Distribution of Mallophaga on the Australian Magpie (*Gymnorhina tibicen* Latham) (Family: Cracticidae)

JANE M. HUGHES

School of Australian Environmental Studies, Griffith University, Nathan, Queensland 4111.

ABSTRACT

Ischnocera were collected from live magpies *(Gymnorhina tibicen). Philopterus* and *Bruelia* were found on all host-types (mainland white-backed, black-backed, western and Tasmanian magpies); *Philopterus* was less common than *Bruelia.* A significantly lower proportion of white-backed magpies than black-backed magpies were infested with *Bruelia.* Seasonal changes in the percentage of birds infested with *Bruelia* and *Philopterus* were observed with highest numbers of parasites in autumn and winter and the lowest numbers in summer.

INTRODUCTION

The Australian magpie (*Gymnorhina tibicen* Latham) shows considerable variation in plumage colour throughout its range. Initially magpies were collected for taxonomic analysis, but an effort was made to collect sufficient Mallophaga on the different plumage types so as to compare their densities and distributions.

There are three distinct forms in the species *G. tibicen.* The black-backed form inhabits most of northern and central Australia, a white-backed form is found in south-eastern Australia and Tasmania and a western form (where males are white-backed and females are black-backed) is found in south western Australia (Slater 1974). There is very little difference between the three mainland forms, when comparing biochemical or morphological characters (Hughes 1980). However, the magpies from Tasmania are quite distinct from mainland magpies, when compared using multivariate morphometric analysis (Hughes 1980).

Three genera of Mallophaga occur on the magpie. They are *Philopterus* and *Bruelia,* which belong to the Division Ischnocera, family Philopteridae; and *Myrsidea,* which belongs to the Division Amblycera, family Menoponidae. There is only a single species of *Bruelia, B. semiannulata* Piaget. The mainland magpies are infested with a single undescribed species of *Philopterus* and the Tasmanian magpies may be hosts for a second species (Hughes 1980). Neither type has been described, and specimens have been sent to R.L.C. Pilgrim (University of Canter-

bury, N.Z.), who is currently working on their taxonomy. Mallophaga live amongst the feathers of their host and feed on feathers and/or blood (Clay 1958). Some inhabit specific parts of the body of the host (e.g. *Philopterus* which lives on head and neck feathers) whereas others roam all over the host (e.g. most Amblycerans).

Little work has been carried out on their ecology. Ash (1960) examined a large number of live passerine birds (belonging to five species) and studied seasonal changes in louse density, numbers of different louse species per host and their distribution on the host. He found large variations in all these factors, with different Mallophagan and host species. Other workers have been involved mostly with examining dead specimens (e.g. Foster 1969) or with domestic birds (Nelson 1971, Crutchfield and Hixon 1943).

The purpose of this study was firstly to determine whether or not *Bruelia* and *Philopterus* occurred in equal densities on the various host-types and secondly to determine whether there were differences in the incidence of louse infestation between host types. Because some previous work suggested seasonal changes in lice density (Ash 1960) and increases in population size correlated with host breeding times (Foster 1969), the data were examined for seasonal variation, since this may affect conclusions about density variation with host-types.

MATERIALS AND METHODS

Collection of Lice

A total of 276 magpies were examined for lice between 1974 and 1979. These birds were trapped, using a live magpie as a decoy. Areas from which birds were sampled are shown in figure 1. Due to difficulties with sample sizes, all magpies collected within a 200km radius of certain localities were included (Fig. 1). Magpies were divided into five categories, based on back colour and geographic locality. Tasmanian magpies were separated from mainland birds because they are distinct in biochemical and morphometric characters (Hughes 1980). The four categories selected were white-backed, black-backed, western and Tasmanian.

