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THE EGGS OF THREE SPECIES OF MALLOPHAGA AND THEIR SIGNIFICANCE IN ECOLOGICAL STUDIES

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ABSTRACT: The eggs of *Ricinus picturatus, Menacanthus* sp., and *Philopterus* sp. (Mallophaga) taken from the orange-crowned warbler (*Vermivora celata*) are described. The location of the eggs on the feathers and in the various feather tracts is reported. It is suggested that museum study skins will prove a valuable source of data concerning distribution and ecology of egg-laying in Mallophaga if the presence of louse eggs, rather than adults or nymphs, is studied.

In order to provide basic data for a study of the life cycles of three species of Mallophaga, I identified their eggs and determined certain ecological aspects of oviposition. Markings of the egg cases of bird lice are species specific (Blagoveshchenskii, 1955; Eichler, 1963), as are their means of attachment and their location in various feather tracts (Clay and Rothschild, 1938). It has been noted that oviposition is usually confined to particular areas of the host even in those louse species which generally may be found on any part of the host's body (Ash, 1960).

The Mallophaga studied were *Ricinus picturatus* (Carriker), *Menacanthus* sp., and *Philopterus* sp. It was impossible to assign specimens of the latter two genera to particular species because these genera are badly in need of revision (Emerson, 1964; pers. comm.). However, all specimens of each genus were compared to confirm that they were members of the same species.

MATERIALS AND METHODS

A total of 2,205 museum specimens of the orange-crowned warbler (*Vermivora celata*) was examined. Of these, 452 showed evidence of parasitism by Mallophaga. Nits of the species studied are easily visible to the naked eye when the feathers of the bird are gently lifted with a dissecting needle exposing their bases. No attempt was made to locate and remove all adult and nymphal Mallophaga from the bird skins. These were detected frequently, however, incidental to the examination for nits; they were collected and their location in the feathers recorded.

The Mallophaga were identified, and a series of reference slides of the eggs of each species was prepared. At least one female carrying an egg with a fully formed case was obtained for each species of louse, enabling specific identification of the nits. The location of the nits on the feathers and in the various feather tracts was noted.

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Designations of feathered regions are based on a previous study (Foster, 1967a); taxonomic designations of Mallophaga follow Emerson (1964).

