

PELLET CASTING BY SOUTH ISLAND ROBINS

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ABSTRACT

Pellet casting was studied in a population of South Island Robins (*Petroica australis australis*) at Kowhai Bush, Kaikoura from April 1977 to July 1978. Pellet regurgitation is described. Casting has a diurnal rhythm. Monthly regurgitation rates reflected the diet of the Robins, with the highest rates occurring in the summer months when the main food is berries and invertebrates with their indigestible seeds and exoskeletons. It was calculated that, during February 1978, the month of highest mean egestion rate, a Robin would egest six pellets per day. The effect of age and sex on the frequency of castings is discussed.

INTRODUCTION

Birds of several avian taxa are known to disgorge pellets containing undigested portions of food (Welty 1975; Thomson 1964; Rea 1973). Although many passerines probably cast pellets, few have been seen to do so because egestion takes only a second or two and occurs infrequently.

Flack (1973) noted that the South Island Robin (*Petroica a. australis*) cast pellets. During the course of a time-budget study of Robins, I noted pellet casting many times. This paper describes the behaviour associated with pellet casting, the dimensions and dry weight of the pellets and the rate at which they are produced both diurnally and monthly. The influence of age and sex on pellet casting are also discussed.

STUDY AREA AND METHODS

All the observations of South Island Robins were made at Kowhai Bush, Kaikoura (42°S 174°E). Kowhai Bush is a 240 ha strip of forest on the north-eastern side of the Kowhai River that lies within the Kowhai River Protection Reserve. It is bounded by riverbed and farmland at 60-150 m a.s.l. The low forest consists of a flood-induced patchwork of successional stages of varying age, structure and species composition often dominated by kanuka (*Leptospermum ericoides*) with a dense understorey (Flack 1973). During this study, from April 1977 to July 1978, there was a population of about 35-110 individually colour-banded Robins of known age.

During the studies of annual time-budgets, individual Robins were watched about their territories. Whenever a Robin ejected a pellet, the associated behaviour, date, time and individual band-combination were recorded. It was usually possible to retrieve the

pellet intact immediately after its egestion. The pellet was then dried to a constant weight in a desiccator and weighed on a Mettler balance to the nearest 0.1 mg. The length and maximum width of the pellets were measured with vernier calipers to the nearest 0.1 mm. Because only a few pellets were seen cast each month, it was necessary to combine all observations to determine whether a diurnal rhythm of casting occurred. Each day was arbitrarily divided into six equal periods (Verner 1965). The limits of daylength were set at sunrise and sunset although Robins were active in twilight. From official sunrise and sunset data, contained in *The Air Almanac* (USA Govt. Printing Office 1976), mean daylength and period length were determined for each month. By dividing the day into periods of diurnal intervals, I was able to assign each egestion to a particular period and then combine the information from throughout the study.

Immature Robins were defined as those independent of parental care, a status attained about four weeks after leaving the nest. Their immature status terminated at the end of July when breeding began. At first, they were readily distinguished by their streaked crown feathers and their small area of white breast feathers, but by March, the growth of more contour feathers made most of them indistinguishable from adults. From then until breeding began, they were recognised as immatures only from their band combinations.

PELLET CASTING

Before the egestion of a pellet, Robins generally stopped whatever they were doing, retired to a sheltered perch and remained resting for about a minute with the plumage slightly loosened out. Just before ejection, the beak was gaped once or twice, possibly in response to the pellet's movement up the oesophagus. The beak was then opened wide and the head given a shake as the pellet was ejected. Usually the casting dropped to the ground but occasionally it was flicked several metres. After egestion, the beak was usually wiped on the perch, the body given a quick shake, and normal activity resumed. On three occasions, a Robin was seen to egest a pellet in two or three small, irregularly shaped portions that were produced at about one-minute intervals.

Apart from while resting, the activities during which pellets were disgorged included foraging, preening, full song, sunbathing and boundary disputes. One female Robin, on egesting a pellet within a metre of her nest, grasped the pellet in her beak rather than allowing it to fall, flew off and dropped it several metres from the nest as if handling a faecal sac.

