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A HABITAT STUDY OF NORTH ISLAND KOKAKO IN PUKETI FOREST, NORTHLAND

by

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ABSTRACT

The vegetation structure and composition, and the activities of kokako were studied intensively in five home ranges in Puketi Forest to determine the significance of kauri to kokako, and the likely impacts of logging and browsing mammals upon kokako. Typically, kokako home ranges in Puketi Forest were situated mainly in dissected terrain and contained a great diversity of vegetation types and species. Additionally, some of the vegetation in, or immediately adjacent to kokako home ranges was influenced by disturbance, either natural (cyclone damage, slips) or man-induced (logging, roading).

Overall, kokako activities were concentrated mainly on vegetation of upper ridge crests and flanks. Gully bottom vegetation was important for feeding, seasonally. Kokako used plant species generally in proportion to their relative abundance. However, when feeding, they could be quite selective and at times comparatively rare plants featured prominently in their diet. Conversely, some very common species were hardly ever fed on. The composition of the diet changed with season, according to the availability of edible material from individual food-producing species. Some of the principle plant food species eaten by kokako were also highly palatable to browsing mammals, particularly possums.

Singing was an important kokako activity in summer. Kauri trees were used particularly (whenever present in a kokako home range) as song posts, owing to their towering stature and tendency to grow on prominent, exposed ridge tops. Kokako spent little time in areas of kauri-dominated forest that had been damaged by logging and roading, and frequented undisturbed sites instead. Logging of kauri stands removed important song platforms, and disrupted the canopy and understorey (which provided most of the food producing species), leaving vegetation that was not favoured by kokako.

It was concluded that no further logging take place, that browsing mammals be controlled, and that formal protection status be given to all of Puketi Forest. Further avenues for research have been identified. A full technical report of the study will be published shortly.

1. INTRODUCTION

1.1 Background and rationale for the study

The kokako, *Callaeas cinerea,* is the only member of the New Zealand endemic Wattlebird family (Callaeatidae) to survive on mainland New Zealand. There has been a substantial decline in both the numbers and distribution of the species since European settlement (Lavers 1978). The South Island

subspecies (C. cinerea cinerea) is extinct, or very nearly so, and there are probably only 1500 of the North Island kokako (*C. Cinerea wilsoni*) in existence (G. Rasch, pers. comm.).

The North Island kokako is now regarded as endangered (Bell 1986). Its decline and the extinction of local populations have resulted from predation, loss of habitat (through logging, burning and clearing), and the effects of introduced browsing mammals (habitat damage and competition for food). The largest populations now occur in the central North Island forests (King Country-West Taupo-Bay of Plenty) and in Puketi Forest, Northland (Lavers 1978; Anderson 1984; 1984). The first intensive ecological study of kokako and their habitat was carried out in the central North Island between 1979 and 1981 by Hay (1981) and Leathwick (1981).

Puketi Forest holds at least 100 kokako. The significance of this population was not known until surveys for kokako were carried out in November 1979. Logging for kauri was in progress at the time and the kokako population was found to be most concentrated in the vicinity of kauri forest that had not been logged (Anderson 1979). A five-year moratorium on logging in Puketi Forest was imposed by the New Zealand Forest Service (NZFS) in March 1980 to enable an intensive study to be carried out on the habitat requirements of kokako, the importance of kauri forest to them, and the possible impact of continued logging on the kokako population. Field work for this co-operative study by the New Zealand Wildlife Service and NZFS was begun in December 1982 and completed at the end of 1984. The findings have important implications for management of kokako in kauri forests and for kokako in other forests in the North Island. From 1982-1984 Puketi Forest was relatively unmodified by possums. Since then possums have had a considerable effect on Puketi Forest. It has been estimated that more than 50% of the northern rata have died from overbrowsing by possums (L. Forrester, cited by Yarwood 1989).

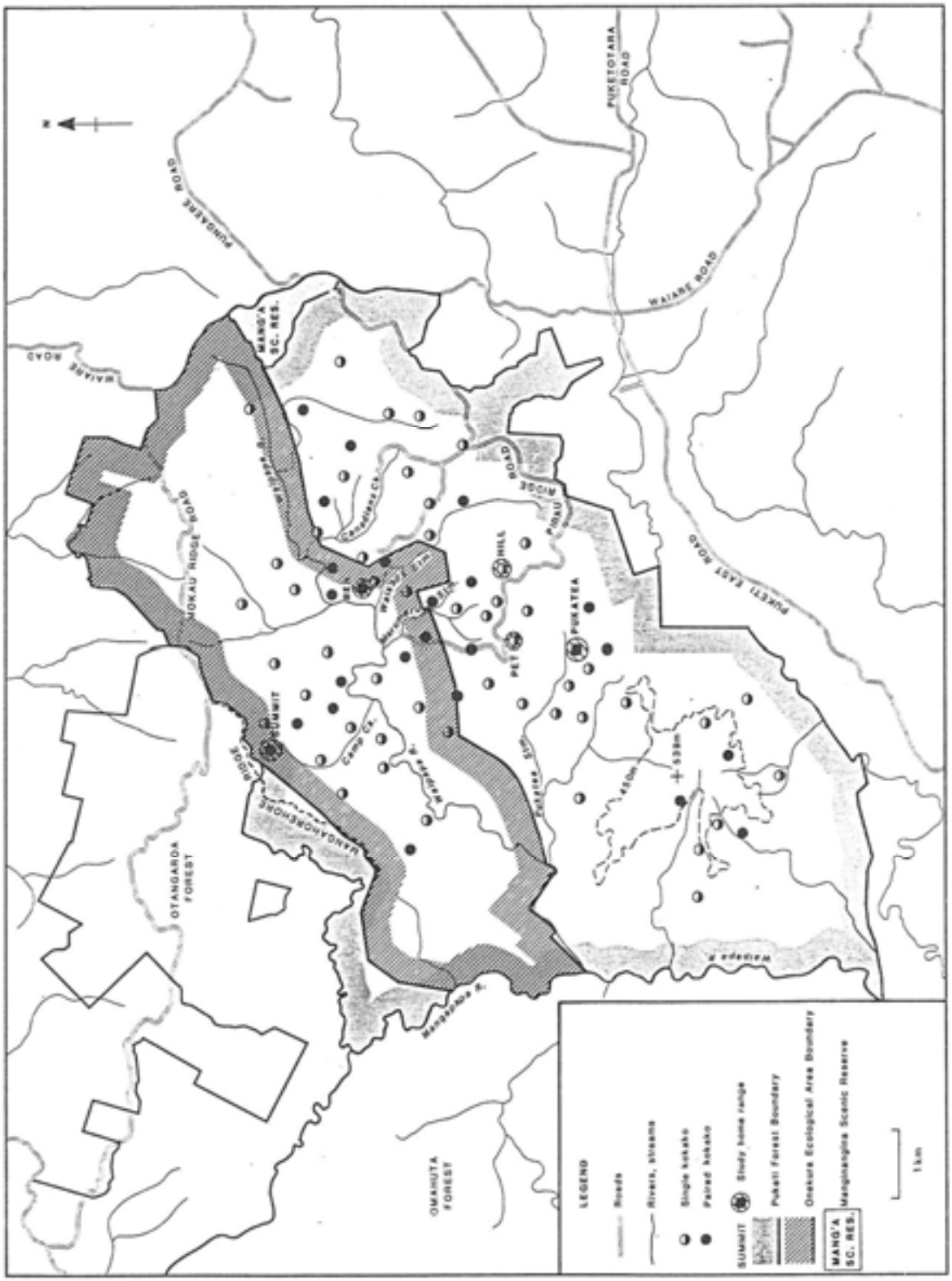
This report summarises the essential features of the study on kokako in Puketi Forest. A more detailed description of the methods, forest habitat, and how kokako use their habitat will be published in a technical report.

2. STUDY AREA

2.1 Topography

Puketi Forest forms the greater part of the Waipapa River catchment which drains south-west into Hokianga Harbour. The high ground on the northern (Mokau and Mangahorehore Ridges) and southern sides of the catchment (Pirau Ridge, and an elevated plateau in the south-west) are flanked by many irregular and broken secondary ridges and spurs. Much of the country is rough, steep and accessible only on foot. By contrast, the bed of the Waipapa River is of gentle gradient, ranging in altitude from about 100 m above sea level (asl) in the north-east to 30 m asl where it joins the Mangapapa River in the west. The crests of Mokau (300-460 m asl) and Pirau (360-460 m asl) Ridges are also of relatively gentle gradient and carry the principal road systems in the Puketi Forest (see Fig. 1). The highest land in the Puketi Forest is on the south-west plateau at 539 m asl.

Figure 1: Map of Puketi Forest showing distribution of kokako



2.2 Logging history

Commercial logging began in the 1860s along the banks of the Waipapa River. Subsequent logging occurred intermittently, with most operations being centred on the eastern third of the Forest (headwaters of the Waipapa catchment) and along the high ground flanking the Waipapa River (i.e. Mokau and Pirau ridges and their major side ridges). The most recent logging took place from 1973-80 and comprised the cropping of selected individual kauri trees using ground hauling techniques. The operation was suspended in 1980 pending results from the kokako habitat use study.

2.3 Introduced mammals in Puketi Forest

Goats have been present since 1935 or earlier (Sexton 1939). Their numbers have been maintained at low levels for almost 50 years. In 1984 goats were seen frequently on old logging roads and this is cause for concern because it is likely that they had escaped from recently developed goat farms nearby.

