Morphometric Variation in the Mallophaga of the Australian Magpie (*Gymnorhina tibicen* Latham)

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ABSTRACT

Ischnocera were collected from live and road-killed Australian magpies in order to examine morphometric variation between lice from different host-types. Lice from the body *(Bruelia sp.)* showed little variation between host-types, but lice from the neck *(Philopterus sp.)* of Tasmanian magpies were quite distinct from those from mainland magpies. There was some differentiation between *Philopterus* from different mainland magpie populations, but differences were not consistent between males and females. These relationships correlate well with those described for the hosts.

INTRODUCTION

Members of the order Mallophaga are unusual among parasitic insects in that they can spend their whole life-cycle on a single bird host (Clay 1958). It has been suggested that, usually, bird lice only transfer between hosts when they come into close contact, such as when mating, nesting or roosting (Clay 1950). If so, then louse populations on a particular bird species will be effectively geographically isolated from louse populations on other bird species, a situation which could theoretically lead to speciation (Mayr 1970). According to Mallophagan taxonomists (e.g. Harrison 1914, Hopkins 1941, Clay 1958) this restricted movement of bird lice between hosts has led to a close correlation between bird and Mallophagan phylogenies. In fact, it has been suggested that Mallophagan phylogenies may aid in bird classification, particularly at the level of order, family and genus (Clay 1958).

The aim of the present study was to determine whether a similar correlation to that observed at the order and family level (Clay 1958) existed at the population and species level. In particular I was interested in relationships between bird lice from different populations of the Australian Magpie (*Gymnorhina tibicen*).

The taxonomic status of the Australian Magpie has long been a matter of debate (e.g. Campbell 1929, Amadon 1951, Slater 1974). There are three distinct colour forms in the species *G. tibicen*. A black-backed form inhabits northern and

central Australia. A white-backed form is found in the south-east of Australia, including Tasmania, and in some highland areas of New South Wales and central Australia. A third form, where the male is white-backed and the female is black-backed, inhabits the south-western part of Australia (Slater 1974). Morphometric, biochemical and behavioural investigations suggest that all mainland forms belong to a single polymorphic species and that the Tasmanian form, if not a separate species, is certainly the most divergent population (Hughes 1980, 1982).

Three genera of Mallophaga are commonly found on magpies. Two of these, *Philopterus* and *Bruelia,* belong to the superfamily Ischnocera, family Philopteridae, while the third genus, *Myrsidea,* belongs to the superfamily Amblycera, family Menoponidae. Members of the latter superfamily are very fast-moving, are relatively non habitat-specific and leave the host soon after it dies. The genus *Myrsidea,* compared to the two Ischnoceran genera, is relatively uncommon on magpies, was difficult to catch on live birds and could not be collected from dead birds. It was omitted from the study. *Philopterus* is found only on the head and neck of the bird, while *Bruelia* occurs mostly on feathers of the back, wings and abdomen. Both forms are slow moving and easily caught, remaining on dead birds for up to a week.

The aim of the present study was to carry out a morphometric study of the lice to determine whether relationships between Mallophagan populations reflected those between their hosts. The species of *Philopterus* from magpies is undescribed and will be referred to as *Philopterus sp. Bruelia semiannulata* is the only member of the genus described from *Gymnorhina* and all populations examined here belonged to this species.

MATERIALS AND METHODS

Collection

Magpies were trapped using a caged decoy inside a wire trap, with a funnel entrance at one end. An assistant was required to hold each bird while it was examined for lice. Each feather on the head, neck and back was searched and all adult lice were collected and stored in 70% alcohol. Breast and abdomen feathers were also examined, but lice were rarely found. Samples were also collected from road-killed magpies, which were thoroughly examined and from which all live lice were collected. Additional specimens of lice were borrowed from Professor R. Pilgrim (Canterbury University, New Zealand), Mr R. H. Green (Queen Victoria Museum), and Miss T. Clay (British Museum of Natural History). Attempts were made to collect lice from at least 2 localities for each magpie form (i.e. white-backed, black-backed and western). However, this was not always possible as many birds examined produced no lice. Specimens of *Philopterus* were particularly difficult to collect in large numbers. Localities from which magpie lice were sampled are shown in Fig. 1.

Preparation and Measurement of Specimens

Specimens were soaked in 10% KOH for 48 hours and then mounted in Canada Balsam using the method of Pilgrim (1977). Head characters shown in Figs. 2 and 3 were measured using a Swift Ocular Micrometer No. 5 in the eyepiece of an Olympus

