

Mosquito Larvae

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I. Mouthbrush Dimorphism and the Hairiness Factor

Although widespread in the aedine genera, mouthbrush polymorphism in mosquito larvae has received little attention in the literature. Its most striking manifestation, a clearcut dimorphism, was first recorded by myself, on the basis of museum material, in Opifex fuscus Hutton¹. I suggested at that time that it might be a genetic dimorphism associated with maximum exploitation of available food resources. The two types of mouthbrush concerned are a fine-haired type associated with filter feeding and a coarse haired type, with the inner setae pectinate, associated with browsing (Fig. 1).

Following on this Dr. Marks studied the phenomenon in natural breeding places of Opifex in seashore rock pools in New Zealand.² This author was able to show that a well marked dimorphism occurred not only in the fourth stage larvae in which I had observed it but also in earlier instars. It was left to McGregor, however, to elucidate the true nature of the phenomenon and to show that, contrary to all expectation, it occurs as a direct response to the environment.³

All first stage larvae of Opifex have fine haired, filter feeding mouthbrushes. If, however, they are supplied with coarse food particles they will switch to the browsing type in later instars. Not only this but larvae which have switched to the browsing type can be caused to switch back to the filter feeding type by substituting a more finely divided diet (in this case Loeffler's blood serum).

Following on the discovery in Opifex I observed a well marked dimorphism in a series of larval skins of Aedes (Finlaya) embuensis Edwards forming part of the material on which Van Someren⁴ based the first description of the male and pupa of this species. Mrs. Van Someren tells me she has since observed a similar dimorphism in larvae of Ae. (F.) ingrami Edwards, Ae. (Aedimorphus) marshalli (Theobald) and ngong Van Someren and Ae. (Diceromyia) adersi Edwards. It has also been recorded in Ae. (F.) britteni Marks & Hodgkin⁵, Ae. (Halaedes) australis (Erichson)³ and Heizmannia nivirostris Lien (= H. macdonaldi Mattingly), H. cheni Lien (= H. reidi Mattingly) and H. taiwanensis Lien⁶. I found it independently in H. macdonaldi and H. reidi and also in H. communis (Leicester) and H. scintillans Ludlow.

The situation in H. reidi requires to be distinguished. In H. communis, macdonaldi and scintillans as in Opifex, there appears to be a quite clear cut dimorphism whereas in H. reidi, although there is a dimorphism in the sense that the mouthbrushes are either pectinate or non-pectinate, the coarseness of the pectinate setae varies considerably as between individual larvae (Fig. 2a-c). This is correlated with the fact that whereas in H. communis, H. macdonaldi and H. scintillans (Fig. 2d,e) development

of pectinate setae is accompanied by shortening of the antenna (clearly adaptive to browsing), in H. reidi there is a conspicuous shortening of the antenna only in exceptional larvae with very strongly pectinate mouthbrush setae (Fig. 2c). In Ae. embuensis changes in the antenna resemble those observed in H. communis and Mrs. Van Someren tells me the same is true of Ae. ingrami, ngong, marshalli and adersi. As against this Ae. (F.) watteni Lien⁸ apparently behaves like H. reidi and I have observed a wide range of variation in Ae. (Stegomyia) horrescens Edwards, ranging from non-pectinate filter feeding mouthbrushes (very unusual in Stegomyia) through finely pectinate to very strongly pectinate ones.

Further material may tend to invalidate the distinction but it seems best, for the present, to distinguish the condition observed in H. reidi, Ae. watteni and Ae. horrescens as a polymorphism, restricting the term dimorphism to the more clear cut cases. It would, however, be very interesting to know to what extent the capacity of a species such as Ae. horrescens to respond to changes in food particle size is under genetic control, if indeed such a capacity exists.

Mrs. Van Someren tells me she has observed changes in the numbers of branches in head setae 5 and 6 correlated with the changes in mouthbrushes and antennae. I have also seen indications of this but I would think this phenomenon would require statistical analysis. From the supposed function of the comb and pecten in cleaning the mouthbrushes one might anticipate correlated changes in these but I have observed none.