There are a few wild cattle in an area south and west of Mangahorehore, where they are quite destructive to the forest. At times cattle from adjacent farms stray into the forest.

Pigs occur in moderate numbers and are widespread in both mature and regenerating forest. They are controlled primarily by recreational hunting.

Of all the introduced mammals, possums pose the greatest threat to the vegetation (and kokako) because they feed in the crowns of trees. Their arrival in the forest is relatively recent (mid 1970s), and they appeared to have increased greatly in number since then. They were found throughout the area by 1984, with highest numbers along the forest margins. During the course of the kokako study it was evident that possum damage was increasing. In 1982, browsing sign was seen infrequently, but by late 1984 some of the five-finger and kotukutuku plants tagged for study purposes appeared to have been killed by repeated browsing.

Predatory mammals seen in Puketi Forest include ship rats, stoats and cats.

2.4 Distribution of kokako in Puketi Forest

Most kokako in Puketi Forest occurred on the south flank of the Waipapa Catchment, especially in Canadian's Creek, mid-lower Waikape Stream, Merumeru Stream and the head of Pukatea Stream (Fig. 1, after Anderson 1984). On the north side of Waipapa River, kokako were found mainly in Camp Creek or in immediately adjacent catchments.

Overall, kokako were most plentiful in places where the vegetation has been disturbed least (by storms or logging) and where the terrain was dissected (as these localities had the most diverse mature forest cover).

3. PHYSICAL FEATURES OF THE VEGETATION

Five kokako home ranges were studied intensively (Fig. 2). Each was gridded into contiguous, permanently-marked 40 x 40 m plots which formed a common framework for collecting data on vegetation characteristics and the activities of kokako.

Eight groupings were recognised from analysis of the vegetation data, based primarily on a sequence from damp, sheltered gully bottoms to broad, rounded ridge tops through to exposed, defined ridge tops in steeply dissected terrain. Altitude and disturbance appeared to be secondary factors influencing the make-up of vegetation groupings (with disturbance from logging and storms being relatively more plentiful on higher altitude sites).

The vegetation groups identified were those that were characteristic of:

a) gully bottoms: dominated by pukatea -supplejack -kohekohe -taraire
b) gully flanks: dominated by rimu -kohekohe -towai -taraire -supplejack
c) gully heads and lower ridge flanks: dominated by rimu - taraire -kohekohe -towai
d) ridge flanks: dominated by towai -taraire–kohekohe
e) steep upper ridge flanks and gently rolling ridge tops: dominated by towai -taraire - kohekohe - tawa
f) ridge tops and upper ridge flanks away from exposed knolls: dominated by Hall's totara – kauri - -towai -taraire
g) ridge knolls, steep side spurs and some steep ridge flanks: dominated by Hall's totara - kauri - miro -northern rata – kiekie - towai - taraire
h) the most prominent knolls and side spurs, on the most finely dissected ridge systems or, in one case, on a raised plateau: dominated by kauri - Hall's totara -miro -towai -kiekie

There were marked differences in the distribution and presence of vegetation groups between the home ranges. Gully bottom vegetation was more plentiful in Summit home range compared with the other home ranges; there was a preponderance of vegetation of steep ridge flank and steep upper ridge flank/gently rolling ridge tops in Pukatea home range while kauri-clad sharp ridges, exposed knolls and steep ridge flanks were characteristic of Ben and Hill home ranges.

4. THE ECOLOGY OF KOKAKO

The method used to obtain data was identical to that chosen by Hay (1981) for his study on kokako in the central North Island. When a bird or pair of birds was found in a study home range information was recorded on the principal activity and components of the habitat used during a 10 second period at one minute intervals. Most observation periods ran for two to nine hours.

4.1 Kokako diet

Kokako ate more than 85 species of plants and invertebrates during this study. Fruits and leaves were the main items of the diet, supplemented with flowers, moss (foliage and capsules), invertebrates, and bark (Fig. 3). Fruit was taken mostly in summer and autumn and flowers in summer. Kokako fed on leaves most often in winter and spring when flowers and fruits were least abundant.

Figure 2: Distribution of vegetation groups in the kokako home ranges studied

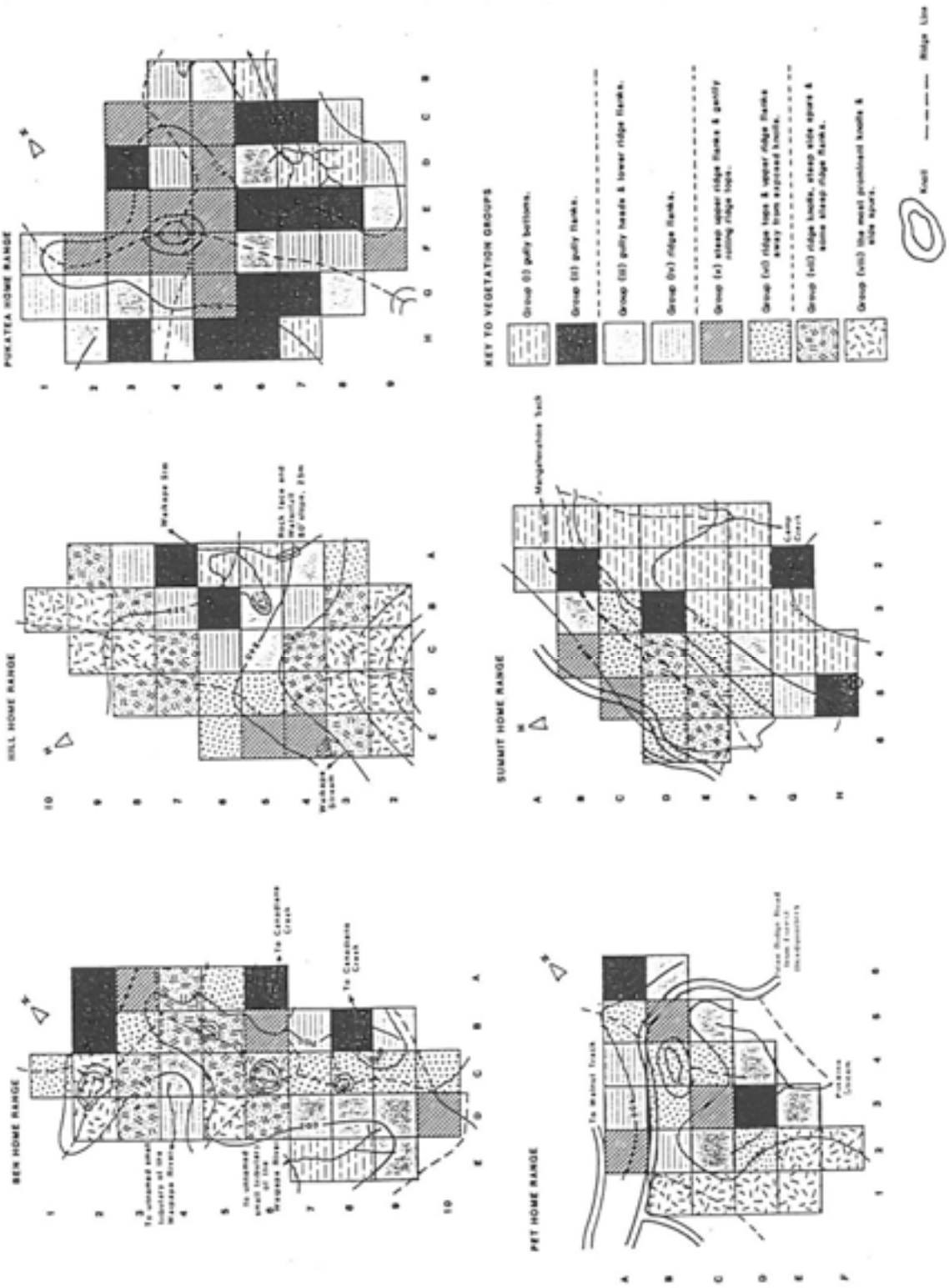
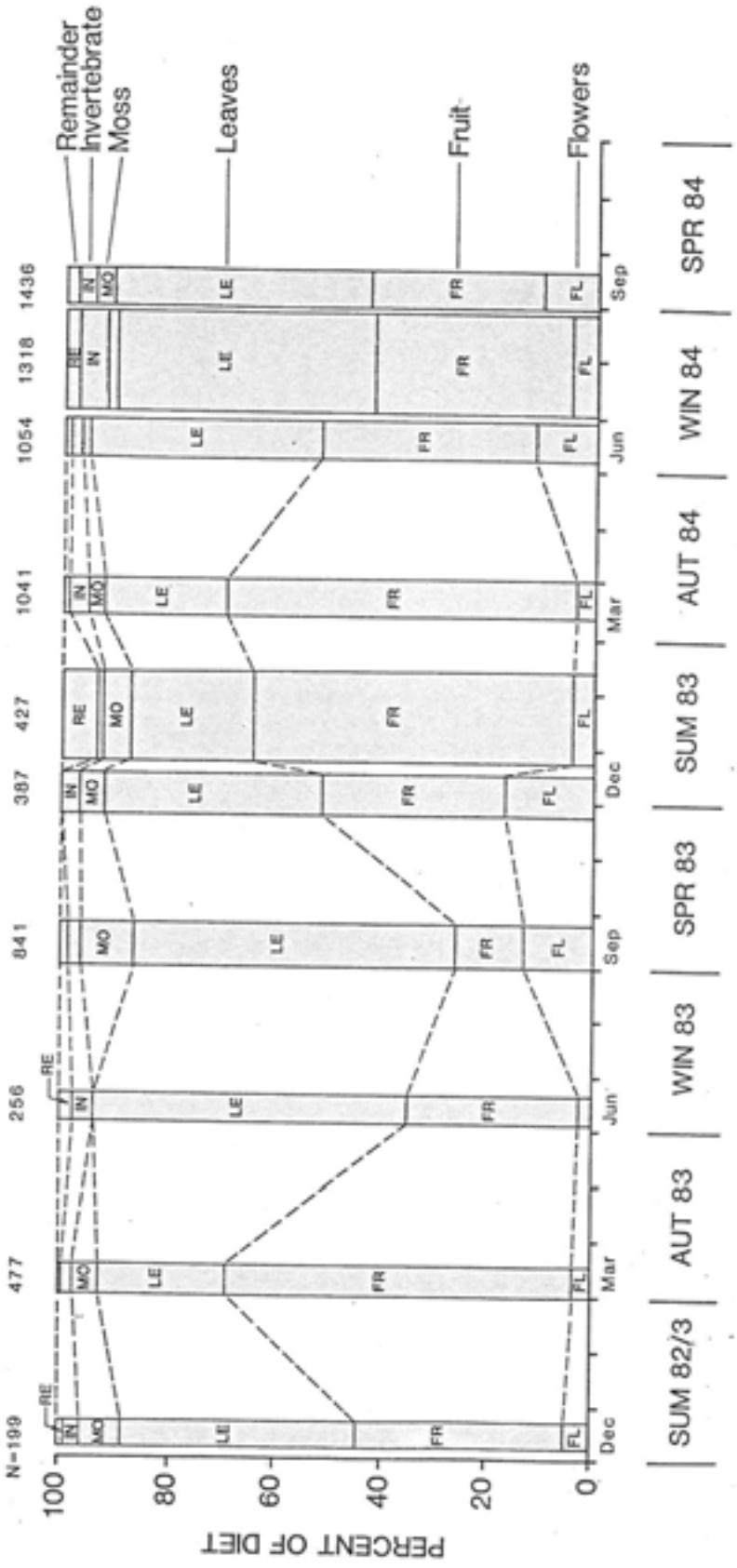


