The Mallophaga of Manx Shearwaters *Puffinus p. puffinus* from Ynys Enlli, Wales

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INTRODUCTION

The Mallophaga of British breeding procellariiform species were described by Fowler and Miller (1984). In that study sufficient data to construct frequency distributions and population structures of infesting lice were obtained only from Storm Petrels *Hydrobates pelagicus* and Fulmars *Fulmarus glacialis*. Subsequent investigations included a comparison of Storm Petrel lice with those of Wilson's Petrel *Oceanites oceanicus* (Fowler & Price 1987), and an analysis of the Mallophaga of Leach's Petrels *Oceanodroma leucorhoa* (Fowler & Hodson 1988).

A study of seabird feather lice may throw light on phylogenetic relationships and geographic origins of birds (e.g. Zonfrillo 1988). Analysis of frequency distributions and population structures of infesting lice can give an insight into the relationship between the ectoparasite and the host (Fowler & Price [1987] review recent work in this field). Fowler & Miller (1984) were able to delouse only four Manx Shearwaters in Shetland, recording two species of Mallophaga. In this paper we report the frequency distributions and population structures of Mallophaga obtained from a very much larger sample of shearwaters from Ynys Enlli, Wales.

METHODS

Adult Manx Shearwaters were captured by hand at night as they came ashore on Ynys Enlli (Bardsey Island), Gwynedd, Wales, during 8-24 August 1987. Birds were not aged or sexed, but unfledged birds were avoided. Shearwaters were deloused at the Bird Observatory in plastic buckets (approx. 13 dm^3) for 20 min, as described by Fowler & Cohen (1983). The delousing anaesthetic was ethyl acetate (5 cm^3) absorbed on a disc of filter paper cut to fit the floor of the bucket where lice collected. Lice were found by careful scanning with a x10 binocular microscope and removed and preserved in 70% ethanol.

Lice from each bird were identified by comparison with reference specimens verified by R.L. Palma. Age-classes of lice were determined biometrically, using length and width measurements of the chitinised head capsule as explained by Fowler, Miller and Cohen (1984). Population structures and frequency distributions of individual population classes (adults and nymphs) were estimated from random sub-samples.

RESULTS

A total of 12,298 Mallophaga of 8 species was collected from 230 Manx Shearwaters (Table 1). All birds carried lice, and the species frequency distribution was: 1 bird had 1 species; 192 had 2 species; 36 had 3 species; 1 had 4 species. There was no tendency for the most heavily infested birds to have also the most species.

Statistical information relating to frequency distributions is presented in Table 2. The frequency distributions of whole populations of *T. aviator* and *H. diversus* are shown in Figures 1 and 2, and the distributions of adult and nymph population classes are shown separately in Figures 3 and 4. In each case the expected frequencies of a negative binomial

distribution based on estimations from sample data of the exponent k are superimposed (joined closed circles). All distributions are described by the negative binomial model, but that for the whole population of *T. aviator* is only a weak fit (chi-square goodness of fit tests). There is no statistically significant difference between the values of k for adult and nymph classes of either species, or between either population class and its whole population ($z<1.5$ in all cases).

TABLE 1. INCIDENCE OF MALLOPHAGA ON 230 MANX SHEARWATERS *PUFFINUS P. PUFFINUS* DELOUSED ON YNYS ENLLI DURING AUGUST 1987.

Species	*% birds infested*	*Number of lice collected*	*Mean (Range in brackets)*	*Variance s*
Ischnocera: *Trabeculus aviator* (Evans, 1912)	99.5	6594	28.7 (0-104)	368.7
Ischnocera: *Halipeurus diversus* (Kellogg, 1896)	99.5	5572	24.2 (0-102)	316.8
Amblycera: *Austromenopon paululum* (Kellogg & Chapman, 1899)	13.5	115	0.5 (0-51)	12.96
Ischnocera: *Saemundssonia* sp.	0.4	7	(0-7)	–
Ischnocera: *Naubates harrisoni* (Bedford, 1930)	1.7	5	(0-2)	–
Amblycera: *Ancistrona* sp.	0.8	3	(0-2)	–
Ischnocera: *Halipeurus g. gravis* (Timmermann, 1961)	0.4	1	(0-1)	–
Ischnocera: *Naubates* sp.	0.4	1	(0-1)	–

TABLE 2. SAMPLE DATA FOR MALLOPHAGA FROM MANX SHEARWATERS *PUFFINUS P. PUFFINUS* DELOUSED ON YNYS ENLLI DURING AUGUST 1987.