As regards the physiological basis of mouthbrush dimorphism nothing is at present known. One can only hazard a guess that the retention of the fine haired mouthbrush characteristic of the first stage larva might be mediated by juvenile hormone or a functionally similar secretion. McGregor suggested, plausibly, that the switch from one type of mouthbrush to the other may be associated with underfeeding in the previous instar. Mrs. Van Someren tells me that she has a little preliminary evidence that it may be affected by crowding. This might support McGregor's hypothesis. Coarser food particles of the kind employed by McGregor (proprietary fish food) tend to sink to the bottom so that the change from one type of mouthbrush to the other is accompanied by an apparent change in behavior. It remains to be seen whether this amounts to anything more than a tendency to aggregate wherever the food supply is most abundant.

All the species mentioned are container breeders favoring tree holes or cut bamboos with the exception of the rock pool breeding O. fuscus and Ae. australis. The distinction is, however, more apparent than real since rock pools clearly belong rather to the container than to the ground pool class of habitats⁹. Heavily shaded rock holes in forest, particularly when containing fallen leaves, may support a wholly tree hole fauna¹⁰.

The only phenomenon comparable to mouthbrush dimorphism hitherto observed in mosquito larvae is the hairiness factor in Stegomyia^{11,12}, which is also associated with tree hole breeding. In this case the presence of non-living, suspended organic particles in the breeding place leads to the development of stellate hairs. The latter are often thought

of as protection against mutual browsing of larvae on one another (Fig. 3). There is thus an interesting ecological relation between the two phenomena. Interestingly Belkin¹³ records a lengthening of the antenna in hairy larvae of the Ae. (Stegomyia) scutellaris (Walker) complex. This might perhaps be expected as contra-adaptive to browsing. However, the ecology of both types of polymorphism calls for much further study.

Hairiness in Stegomyia larvae has led to considerable taxonomic confusion in the past. This does not, however, exhaust the taxonomic interest of this type of phenomenon. Both hairiness and browsing mouthbrushes have an extremely interesting distribution in non-aedine genera. Still more interesting is the existence of two types of morphological character ecologically related, directly controlled by the environment and varying in relative fixity or fluidity of response as between one species and another. This must surely be a most promising field for collaboration between the geneticist and the experimental taxonomist. Aedes horrescens is highly polymorphic with respect to both types of character and ought not to be too difficult to colonize. Opifex fuscus is stenogamous and autogenous and its eggs are resistant to desiccation. It has been colonized with success.¹⁴

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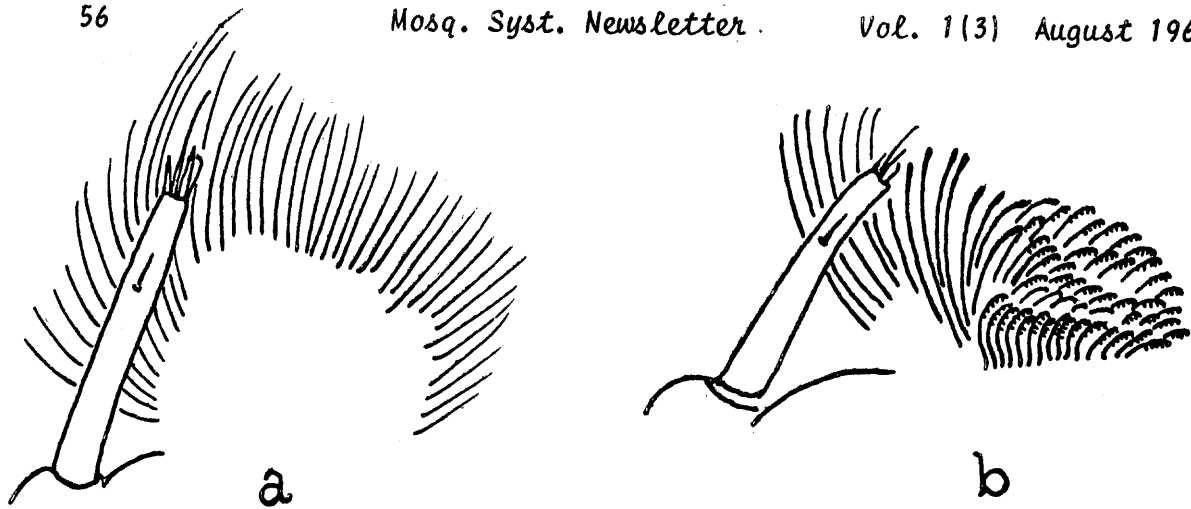


Fig. 1.