Figure 3: Seasonal use of food items by kokako in Puketi Forest



4.1.1 Species composition of the diet

The relative importance of species eaten by kokako during the term of this study is listed in Table 1. A few species formed the mainstay of the diet; the first ten species listed on Table 1 made up half (49.6%) of the diet. Although the other species eaten by kokako represented a minor portion of the diet overall, they could be seasonally important sources of food within a home range.

The composition of the diet changed markedly with season, as illustrated for Summit home range in Figure 4. In all, 24 species were important seasonally. However, only Hall's totara was a major food in all the seasons depicted. Some of the other 23 species were taken relatively commonly (e.g. puka, heketara and nikau in four seasons, and *Phymatosorus diversifolius,* pate and raurekau in three seasons). The remaining 16 were taken less frequently (in one or two seasons).

Table 1. Species composition of kokako diet, Forest, December 1982 September 1984 (for species comprising 1.0%or more of the diet overall).

Species	Percent	Species	Percent
Heketara (S)	7.3	Rimu (P)	1.8
Asplenium flaccidum (E)	6.6	Filmy ferns (E)	1.9
Hall's totara (P)	6.0	Pigeonwood (S)	1.8
Nikau (Pa)	5.9	*Earina autumnalis* (E)	1.7
Puriri (T)	5.7	*Melicytus macrophyllus* (S)	1.7
Raurekau (S)	5.3	Miro (P)	1.6
Puka (E)	5.3	*Earina mucronata (E)*	1.5
Five-finger (S)	4.6	*Nestegis montana*	1.4
Phymatosorus diversifolius (E)	4.3	Lancewood (S)	1.3
Supplejack (L)	3.9	Mahoe (S)	1.2
Moss (E)	3.5	Taraire (T)	1.2
Kohuhu (S)	2.6	Raukawa (S)	1.1
Mapou (S)	2.4	Rewarewa (T)	1.0
Bag moth (I)	2.4	*Clematis paniculatus*	1.0
Hangehange (S)	2.3		
		TOTAL =	88.3

Note: E = epiphyte, L = liane, I = invertebrate, P = podocarp, Pa = palm, S = shrub hardwood, T = tree hardwood.

There were also marked differences in the composition of the diet between kokako home ranges in the same season (e.g. Autumn 1984, Fig. 5) and this reflected differences in the availability and abundance of food between home ranges. Of the 25 species depicted, none rated in the ten most commonly eaten species for all five home ranges. However, six species (24%) rated in four home ranges (five-finger, Hall's totara, heketara, *Melicytus macrophyllus,* miro, nikau). An additional three species (12%) were rated in three home ranges (hangehange, raurekau, supplejack), while bag moth,

Figure 4: Seasonal composition of diet in Summit kokako home range

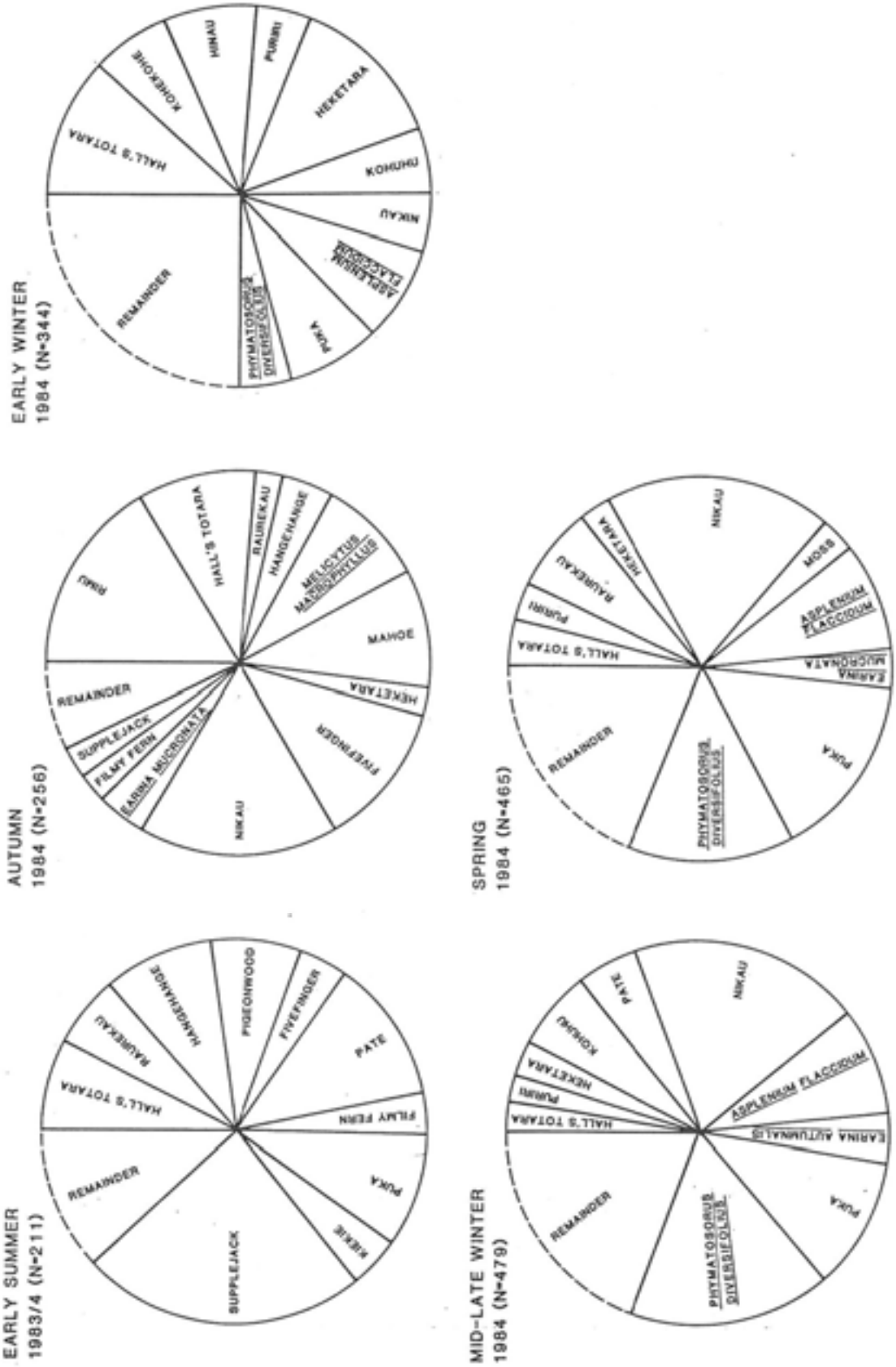
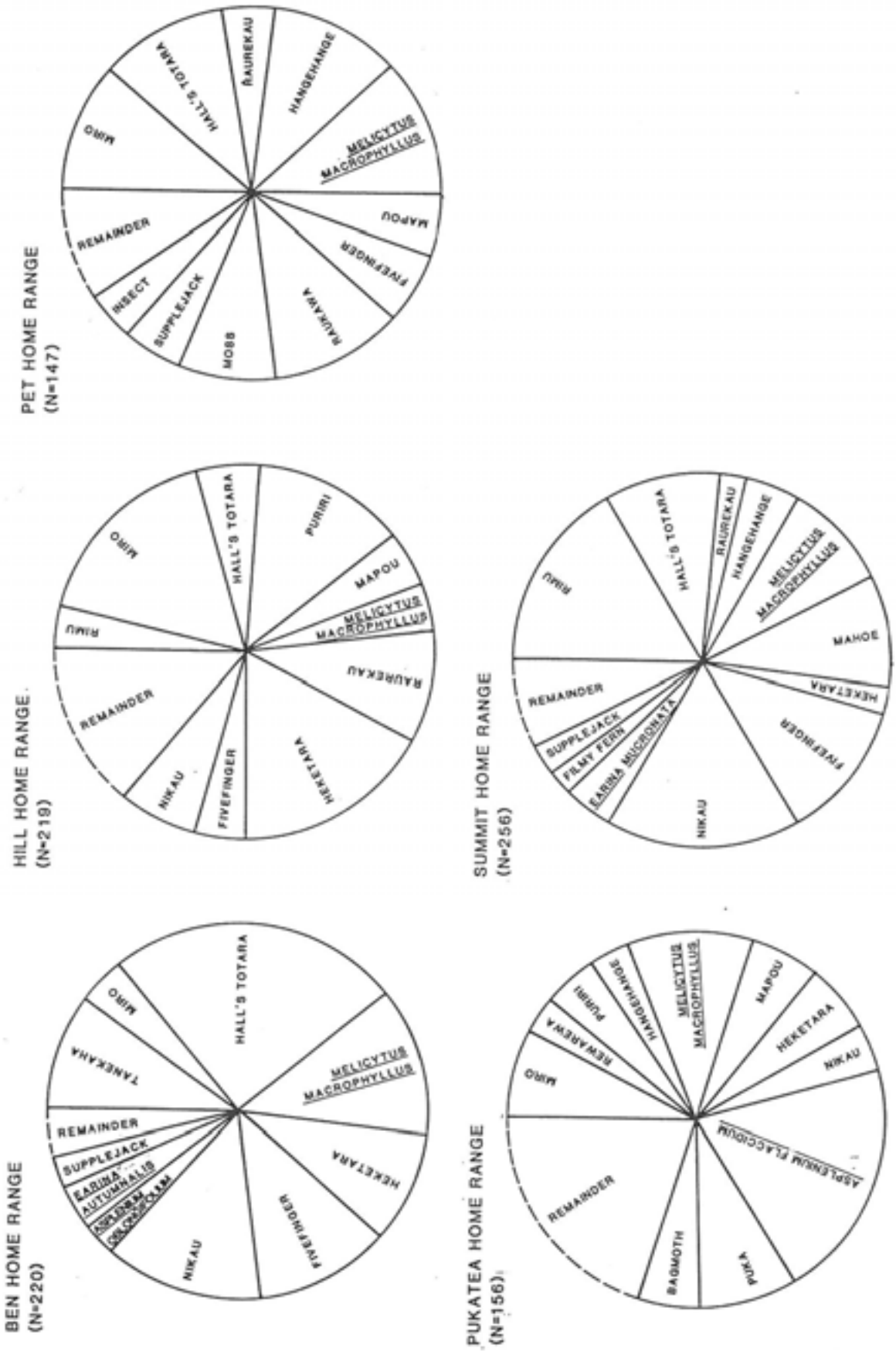