Each bird was examined systematically working down the back, from the head to the insertion of the tail, examining each feather and collecting lice of all stages. The process was then repeated on the underside of the bird. This procedure ensured that a similar proportion of the total number of lice present was collected from each bird. Because *Philopterus* occurs on head and neck feathers, which are smaller and easier to search, it is probable that a greater proportion of the population of this species was collected than of *Bruelia,* which is more common on the back feathers, which are more difficult to search. If no lice were found after this procedure had been carried out, the bird was said to be 'clean'.

The number of lice observed on live birds is only a part of the total number present. However, it is assumed that this number is proportional to the actual number present and that the data from live birds can therefore be used to make comparisons between different host-types. Also, most analysis involved comparisons between individual birds which had lice and those which did not, so that the actual number present was ignored.

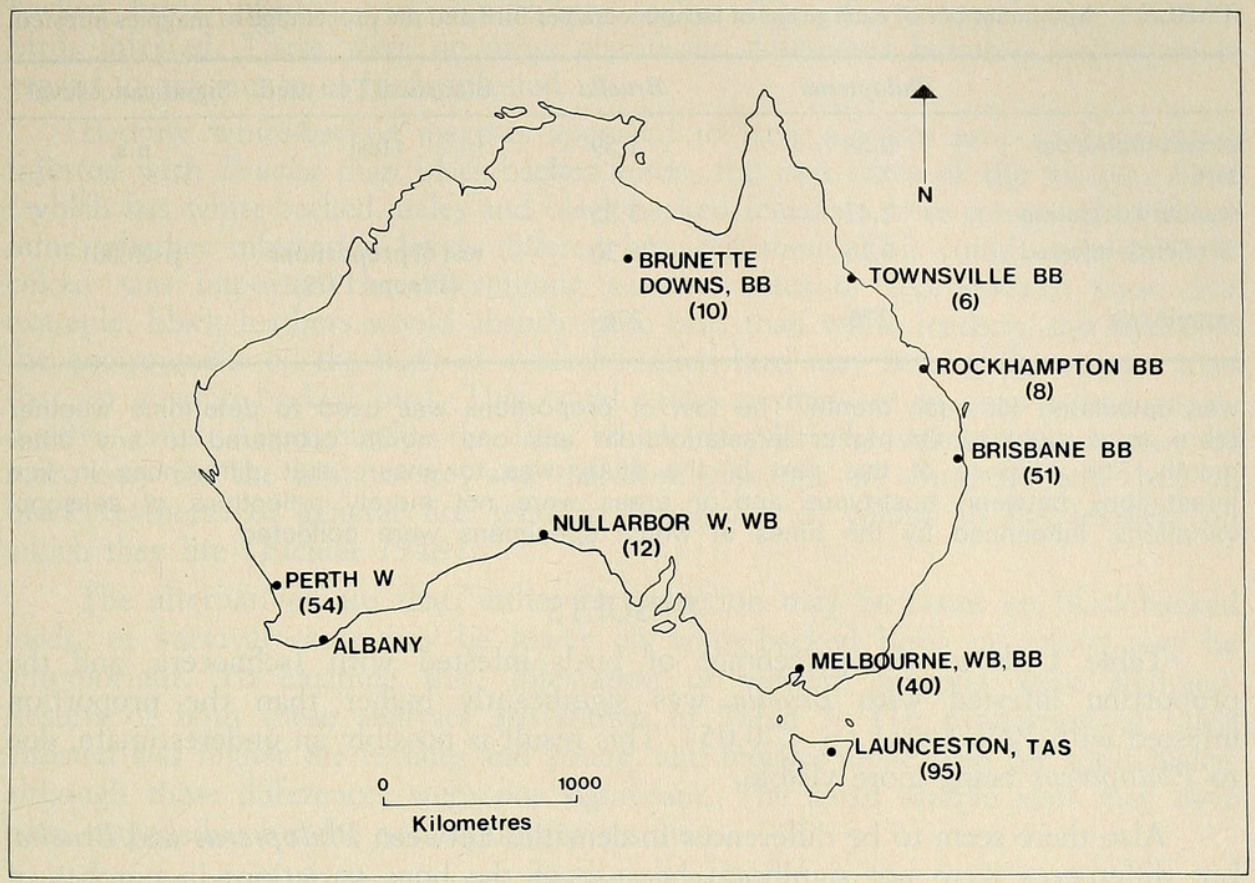

Fig. 1. Map of Australia showing areas sampled for magpie lice. Letters after place names indicate the types of magpies sampled in those areas. BB: Black-backed, W: Western, WB: mainland white-backed, Tas: Tasmanian white-backed. Numbers below place names indicate the number of magpies examined.

Only the results of *Philopterus* sp. and *Bruelia* sp. were analysed further because individuals belonging to the genus *Myrisidea* are fast moving and very difficult to catch. It was not always possible to determine with any certainty whether or not *Myrsidea* were present on the birds.

Analysis

For each host-type (i.e. white-backed, black-backed, western or Tasmanian), the percentage of birds infested with each species was calculated. The mean number of lice per bird was also calculated. However, the standard deviations were larger than the means, due to the high number of zero values in the data; and it was not possible to compare statistically the means for each host-type. The test of proportions (Freund 1979) was used to compare the percentage of each host-type infested with each species of louse. In order to examine the possibility of any difference between host-types being solely due to differences in host plumage colour, westerns were subdivided into males (white-backed) and immatures and females (black-backed) and their rates of infestation compared. Some reports, however, suggest that juveniles may be either more heavily (Clay 1958) or less heavily (Ash 1960) infested with lice than adults. Therefore the procedure was repeated using only adult males and females.