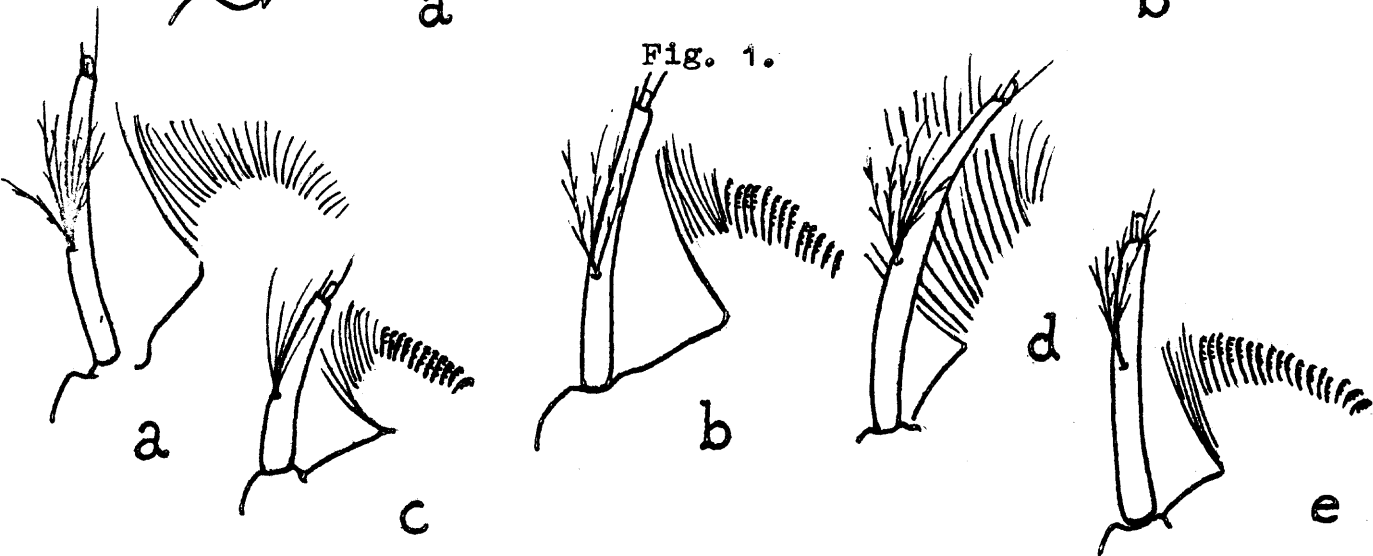


Fig. 2.



Fig. 3.

Fig. 1. Larval antennae and mouthbrushes, Opifex fuscus. a. Filter feeding type, b. Browsing type. Fig. 2. Larval antennae and mouthbrushes, Genus Heizmannia. a-c. H. reidi, d,e. H. communis. Fig. 3. First segment of larval abdomen, Ae. albopictus (Skuse). a. Reared in grass infusion, b. Reared in tree hole contents.

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The Aedes Mosquitoes of New England. III.
Saddle Hair Position in 2nd and 3rd Instar Larvae, with
Particular Reference to Instar Recognition and Species
Relationships¹

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In the 4th instar Aedes larvae of New England, the saddle hair (lateral hair of the anal segment) is inserted on the saddle (anal plate) (except in A. atropalpus in which it arises from the membrane in all four instars). In the first instar, the hair is invariably located on the membrane below and distinct from the saddle. In 2nd and 3rd instars, the hair may arise from the membrane, from the edge of the saddle (either tangent to or partially enveloped by the saddle), or from the saddle, distinctly removed from its edge. If on the saddle, however, it lies closer to the ventral than to the posterior margin, rarely equidistant. In the 4th instar it is inserted nearer the posterior margin (Smith 1965, 1969).

In the accompanying table, the position of the saddle hair in the 2nd and 3rd instar larvae is given, if known, for each of the 25 New England Aedes species. Although in some of the species sufficient material has not been available to give reliable data for this character, nevertheless certain trends are suggested, so that it seems advisable to present the material at this time, as a possible basis for further investigations along these lines, rather than to wait indefinitely for more adequate data.

¹ Contribution #1423, Department of Entomology, University of Massachusetts.