Figure 5: Composition of diet in five kokako home ranges in Autumn 1984.



mapou, moss and rimu were amongst the ten most commonly eaten species in only two home ranges.

Feeding on individual species of plants changed seasonally in relation to the availability of certain items of food, as illustrated by supplejack and puriri (Figure 6a, b).

Feeding on supplejack was greatest in summer. The leaves were taken mostly in late November to mid December 1983 when new foliage was relatively plentiful, and flowers were taken when available. The main intake of fruit occurred in mid to late summer (late December to mid February), a time when flowers and new leaves had become less plentiful and when fruit availability was greatest. Supplejack comprised a minor component of the diet over the rest of the year (mainly ripe fruit, which was present in small quantities throughout the year).

Similarly the fruits and flowers of puriri were favoured foods. Puriri was an important food source in most seasons because fruit and flowers were produced nearly all year round (Fig. 6b). The only exception to this was in June 1983. (But note that during this period there were persistent storms and only one home range was accessible by road vehicle.) Although puriri flowers and fruit were available at the time, the birds did not feed on them because the only tree in the home range was on an exposed situation. The birds were confined to another part of their home range which was more sheltered (see 4.1.6, Home range use).

These features of the species composition of the diet illustrate the importance of a wide range of food species within a kokako home range to sustain birds over a year.

4.1.2 Classes of food

Kokako obtained most of their food from shrub hardwoods (34.5%), epiphytes (28.4%), tree hardwoods (11.8%), podocarps (10.0%), lianes (5.9%) and nikau (5.9%). There was greater use of shrub hardwoods as they tended to be prolific flowerers and fruiters, and because birds also ate the leaves. There was also a greater range of shrub hardwoods present (33 species) than for podocarps or tree hardwoods. By contrast, tree hardwoods (the most common canopy trees in Puketi Forest) and podocarps comprised relatively few species (12 and seven respectively), and only the flowers or fruits tended to be eaten.

The greatest use of shrub hardwoods was in summer (35.1 - 67.3%; Fig. 7) and least in winter - spring (26.6 – 34.5%)[1]. Feeding on podocarps was greatest in autumn (22.2 – 24.6%), mainly for fruit; epiphytes in late winter-early spring (35.7 – 41.0%), for foliage; and lianes during summer (12.6 – 27.9%), mostly for supplejack leaves, flowers and fruit.

The only other food classes that contributed more than 5% to the diet in any one season were tree hardwoods and nikau palms. Consumption of tree hardwood foods fluctuated seasonally between 6.8% and 21.1% of the diet. Nikau fruit comprised less than 1% of kokako diet in the first year of study but formed between 2.1% and 11.2% of the diet from January 1984 until September 1984.

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[1] Except in winter 1983, when protracted stormy weather forced the only kokako pair that could be studied intensively into a part of their home range that consisted mainly of shrub hardwoods; then 53.1% of the diet was of these plants.

Figure 6: Frequency of feeding by kokako in relationship to abundance of two plant species