Because there appeared to be seasonal variations in lice density, the hosts were then grouped according to the month of capture and the proportion of birds infested

TABLE 1. Mean number of each genus of Ischonocera per bird and the precentage of magpies infested.

	Philopterus	*Bruelia*	Statistical Test used	Significance level
mean number per bird	0.58	1.59	t test	n.s.
standard deviation	2.47	5.35		
% of birds infested	6.16	25.36	test of proportions (Freund 1979)	$p<0.001$
sample size	276	276		

was calculated for each month. The test of proportions was used to determine whether there were significantly higher infestations in any one month compared to any other month. The purpose of this part of the study was to ensure that differences in lice infestations between host-types and/or areas were not merely reflections of seasonal variations, influenced by the times at which specimens were collected.

RESULTS

Table 1 shows the percentage of birds infested with Ischnocera, and the proportion infested with *Bruelia* was significantly higher than the proportion infested with *Philopterus* ($p < 0.05$). This result is possibly an underestimate, due to *Philopterus* being more visible.

Also there seem to be differences in densities between *Philopterus* and *Bruelia,* but differences were not significant because of the huge variations in number of lice per bird. Numbers of *Bruelia* per host ranged from zero to over 500 and numbers of *Philopterus* per host ranged from zero to over 70.

TABLE 2. Percentage of magpies of different types infested with Ischnocera. Comparisons are between host-types for each genus of Ischnocera. Within each genus, samples with similar superscripts are not significantly different ($p>.05$).

Host-type	N	% of magpies infested	
		Philopterus	*Bruelia*
mainland white-backed	40	15.00^{b}	12.50^{a}
black-backed	77	6.49^{ab}	40.26^{b}
western	64	6.25^{ab}	14.06^{a}
Tasmanian white-backed	95	2.11^{a}	26.32^{ab}
all mainland birds	181	8.29^{b}	24.86^{ab}

Only the white-backed mainland birds and Tasmanian birds had significantly different percentage infestations of *Philopterus,* with the proportion of white-backed mainland birds being significantly higher than for Tasmanian birds (Table 2). When the results for all mainland birds were pooled a significantly higher proportion of mainland birds than of Tasmanian birds were infested with *Philopterus.* For *Bruelia,* infestations of mainland white-backed birds were significantly lower than those of black-backed birds. Also, the proportion of black-

backed birds infested was significantly higher than the proportion of western birds infested. There were no other significant differences between host-types in regard to percentage of birds infested.

