SPECIFIC AND SEXUAL DIFFERENCES IN BODY MEASUREMENTS OF NEW ZEALAND HONEYEATERS

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ABSTRACT

Morphometric measurements of the three New Zealand honeyeaters show that Stitchbirds and Bellbirds are of a similar size and both are markedly smaller than Tuis. Males are larger than females in all three species but few measurements appear reliable discriminators of sex. Some implications of these differences are discussed briefly.

INTRODUCTION

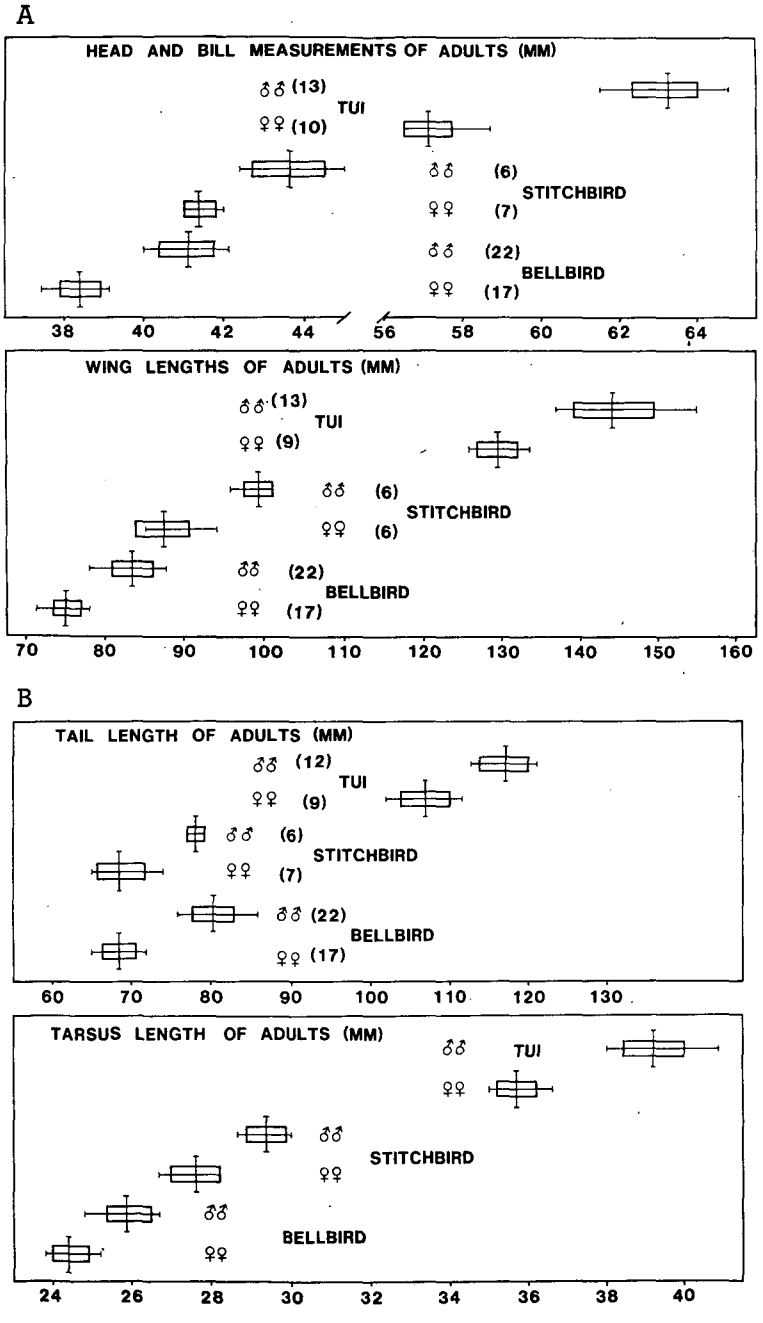
Body measurements of birds can be used to determine sex and also to help assess the degree of competitive overlap between similar species. For example, bill size is often used to predict range of food sizes eaten (Keast 1968, Schoener 1974) while sizes of other body characteristics have been related to feeding site (Ford & Patton 1976), to range size (Schoener 1968) and to interspecific dominance rank (Stiles & Wolf 1970, Ford & Patton 1976, Feinslinger & Colwell 1978).