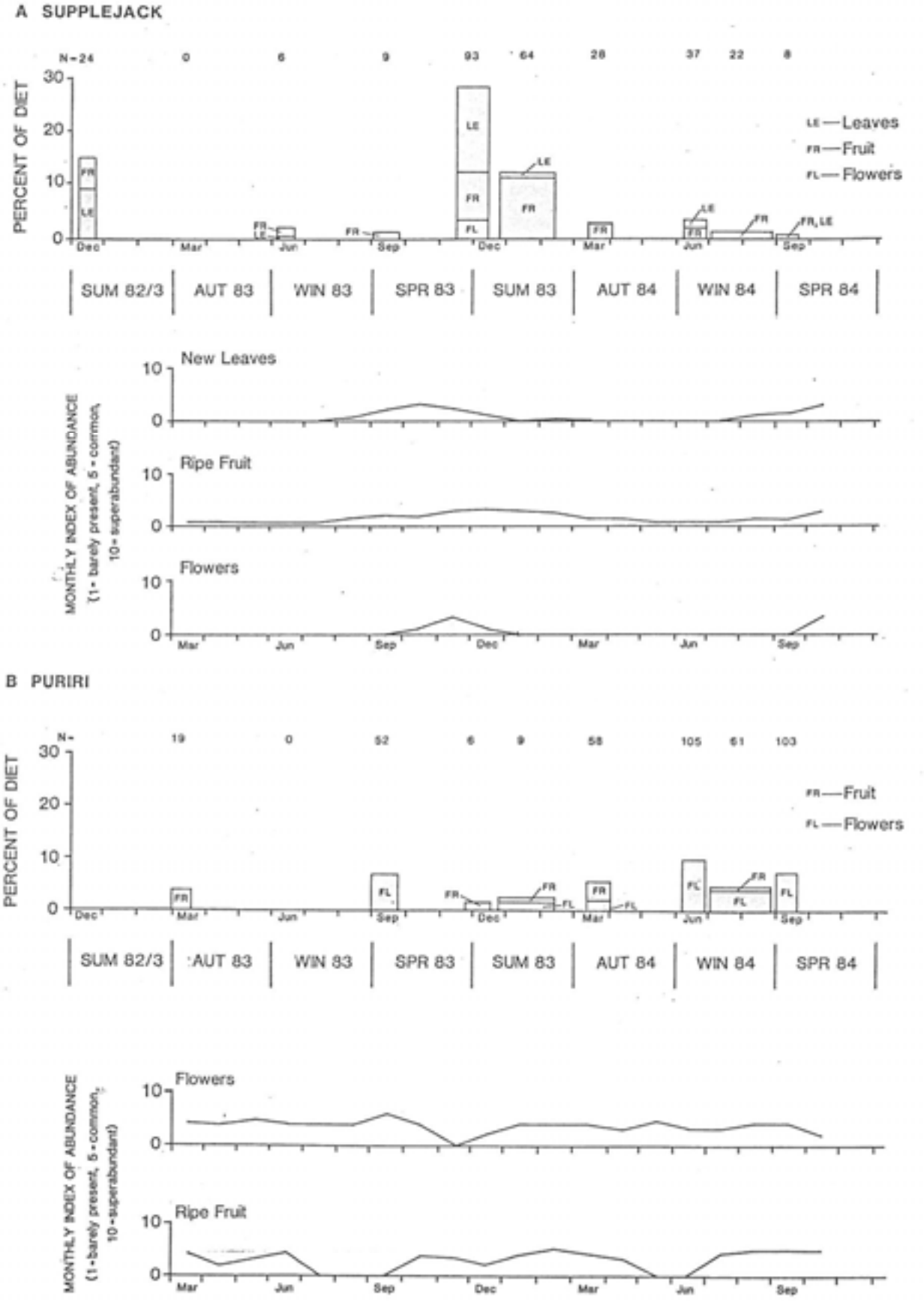
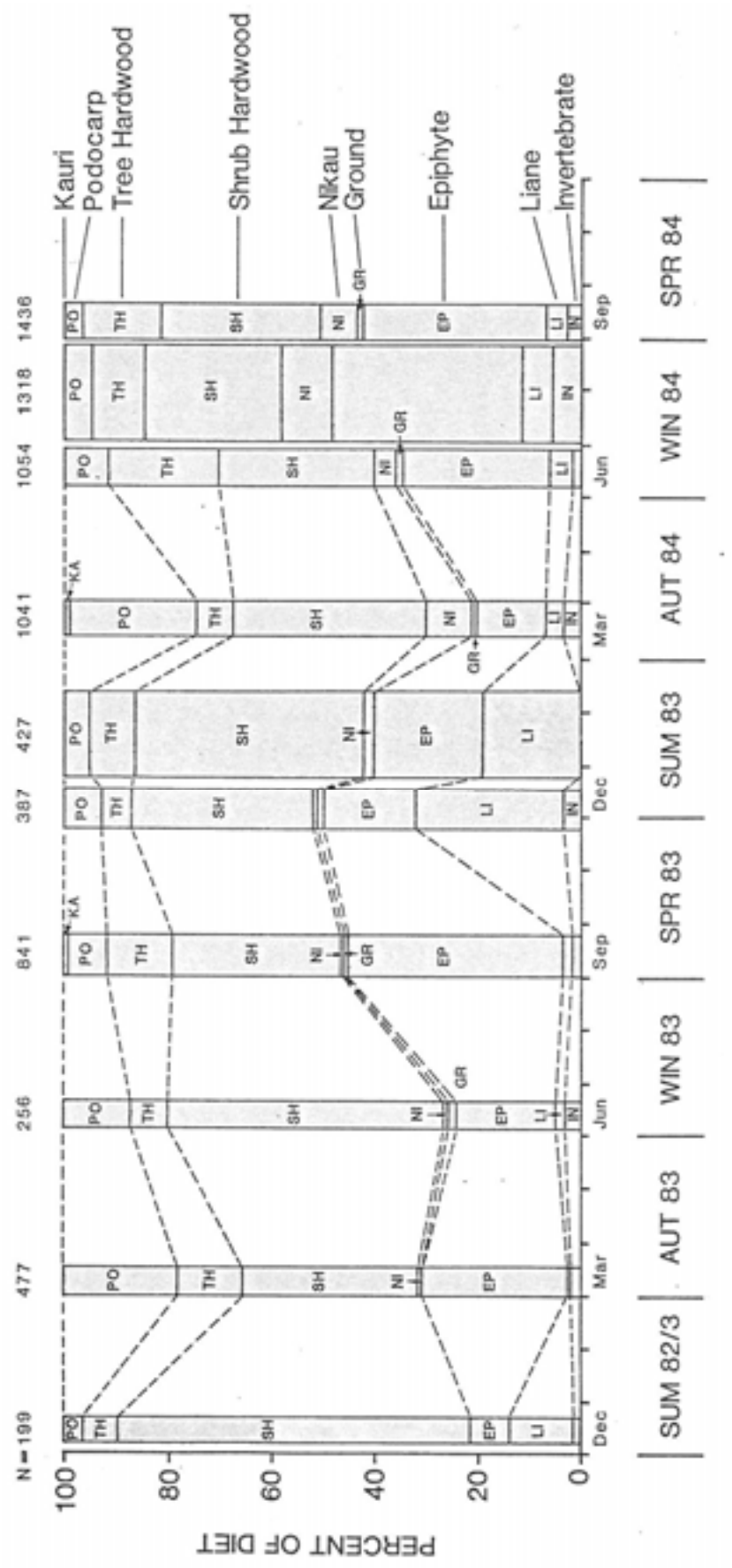


Figure 7: Seasonal use of food classes by kokako in Puketi Forest



Kauri, invertebrates, tree ferns, ground plants, and 'other' (dead trees, self-entwined supplejack and liane thickets, and unknown), contributed minor amounts to the diet. Kauri was recorded as a food item only in spring 1983 and autumn 1984, when it constituted less than 0.5% of the diet (dead twigs). Invertebrates made up 0.2% to 3.5% of the diet per season.

Seventy percent of the 2109 records of epiphyte foods taken by kokako came from tree hardwoods (particularly kohekohe [30%], and taraire [19%]), and 19% from podocarps (Hall's totara [11%], and miro [5%]). Shrub hardwoods (6% use) and the remaining epiphyte hosts (5% use) were used only to a minor degree.

The principal hosts of lianes and invertebrates used by kokako were similar to those for epiphytes. Most liane and invertebrate foods were obtained from tree hardwoods (59% and 79% of 439 and 216 records respectively), especially kohekohe (20%), towai (15%) and taraire (11%) for lianes, and towai (38%), taraire (21%) and tawa (16%) for invertebrates.

Because epiphytes, lianes and invertebrates were more plentiful on tree hardwoods than shrub hardwoods the addition of these components to their host plants resulted in tree hardwoods being as important as shrub hardwoods when regarded as overall sources of food (Fig. 8).

Shrub hardwoods, because of their smaller size, did not carry sizeable loadings of epiphytes. Kauri, nikau and tree ferns also had small loadings of attendant species. Kauri were generally clean-trunked and -limbed, presumably because their bark is shed in large flakes.

Tree hardwoods were the dominant food hosts in four sampling periods (spring 1983, early winter 1984, mid to late winter 1984, spring 1984) probably because they had the greatest loadings of epiphytes, and epiphytes were fed upon extensively during these periods.

The importance of podocarps and shrub hardwoods as food sources also increased when they were considered as food hosts, but generally to a far lesser degree than that shown for tree hardwoods (about 6% increase for podocarps and 5% for shrub hardwoods in most sample periods). The greatest use of podocarps as food hosts was in winter 1983 [12.1%] for epiphytes, whereas for shrub hardwoods it was in early and mid to late summer 1983/84 (18.9 & 11.9%), mostly for supplejack leaves flowers and fruit.

Kokako obtained little food from the remaining host classes of vegetation (i.e. kauri, nikau, 'other'). Kauri featured only in three seasons (comprising less than 1% of the feeding records for each), and nikau showed less than 2% increase per season. In some seasons there were appreciable increases in the use of 'other' food hosts, e.g. in winter 1983 when kokako fed from the ground on unripe supplejack fruits and other foods blown out of the canopy by storms, and also in mid to late summer 1983/84, when birds perched on tree ferns and dead standing trees while feeding on fruits of supplejack.

4.1.3 Seasonal activity patterns

The activities of kokako revolved mainly around feeding and singing (Fig. 9). Singing was undertaken to advertise occupation of home ranges. Moving and calling activities were accessory to feeding and singing because birds moved to search for food and to find suitable song posts. Calls often preceded bouts of song, were given during intervals in song periods, or when a song session was winding down. Birds also called to their mates when they became separated while feeding. On occasions birds