Because white-backed magpies appeared to have a lower proportion of birds infested with *Bruelia* than black-backed birds, the two sexes of the western form (which has white-backed males and black-backed females) were compared to determine whether infestation levels differed between them. This could occur if back-colour was important in determining survival rates or reproductive rates. For example, black feathers would absorb more heat than white feathers and therefore the environment on the back of a black-backed bird may be slightly warmer than that on a white-backed bird. This could cause an increase in growth and reproductive rates. Alternatively, the lice, which are dark brown in colour, may be more easy for the host to see, and therefore pick off, on white feathers than on black feathers. In general lice tend to be similar in colour to the feathers on which they life (Eichler 1948).

The alternatives are that, either reproduction may be faster on black-backed birds, or survival rates may be lower on white-backed birds or colour may be unimportant. To examine this, infestation of western magpies were analysed. Results of both these analyses are shown in Table 3. The proportion of birds infested was higher for females and young, and females alone than for adult males, although these differences were not significant. The small sample sizes may have been responsible for the non-significant results.

TABLE 3. Percentage of western magpies infested with *Bruelia*.

Females, immatures and juveniles combined		Adult females		Adult males	
%	N	%	N	%	N
20.00	35	11.76	17	8.33	12

The seasonal variation in percentage of birds infested is illustrated in Fig. 2. The highest infestations of *Philopterus* appear to be in July with much lower infestations in the other months. Infestations of *Bruelia* are highest between April and June.

Very few months had significantly different (at the .05 level) levels of *Philopterus* infestation (Fig. 2). July had significantly higher levels of infestation than most other months. January infestations were significantly lower than April, May, June, July, August, November and December infestations and August, September, October, November and December infestations were lower than those in April and May. No birds were caught in February and March.

DISCUSSION

The results suggest that a higher proportion of birds are infested with *Bruelia* than with *Philopterus* (significant at .05 level) and that the mean number