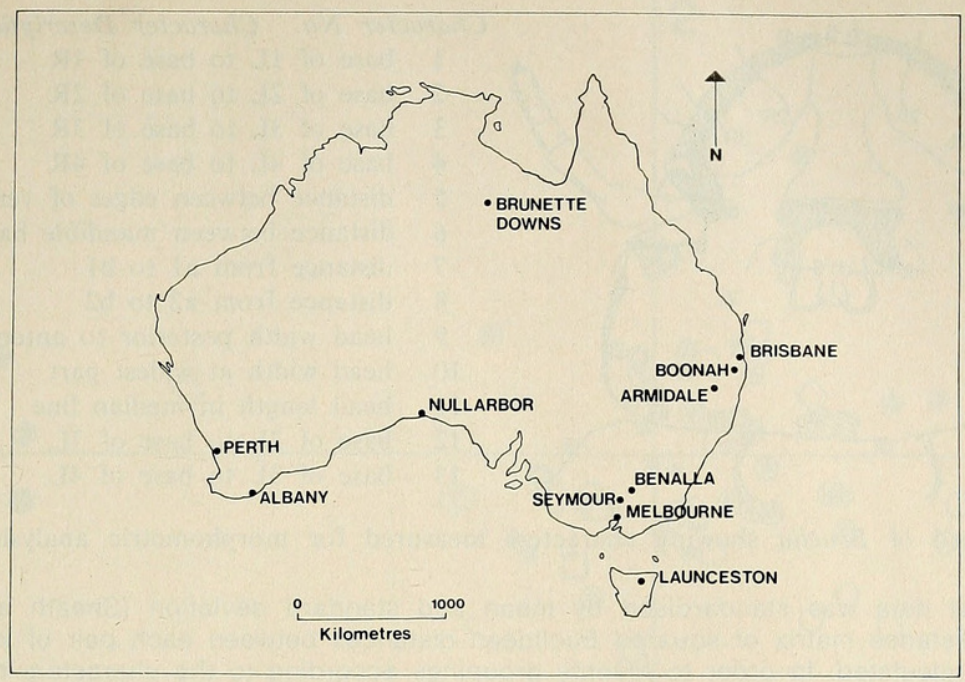
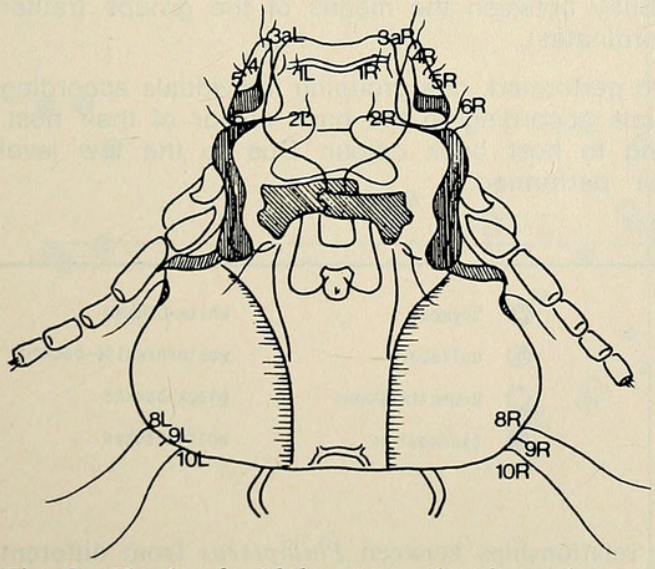


Fig. 1. Map of Australia showing localities from which magpie lice were collected.

monocular microscope. Only head measurements were made because (a) the head characters (particularly the chaetotaxy) of Mallophaga have been widely used in traditional taxonomic studies and have been found very useful for differentiating between species, and (b) because the lice were soaked in KOH, some of the body parts became softened. The head is very chitinous and retains its shape, even after 96 hours in KOH, whereas the abdomen can lose its shape after exposure to KOH.

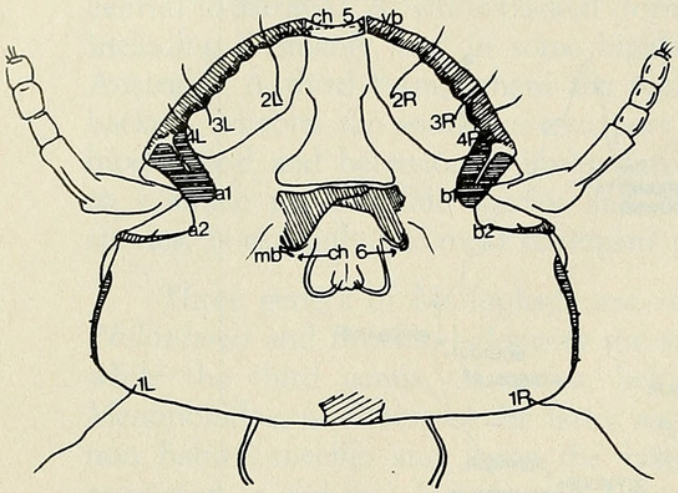
Analysis

Only adults were used and males and females were analysed separately because sexual dimorphism is common in Mallophaga (Eichler 1938, Clay 1958). For each analysis



Character No.	*Character Description*
1	base of 1L to base of 1R
2	base of 2L to base of 2R
3	base of 2aL to base of 3aR
4	base of 4L to base of 4R
5	base of 6L to base of 6R
6	base of 8L to base of 8R
7	base of 9L to base of 9R
8	base of 10L to base of 10R
9	base of 2L to base of 3L
10	base of 4L to base of 4L
11	base of 2L to base of 5L
12	base of 3L to base of 5L
13	base of 3L to base of 6L
14	head length in median line

Fig. 2. Head of *Philopterus* showing characters measured for morphometric analysis.



Character No.	*Character Description*
1	base of 1L to base of 1R
2	base of 2L to base of 2R
3	base of 3L to base of 3R
4	base of 4L to base of 4R
5	distance between edges of vential band (vb)
6	distance between mandible bases (mb)
7	distance from a1 to b1
8	distance from a2 to b2
9	head width posterior to antennae
10	head width at widest part
11	head length in median line
12	base of 2L to base of 3L
13	base of 3L to base of 4L

Fig. 3. Head of *Bruelia* showing characters measured for morphometric analysis.

the original data was standardised by mean and standard deviation (Sneath and Sokal 1973). A distance matrix of squared Euclidean distances between each pair of individuals was then calculated. In order to identify groupings according to the characters measured, a principal coordinates analysis (Gower 1966) was performed on the matrix, using the programs MULCLAS and GOWER, from the CSIRO statistical package TAXON, on the Cyber 76 computer Canberra. This produces an ordination of all individuals on transformed or principal axes. The first principal axis produces the greatest separation between all individuals. The second principal axis is perpendicular to the first and produces the next greatest amount of separation, and so on. Usually the first two axes account for more than 50% of the total variation, so that it is possible to visualise the separation by plotting the first two principal axes against one another.

