SAP-FEEDING BY THE KAKA (*Nestor meridionalis*) IN SOUTH WESTLAND, NEW ZEALAND

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South Island Kakas (*Nestor m. meridionalis*) use two distinct techniques to feed on sap. First they may strip bark from a branch or trunk, exposing the surface cambium, and then lick the sap exudate from the surface. Buller (1888) recorded this behaviour on *Pseudopanax colensoi*, and in South Westland we noted it on *Griselinia littoralis*. Beggs (1988) found that two female Kakas spent 40% of their time in winter feeding in this fashion on mountain beech (*Nothofagus solandri* var. *cliffortioides*). In this note we describe a second, more specialised technique of sap-feeding observed in South Westland.

During our studies of the use by forest birds of tree species, food types and forest strata in South Westland between 1983 and 1985 (O'Donnell & Dilks 1986), we observed South Island Kakas actively "tapping" and feeding on sap from "trapdoors" in the trunks of southern rata (*Metrosideros umbellata*).

Our observations were made during 12-day trips every two months in the Windbag Valley along an altitudinal transect up the Konini Ridge from the valley floor to the bushline at 1100 m a.s.l. At low altitudes the transect passed through forest dominated by rimu (*Dacrydium cupressinum*) and kamahi (*Weinmannia racemosa*). Between 400 and 500 m a.s.l. the forest gradually changed into silver beech (*Nothofagus menziesii*), kamahi, southern rata, and mountain totara (*Podocarpus cunninghamii*), and into pure silver beech above 800 m a.s.l. Most sap-feeding observations were made in forest with a silver beech/southern rata canopy. Kakas have a specialised brush tongue (Garrod 1872, Oliver 1955) with which they can collect liquids such as nectar and sap more effectively than other New Zealand parrots.

SAP-FEEDING BEHAVIOUR

A Kaka would start by peeling and discarding loose bark from the tree trunk. It then used its lower mandible to prise a "trapdoor" through the remaining bark, and gouged a series of tiny holes into the superficial layer of yellow cambium 6-10 mm below the surface. Sometimes, when a bird was hanging upside down, it levered the trapdoor downwards. The resulting horizontal marks on the tree trunk were very distinctive (Figures 1,2, & 3). Marks were obvious on trunks and large branches from ground level to high in the canopy. Almost all trees which had sap-feeding signs had many hundreds of scars (Figure 4).

We watched a bout of sap-feeding for 57 minutes on 7 August 1984 between 1433 and 1530 (NZST). Two Kakas spent an average of 6.6 minutes (range 1-12, n = 7 spells) prising open bark. Between these spells they revisited older scars and extracted sap which had leaked from the wounds. They spent on average 1.8 minutes lapping sap (range 1-3, n = 6 spells). One new scar was visited at least 4 times while we watched the birds.

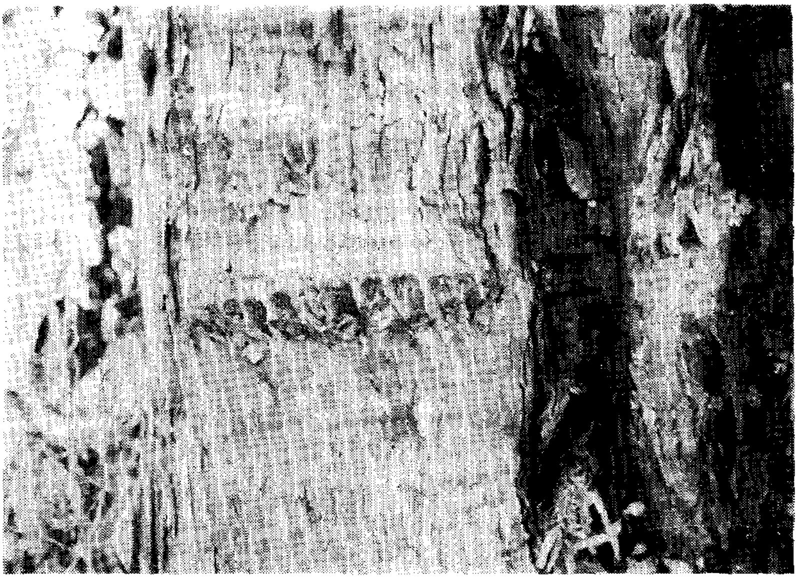

FIGURE 1 — Kaka sap-feeding marks on southern rata. The bark "trapdoors" are levered down to expose the inner cambium layer, which is tapped for sap. (Note the small holes into the cambium.)