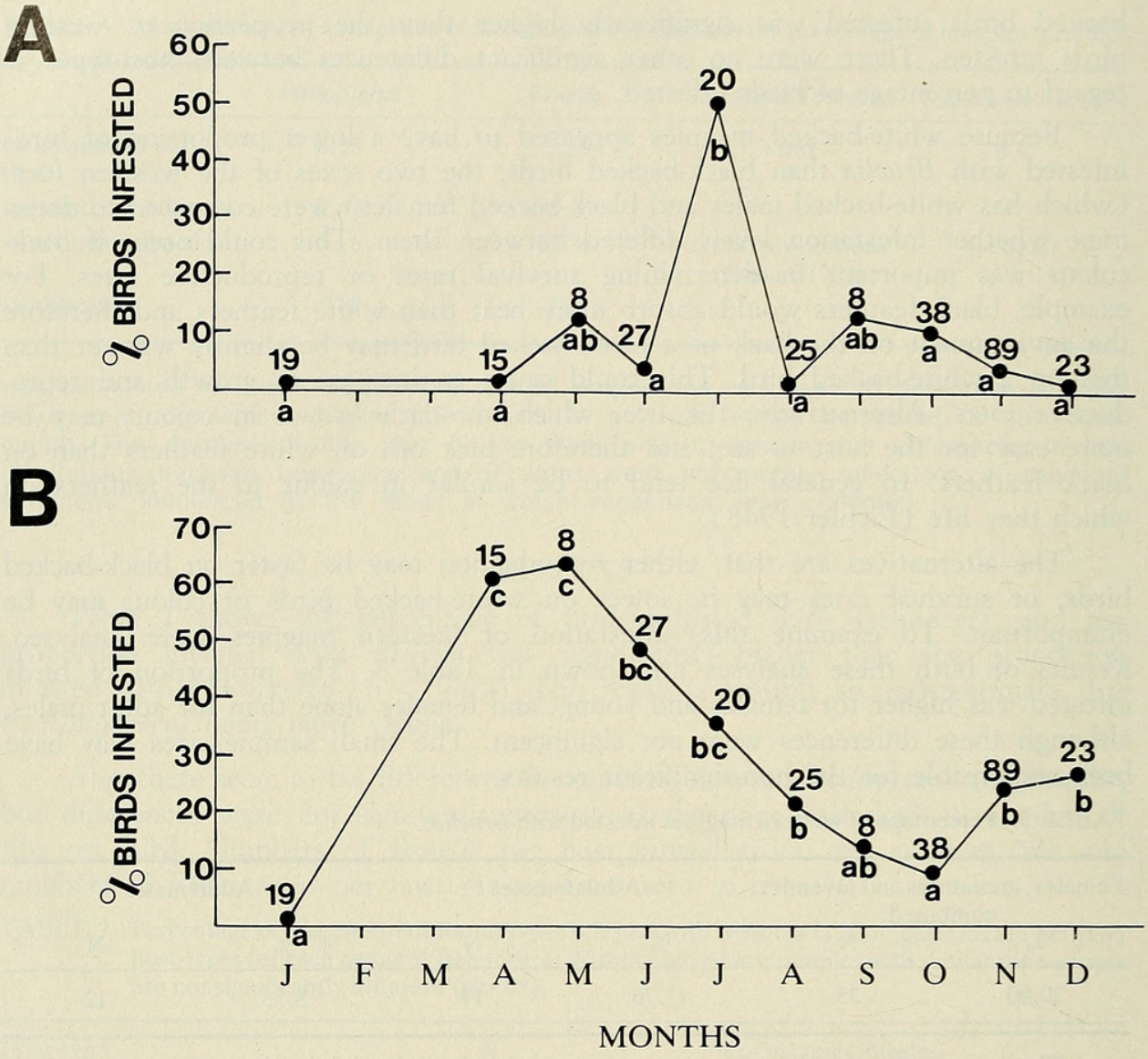

Fig. 2. Seasonal variations in infestation rates. A. *Philopterus*, B. *Bruelia*. Numbers above points indicate the number of birds examined. Any two points with the same letter beneath them were not significantly different in the percentage of birds infected.

of *Bruelia* per bird is higher than the mean number of *Philopterus* per bird (although this difference was not significant because of the high number of zero values). This result differs from reports by Ash (1960), who found *Philopterus* and *Bruelia* occurring with equal frequency on 54 blackbirds. No doubt there is much variation between host-types in relative frequencies of the various genera of Mallophaga ,even though the same two genera may be present in each case.

Significantly fewer Tasmanian than mainland birds (treated as a whole) were infested with *Philopterus*. Only two Tasmanian birds of 95 examined by the author and a further 40 birds examined by Mr R. H. Green (of the Queen Victoria Museum, Launceston) were found to harbour any *Philopterus*. Both

of these birds belonged to the same territorial group, one probably being the offspring of the other. From Table 2 it can be seen that if the mainland birds are divided into host-types only the mainland white-backed birds, which geographically are closest to the Tasmanian birds have significantly higher *Philopterus* infestations than Tasmanian birds. A study of morphometric differentiation among *Philopterus* populations on different magpie host-types showed that the Tasmanian individuals were distinct from mainland forms (Hughes 1980). Possibly these individuals belong to a distinct species or geographic race which may have different reproductive rates and/or dispersal abilities from mainland forms, which would result in different rates of infestation.