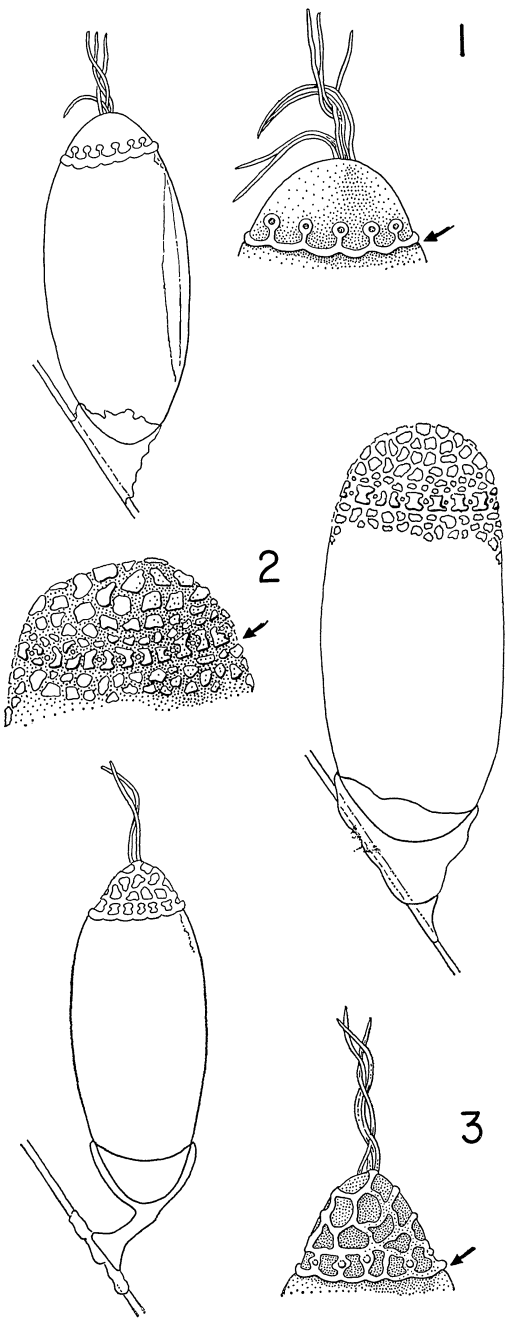
ECTOPARASITES

Adults, nymphs, and eggs of three members of the order Mallophaga, representing two suborders and three families, were taken from the orange-crown during the course of this study. Parasitism of a single species of host by more than one species of louse is not uncommon, though, as observed in the present study, the different species of lice usually do not occur with equal frequency.

Ricinus picturatus (Carriker), Amblycera: Ricinidae

This was the most common of the mallophagan species present. Adult and nymphal males and females were found in nearly all feathered regions, perhaps as the result of wandering after the death of the bird or perhaps because of generalized habitat requirements. Members of this genus are not considered highly specialized, but rather to be rapidly running forms able to occupy the more exposed areas of the breast, back, and rump. Their greater speed apparently allows them to escape the preening bill of the host (Peters, 1928, 1933).

The eggs are located on the contour feathers usually in the submalar and ventral cervical regions. On birds carrying an extremely large number of nits, the area occupied may extend posteriorly into the sternal region and laterally into the postauricular tract. In only three of the 384 birds which carried *Ricinus* eggs were the eggs located elsewhere, once each in the dorsal cervical region, the interscapular tract, and the femoral tract. In none of these instances were eggs of any type located in the more common areas as well. Presumably, it



FIGURES 1–3. Eggs of Mallophaga. **1.** *Menacanthus* sp.; **2.** *Ricinus picturatus*; **3.** *Philopterus* sp. Arrows indicate abscission lines.

would be advantageous for *Ricinus* to confine its eggs to the underside of the avian throat because the bird would have difficulty removing the eggs from this area with its bill.

The eggs were usually attached to the inner side of the most distal portion of the calamus or most proximal portion of the rachis. The fluffy barbules of this region frequently are caught in the adhesive substance; however, the nits were never attached directly to these portions of the feather. This is in keeping with the findings of Balát (*in* Eichler, 1963) who noted that the eggs of *Ricinus*, *Menacanthus*, *Philopterus*, and other genera usually are placed on the feather shaft. In instances of extreme parasitism two eggs are commonly attached to a single feather, and, rarely, three or four may be found on the same feather. These eggs are then placed one above the other on the ventral side of the shaft or at the same level on opposite sides of the shaft. One specimen had as many as six eggs per feather, three on either side of the shaft.

The eggs of *Ricinus picturatus* are capsule-shaped (Fig. 2) and approximately 1.45 mm long and 0.60 mm in diameter. The most proximal 0.15 to 0.20 mm is embedded in an adhesive substance which attaches the eggs to the feathers. The cases of these eggs are translucent-white, though the presence of a developing embryo gives them a pinkish, or occasionally dark brown tinge. All of the mallophagan eggs were taken from study skins which had been exposed periodically to carbon bisulfide or other similar fumigants. Possible effects on the colors of the egg cases are not known.

Each egg case has a cap or operculum which is sculptured with an irregular, reticulate pattern. On some eggs this opercular area appears asymmetrical, extending slightly down one side of the case. At one point near the perimeter of the cap, and just above the line of abscission, the reticulations are more regular, forming a ring of circles around the cap. Extending distally to a point just beyond the ring of circles and proximally to a point just below the line of abscission is a zone of minute pores which apparently allow for the entry of sperm and for ventilation (Hase *in* Eichler, 1963; Rothschild and Clay, 1952).

Menacanthus sp., Amblycera: Menoponidae

As with *R. picturatus*, the adults were collected from all feathered areas. Members of this genus also are reported to be unspecialized,

rapidly running forms which occupy the more exposed breast, back, and rump feathers. The eggs, which were found on 39 orange-crowned warblers, were always attached to the underside of the distal calamus or proximal rachis of the contour feathers. The nits are usually confined to the anterior portion of the submalar region, though occasionally, when infestation is extensive, they are located posteriorly and even laterally into the postauricular tracts.