This paper presents preliminary data on the body measurements of the three New Zealand honeyeaters. These species, the Tui *(Prosthemadera novaeseelandiae)*, the Bellbird *(Anthornis melanura)*, and the Stitchbird *(Notiomystis cincta)* all feed on nectar, insects and fruit. There is conflicting data on the relative proportion of these items in their diets (Craig, Stewart & Douglas 1981) and comparative body measurements are required to assess predictions related to body size. Dimensions of beaks are available (Gravatt 1970, 1971) but not of other body characteristics. Adult Bellbirds and Stitchbirds are sexually dimorphic in plumage, but the sex of Tuis and of juvenile Bellbirds and Stitchbirds is not easy to determine visually. Body measurements that best distinguish sex are required for each species.

METHODS

All measurements were taken from live birds caught in mist nets. Tuis and Bellbirds were measured between 1974 and 1979 on Tiritiri Matangi Island and the adjacent Whangaparaoa Peninsula. The Stitchbirds measured were caught in April 1980 on Little Barrier Island for release on Hen Island.

All birds were classified as adult, juvenile, or unknown by their


A
HEAD AND BILL MEASUREMENTS OF ADULTS (MM)
♂♂ (13)
TUI
♀♀ (10)
♂♂ (6)
STITCHBIRD
♀♀ (7)
♂♂ (22)
BELLBIRD
♀♀ (17)
38 40 42 44 56 58 60 62 64
WING LENGTHS OF ADULTS (MM)
♂♂ (13)
TUI
♀♀ (9)
♂♂ (6)
STITCHBIRD
♀♀ (6)
♂♂ (22)
BELLBIRD
♀♀ (17)
70 80 90 100 110 120 130 140 150 160
B
TAIL LENGTH OF ADULTS (MM)
♂♂ (12)
TUI
♀♀ (9)
♂♂ (6)
STITCHBIRD
♀♀ (7)
♂♂ (22)
BELLBIRD
♀♀ (17)
60 70 80 90 100 110 120 130
TARSUS LENGTH OF ADULTS (MM)
♂♂
TUI
♀♀
♂♂
STITCHBIRD
♀♀
♂♂
BELLBIRD
♀♀
24 26 28 30 32 34 36 38 40

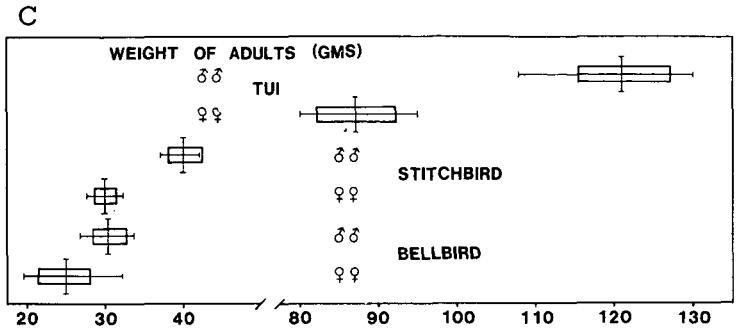


FIGURE 1 — Measurements of adult male and female honeyeaters. Horizontal lines indicate the range of observed values; vertical lines designate the mean; open rectangles enclose one s.e. above and below the mean. Sample sizes are as for Head + Bill Length unless otherwise stated. 'Tarsus' = tarsometatarsus.

plumage. Adult Bellbirds and Stitchbirds could be separated into male and female by plumage, whereas the sex of Tuis was determined by observation of mated pairs. The sex of juvenile Bellbirds was determined by song and subsequent observations of the birds as adults. Juvenile Stitchbirds were tentatively assigned as male if they had yellow feathers on the wing as in adult males. Juveniles lacking these feathers were presumed to be female.