FIGURE 2 — Fresh sap-feeding sign on rata with the "trapdoors" levered up at left, and an older row of five holes at right

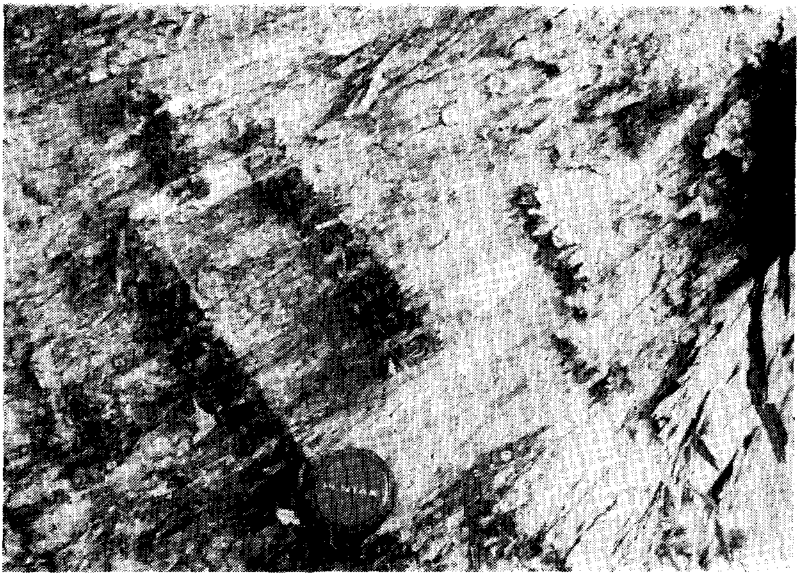

FIGURE 3 — A series of feeding scars on a rata trunk with a lens cap for scale. Two fresh scars at right, three older ones centre and left

FIGURE 4 — A heavily scarred rata trunk *c.* 70 cm in diameter. Each scar is formed by a series of "trapdoors" made during a single bout of sap-feeding

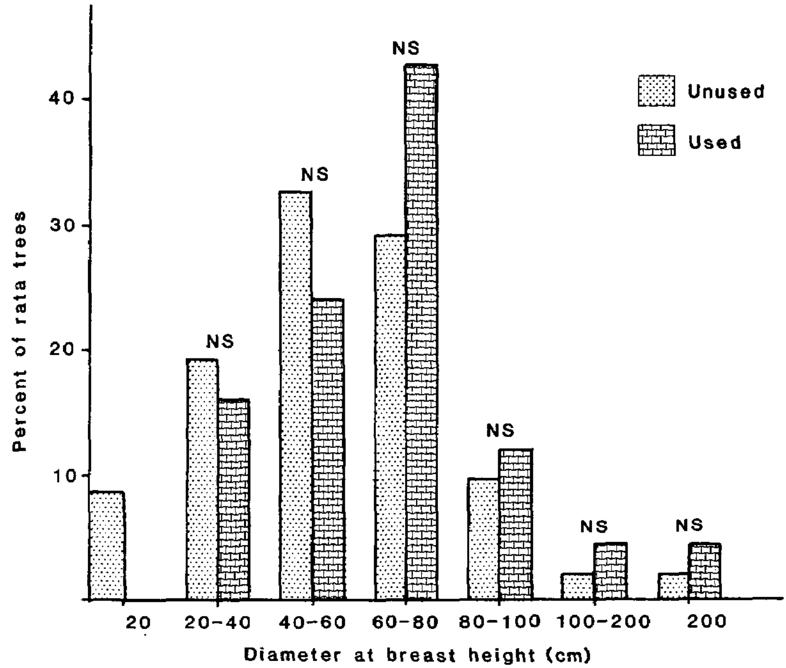

FIGURE 5 — Trunk diameter (dbh) of rata trees used for sap-feeding by Kakas, and of unused trees. The difference between the frequency of use and frequency of availability of rata tree dbh classes was tested using G-test of independence (Sokal & Rohlf 1981) for each size class. NS = no significant differences

