Ectoparasite populations from breeding and wandering Storm Petrels

by James A. Fowler, Carolyn J. Miller and Sharon Cohen

Samples of Storm Petrels captured separately at a colony and by attraction to tape-lures away from colonies differ in the population structures of an infesting feather-louse.

IT IS NOT POSSIBLE to distinguish between age-classes within Storm Petrel *Hydrobates pelagicus* populations on the basis of plumage characters, so studies on population dynamics and life history have been conducted by means of ringing methods. In this way it has been shown that young birds on Skokholm (Dyfed) start visiting their natal colonies when two or three years old, and behave as 'wandering non-breeders' before occupying burrows and breeding one or two years later (Scott 1970). The wanderers range widely, visiting (but not occupying) colonies during July and August (Mainwood 1976, Fowler *et al* 1982, Fowler and Swinfen 1984), and their presence introduces sample heterogeneity which precludes simple capture-recapture estimations of the size of breeding populations (Love 1978). Storm Petrels can be captured far away from breeding colonies by attraction to tape-lures (Maguire *et al* 1980); Furness and Baillie (1981) noted differences in behaviour between the birds which were breeding at a colony on St Kilda (Western Isles) and those which were tape-lured elsewhere on the island and presumed to be wanderers.

A recapture analysis of tape-lured Storm Petrels in Shetland showed that recapture rates diminished rapidly in the years which followed ringing, presumably as birds became established at colonies and 'immune' to distraction by lures (Fowler *et al* 1982). In contrast, recapture rates of birds ringed at two Shetland colonies where tape-lures had never been used were consistently much higher (Fowler *et al* 1982), an observation which supports the view of Furness and Baillie (1981) that birds retrapped two or more years after ringing at the same colony are likely to be breeders. Fowler *et al* (1982) concluded that the use of tape-lures away from colonies to attract Storm Petrels was selective for birds representative of a homogeneous population-class upon which capture-recapture analyses could be undertaken realistically.

Comparatively few Storm Petrels have been ringed as chicks (due to their inaccessibility in burrows), so the exact status of captured birds is unknown. Evidence of status based on ringing data must therefore be regarded as circumstantial. Independent evidence that samples of birds captured at tape-lures away from colonies are derived from a different population class from those caught in colonies would be very valuable.

Several authors (eg. Ash 1960, Baum 1969) have described differences in ectoparasite infestation levels between different age-classes of their hosts. The occurrence of four species of feather-lice (Mallophaga) infesting Storm Petrels has been described by Fowler and Miller (1984), who found that one of the species — *Halipeurus pelagicus* Denny (Ischnocera: Philopteridae), living on the wings of the host — was by far the most numerous, accounting for 97% of the lice collected.

This paper compares the infestation levels and age-class structures of populations of *Halipeurus pelagicus* collected from (a) samples of breeding Storm Petrels caught at a colony and (b) those from wandering birds caught away from colonies by attraction to tape-lures.

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METHODS

Storm Petrels were captured at night in Shetland during July 1981 and July 1982. 'Wandering' birds were caught by attraction to amplified tape-recordings of their calls, played on beaches away from breeding colonies. 'Breeding' birds were caught at an established colony on Copister Broch in Yell Sound, but only recaptured birds which had been ringed at least three years previously were regarded as breeding. Birds were deloused in individual chloroform chambers exactly as described by Fowler and Cohen (1983), who demonstrated that (by adopting a standardised procedure) representative samples of ectoparasites could be removed quickly and safely from large numbers of birds for comparative analyses.

Breeding petrels were always deloused at the place and time of capture and released immediately afterwards. However, tape-lured birds were sometimes deloused in a field laboratory; an experimental control showed that this difference in procedure did not affect the composition of ectoparasite samples collected[1] (see Appendix for statistical notes). The delousing time was restricted to 20 minutes, as this yielded statistically identical samples of ectoparasites from equivalent samples of birds (see Results).

The age-classes of *Halipeurus pelagicus* populations were determined biometrically. The dimensions of the chitinised head-capsule are less susceptible to change on preservation; these, together with overall body length, were selected for measurement (Figure 1). In each case the measurements clustered into five distinct size-classes, of which the two largest corresponded morphologically with adult males and adult females. The smallest three size-classes were all nymphs and it was assumed that these corresponded to the three nymphal instars characteristic of Mallophaga (Marshall 1981). Table I shows the mean values of the size-class clusters for each dimension measured.