RESULTS

The average measurements of 43 pellets were 12.9 ± 8.0 mm long (range 20.4-8.9) by 7.3 ± 0.005 (8.9-6.2) wide, and 64 dried ones averaged 123 ± 0.2 mg (305-45.7). The standard errors show that length was the most variable feature. Of 13 pellets produced

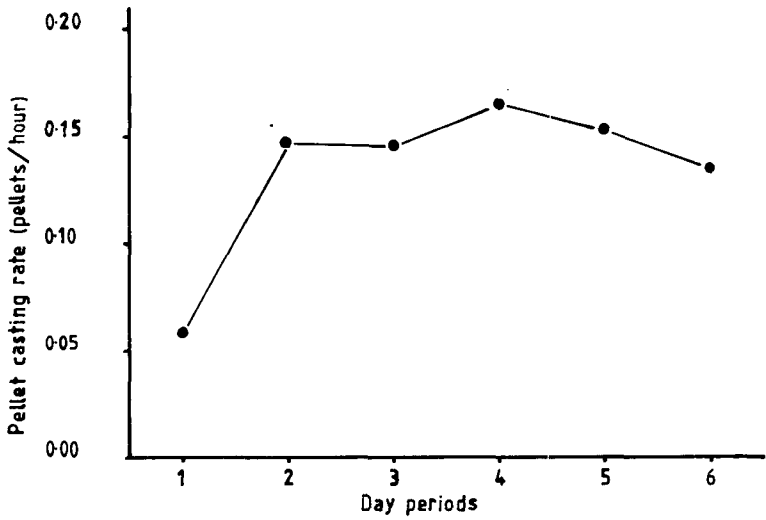


FIGURE 1 — Diurnal rhythm of pellet casting.

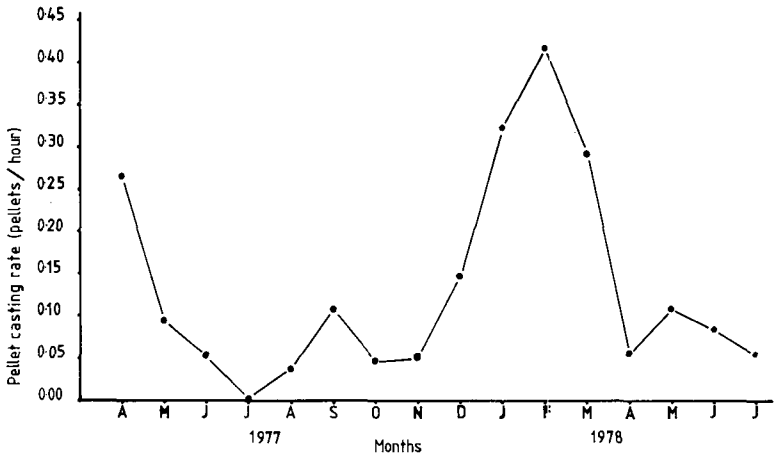


FIGURE 2 — Monthly rate of pellet casting.

by adults in the breeding season (August to December 1977), only 8% contained seeds, but in the non-breeding season (April to July 1977 and January to July 1978), 39% of adult Robin pellets ($n = 28$), and 64% of immature Robin pellets ($n = 25$), contained seeds. Evidently Robins fed on berries mainly during the non-breeding season, although they were available all year, and berries formed a greater proportion of the diet of immature Robins than of adults.

Figure 1 shows a diurnal rhythm of pellet egestion. Few pellets were ejected during the first day-period but an almost constant rate occurred for the rest of the day. The analysis of monthly rates of casting (Fig. 2) shows that the highest rate occurred during the summer months, and that few pellets were cast from May to November inclusive. Two instances were seen of Robins casting two pellets in a day, 3 hours apart on 27 March and 3.5 hours apart on 8 April 1978. These egestion rates were similar to that calculated for March 1978 when one pellet every 3.4 hours was egested. Neither Robin was observed continuously, and so another pellet could have been cast between observations.

The pellet egestion rates of adult and immature male and female Robins are given in Table 1. A chi-squared test to compare the egestion rates of male and female Robins of the same age showed no significant differences within the three sample times. Also, at the same time of year there was no significant difference in egestion rates between adults and immatures. Nor were the rates for immatures different during the two non-breeding seasons, but the rates for adults were (chi-squared = 5.55, $P < 0.05$). Thus the probability that the difference between the two rates at which adults egested pellets during the two non-breeding seasons was due to chance alone was less than five percent.

