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Coping With an Erratic Nectar Source – Eastern Spinebills *Acanthorhynchus tenuirostris* at New England National Park

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Australian honeyeaters frequently congregate in areas of prolific flowering of nectar-producing trees and shrubs (Keast 1968; Ford & Paton 1985). On occasion the amount of nectar produced greatly exceeds the requirements of the honeyeaters (Ford 1979; Pyke 1983). At other times nectar is depleted very rapidly to uneconomical levels (Ford 1979; Ford & Paton 1982; Paton 1985). Therefore, the local availability of nectar has the potential to influence the survival of individuals, the size of populations and the level of competition between species. So far, most researchers have emphasised how seasonal changes in the abundance of nectar affect the behaviour, abundance and species composition of honeyeaters (e.g. Ford 1979; Pyke 1983; Paton 1985), though changes within a day have also been examined (e.g. Collins & Briffa 1983a). However, there are also day-to-day changes in the quantity of nectar available and the ways in which birds respond to these have received little attention.

In New England National Park, *Banksia spinulosa* flowers regularly and prolifically every winter, when large numbers of Eastern Spinebills *Acanthorhynchus tenuirostris* invade the area (Ford & Pursey 1982; McFarland 1986b). There is a close correlation between the density of nectar-producing inflorescences and the abundance of Eastern Spinebills (r = 0.62-0.85) and most other species of honeyeater (r = 0.60-0.86 for all honeyeaters — McFarland 1986b). However, there is no consistent relationship between abundance of the honeyeaters and productivity of nectar (r = 0.27 for Eastern Spinebills, r = 0.07-0.37 for six other species — McFarland 1986b). This could have been partly because the production of each inflorescence varies greatly from day to day, as a result of changes in the weather (McFarland 1985). Productivity is correlated with minimum temperature, so that little nectar is secreted after nights colder than -2°C, and nectar may be washed out of inflorescences during heavy rain. This means that there are days when the total energy demand of nectar-feeding birds greatly exceeds the energy produced from banksia nectar (McFarland 1986a). This paper looks at the ways in which Eastern Spinebills respond to this erratic nectar supply.

Methods

The study area was at about 1400 m asl, near the western edge of New England National Park (30°30′S, 152°30′E) and has been described in some detail previously (Ford & Pursey 1982; McFarland 1985). Eastern Spinebills were captured in mist nets during the winter of 1986 and weighed. Four nets were set up soon after dawn and kept up until late afternoon unless heavy rain fell. There was no consistent change in the mean weights of the birds through the day (Ford unpubl.). This is possibly because birds gain weight soon after dawn and remain at a similar weight throughout the rest of the day. As nectar production of *Banksia spinulosa* is highly correlated with minimum temperature ($r = 0.77$, McFarland 1985), nectar was not measured. Instead, the relative availability of nectar from day-to-day was inferred from the minimum temperature of the previous night.

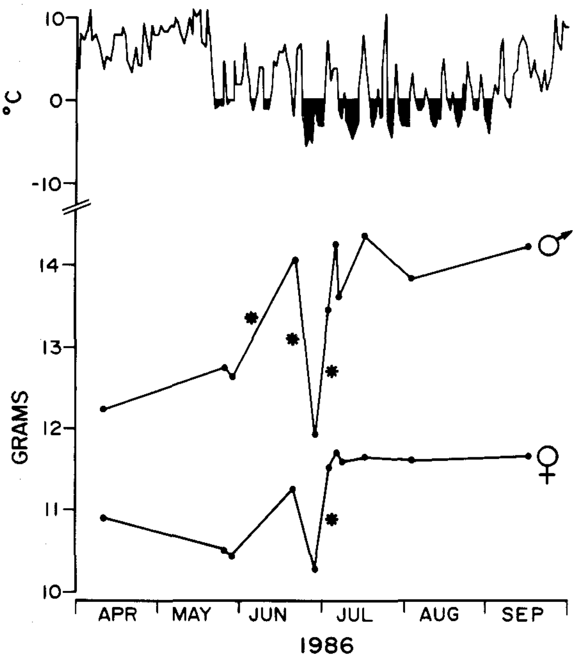

Figure 1 Minimum temperature at New England National Park from April to September 1986, and mean weights of male and female Eastern Spinebills through this period. Asterisks indicate significant changes in weight between successive dates (*t*-test). Darkened areas indicate sub-zero temperatures.

Results and discussion

Both male and female Eastern Spinebills were generally heavier in winter (June-August) than in autumn (April-May) (Fig. 1), as also found in 1978 and 1979 (Ford & Pursey 1982), and 1982 and 1983 (McFarland 1986b). Males are consistently about 2 g heavier than females and also outnumber females (3:1). An index of abdominal fat shows a similar seasonal pattern to that of weight, indicating that much of this additional weight is fat deposited sub-cutaneously (Ford & Pursey 1982; McFarland 1986b).