Population category	*Number of birds n*	*Mean number of lice*	*Variance s^2*	*k± S.E.*	*X^2 (d.f.)*	*Significance*
Trabeculus aviator (all classes)	230	28.7	368.7	2.42± 0.291	28.46 (14)	$0.05>P>0.01$
T. aviator (adults)	51	15.33	121.15	2.22± 0.607	3.16 (5)	NS
T. aviator (nymphs)	51	10.88	82.30	1.66± 0.479	10.02 (5)	NS
Halipeurus diversus (all classes)	230	24.2	316.8	2.00± 0.247	9.94 (12)	NS
H. diversus (adults)	49	13.71	187.86	1.40± 0.410	5.63 (4)	NS
H. diversus (nymphs)	49	11.52	62.68	2.60± 0.764	5.75 (4)	NS

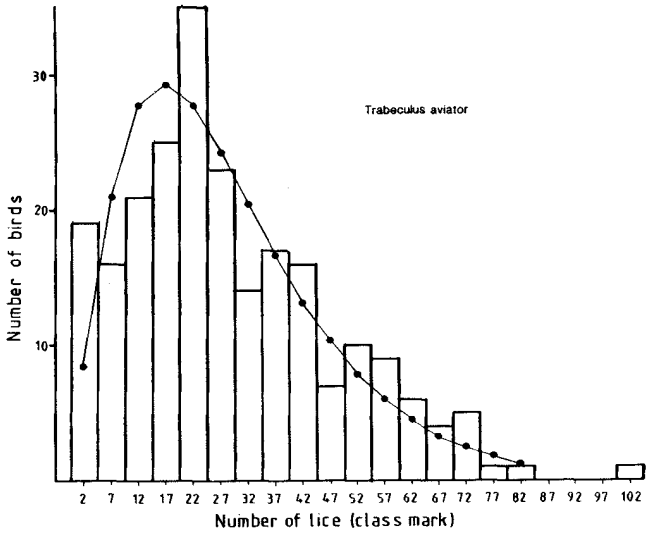

Figure 1. Frequency distribution of *Travebulus aviator* (whole population) on 230 Manx Shearwaters, August 1987. Individual frequencies are grouped into classes of 5. Thus class mark 2 represents individuals with 0-4 lice etc. Joined closed circles are the expected frequencies of a negative binomial distribution.

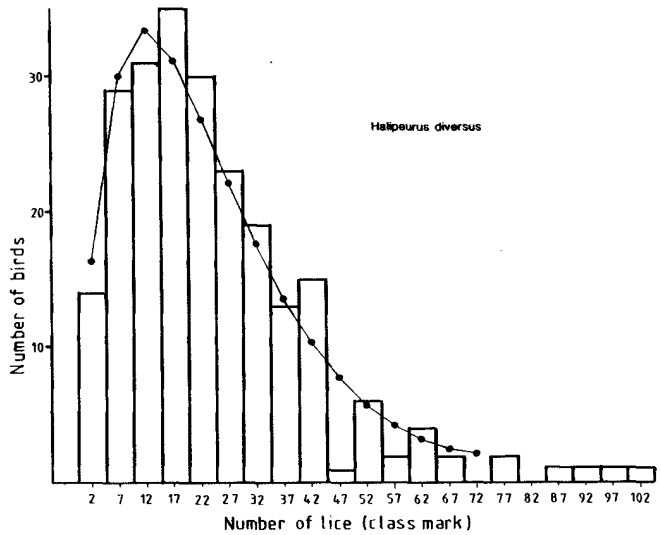

Figure 2. Frequency distribution of *Halipeurus diversus* (whole population) on 230 Manx Shearwaters, August 1987. Individual frequencies are grouped in classes of 5. Joined closed circles are the expected frequencies of a negative binomial distribution.

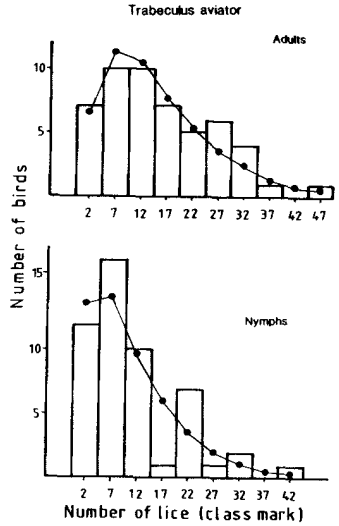

Figure 3. Frequency distribution *Trabeculus aviator* adults (upper) and nymphs (lower) on 51 Manx Shearwaters, August 1987. Individual frequencies are grouped in classes of 5. Joined closed circles are the expected frequencies of a negative binomial distribution.