Figure 8: Seasonal use of food hosts by kokako in Puketi Forest

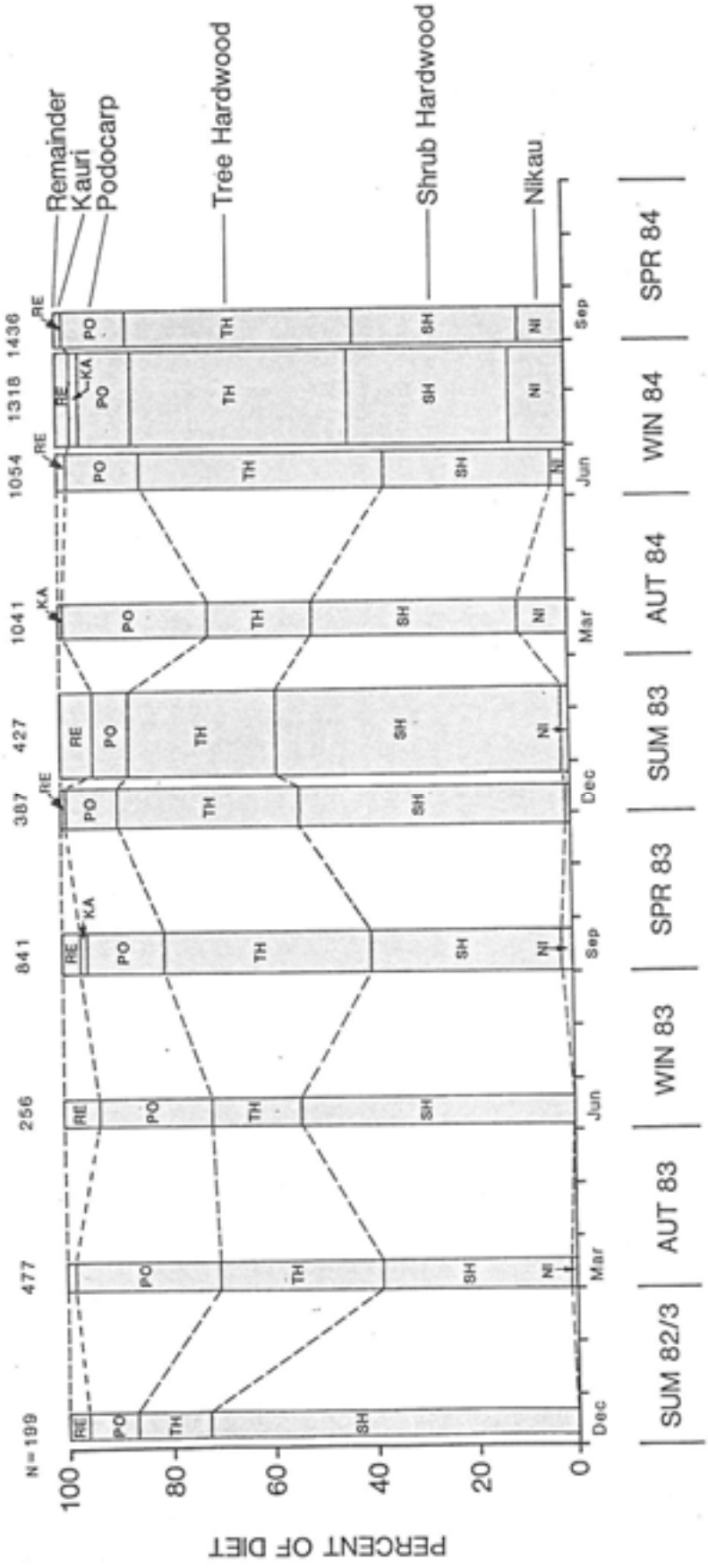
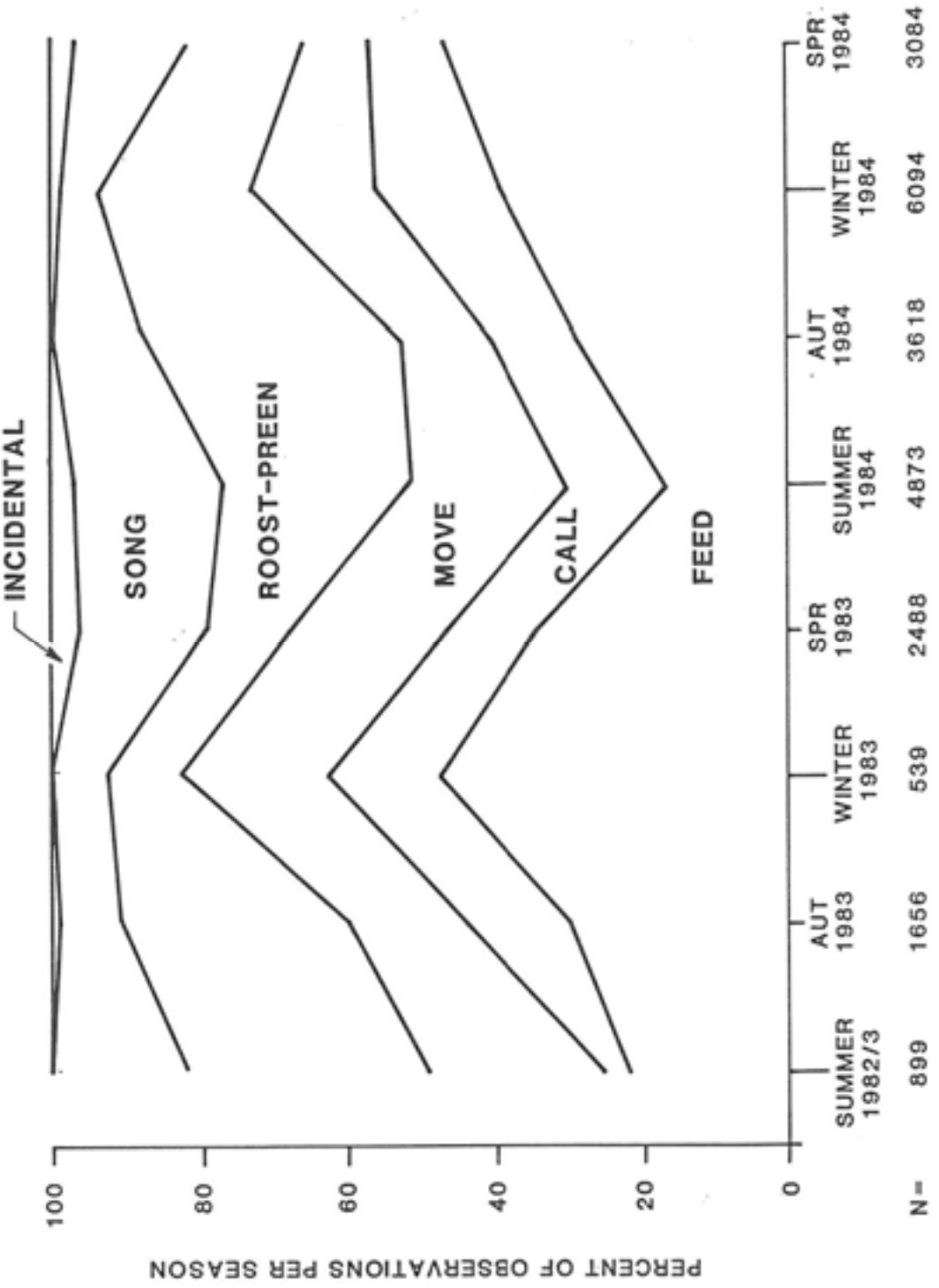


Figure 9: Seasonal variation in kokako activities



called spontaneously for several minutes regardless of whether they were single or paired, its mate was nearby or some distance away, or whether there was a reply or not.

Feeding activity per hour was greatest during the colder parts of the year (38.9 to 47.5% of all activities in June-September) and least during summer (16.7-21.2% of all activities). Singing was more frequent in spring, summer and autumn; roosting-preening was most common in summer and autumn (during moult); and 'incidental' activities (gathering nest material, displaying, bathing) were seen mostly in spring and summer.

Singing activity was reduced in winter presumably in response to the shorter daylength, and the need to spend proportionally more time feeding when the range of available foods was reduced.

4.1.4 Diurnal activity patterns

The diurnal activity patterns of kokako in summer 1983/4 and winter 1984 are shown in Figures 10a and 10b, respectively. In summer, singing was the dominant activity in the first and last quarter of the day, whilst feeding was most common in the middle half of the day. The diurnal pattern for winter was similar in that singing occurred mainly at either end of the day. However, the amount of time spent singing more than halved and there was a corresponding increase in feeding compared to that in summer.

4.1.5 Use of components in the habitat

4.1.5.1 Vertical use of the forest

Nearly all kokako activities took place in canopy trees (65.9-85.9%) except for singing which was undertaken predominantly from emergents (81.5%; Fig. 11). Understorey and ground tier plants were used infrequently by kokako (5.5% and 0.8% use respectively overall). In general, feeding was undertaken 1-2 m below the canopy, especially in vegetation with a relatively low canopy height (mainly because a significant amount of the diet comprised canopy forming shrub hardwoods) -see Figure 11. By contrast, singing was concentrated in the uppermost vegetation (median height for singing was 25 m above ground level).

The height zones used by kokako when feeding changed seasonally because of changes in the availability of food. Median feeding heights were lowest in summer, when much of the diet came from lianes and shrub hardwoods, and were highest when birds fed on epiphytes in the tops of emergents (winter 1984). Feeding at intermediate heights was observed in autumn and spring.

Feeding on the ground occurred in winter and spring (0.1-3.9% of feeding observations/season) and (0.5%) in early and mid to late summer 1983/4. Ground feeding was more frequent in the winter of 1983 (4.8% of the feeding in one home range) after unripe fruits had been shaken out of the canopy during prolonged stormy weather. In general, feeding on the ground tended to occur when food was less abundant.

4.1.5.2 Use of vegetation groups

Overall, kokako concentrated their feeding, singing and other activities mainly on vegetation of upper ridge crests and flanks, but gully bottom vegetation was also favoured for feeding.

Figure 10: Comparison of kokako diurnal activity patterns between summer and winter