PLANT SPECIES USED FOR SAP-FEEDING

Along Konini Ridge we found 37 trees with the characteristic signs of sap-feeding: 26 southern rata, 2 vine rata (*Metrosideros fulgens*), 1 kamahi, 4 rimu and 4 mountain totara. Thus 74% of sign was observed on rata, a species which makes up only 2.6% of canopy tree stems in the Windbag Valley.

We then classed the trunk diameters (dbh) of 74 rata trees, including 26 (35%) which had sap-feeding marks. Although there appears to be a trend towards using larger trees there was no significant difference between rata availability and use (Figure 5). This suggests that the tree diameter and hence the age of a tree did not influence selection by Kakas. Most rata trees selected for sap-feeding had numerous scars of varying ages, some being partly or wholly healed over and others being fresh. All trees with feeding signs looked healthy. Some trees were used repeatedly for sap-feeding whereas others, often close to them, were not visited at all.

SEASONAL AND GEOGRAPHICAL DISTRIBUTION OF SAP-FEEDING

Sap-feeding occurred mainly in late winter and spring, 64% of observations being in August (Table 1). Over the whole year, sap-feeding contributed

TABLE 1 — Seasonal use of sap and nectar by Kakas in South Westland

	USE OF SAP			USE OF NECTAR			
		Proportion of feeding observations	Proportion of sap-feeding observations		Proportion of feeding observations	Proportion of nectar feeding observations	Total number of feeding observations
MONTH	n	(%)	(%)	n	(%)	(%)	(Minutes)
FEBRUARY	0	-	-	118	16.9	30.7	428
APRIL	0	-	-	0	-	-	382
JUNE	0	-	-	23	5.0	6.0	472
AUGUST	57	10.3	64.0	0	-	-	555
OCTOBER	16	3.3	18.0	60	12.4	15.6	485
DECEMBER	16	2.0	18.0	184	22.4	47.7	858
TOTALS	89		100.0	385		100.0	3180

to 2.8% of 3180 minutes of Kaka feeding observations but its importance increased to 10.3% in August when no flower or nectar sources were available (Table 1).

Between 1983 and 1985 about 147 000 ha of forest in South Westland were surveyed (O'Donnell & Dilks 1986). Characteristic sap-feeding marks were recorded throughout these forests from the Copland Valley and Karangarua State Forest in the north, south to Big Bay and inland as far as the Landsborough Valley. Sap-feeding marks were almost always recorded only on rata.

DISCUSSION

We found few references to sap-feeding by New Zealand parrots. Buller (1888) and Beggs (1888) recorded Kaka sap-feeding by the bark stripping technique. McCann (1963) made a statement that the Kakapo (*Strigops habroptilus*) and the Kea (*Nestor notabilis*) feed on sap and gummy exudates from the trunks and branches of trees and shrubs. However, recent detailed studies of both species have not identified sap as forming part of their diets (Jackson 1960, Clarke 1970, Best 1984, O'Donnell & Dilks 1986, R. Powlesland pers. comm.).

It has become clear that Kaka sap-feeding by active tapping occurs widely in other parts of New Zealand. The characteristic marks have been recorded on podocarps, particularly mountain totara, in the central North Island (B. Molloy, pers. comm.), Central Westland (C. Woolmore, pers. comm.), Stewart Island (R. Tindal, pers. comm.) and Codfish Island (R. Nilsson, pers. comm.). Damage to rimu by Kakas in Southland forests reported by Holloway (1948) also appears to be the characteristic feeding sign.

In South Westland, both the frequency of occurrence of sign on trees and the hundreds of scars on each tree indicate that sap-feeding is common. Beggs & Wilson (1987) concluded that Kakas require food with a high net energy return in order to balance their energy budget. Sap could provide this balance when little nectar is available.