Canonical variates analysis was also performed on each genus. This method is described by Blackith and Reyment (1971) and has been used extensively by biologists for discriminating between taxonomic groups (e.g. Blackith and Blackith 1969, Phillips et al. 1975). Basically, the method involves the computation of transformed axes, as for principal coordinates analysis. In canonical variates analysis, however, the axes are in the direction producing the greatest variability between the means of the groups (rather than the individuals, as in principal coordinates).

For *Philopterus*, separate analyses were performed, one grouping individuals according to locality and the other grouping individuals according to the back colour of their host. *Bruelia* individuals were grouped according to host back colour. Due to the low level of separation, further analyses were not performed.

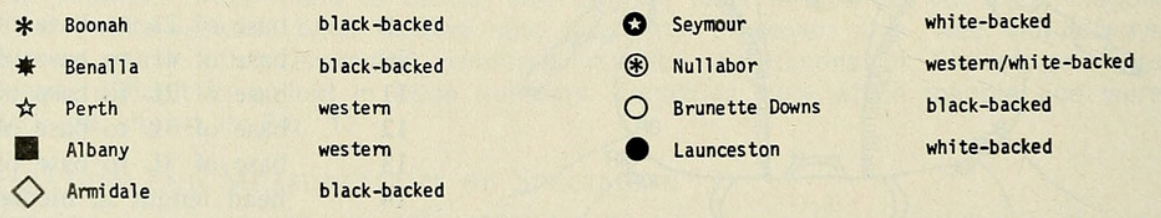


Fig. 4. Principal coordinates plots showing relationships between *Philopterus* from different localities and host-types. a. Females; b. Males.