Because many workers were involved, only those body measurements which have minimum operator error were used. These measurements are (i) head plus bill length — the maximum length from the tip of the bill to the back of the skull, including depressed feathers; (ii) wing length; (iii) tail length; (iv) modified tarsometatarsus length — from the notch to the edge of the bent-over foot; (v) weight.

The data were not analysed statistically because of the small samples and because we wanted to find absolute measures for determining sex, i.e. those for which there is no overlap.

RESULTS

Tuis are markedly larger than Stitchbirds and Bellbirds for all measurements (Fig. 1). Except in tail length, Stitchbirds tended to be larger than Bellibrds, although the measurements overlapped considerably.

Males were larger than females in all measurements and in all three species. Using the summed difference between means, the difference between the sexes was 16% for Tui, 14% for Stitchbird, 13% for Bellbird. Overlap between the sexes occurred for some measurements for each species, the degree of overlap being greatest in the Bellbird. In contrast, the Stitchbird and Tui appear markedly dimorphic for most measurements, perhaps because of too small a sample size.

Those body characters in which the ranges of males and females do not overlap may be useful for determining the sex of captured birds. However, to determine the real value of any body character as an indicator of sex, results for all birds of all ages must be used. The ideal character is one in which there is a bimodal distribution of measurements and no overlap. If overlap occurs, principal component analysis may be required to determine which characters or sets of characters best discriminate between the sexes (cf. Craig, McArdle & Wettin 1980). Each honeyeater is considered separately and results are summarised in Table 1.

TABLE 1 — Measurements that can be used to discriminate the sex of honeyeaters

	Male	Female
(a) Tui		
head + bill length*	≥ 60.0 mm	< 59.5 mm
'tarsometatarsus' length	≥ 38.0 mm	< 38.0 mm
weight	≥100 g	<100 g
(b) Stitchbird		
head + bill length	≥ 42.5 mm	< 42.5 mm
'tarsometatarsus' length	≥ 28.5 mm	< 28.5 mm
wing length	≥ 90.0 mm	< 90.0 mm
(c) Bellbird		
head + bill length*	≥ 40.0 mm	< 40.0 mm
tail length*	≥ 74.0 mm	< 72.0 mm

* reliable discriminator

Bellbird (Fig. 2): Using measurements of birds of all ages, head + bill length and tail length retain disjunctive distributions and so can be used to discriminate reliably the sex of any Bellbird. Tarsometatarsus and wing length are strongly bimodal, but overlap does occur. Thus, Bellbirds with a head + bill length exceeding 40 mm and a tail length exceeding 72 mm are male. Smaller birds are female (Table 1).

Stitchbird (Fig. 3): There is some overlap between the sexes for all measurements of Stitchbirds of all ages. The least overlap occurs for head + bill length, tarsometatarsus length, and wing length. As the sex of juveniles was doubtful, some misplacement of individuals was likely. Thus, if the single odd individual is omitted, males can be taken as those with a head + bill length of 42.5 mm or more, a tarsometatarsus of 28.5 mm or more, and a wing length of 90.0 mm or more. Smaller birds are considered female (Table 1).