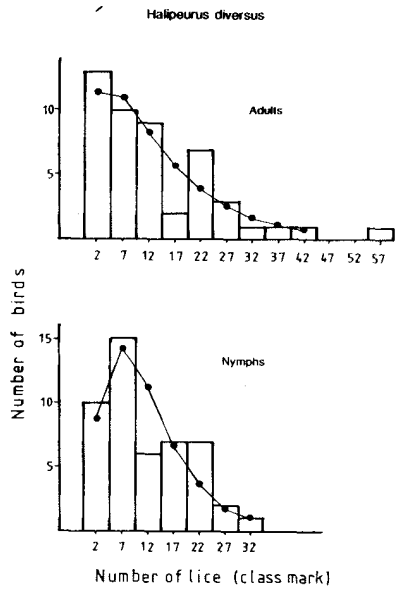

Figure 4. Frequency distribution of *Halipeurus diversus* adults (upper) and nymphs (lower) on 49 Manx Shearwaters, August 1987. Individual frequencies are grouped in classes of 5. Joined closed circles are the expected frequencies of a negative binomial distribution.

Population structures of *Trabeculus aviator* and *Halipeurus diversus* obtained from 30 birds are shown in Figure 5. In both structures the dominant age-class is adult.

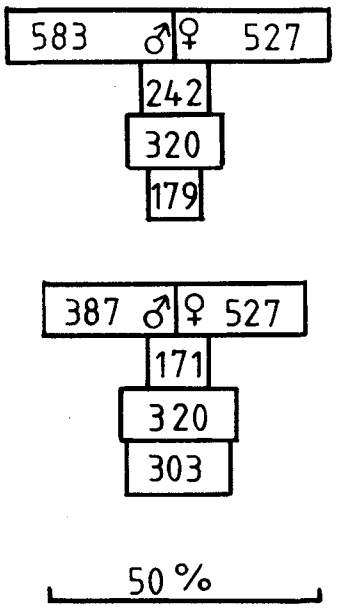

Figure 5. Population structures of Mallophaga from Manx Shearwaters, August 1987. Each "tier" in the structure represents, in ascending order, 1st, 2nd, 3rd instar nymphs, adults. Numbers within the structures are the number of lice obtained from a random sub-set of 30 birds. Upper: *Trabeculus aviator*; Lower: *Halipeurus diversus*.

DISCUSSION

Trabeculus aviator, Halipeurus diversus and *Austromenopon paululum* are well known mallophagan ectoparasites of the Manx Shearwater. *Naubates harrisoni* was first reported from Manx Shearwaters by Fowler & Furness (1987) on Rhum. Its presence in a second colony suggests that, despite its low infestation level, it may be widely dispersed among this host. It appears that the three specimens (a female and two nymphs) of *Ancistrona* sp. are the first record for the Manx Shearwater. R.L. Palma (National Museum of New Zealand) communicates:

> "*Ancistrona* is widespread on many species of almost all the genera of Procellariidae, and on at least one of the Hydrobatidae. Sampling shows that its abundance and frequency is extremely low, hence its scarcity in collections, and males are even more scarce than females. The earliest name available is *A. vagelli* (J.C. Fabricius, 1787) *ex Fulmarus glacialis.*"

Clearly further sampling is required to assess the true status of *Ancistrona* on shearwaters.

The seven *Saemundssonia* sp. were all on a single bird and, since they comprise one female and six nymphs, they evidently represent a "breeding" population. We do not speculate as to whether the species is a true ectoparasite of the Manx Shearwater, or merely a straggler. However, it is a remarkable coincidence that the species was found on the *only* shearwater that did not carry *T. aviator* which it resembles superficially.

The only known host of *Halipeurus g. gravis* is the Great Shearwater *Puffinus gravis*. The louse was found recently as a straggler on a Sooty Shearwater *P. griseus* by Zonfrillo (1988) who discusses how chance transfers between hosts may arise. The remaining louse, *Naubates* sp., is a straggler of unknown origin.

The agreement of the frequency distributions with a negative binomial model is consistent with a number of seabird ectoparasites (Fowler 1988). The agreement of adult and nymph classes of *T. aviator* is considerably better than that for the whole population but we are unable to explain this observation. Reasons why ectoparasites are dispersed contagiously among birds are given by Fowler & Price (1987).

Population structures of *H. diversus* and *T. aviator* closely resemble those determined for other seabird Mallophaga (e.g. Fowler & Price 1987), which are dominated by adult classes. Although the proportion of each population class in a population at a point in time is a function of its relative longevity, proportions of nymphs increase with reproductive activity (Marshall 1981). The high proportion of adult lice on shearwaters in August suggests that reproductive rates are in decline at that time of year, but collections from other seasons are required to confirm this.

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SUMMARY

A sample of 230 Manx Shearwaters *Puffinus p. puffinus* from Ynys Enlli yielded over 12,000 Mallophaga of 8 species. One, *Ancistrona* sp., is the first record from this host; three other species not previously reported are probably stragglers. Frequency distributions of the two most numerous lice are aggregated and conform with a negative binomial model. Population structures of *Halipeurus diversus* and *Travebulus aviator* are dominated by adult classes.

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