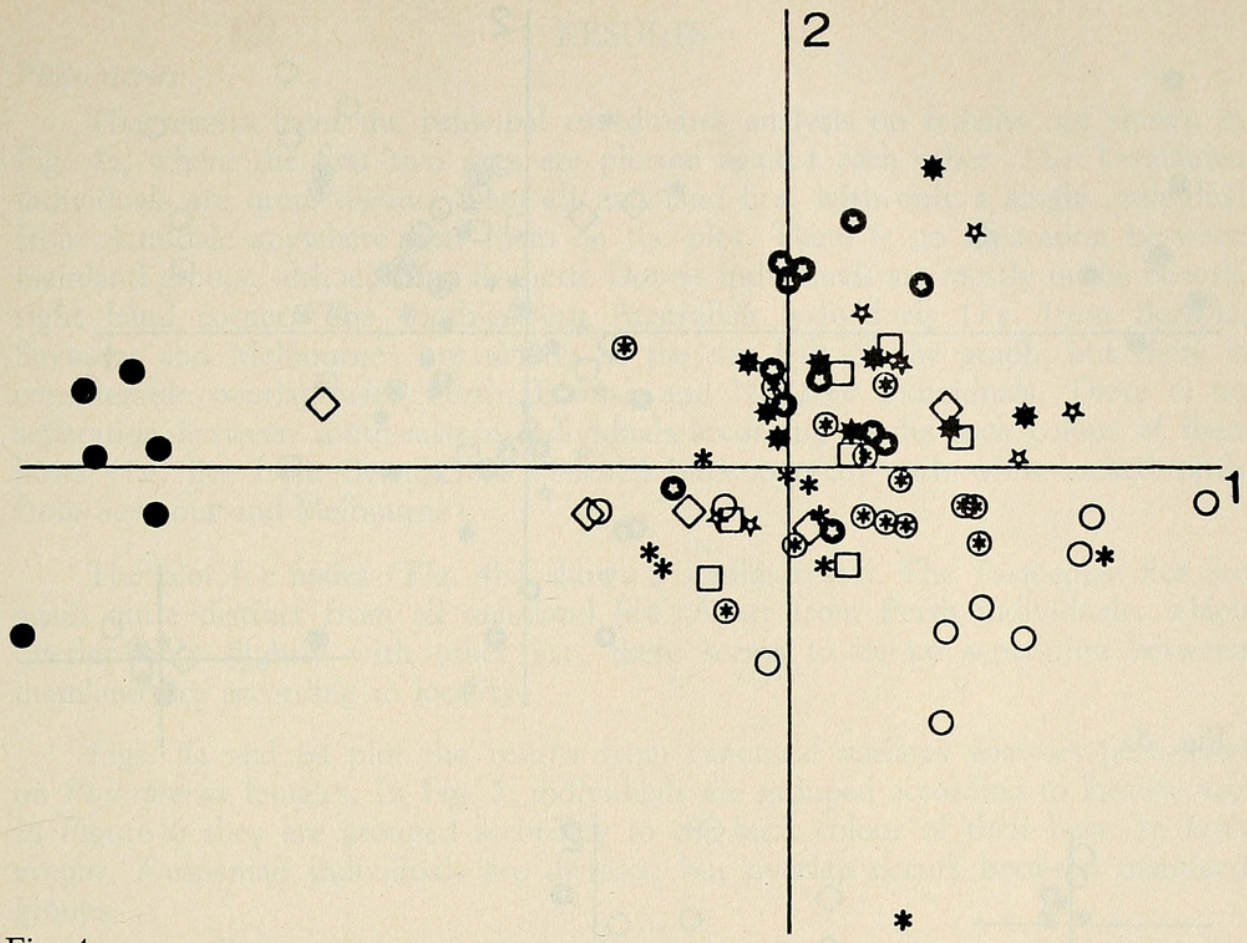


Fig. 4a

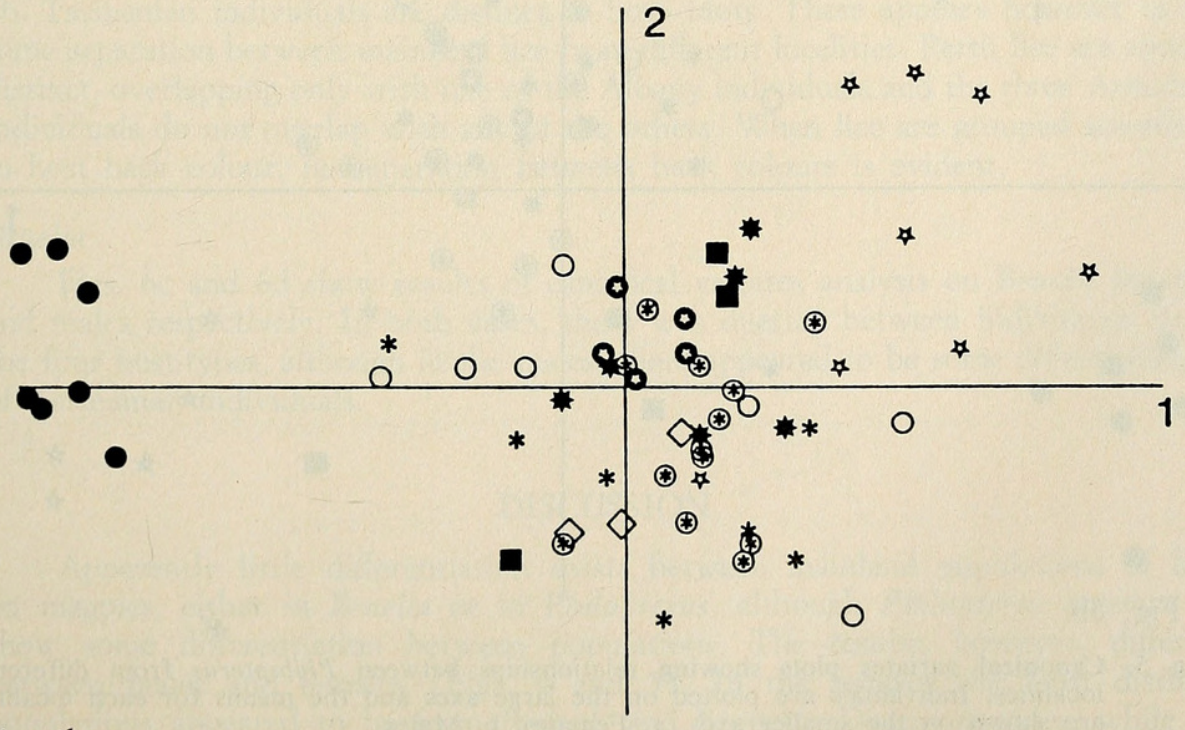


Fig. 4b

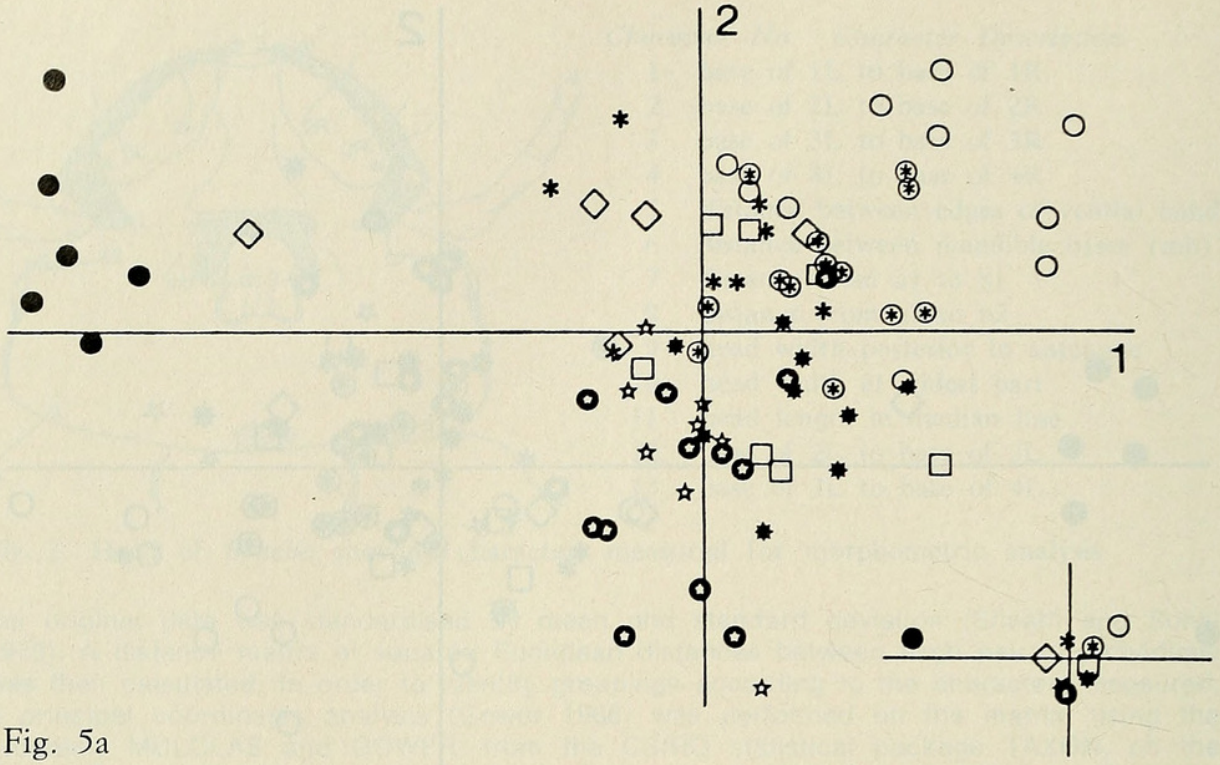


Fig. 5a

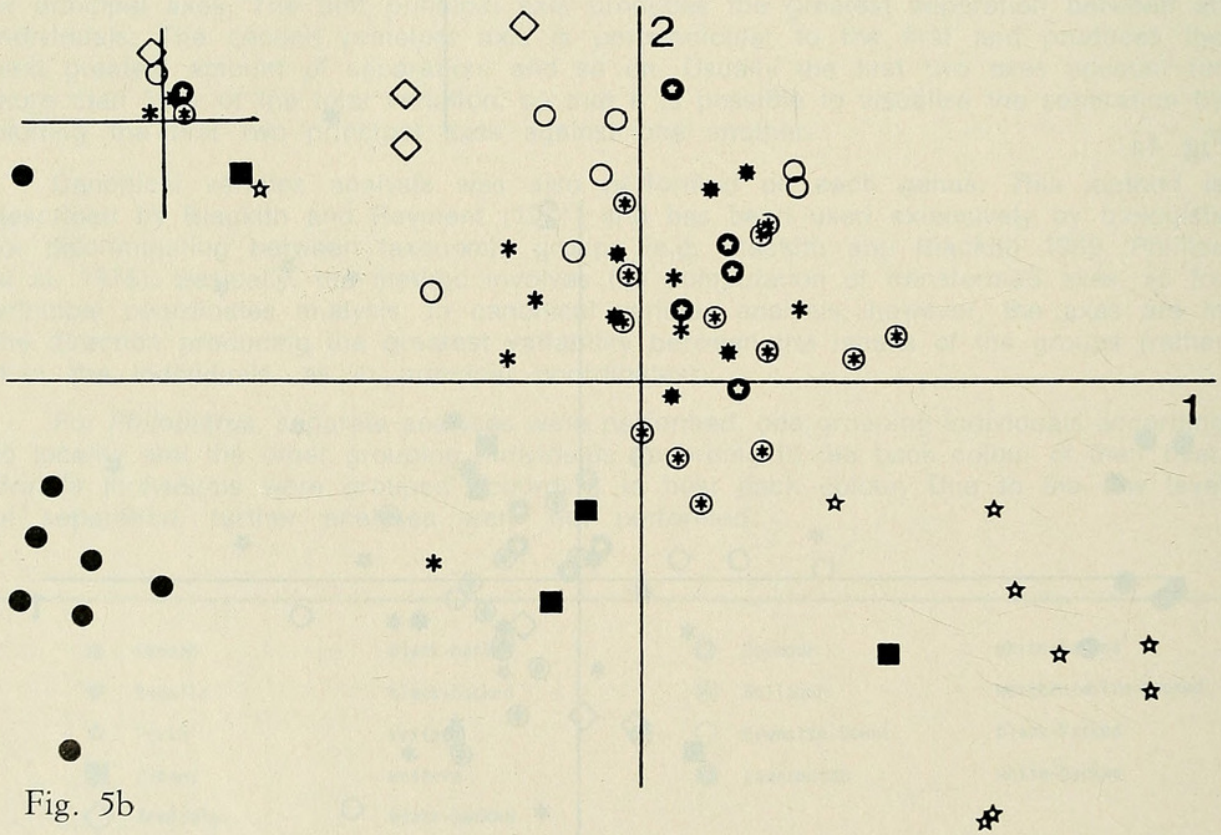


Fig. 5b

Fig. 5. Canonical variates plots showing relationships between *Philopterus* from different localities. Individuals are plotted on the large axes and the means for each locality are shown on the smaller axes. a. Females; b. Males.

RESULTS

Philopterus

The results from the principal coordinates analysis on females are shown in Fig. 4a, where the first two axes are plotted against each other. The Tasmanian individuals are quite distinct from all mainland lice, with only a single individual from Armidale anywhere near them on the plot. There is no separation between mainland groups, although the Brunette Downs individuals are mostly in the bottom right hand corner. The south-eastern Australian individuals (i.e. from Benalla, Seymour and Melbourne) are mostly in the top half of the graph, but there is considerable overlap with Perth, Boonah and Nullabor individuals. There is no separation between south-eastern individuals according to the back colour of their hosts (i.e. lice from Benalla black-backed birds overlap with white-backed birds from Seymour and Melbourne).

The plot for males (Fig. 4b) shows a similar result. The Tasmanian lice are again quite distinct from all mainland lice. Apart from Perth individuals, which overlap only slightly with other lice, there seems to be no separation between mainland lice according to locality.

Figs. 5a and 6a plot the results from canonical variates analyses performed on *Philopterus* females. In Fig. 5, individuals are grouped according to locality and in Figure 6 they are grouped according to the back colour of their host. In both graphs, Tasmanian individuals are distinct, but overlap occurs between mainland groups.

Results for canonical variates analyses on males are illustrated in Figs 5b and 6b. Tasmanian individuals are distinct in both plots. There appears however to be some separation between mainland lice from different localities. Perth lice are almost distinct, overlapping only with one of the Albany individuals and the three Armidale individuals do not overlap with any of the others. When lice are grouped according to host back colour, no separation between back colours is evident.