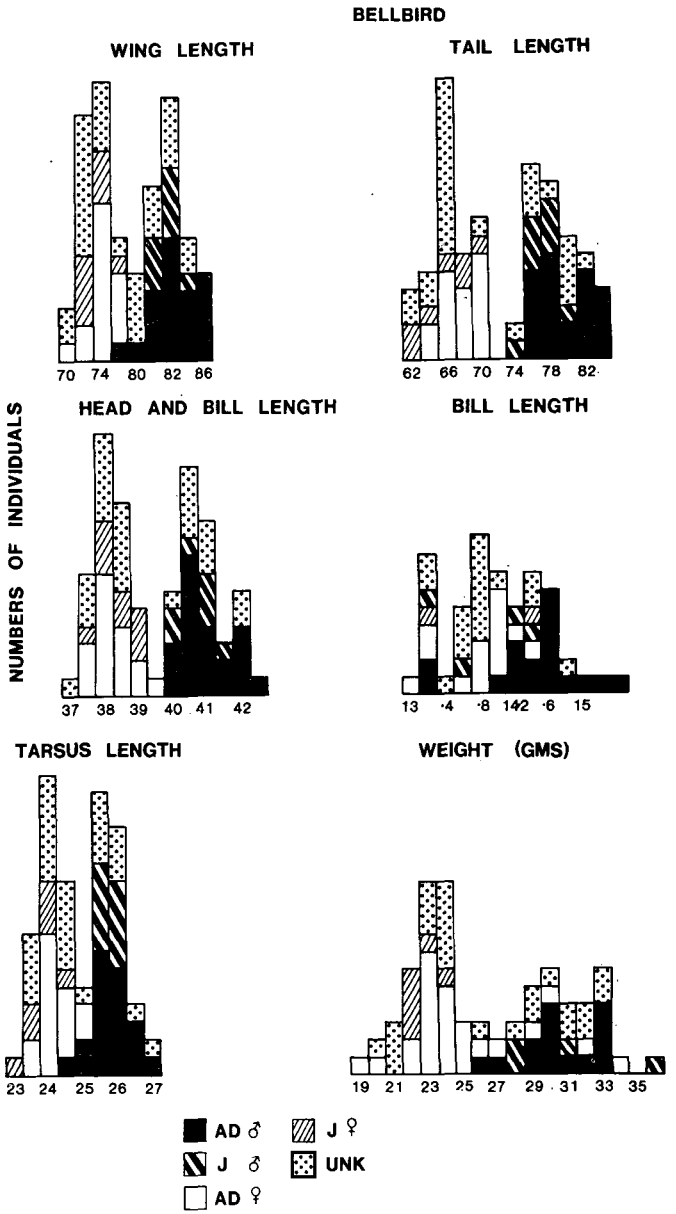


FIGURE 2 — Size frequency distribution of selected Bellbird measurements according to sex and age. Lengths are in mm. 'Tarsus' = tarso-metatarsus.

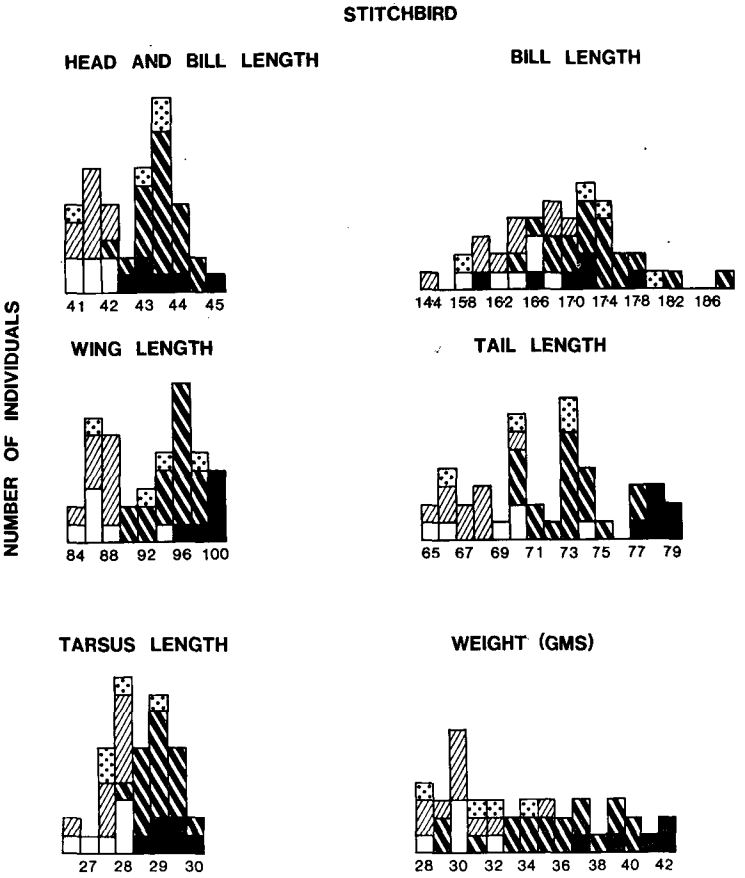


FIGURE 3 — Size frequency distribution of selected Stitchbird measurements according to sex and age. Key as in Fig. 2.