The white-backed mainland magpies had significantly lower infestations of *Bruelia* than black-backed magpies. However, when young and adult female westerns were compared with adult male westerns, no significant differences were found in proportion of birds infested with *Bruelia,* although females and immatures were approximately twice as heavily infested as adult males. The small number of adult males and adult females examined were probably responsible for the lack of any significant difference. This suggests that differences in levels of *Bruelia* infestation between black-backed and white-backed birds may be a result of the back colour. The observation that males have a lower frequency of infestation than females is contrary to Ash's report that males are slightly more heavily infested than females (Ash 1960). Therefore the lower level of infestation is males in the western magpie cannot be explained as a general sex trend.

The seasonal variations in louse infestations differ between the two genera (Ash 1960; Foster 1969). In *Philopterus* the peak occurs just prior to the breeding time of the hosts, i.e. July to September (Carrick 1972). This increase in infestation prior to breeding has been observed by other authors (Ash 1960, Foster 1969). According to Foster (1969), louse breeding usually occurs just prior to the bird breeding time, so that there are large numbers of young ready to transfer to the young hosts in the nests. In *Bruelia* the peak appears to be much earlier than the breeding time of the host.

To conclude, it seems that there is a higher frequency of *Bruelia* than *Philopterus* infestations. The proportion of Tasmanian birds infested with *Philopterus* is lower than mainland birds. It is possible that this is due to differential selection between the two populations but *Philopterus* live mostly on the nape of their host which is white in all host-types and therefore the habitats provided by the different host-types must be very similar. Possibly the Tasmanian magpies which are distinct from mainland birds on morphometric and biochemical characters (Hughes 1980) provide a slightly less favourable habitat than mainland birds for *Philopterus.* Alternatively the *Philopterus* found on Tasmanian magpies may be a distinct species or geographic race, which has lower reproductive rates and/or dispersal abilities than the mainland form and therefore infests fewer birds.

The difference in *Bruelia* infestation between white-backed and black-backed birds could be due to differing survival on the two colour types. Black feathers may provide a more suitable habitat for *Bruelia* than do white feathers.

ACKNOWLEDGEMENTS

This work was carried out while on a Commonwealth Postgraduate Award. I would like to thank Professor I. Thornton, Mr P. Mather and Mr R. Floyd for comments on previous drafts of the paper and Kaye Ingold for typing the manuscript. Special thanks to Peter Mather for invaluable field assistance.

REFERENCES

ASH, J. S. (1960). Study of Mallophaga on birds with species reference to their ecology. *Ibis* **102**: 93-110.

CARRICK, R. (1972). Population ecology of the Australian black-backed magpie, royal penguin and silver gull. *In*: Population Ecology of Migratory Birds. A Symposium. *Wild. Res. Rep. U.S. Dep. Interior* No. 2.

CLAY, T. (1958). The Mallophaga of birds: *In*: Premier Sympos. Sur la specificite parasitaire de parasites de Vertebres 1957, *Union Internationale des Sci. Biolog. Ser. B.* **32**: 120-158.

CONDON, H. T. (1969). A handlist of the Birds of South Australia. S. Aust. Orn. Assoc., Adelaide.

CRUTCHFIELD, C. M. and HIXSON, H. (1943). Food habits of several species of Mallophaga with special reference to blood consumption. *Florida Entom.* **26**: 63-66.

EICHLER, W. (1948). Shutzfarbung bis Federlingen. *Die Vogel der Heimat* **6**: 103-109.

FOSTER, M. S. (1969). Synchronised life cycles in the orange-crowned warbler and its mallophagan parasites. *Ecology* **5**J: 315-322.

FREUND, J. E. (1979). Modern Elementary Statistics. Prentice Hall Press, London.

HUGHES, J. M. (1980). Geographic Variation in the Australian Magpie and its Mallophagan Parasites. Ph.D. Thesis, La Trobe University.

NELSON, B. C. (1971). Successful rearing of *Colcocephalum turbinatum (Phthiraptera). Nature New Biology* **232**: 255-256.

SLATER, P. (1974). A Field Guide to Australian Birds: Vol. II Passerines. Rigby: Adelaide.