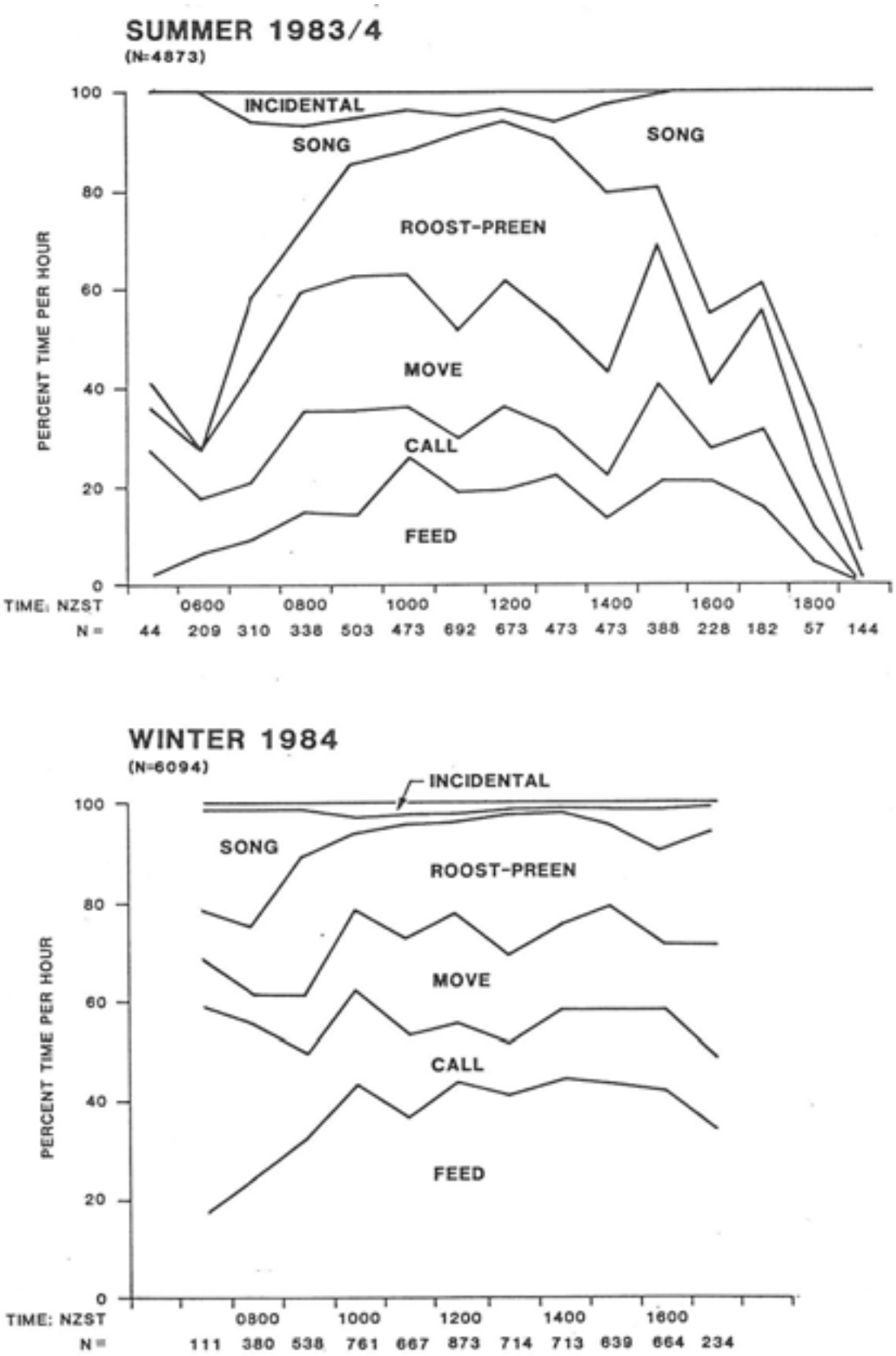
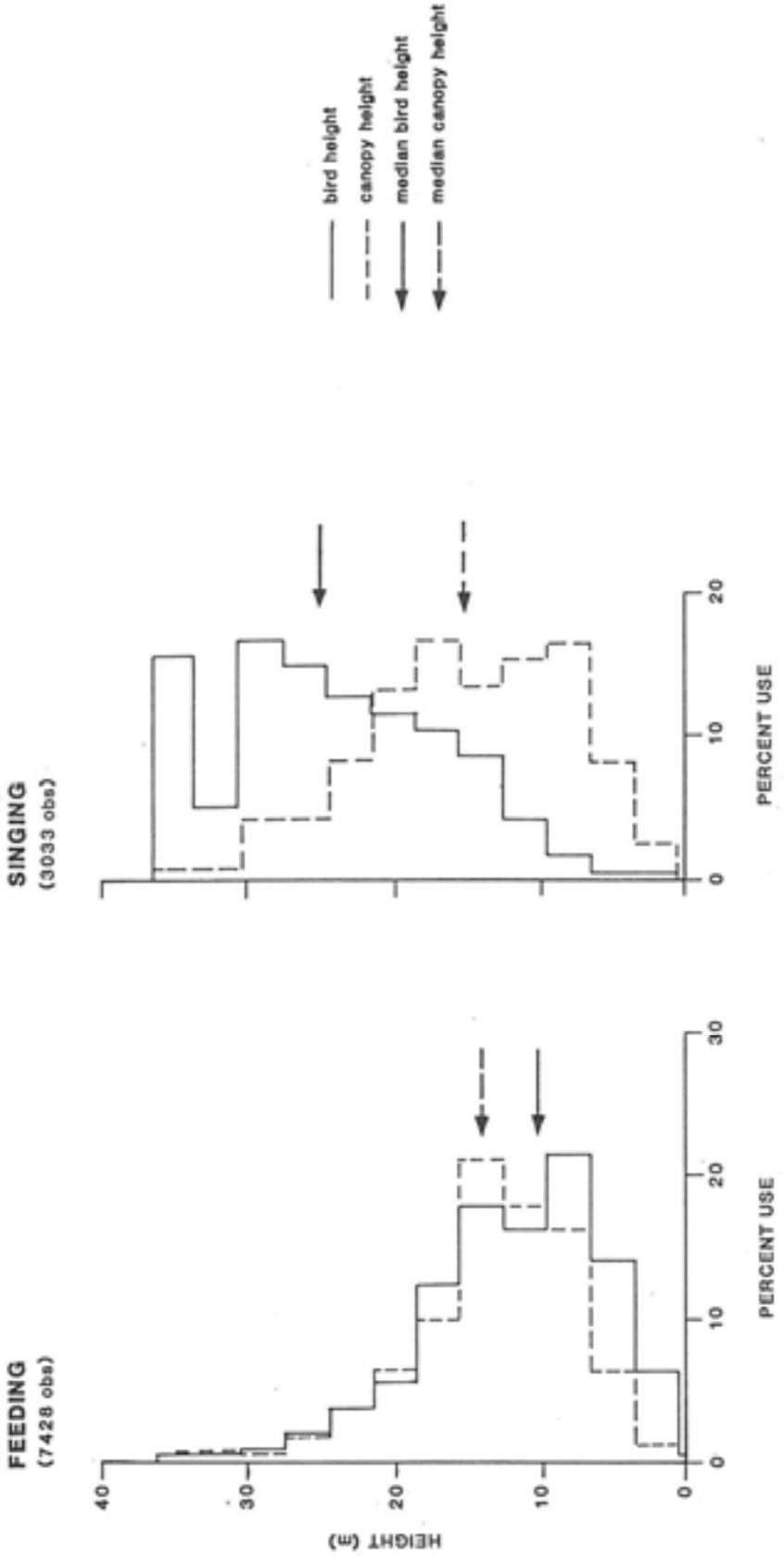


Figure 11: Use of forest height levels by kokako for feeding and singing



Changes occurred in the use of vegetation groups with season. In summer, kauri-dominated sites (whenever present) were favoured primarily for singing, while in autumn there was an increase in the use of podocarp-dominated sites because the fruits of these trees were most plentiful then.

Vegetation damaged by roading or logging was available to kokako in four of the five home ranges studied, but it was generally avoided. Logging removed important song posts and disrupted the canopy and understorey, thereby reducing the abundance of food producing plants. Whenever kokako ventured into logged parts of the forest they almost always stayed for short intervals and usually frequented the edges. The only time that logged forest was used for a longer period was in Summit home range during winter 1983. On this occasion the birds used a compact area that included second-growth shrub hardwoods; it was the only part of their home range sheltered from the prevailing easterly storms. The birds visited this area far less frequently at any other time during the study. None of the kokako studied lived habitually in areas of logged forest.

4.1.5.3 Use of plant species

Plant species in each forest tier (emergent, canopy, subcanopy) were used generally in proportion to their relative abundance for feeding, singing and other activities. However, feeding birds could be quite selective, for at times comparatively rare plants such as puriri were prominent in the diet (Table 1). Conversely, some of the more plentiful species such as towai were virtually never fed upon.

When singing, kokako also showed seasonal preferences for plant species. Kauri was used particularly in summer (whenever present).