Sixteen of the warblers examined carried unhatched eggs of both *Menacanthus* and *Ricinus*. In all instances, the *Menacanthus* nits were confined to the anterior portion of the submalar region and the *Ricinus* eggs to the posterior portion, the two rarely overlapping in their distribution. Only once were eggs of the two species found on the same feather, though a more detailed examination might reveal that this is more common. None of the specimens examined carried more than one *Menacanthus* egg per feather. This is in contrast to the habit reported for *Menacanthus stramineus* (Nitzsch) and other closely related members of this family which apparently lay their eggs on top of each other in clumps (Eichler, 1963).

The eggs of *Menacanthus* sp. (Fig. 1) are approximately 0.83 by 0.35 mm at their greatest dimensions. The most proximal 0.10 mm is embedded in an adhesive substance which attaches the egg to the feather. The egg capsule is translucent, though the presence of a developing embryo may give it a slightly yellowish cast. The distal 0.15 mm of the case forms an operculum ornamented with sculpturing which marks its circumference just distal to the line of abscission. Numerous minute air pores form a zone which encompasses the area of sculpturing and the line of abscission. Projecting from the tip of the cap are several (4 to 8?) intertwining, plumelike processes which appear to be associated in groups of two.

Philopterus sp., Ischnocera: Philopteridae

Very few adults or nymphs of this species were located, but those collected did not appear to be confined to particular feather tracts. As in *Menacanthus*, the nits usually are attached to the ventral shaft of the contour feathers of the anterior submalar region, though on some specimens, they were confined to the postauricular and dorsal cervical regions. Eight of the 30 orange-crowns with eggs of *Philopterus* sp. also carried unhatched eggs of *Ricinus picturatus*. Again, the eggs of *Ricinus* occupied the posterior portions of the submalar tract while the *Philopterus* eggs were located anteriorly. No specimens examined carried eggs, nymphs, and/or adults of both *Philopterus* and *Menacanthus*.

The eggs of *Philopterus* sp. (Fig. 3) are approximately 0.73 by 0.30 mm at their greatest dimensions. The adhesive substance attaching each egg to the feather shaft forms a pedicel approximately 0.16 mm long and extends an additional 0.08 mm onto the egg capsule. The upper 0.10 mm of the egg capsule forms a cap of slightly smaller diameter than the rest of the capsule. This cap has a dark yellow-brown cast to it, though undoubtedly some of this color is due to the presence of the nymph within. The remainder of the capsule is nearly transparent, and the body of the contained nymph is clearly visible. Several plumelike processes arise from the center of the operculum which is ornamented with irregular, reticulate sculpturing. Near the perimeter of the cap, the sculpturing is more regular, forming circles which lead into a single wavy band marking the line of abscission.

DISCUSSION

One method widely used in the past to determine the ectoparasite fauna of a particular group of animals or the host distribution of a particular parasitic species has been the examination of museum study skins. Such a practice with Mallophaga has been complicated by the tendency of these lice to migrate from their host after it dies (Martin, 1934) or from one freshly killed bird to another (Hopkins, 1949; Peters, 1934; Wilson, 1928). Modern collectors of lice take precautions against such migrations. However, they would find it difficult to amass the numbers of host specimens already available in museums, particularly from such a wide range of geographic localities and dates. Museum study skins may still prove a valuable source of data if the presence of mallophagan eggs, rather than adults or nymphs, is studied.

Markings of the eggs are species specific and the eggs remain firmly attached to the feathers,

apparently indefinitely. Careful examination of a series of birds carrying intact louse eggs usually will yield at least one adult female carrying an egg with a fully formed case, allowing specific identification of the eggs.

Study of the eggs will give not only an idea of the distribution of the parasite but also information concerning timing and location of egg-laying and correlations between parasite reproductive behavior and various aspects of the host's life cycle (Foster, 1967b, 1969). In addition, questionable distribution records of the lice may be clarified if eggs are located, since the true test of parasite establishment on a host is its ability to reproduce on the host.

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