile, adults curious
Mohaka	13/01/05	Pair + juvenile	0	Very vocal, some dive-bombing

A single falcon was seen flying over the top end of the Ohane block of Esk Forest. In the Glenfalls Block (Esk Forest) a juvenile was seen. In the same block, a pair was found in a two-year-old compartment. They were vocal and appeared to ignore the researchers, suggesting, they were not breeding. A pair and juvenile were found in mature pines (thirty-five-years-old) in Esk Forest's North Block.

The birds in Mohaka Forest were located in the main block, Anaura. One pair with two juveniles were found nesting near the edge of a one-year-old compartment on a slight rise. An individual bird was seen flying over a stand of three-year-old trees. A pair and a fledged juvenile were located in a compartment that had recently been harvested (zero-aged). Another pair and a fledged juvenile were seen in a valley on a two-year-old compartment close to the boundary. Two adults and a fledged juvenile were located in an unplanted compartment (zero-aged).

Density of falcons. Falcon densities in the Pan Pac Forests are comparable to those found in Kaingaroa Forest (R. Seaton, pers. comm., 2005). The information presented in Table 3 reflects the relationship between forest size, topography and falcon activity.

Table 3: Forest topography, size and falcon density.

Forest	Size (Ha)	Predominant Topography	Number of pairs	Density (pairs per 10000 ha.)
Gwavas	8 427	Steep hill	1	1.2
Kaweka	7 522	Steep hill	1	1.3
Esk	7 558	Steep hill	2	2.6
Mohaka	15 482	Rolling to steep hill	4	2.6
Kaingaroa	189 000	Flat	30	1.6

Discussion

The results of the New Zealand falcon expert survey were helpful. The results aided interpretation of the study's observations of falcon behaviour, and were corroborated by Marchant & Higgins (1993), who summarised the behaviour of New Zealand falcons in captive and native settings. There are no current data published on the behaviour of falcons in pine plantations. Breeding activity could be inferred from the falcons' behaviour. All but one of the breeding pairs was located in open, clear-cut compartments; the exception being a nest found in a thirty-five-year-old stand. The majority of the birds found in the Pan Pac Forests were in zero- to three-year-old compartments. The conclusion that New Zealand falcons hunt and breed in pine plantation clear-cuts is consistent with observations of Stewart & Hyde (2004), Maunder *et al.* (2005) and Richard Seaton, a doctoral researcher at Massey University.

Observations of falcon breeding and distribution in the Hawke's Bay pine plantations are consistent with similar observations in Kaingaroa even though the two plantations are different. There are substantial differences in the physical environment between the study area and Kaingaroa. Kaingaroa's 189,000 ha continuous pine forest is almost six times larger than all of Pan Pac's forests (32,500 ha). The Kaingaroa topography is predominantly flat and compartment sizes are relatively large and uniform. There are also differences in geology, climate, size of clearcuts and the landuse adjoining the plantation forest area. Field observations in Kaingaroa indicate that falcons will be mainly be found in compartments aged zero- to three-years-old, with only occasional sightings of pairs in older compartments (R. Seaton, pers. comm., 2005).

Hawke's Bay forests were comparable to Kaingaroa Forest in terms of falcon behaviour and densities. In both areas, falcon breeding behaviour is characterised by aggressive displays from both birds and clear-cut areas are used as breeding habitats. Furthermore, the densities in both forests appear to be similar, with average densities of two pairs per 10,000 hectares in both the Hawke's Bay and Kaingaroa forests. Field observations indicate that falcons will be found mainly in compartments aged zero- to three-years-old, with only occasional sightings of pairs in older compartments (R. Seaton, pers. comm., 2005).

The uniformity of behaviour between the Hawke's Bay and Kaingaroa falcons, principally their breeding behaviour and the use of clear-cuts, suggests that New Zealand falcons will utilise other pine plantations in the same way. It would therefore be proactive for forestry companies to include a falcon management plan in their operational guidelines Forestry managers should refer to the New Zealand Forest Owner's association website, which has a useful on-line management guide that covers rare species in plantations, including New Zealand falcon management.

Despite its status as "nationally vulnerable", the New Zealand falcon is a tolerant species, and will remain relatively undisturbed by forestry management practices. For example, falcon nests have been found close to roadsides, busy harvesting areas, and within helicopter spray zones (R. Seaton, pers comm., 2005; Holland & McCutcheon, in prep.). It is suggested that forestry workers avoid going closer than 50m to a nest, mainly to prevent disturbance of the nest and any eggs or juveniles it may contain. Activities such as planting, fertilising and bait laying appear to have little or no impact on the survival of New Zealand falcons in pine forests, and current management practices seem to have encouraged an increase in falcon numbers since they were first found nesting in pine plantations (R. Seaton, pers. comm., 2005).

In addition, forestry environmental officers should place emphasis on recording falcon sightings and locations to build on species knowledge within their forests, thus enabling more informed management decisions for the conservation of the species in a particular forest (Maunder *et al.*, 2005; Maunder & Shaw, 2005).

Conclusion

The breeding behaviour of New Zealand bush falcons and the choice of clear-cut stands as breeding habitat are similar in Hawke's Bay forests and the Kaingaroa Forest in the Bay of Plenty. Falcons are mainly found in stands aged

less than three-years-old although, on rare occasions, falcons may be found in older stands such as the thirty-five-year-old stand in this study. The predictability and uniformity of behaviour observed in this study will be of value to forestry environmental managers as they develop species management plans that can be implemented in plantation forests around New Zealand. Emphasis should be placed on avoiding the immediate nest area to prevent disturbance of the nest and any eggs or juveniles it contains.

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