Bruelia

Figs. 6c and 6d show results of canonical variates analysis on *Bruelia* females and males respectively. In both cases, there was overlap between individuals from the four host-types, although in the males, there appeared to be some differentiation of Tasmanian individuals.

DISCUSSION

Apparently little differentiation exists between mainland populations of lice on magpies, either in *Bruelia* or in *Philopterus,* although *Philopterus* appears to show some differentiation between populations. The results, however, differed between males and females (Figs. 4 and 5). In the females the most distinct populations appeared to be from Boonah and Brunette Downs magpies, while in

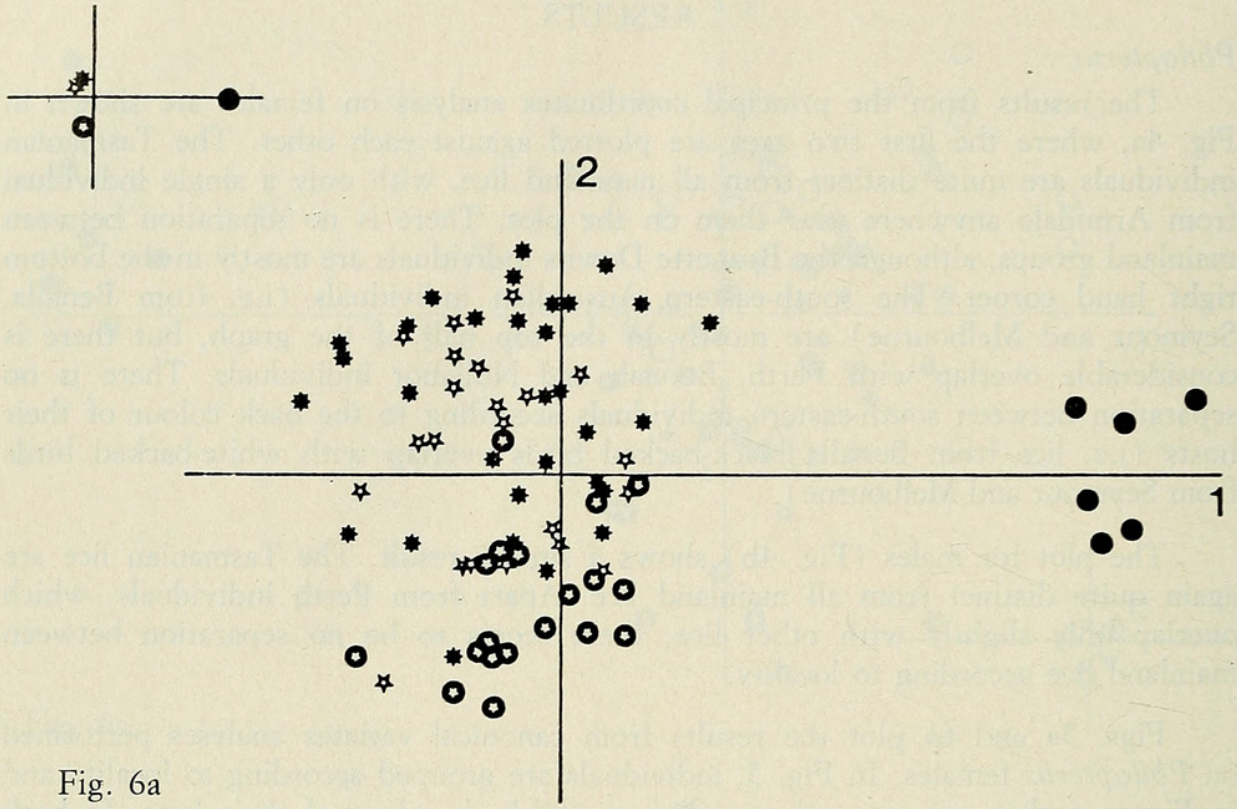