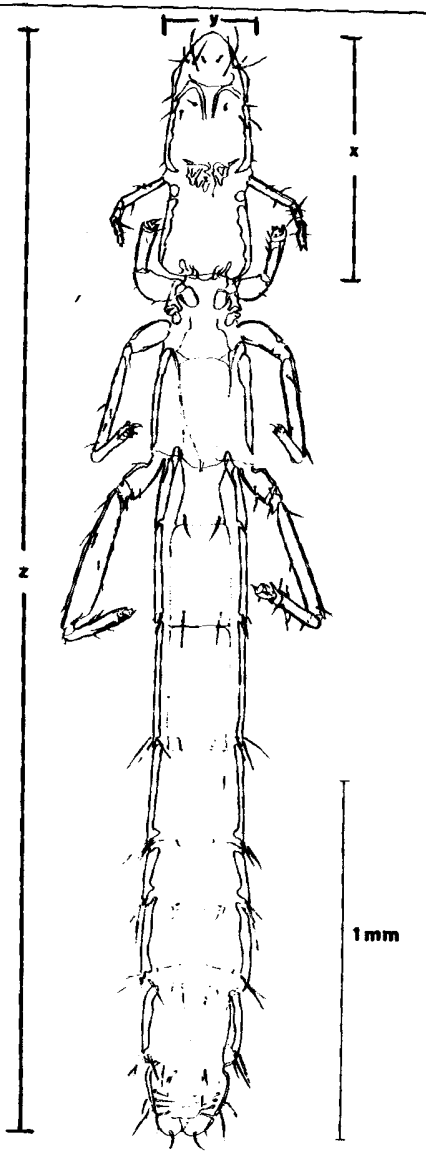

Figure 1. *Halipeurus pelagicus* Denny (Mallophaga, Philopteridae), male, collected from a Storm Petrel in Shetland in July 1981. Key: x = head length; y = head width; z = overall body length.

TABLE I. MEAN VALUES OF SIZE-CLASS CLUSTERS OF THREE MEASURED PARAMETERS OF *HALIPEURUS PELAGICUS* (MALLOPHAGA) COLLECTED FROM STORM PETRELS.

Parameter measured	*Nymphs (instar)* 1	2	3	*Adults* males	females
Overall length	1.46 ± 0.04	2.04 ± 0.02	2.72 ± 0.04	3.20 ± 0.03	3.74 ± 0.03
Head length	0.40 ± 0.04	0.48 ± 0.004	0.59 ± 0.006	0.69 ± 0.006	0.73 ± 0.04
Head width	0.19 ± .006	0.23 ± 0.003	0.29 ± 0.006	0.29 ± 0.006	0.38 ± 0.04
Sample size	25	70	45	45	49

All measurements are in mm; 95% confidence limits are given.

RESULTS

Mallophaga were collected from five separate samples of Storm Petrels: 25 wanderers in early July 1981, 22 wanderers in late July 1981, 38 wanderers in late July 1982, 25 breeders in July 1981, and 36 breeders in July 1982. The numbers of *Halipeurus pelagicus* collected, and the proportion of the different age-classes collected from them, are shown in Figure 2. The differences in proportions of the louse age-classes from the separate host samples can be tested statistically[2]. Firstly, however, it is necessary to eliminate the possibility that the date of capture influenced the population structure. Comparing various pairs of mallophagan population structures from Figure 2, there are no statistically significant differences between those populations from: (a) wanderers in early July 1981 and wanderers in late July 1981[3]; (b) wanderers in late July 1981 and wanderers in late July 1982[4]; or (c) breeders in July 1981 and breeders in July 1982[5]. Thus, for Storm Petrels within the same sample category, the proportions of the age-classes of *Halipeurus pelagicus* infesting them were not dependent on the date at which the samples were taken.

However, comparison of the proportions of the louse age-classes in populations collected from different sample categories of the host revealed statistically significant differences: (d) wanderers in late July 1981 and breeders in July 1981[6]; (e) wanderers in late July 1982 and breeders in July 1982[7]. The level of confidence increased in the 1982 samples, as would be expected in a larger sample size. The difference was attributable to a higher proportion of first instar nymphs (with a correspondingly lower proportion of adults) on the wandering birds. In addition, the mean number of lice per bird was significantly lower on breeding adults[8].

DISCUSSION

Whilst there have been a number of reports of differences in the degree of infestation by Mallophaga between different age-classes of their hosts (eg. Ash 1960, Baum 1969), we have been unable to trace any which demonstrated differences in the age-class structure of populations of a particular mallophagan species between different age-classes of its host. It is possible only to speculate as to why wandering Storm Petrels have a larger proportion of first instar nymphs of *Halipeurus pelagicus* than do breeding birds. It has been suggested by Foster (1969), for example, that blood-feeding Mallophaga may respond to the hormonal condition of their breeding hosts in the same way that the breeding of the rabbit flea *Spilopsyllus cuniculi* is controlled by the production of sex hormones in its mammalian host (Rothschild and Ford 1964). Mallophaga are only occasionally haematophagous, however, and perhaps a more likely explanation would be that the microclimate which surrounds incubating birds (both sexes incubate in turn) occupying