TABLE 1 — PELLETT EGESTION RATES (PELLETS/HR) OF ADULT AND IMMATURE, MALE AND FEMALE ROBINS

	Time of Year		
	Apr to Jul 1977	Aug to Dec 1977	Jan to Jul 1978
Adult			
Male:	0.086(92.9)*	0.109(138.2)	0.206(121.2)
Female:	0.086(58.3)	0.051(155.7)	0.146(95.9)
Total:	0.086(151.2)	0.078(293.9)	0.180(217.1)
Immature			
Male:	0.187(32.1)	—	0.181(83.1)
Female:	0.111(36.1)	—	0.225(98.0)
Total:	0.147(68.2)	—	0.204(181.1)

(* Number of hours of observation)

DISCUSSION

The behaviour of South Island Robins of retiring to a sheltered perch and resting before egesting a pellet was very similar to that described by Pellow (1971) for the Dorset Wallcreeper (*Tichodroma muraria*). Also both species shook themselves and resumed normal activity after pellet egestion. Like Ovenbird (*Seiurus aurocapillus*) pellets (Zach & Falls 1977), Robin pellets were moist, soft and spindle-shaped when cast. They were compact and held together by mucus and, being fragile, some broke or were distorted when they struck objects while falling.

Pellet length was the most variable feature, as was noted also by Fox (1977) for pellets of the New Zealand Falcon (*Falco novae-seelandiae*). A pellet's maximum width may have been restricted by the width of the Robin's throat whereas pellet length varied with the quantity of material present for regurgitation.

The Robins studied at Kowhai Bush ate a variety of invertebrates and berries. The pellets that they ejected were composed, therefore, of seeds and indigestible portions of invertebrates. Flack (1973) stated that cast pellets never contained seeds, but of 66 pellets retrieved during this study, 42.4% contained seeds and 22.7% had more than ten.

Few pellets were cast in the early morning, presumably because indigestible fragments of food eaten the previous evening would have been cast during the night. Warham (1957) collected the castings of Splendid Blue Wrens (*Malurus splendens*) from beneath their roosting site, but as I was unable to find Robin roosts I could not confirm whether they regurgitated at night. The rate of egestion was fairly constant during the rest of the day with a slightly faster rate about midday. During period four, more of the Robins' time was devoted to comfort movements and resting, when pellets are usually disgorged, compared to the other day-periods.

The monthly pellet-regurgitation rates reflected the Robin's diet and, in particular, the amount of indigestible food eaten. The highest rate of egestion occurred from January to March when most of the food was berries and adult invertebrates. Cicadas, mainly *Amphipsalta zelandica*, which emerged during January and had almost disappeared by late March, were an important Robin food during this period. Some pellets were almost entirely the indigestible exoskeletons of these large insects and would have caused the high regurgitation rates.

Berries also contributed to the high rates of the summer months. As many were swallowed whole, the seeds formed a large part of some pellets. However, it was not unusual to see a Robin breaking up a berry, possibly to remove the seeds before eating the fleshy receptacle. Judging by the mean egestion rate of 0.4 pellets per hour and the mean daylength of 14 hours for February 1978, a Robin in February would have cast six pellets per day. This was an egestion rate 18 times greater than that calculated for August 1977.

In winter, when adult insects were scarce, Robins ate earthworms, slugs, snails, and larval insects, all of which had few hard parts. During April 1978, over 400 mm of rain fell in a week, and the rate of casting was lower than for the previous April because of the almost exclusive consumption of soft-bodied organisms, particularly earthworms.

The significant increase in the pellet-regurgitation rate of adult Robins during the 1978 non-breeding season was probably due to the drought from January to early April. Presumably adults were forced to eat foods containing much indigestible material, which in a typical season, they would have ignored. Immature Robins had a higher ejection rate than adults because they ate more berries with seeds. Berthold (1976) concluded that usually, omnivorous songbirds ate nutrient-poor plant foods, such as berries and other pulpy fruits, only when there was a shortage of animal food. The immature Robins' lack of experience with the changing variety of prey may have forced them to eat more berries than did the adults.

ACKNOWLEDGEMENTS

I am grateful to J. van Berkel, Resident Technician, EPML, Kaikoura, for technical assistance, and Dr J. Warham, K. W. Duncan and P. M. Sagar for much constructive criticism of earlier drafts of this paper. The Marlborough Catchment Board granted permission to study the South Island Robin in the Kowhai River Protection Reserve.

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