Fig. 6a

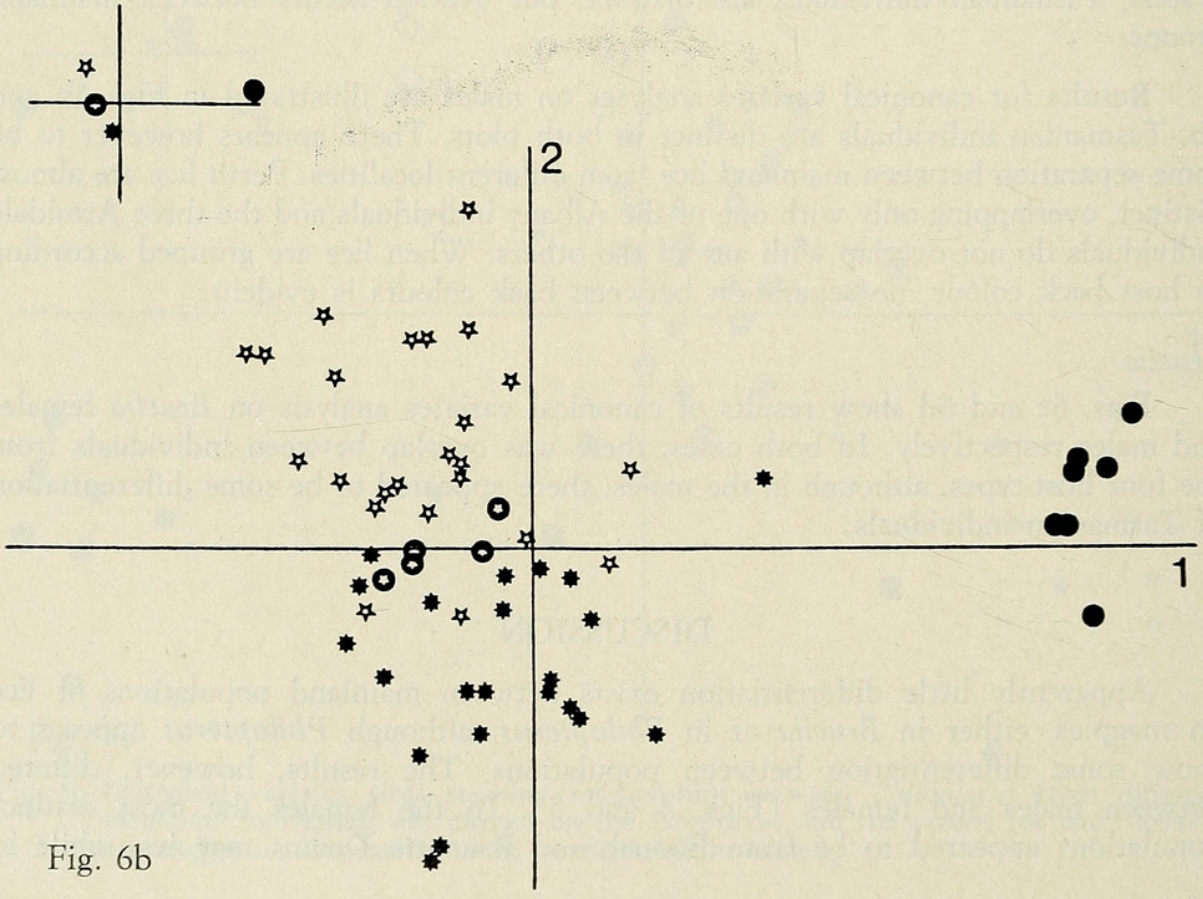


Fig. 6b

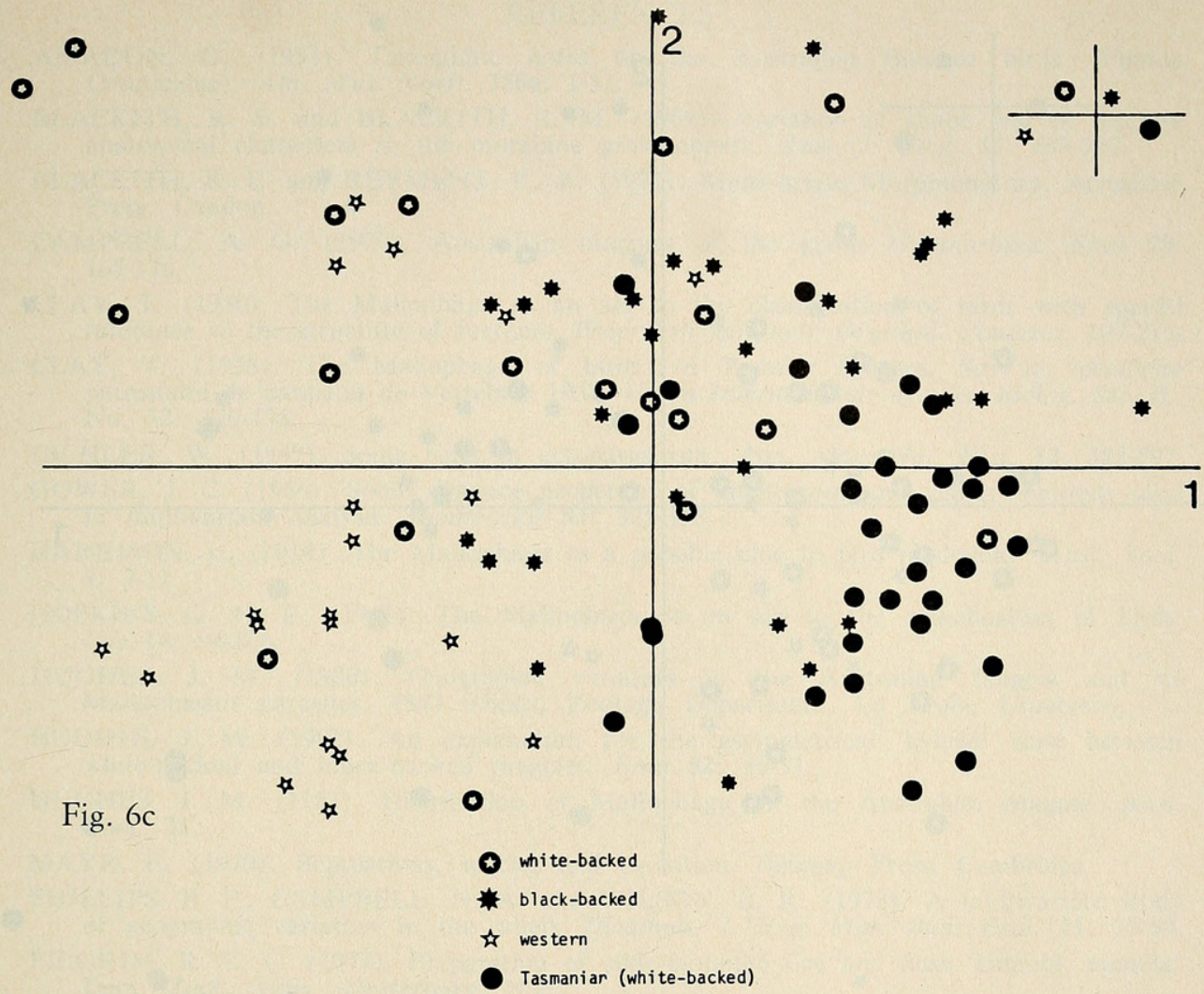


Fig. 6c

Fig. 6. Canonical variates plot, showing relationships between lice from different host-types. Individuals are plotted on the large axes and the means for each host-type on the smaller axes. a. *Philopterus* females; b. *Philopterus* males; c. *Bruelia* females; d. *Bruelia* males.

the males, lice from Perth, Armidale and Benalla magpies were most distinct. These results probably reflect the arbitrary nature of the grouping and therefore little reliability can be placed on them. Only the separation of Tasmanian lice was observed in both sexes, which suggests complete isolation, in terms of the characters measured.