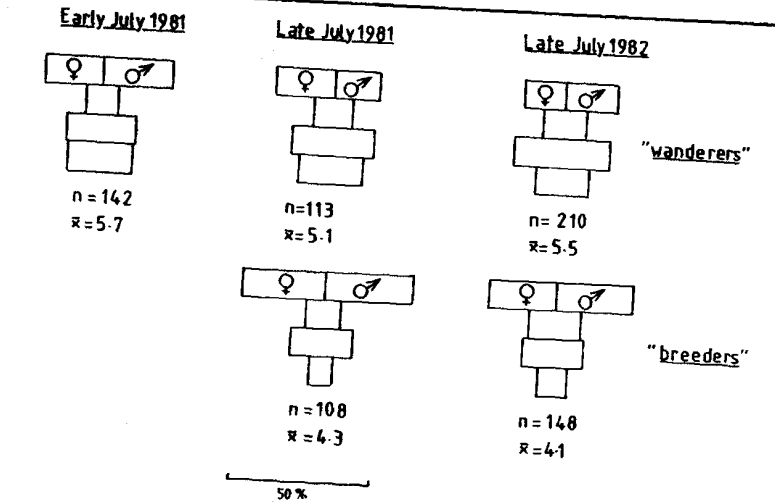

Figure 2. Population structures of the feather-louse *Halipeurus pelagicus* from samples of 'wandering' and 'breeding' Storm Petrels in Shetland.
Each tier in the structure represents the percentage of a particular age-class in the population, in ascending order: 1st, 2nd and 3rd instar nymphs; adults (male and female as indicated). n = total number of individuals in a louse population; $\bar{x}$ = mean number of lice per bird. See text for definition of 'wandering' and 'breeding' Storm Petrel categories.

burrows for long periods is sufficiently different from that out at sea to affect the dynamics of mallophagan populations. Ash (1969) noted that Mallophaga are very sensitive to temperature changes and suggested that the different age-classes of a species may require slightly different conditions for optimal growth. Foster (1969) additionally recorded that both temperature and humidity of the atmosphere surrounding the host affected feather-louse egg production and life-cycle duration. A third possibility is that, if the life cycle of the feather louse is synchronised with the migration of its host, the later arrival of wanderers in northern waters (Fowler *et al* 1982) would introduce asynchrony in the louse life cycle on the two host population classes. The observation that, in July, the breeding birds have a greater proportion of adult lice — indicating an older, declining population (Marshall 1981) — supports this hypothesis.

Whatever the true explanation might be, these observations of parasite populations provide independent evidence that Storm Petrels which are attracted to tape-lures are representatives of a different population class from that which may be recaptured in colonies several years after first ringing.

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SUMMARY

There is much circumstantial evidence from ringing that Storm Petrel populations comprise two classes (breeders and wanderers) which may be sampled by capture in colonies and at tape-lures respectively. The two classes differ in the population structures of an infesting feather-louse *Halipeurus pelagicus* which have a higher proportion of adults to nymphs on breeding hosts.

APPENDIX OF STATISTICAL NOTES

1. $\chi^2 = 1.09$, $P<0.01$
2. Chi squared (2 x k) "Goodness of fit" test
3. $\chi^2 = 2.73$
4. $\chi^2 = 2.24$
5. $\chi^2 = 2.95$
6. $\chi^2 = 10.00$, $P<0.025$
7. $\chi^2 = 14.7$, $P<0.01$
8. $\chi^2 = 6.39$, $P<0.05$. The non-parametric test is preferred here to the *t*-test because of the skewed frequency distribution of the parasite on its hosts (see Fowler and Miller 1984).

REFERENCES

ASH, J. S. 1960. A study of the Mallophaga of birds with particular reference to their ecology. *Ibis* 102: 93-110.

BAUM, H. 1969. Biologie und Ökologie der Amselfederläuse. *Parasitologie* 9: 129-175.

FOSTER, M. S. 1969. Synchronised life cycles in the Orange-crowned Warbler and its mallophagan parasites. *Ecology* 50: 315-323.

FOWLER J. A. and S. COHEN. 1983. A method for the quantitative collection of ectoparasites from birds. *Ringing and Migration* 4: 185-189.

FOWLER, J. A. and C. J. MILLER. 1984. Incidence of non-haematophagous ectoparasites of Procellariiform birds in Shetland, Scotland. *Seabird* 6.

FOWLER, J. A., J. D. OKILL and B. MARSHALL. 1982. A retrap analysis of Storm Petrels tape-lured in Shetland. *Ringing and Migration* 4: 1-7.

FOWLER, J. A. and R. SWINFEN. 1984. Scottish Storm Petrels in Iceland. *Scott. Birds.* 13: 520.

FURNESS, R. W. and S. R. BAILLIE. 1981. Factors affecting capture rate and biometrics of Storm Petrels on St Kilda. *Ringing and Migration* 3: 137-148.

LOVE, J. A. 1978. Leach's and Storm Petrels on North Rona: 1971-1974. *Ringing and Migration* 2: 15-19.

MAGUIRE, E. J., B. ZONFRILLO, H. CLARK and M. WILKINS. 1980. Status of Storm Petrels in Clyde and Forth. *Scott. Birds* 11: 51-53.

MAINWOOD, A. R. 1976. The movements of Storm Petrels as shown by ringing. *Ringing and Migration* 1: 98-104.

MARSHALL, A. G. 1981. *The Ecology of Ectoparasitic Insects.* London (Academic Press).

ROTHSCHILD, M. and B. FORD. 1964. Maturation and egg-laying of the rabbit flea *Spilopsyllus cuniculi* induced by the external application of hydrocortisone. *Nature Lond.* 203: 210-211.

SCOTT, D. A. 1970. The breeding biology of the Storm Petrel. D.Phil. thesis, Oxford University.

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