Gouging bark specifically to produce a flow of sap is rare among vertebrates, but it has been recorded in primates, marsupials and woodpeckers. Sap is an essential food for the pigmy marmoset (*Cebuella pygmaea*) (Kinzey *et al.* 1975), marmosets of the genus *Callithrix* from Brazil (Coimbra-Filho & Mittermeier 1976), and sapsuckers (*Sphyrapius* spp.) in North America (Rushmore 1969, Ostry & Nichols 1976). The marsupial sugar glider (*Petaurus breviceps*) and yellow-bellied glider (*P. australis*) of Australia specialise in feeding on exudates from *Acacia* and *Eucalyptus* trees (Wakefield 1970, Smith 1982, Craig 1985).

Sap-feeding behaviour in these groups has many parallels with Kaka behaviour. All groups gouge characteristic feeding wounds and return at intervals to feed on the sap. Trees used for feeding by marsupial gliders are no larger than other trees in surrounding forest (Craig 1985). The properties of individual *Eucalyptus* trees which make them suitable as sap sites is not known (Smith 1982). Both yellow-bellied gliders and marmosets have favoured individual trees, sometimes riddled with holes, while other nearby trees of the same species remain untouched (Coimbra-Filho & Mittermeier 1976, Smith & Russell 1982). Like Kakas, gliders feed on sap predominantly in late winter (Smith 1982, Craig 1985).

Sap-feeding in Australia and South Westland occurs mainly on trees of the family Myrtaceae. The sap from these trees may have a high sugar content and corresponding energy value or it may be more voluminous or reliable. Perhaps it is more accessible, rata bark being fibrous and sapwood continuous compared with the hard bark and discontinuous cambium of rimu. Sap-feeding by Kakas is concentrated in late winter and spring, when very few nectar sources are available, temperatures are lower and energy demands are high (Weathers *et al.* 1984). In early spring sap begins rising again and is also probably more accessible (B. Molloy, pers. comm.). The nutritional value of rata sap has not been investigated in New Zealand, but Australian studies have shown that phloem saps of *Eucalyptus* spp. are rich in soluble sugars and low in protein (Stewart *et al.* 1973). Smith (1982) indicated that the exudates produced at two or three feeding sites on a *Eucalyptus* tree would satisfy a glider's daily energy needs. The gum of *Anacardium occidentale* (Anacardiaceae), a principal food of marmosets, is also a high-energy food source containing 84% carbohydrate and several minerals (Coimbra-Filho & Mittermeier 1976).

South Island Kaka weights average about 550 g (Beggs & Wilson 1987), roughly the same as for yellow-bellied gliders (Smith & Russell 1982). Even allowing for differences in energy efficiencies between the species it is likely that quite small amounts of sap may largely satisfy the energy needs of Kakas as they do for gliders. Thus specialisation in the extraction of plant saps could overcome some seasonal shortages of high-energy foods. Sap flow probably increases with rainfall (Smith 1982), making sap a reliable food in Westland, where rainfall ranges between 3000 and 6000 mm per annum.

This sap-feeding behaviour in Kakas raises many questions to investigate. Kakas may have alternative energy sources elsewhere, such as honeydew in the Nelson region (Beggs & Wilson 1987, Beggs 1988) and winter flowering puriri (*Vitex lucens*) and kohekohe (*Dysoxylum spectabile*) in North Island forests. Do Kakas take sap from the eucalypts which occur widely in exotic plantations in the central North Island, or pohutakawa (*M. excelsa*) in coastal areas? Why does almost all sap-feeding occur on ratas in South Westland and why are certain trees preferred? The extensive rata/kamahi dieback in areas of Westland may have a major effect on Kaka distribution and abundance. We found that, in South Westland, Kakas were abundant south of the Paringa River and in low numbers to the north (O'Donnell & Dilks 1986). Paringa River is also the boundary between healthy high-country forest to the south and extensive rata/kamahi dieback to the north. A detailed study of sap-feeding behaviour may be important to the long-term conservation of the Kaka in New Zealand.

ACKNOWLEDGEMENTS

Our thanks to Colin Ogle, Phil Moors, Dave Towns, Jacqueline Beggs and Barrie Heather for critically reading the manuscript.

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