Philopterus exhibits greater divergence between populations than does *Bruelia.* Clay (1958) observed that *Philopterus* varied more between host species than did *Bruelia,* so the greater between population variation of *Philopterus* was not unexpected. The reasons for this difference are not clear but could be due to greater habitat specificity of *Philopterus* [suggested by Clay (1958)] or different rates of movement between hosts in the two genera.

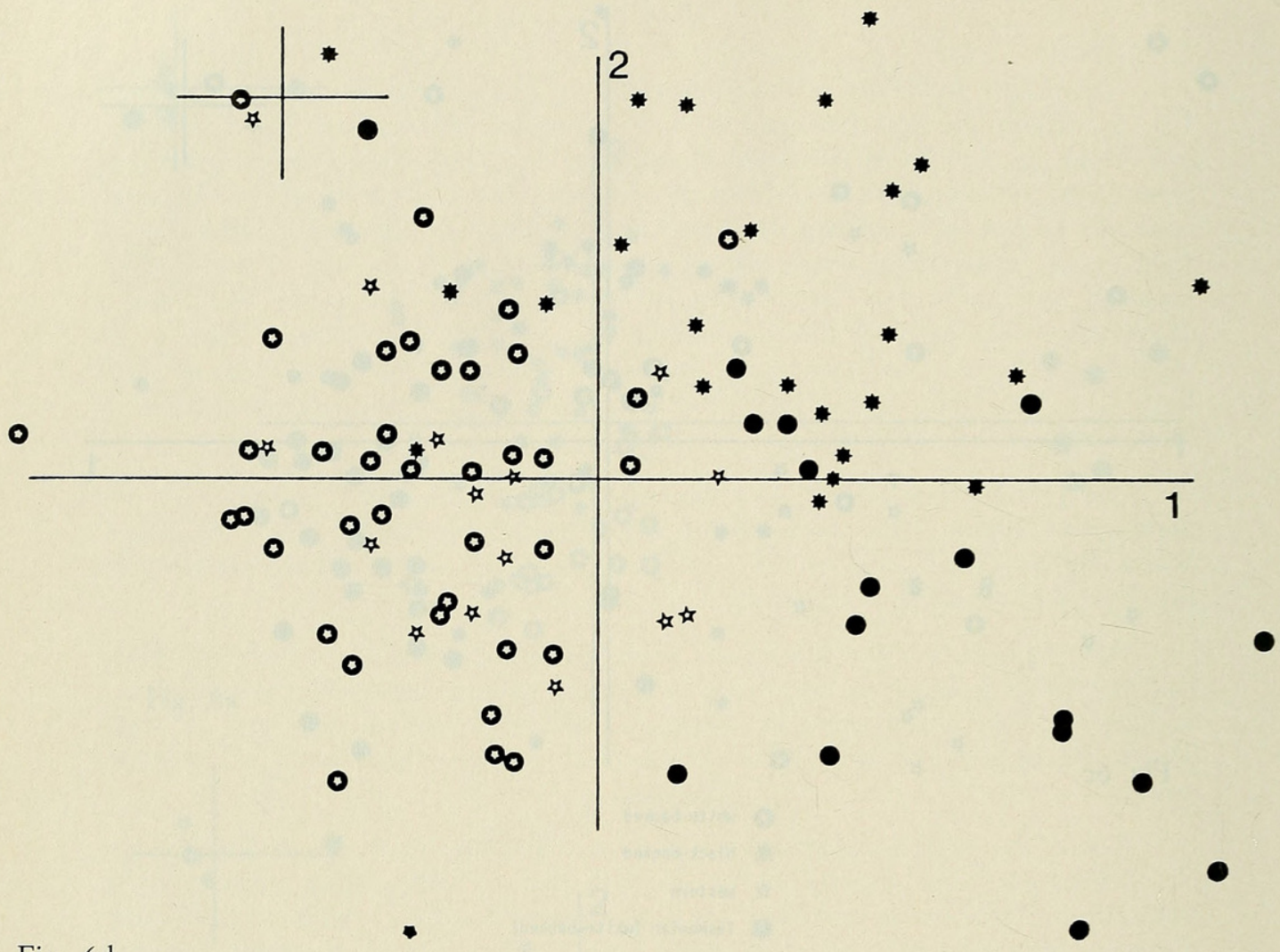


Fig. 6d

Results from the morphometric analysis of the lice correlate well with those described earlier for magpies. Very little differentiation occurs between mainland populations in either *Philopterus* or *Bruelia*. There seems to be no differentiation between lice from white-backed, western or black-backed magpies. As in the magpies however, the Tasmanian *Philopterus* are distinct from mainland populations. The fact that *Philopterus* seems to reflect more exactly relationships between host populations suggests that this genus may be more useful than *Bruelia* as an aid to understanding bird phylogeny. Certainly within host-species, *Bruelia* shows very little differentiation.

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