Tui (Fig. 4): Head + bill length, weight, and tarsometatarsus length appear to be good discriminators of the sex of Tuis of all ages. Tarsometatarsus length is strongly bimodal, but the presence of individuals of unknown sex in every size class makes minor overlap a possibility. Head + bill length is the best measurement for discriminating sex. Thus, males have a head + bill length greater than 60.0 mm and a tarsometatarsus of 38.0 mm or more. Females are smaller (Table 1).

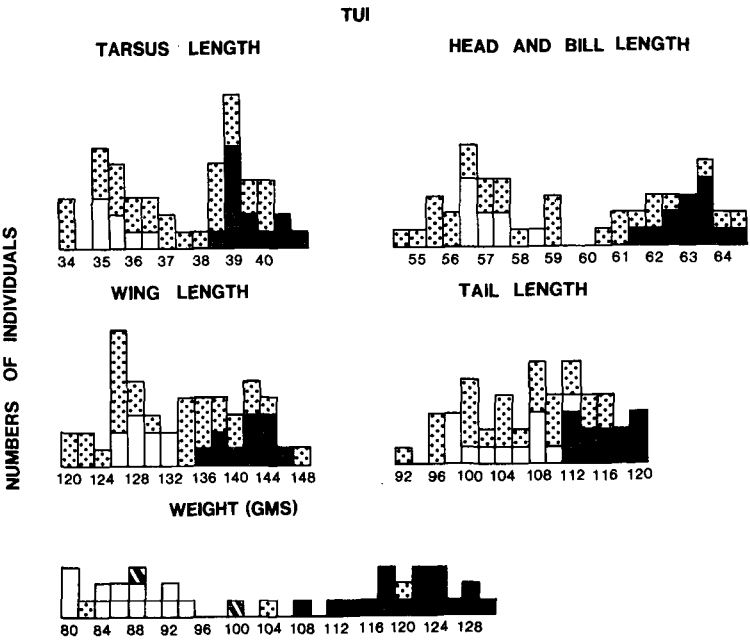


FIGURE 4 — Size frequency distribution of selected Tui measurements according to sex and age. Key as in Fig. 2.

DISCUSSION

The three New Zealand honeyeaters are all dimorphic for many body characteristics. In our samples, weight appeared to be a possible discriminator of sex for Tui and possibly Stitchbird, but sample sizes are small and weight is variable in many birds. This is true for Bellbirds where repeated measuring of individually colour-banded birds showed marked individual changes (Craig & Douglas, unpub.). For example, RW-AW (♀) on 12 May 1977 was 24.0 g. By 23 June 1977, she weighed 29.5 g and on 28 February 1978, 34.2 g. A-YRG (♀) weighed 32.0 g on 16 March 1977 but only 24.3 g on 12 April 1978. Many smaller changes are known and can be related to the demands of breeding or to local variations in food supply. Body weight is therefore unreliable, and its use is not recommended for any species.

The Tui is much larger than Stitchbird and Bellbird, which suggests that they differ in many aspects of their biology. Taken with the 60% larger bill size (Gravatt 1970) Tuis can presumably take larger-sized food items than the other two species, but their greater size and weight presumably exclude them from feeding within small enclosed feeding stations or on fine plant parts. Comparable separation is unlikely to occur between Bellbird and Stitchbird. Some difference

between these latter species is predicted as a result of competition (see Craig, Stewart & Douglas 1981). Gravatt (1970, 1971) showed that both Bellbirds and Stitchbirds use the shrub to canopy layers of the forest but his claimed differences in food and feeding station of these similar sized honeyeaters result, at least in part, from recording the species unequally in different habitats and seasons. Further work on such microhabitat differences is required.

The competition avoidance hypothesis states that sexual dimorphism in size is favoured where it reduces the competition between males and females (e.g. Selander 1966, 1972). There is strong competition between individuals of all three honeyeater species, especially in winter, and the sexual dimorphism demonstrated in many measurements for these species may serve to reduce competition between the sexes (see Craig, Stewart & Douglas 1981, for further comments).

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