4.1.6 Home range use

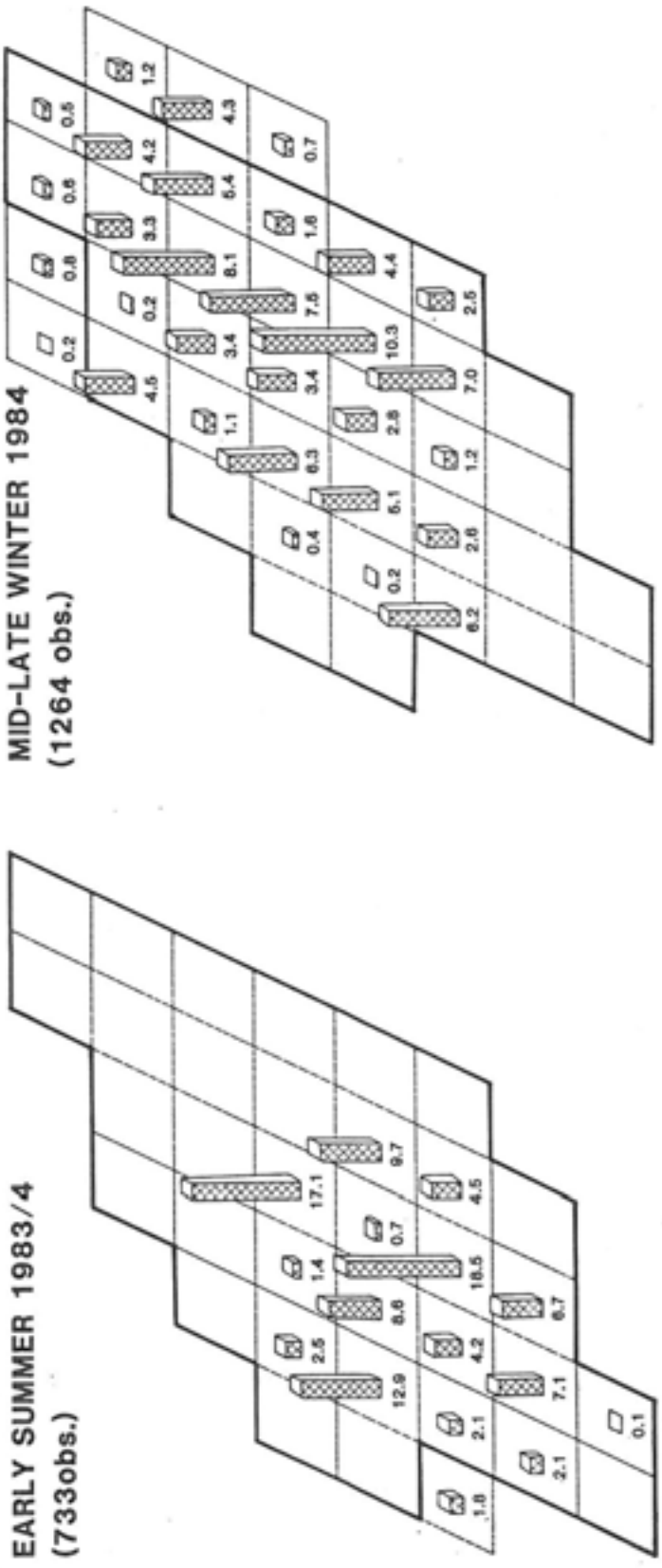
Kokako occupied discrete home ranges throughout the year, but different parts were used from season to season (Fig. 12). At times relatively compact portions of their home range were used (generally in summer and autumn) while at other times (e.g. late winter-early spring) birds were active over most of their home range.

Within each home range, birds frequented places where food was most plentiful at the time. Although singing may be centred away from the area used for feeding and other activities, it tended to take place nearby. In most instances, birds sang from the closest prominent trees available to them.

Use of a particular area of a home range for feeding appeared to depend not only on the foods it contained but also on the availability of food nearby. Small areas with abundant food were often likely to be under-utilised if they were some distance from larger areas having a comprehensive range of foods. For example, the only puriri tree available to the Summit pair was located on the periphery of their home range. This tree was used only when the birds frequented that general area of their home range (early winter 1984 -spring 1984). However, puriri was an important food in Hill home range during most seasons as the three trees available were located centrally.

Storms could have a large influence on the sector of a home range used by kokako. During winter 1983, the kokako in Summit home range spent most of their time in a compact area sheltered from the prevailing easterly storms. During the following winter, the weather was calmer and the birds ranged more widely.

Figure 12: Use of Summit kokako home range in two seasons.
Each square is 40 x 40 m. The heavy line delineates the perimeter of the gridded squares.



5. CONCLUSIONS

5.1 The likely consequences of logging on the kokako population of Puketi Forest

Kokako seldom ventured into logged areas and then usually only along the fringes for short periods. Most kokako activities were conducted above 10 m and very little vegetation remained above this height after logging.

Logging has a major impact on forest structure and composition. Damage occurs to all vegetation tiers, and gaps created in the canopy cause changes in the microclimate. Overall, the forest structure is simplified and species abundance is reduced substantially.

Removal of podocarps and tree hardwoods results in a great reduction in the food supply. Such trees are important not only for the food they supply themselves but also as they carry the greatest loadings of epiphytes and lianes, which contribute substantially to the diet. Kauri are highly favoured song posts.

Regeneration is slow, especially in areas logged for kauri. Typically, dense mats of the sedge *Gahnia xanthocarpa* establish over the disturbed soil. Colonisers such as *G. xanthocarpa,* wineberry, and treefern are not used to any extent by kokako.

Generally, kokako in Puketi Forest are most plentiful where the habitat is most diverse (usually where the terrain is most variable), along prominent ridges, and where there has been least disturbance to the mature indigenous forest cover. Currently, very few birds occur in forest that was logged before 1973 or in the areas that have been selectively logged since then (Anderson 1979, 1984).

5.2 The likely effects of mammalian browsing on kokako habitat

Some plant food species favoured by kokako are also highly palatable to browsing mammals, particularly possums. These include five-finger, hangehange, kohekohe, kotukutuku, pigeonwood, raukawa, raurekau, rewarewa and supplejack (Fitzgerald 1976, Fitzgerald and Wardle 1979, Leathwick *et al.* 1983). In Puketi Forest, possum browse was evident on most of these species as well as on *Melicytus macrophyllus, Mida salicifolia* and northern rata. Some of the five-finger and kotukutuku plants monitored in the course of this study were browsed heavily by possums and died. The overlap in diet between kokako and possums in the Forest is of concern. Left unchecked, possum browse is likely to result in a significant reduction of the availability of many of the species preferred by kokako in the forest. It is estimated that more than 50% of the northern rata (a favoured kokako song post) in Puketi have now been killed by possum browse (Yarwood 1989, citing Lisa Forrester, northland Conservancy, DOC).

Low numbers of cattle and goats in Puketi Forest may also have an adverse influence on quality of habitat for the kokako population. If allowed to remain, their browsing may lead to depletion of important food plant species in the kokako diet. Leathwick *et al.* (1983) have implicated impoverishment of habitat by browsing mammals in the collapse of kokako populations elsewhere in the North Island.

6. THE VALUE OF PUKETI FOREST TO KOKAKO

Puketi Forest

- comprises the largest known kokako population centre in Northland and is isolated from all other kokako populations.
- contains one of the largest and densest kokako populations known to exist. The population is within a contiguous forest tract, unlike some other North Island populations.
- has a breeding population of kokako. Juveniles were seen and a nest was found during the study.

Less than half of the kokako population of Puketi Forest lies within protected areas. (Reserves in the forest tract include the 92 ha Manginangina Scenic Reserve and the 2351 ha Onekura Ecological Area). Puketi Forest forms, along with the adjacent indigenous forested areas of Omahuta Forest, Otangaroa State Forest and Scenic Reserves, a contiguous tract of c. 14 600 ha. Even though much of the forest in Omahuta has been logged, given many decades its value as kokako habitat will increase, allowing room for considerable expansion of the existing kokako population in Puketi Forest. Thus, an opportunity exists for the long-term rehabilitation of an area with major potential for kokako.

7. FUTURE REQUIREMENTS FOR WORK ON KOKAKO IN PUKETI FOREST AND IN NORTHLAND.

7.1 Assessment of the dynamics of the Puketi population

Although information is available on the numbers and distribution of kokako in Puketi Forest, it is not known if the breeding that occurs is sufficient to maintain the population. Surveys have indicated that a sizeable portion of the population is not paired; 25 pairs and 50 singles were reported to be present in November 1983 (Anderson 1984). Of the 18 kokako home ranges visited during our study, 10 had only single birds. The presence of paired birds in less than half of all home ranges clearly limits the breeding potential of the population. It is not known if such a dispersion of birds is typical of a healthy kokako population, or is indicative of one under pressure from some environmental factor.

Studies of kokako in the central North Island indicate that these populations have low annual production (Hay 1981, J.G. Innes pers. comm.). Furthermore, there is evidence that not all pairs attempt to breed each year (Hay *et al.* 1985).

At Puketi it is essential to determine

- the status of the population (stable, increasing or declining) and whether breeding is sufficient to maintain the kokako population
- the factors that influence breeding success, and
- suitable methods for increasing productivity and survival of birds

7.2 Surveys to determine the distribution of kokako in Northland

At present, apart from Puketi Forest, the large remnant tracts of mature indigenous forest have not been surveyed adequately for kokako. Although wildlife surveys of Northland were conducted between January 1977 and January 1979 (Ogle 1982), the techniques used were unsuitable for recording the rarer and more secretive species such as kokako, for which specific techniques are required. Such techniques are now available and should be applied in all the large forests in Northland having suitable habitat, the prime candidates being Waipoua-Waimea-Mataraua forests continuum, Warawara Forest and the Maungataniwha Range. A walk through survey should be made of the more intact parts of Omahuta Forest also, as kokako have been seen there.

8. RECOMMENDATIONS

a) **THAT NO FURTHER LOGGING TAKES PLACE.** This recommendation extends not only to mature forest but also to regenerating forest and shrubland which may provide future habitat into which the kokako population could expand.

b) **THAT CONTROL OF BROWSING MAMMALS BE CARRIED OUT.** The present control of pigs should be maintained, and attempts made to eradicate goats and cattle. Fencing to exclude goats and other livestock should be carried out. There is an urgent need to estimate the size of the possum population in Puketi Forest and to reduce it to its lowest possible level.

c) THAT FURTHER WORK ON KOKAKO BE UNDERTAKEN.

- Undertake an assessment of the dynamics of the Puketi population to see if current productivity is sufficient to maintain the population.

- Survey the other large Northland forest remnants (including Raetea, Waipoua, Mataraua, Marlborough, Warawara, and Omahuta forests) to determine the presence and status of kokako populations.

d) **THAT THE ONEKURA ECOLOGICAL AREA BE EXTENDED TO GIVE PROTECTION TO ALL THE INDIGENOUS FOREST IN PUKETI FOREST.** This extension would include all forest occupied by kokako and would protect a wildlife habitat of international importance. The presence of kokako in Omahuta Forest underlies the protection of the entire forest tract.

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