Fortuitously, birds were captured and weighed immediately before (20 June) and immediately after (27 June) a period of five consecutive nights of sub-zero temperatures. Three of these nights were below -4°C, when negligible nectar would have been produced. Weights of both males and females declined during this period of inferred nectar shortage ($t = 5.32$, $P < 0.01$, $n = 34$, 7 for males; $t = 2.15$, $P = 0.05$-0.1, $n = 8$, 5 for females). There followed three further cold nights and then two nights with minima above zero, when nectar was presumably more plentiful. The weights of both sexes returned to the levels before the period of scarcity ($t = 4.04$, $P < 0.01$, $n = 7$, 31 for males; $t = 3.49$, $P < 0.05$, $n = 5$, 14 for females). A few males were captured on both 20 and 27 June or on 27 June and again a few days later (Table 1). These showed a decline through the cold spell of up to 3.4 g, or an increase subsequently of up to 3.1 g. No other Eastern Spinebills weighed on different days in 1986 showed weight declines of this magnitude, though four males increased between late May and 20 June by up to 3.7 g. This indicates that the changes shown by the population resulted from individuals losing weight then regaining it, rather than by an

Table 1 Weights (g) of individual male Eastern Spinebills recaptured around the cold spell in 1986.

28 May	20 Jun	27 Jun	2 Jul	4 Jul
12.0		10.6		
	16.0	12.6	14.2	
	13.9	11.8		
		13.3	16.4	
		11.8		14.2

Table 2 Numbers of Eastern Spinebills caught each day in 1986, with netting effort in net-hours.

	27 May	28 May	20 Jun	27 Jun	2 Jul	5 Jul	6 Jul	15 Jul	2 Aug
Birds	57	46	42	12	45	63	57	39	41
Net-hours	28	20	34	30	28	28	35	23	28

influx of lighter followed by heavier birds. It also shows how rapidly Eastern Spinebills can lose and regain weight.

Fewer Eastern Spinebills were captured on 27 June than on any other day during the winter, despite favourable conditions for netting (Table 2, $\chi^2 = 47.6$, $d.f. = 8$, $P < 0.01$). This suggests that many birds left the area or died during the period of food shortage. If birds left, they must have gone downhill as there is no higher country in the area. They could descend over 1000 m within 1 km of the study area. I have not found major sources of nectar in winter in the lowland forest but temperatures are higher, and invertebrates and alternative carbohydrates probably available.

Nine of the 32 male Eastern Spinebills captured and weighed on 20 June were subsequently recaptured. These were significantly heavier on 20 June than birds that were not recaptured (recaptured: $\bar{X} = 14.96$ g, $s.e. = 0.42$; not recaptured: $\bar{X} = 13.49$ g, $s.e. = 0.20$, $t = 3.19$, $P < 0.05$). This indicates that heavier birds survived better than lighter birds or that lighter birds were more likely to leave. This could be because the former carried more fat reserves or, by being larger, were able to defend the few remaining nectar sources from smaller birds.

Despite the appearance of abundant flowers and plentiful nectar at New England National Park, there are periods when very little nectar is produced. In addition to the eight consecutive days of frost from 23 to 30 June, there were several periods of three to five consecutive days with minima below zero in 1986 (Fig. 1). McFarland (1985) showed that 20 or more days of frost in each of the winter months was not unusual in other years. Not only do periods with low overnight temperatures lead to little nectar being produced, but they also mean that the energy demand of the birds would be very high.

Eastern Spinebills respond to these periodic shortages in a variety of ways. They may increase the amount of time spent feeding (McFarland 1986b). However, this would only help when there is nectar left over from previous days or when some nectar is being produced. They also store fat during times when nectar is more plentiful and deplete this when nectar is scarce (Fig. 1, Table 1). Males carrying about 3 g of fat in midwinter would be able to generate about 100-120 kJ of energy, enough to maintain an inactive bird for about 48 hours at ambient temperatures (McFarland 1986a). Eastern Spinebills do not appear to enter torpor, at least regularly, although a decline in body temperature and metabolic rate may occur when energy reserves have been depleted (Chan *et al.* 1990). Brown Honeyeaters *Lichmera indistincta* show decreased energy expenditure at night due to slight hypothermia and postural changes (Collins & Briffa 1983b). It is possible that during food shortages Eastern Spinebills could drop their metabolic rates to night-time levels.

A prolonged shortage of nectar apparently causes many birds to leave the area. The topography of New England National Park allows easy access to lower, warmer and probably more predictable habitats. Finally, a severe nectar shortage may lead to selective mortality which is indicated by the greater chance of recapturing heavier birds. Weight has a high heritability in some birds (e.g. Grant 1986) but the extent to which it is heritable in honeyeaters is unknown. Hence, I cannot say whether these birds simply carried more fat or were larger for genetic reasons.

This study indicates the importance of looking at very specific events as well as general patterns in ecology. The superficial appearance of abundant nectar being consumed by fat Eastern Spinebills contrasts with dramatic declines in the abundance of the population and the weight of individuals over a few days of severe shortage. Wiens (1977) coined the phrase 'ecological crunch' for a period of adversity which can lead to high mortality and intense intra- and interspecific competition. The week-long cold spell at New England National Park in 1986 was probably an 'ecological crunch' for Eastern Spinebills and other honeyeaters. It is likely that short-term studies will miss such events and underestimate the importance of acute food shortage in increasing mortality and competition for limited resources in honeyeaters.

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The Bony Casque of the Southern Cassowary *Casuarius casuarius*

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In the adult Southern Cassowary *Casuarius casuarius* the casque, when viewed from its lateral side, is a roughly trapezoidal structure measuring about 17 cm in height, 15 cm in length. It has a maximal width of 7 cm. The outer layer of the casque, usually a light to dark brown colour, resembles hoof material, similar to the 'tortoise shell' as found in the epidermal scales of the marine turtle. When handled, the casque is not as rigid