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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 Relationships[1]

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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.

The change in hair position from an earlier instar to a later one appears to be the result of a downward extension of the saddle as it increases in size in successive instars, rather than a migration of the hair position itself. Thus, in more than half the species examined in sufficient numbers to indicate a trend, there is, in the 3rd instar, a decrease in the percentage of hairs occurring on the membrane, and a progression towards saddle-edge and saddle positions. For example, in canadensis, while the highest percentage of hairs occurs on the membrane in the 2nd instar, in the 3rd most are at the saddle edge with a few on the membrane or the saddle; in communis, none occur on the membrane in the 3rd, the highest percentage being found on the saddle. Such regular growth of the saddle does not occur in all species, however, since in several instances (e.g. cinereus and vexans) the hair is found on the membrane in the 3rd as well as the 2nd instar, and does not arise from the saddle until the 4th.

It might also be expected that, in the six species having the saddle complete (i.e., encircling the anal segment) in the 4th instar, the saddle size would be proportionately larger in early instars than in corresponding instars of those species having a short and incomplete saddle, with a higher percentage of hairs located on the saddle itself. Such is true of abserratus and punctor, but not of trivittatus in which the saddle is reportedly short, not enveloping the hair, in both 2nd and 3rd instars (Abdel-Malek 1949), nor of sollicitans, where the position in the 3rd is predominantly at saddle-edge. (A. mitchellae and taeniorhynchus were not examined in sufficient numbers to give any clear indication of the trend.)

Bohart and Washino (1957) state that in the earlier instars of California Culex, "The position of the lateral hair.....relative to the saddle has taxonomic significance." They cite in particular 2nd and 3rd instar C. pipiens L. and C. quinquefasciatus Say as having the hair inserted "plainly on the saddle", while in certain other species it lies tangent to or near the saddle. In Aedes, its location on the membrane is characteristic of both instars of several species (atropalpus, cinereus, vexans, and probably dorsalis, sticticus, and trivittatus). In cantator and triseriatus it occurs on the membrane or at the saddle edge, but has not been observed on the saddle. Only in aurifer and taeniorhynchus is there a suggestion that the saddle position may be constant, but more material needs to be studied for verification. In most Aedes species, however, the hair position is so variable that only rarely can it be used as a species character.

It is obvious that the position of the hair in 2nd and 3rd instars cannot be relied upon as an absolute indication of instar for any of those species examined in adequate numbers, since in no instance is it consistently different in the two instars. Within a single species the hair position may be the same for both instars (i.e., on the membrane), but more often two (or even three) different positions may be observed within the same instar, or even on the same individual.

However, in some species the hair position may serve as a character useful for instar recognition in a portion of the individuals. For instance, the hair may (but does not always) occur on the membrane in the 2nd, but not in the 3rd (abserratus, communis, diantaeus, and punctor); or it may sometimes be located on the saddle in the 3rd, but never in the 2nd (diantaeus, excrucians, fitchii, intrudens, punctor, and stimulans).

It is of particular interest to note the correspondence of this character to the species groups which have been recognized in Aedes by Edwards (1932) or as proposed by other workers (Rohlf 1963b, Steward 1968, etc.). If the location on the membrane may be considered the most primitive, since this is the first instar condition, and the saddle position the most advanced, then we may have in this character a valuable means of assessing relationships among species, especially so as the hair occurs and often changes in position during the four larval instars.

In the subgenera Aedes and Aedimorphus, the species cinereus and vexans, respectively, retain the primitive hair condition (i.e., on the membrane) in both instars. A. aegypti of the subgenus Stegomyia also shows the membrane position in the few specimens examined, although the species is not within the range of this paper. In the subgenus Finlaya, atropalpus retains the primitive position into the 4th instar, a condition apparently unique among North American Aedes and substantiating the isolated position of this species in Steward's larval dendrogram (1968). In triseriatus, usually placed in a different group of the same subgenus, a more advanced condition occurs, with the hair sometimes located on the saddle edge: occasionally in the 2nd, more often in the 3rd; it has not been observed on the saddle itself.

The members of the subgenus Ochlerotatus include species with the hair in the advanced saddle position, as well as a few in which it occurs on the membrane. Several of the groups (A - H) recognized by Edwards (1932), and in which adequate material has been studied, show consistent patterns in the hair position of many of the species, although there may be species deviating from the group trend.

The three species (mitchellae, sollicitans, taeniorhynchus) of Edwards' Group A (sometimes placed in a separate subgenus, Culicelsa or Taeniorhynchus), were not examined in sufficient numbers to permit any conclusions as to pattern or relationships; in all, however, at least some of the hairs occur on the saddle or at its edge.

In most species of Group B, the greater number of hairs occurs on the membrane in the 2nd instar, and on the membrane or at the saddle edge in the 3rd with a few on the saddle itself in the 3rd only. Such an arrangement might be interpreted as being more advanced, the next step beyond the primitive position. The species excrucians, fitchii, and stimulans fall here, with fitchii the most conservative in this character, retaining the greater frequency on the membrane in both instars, and stimulans the most advanced, having a higher proportion on the saddle edge. A. cantator will likely agree with the other species of this group when more 2nd instar larvae are studied; the saddle edge is typical of the 3rd instar, and no hairs were noted on the saddle itself. A. grossbecki was not available for examination.

In Group E, dorsalis reportedly retains the primitive position (Barr 1958); no specimens were examined by the writer. Its placement by Rohlf (1963b) in Group B is thus not substantiated by this character. A. canadensis, a problem species in its relationships, shows all hair positions in both instars, but typically the membrane location in the 2nd, the saddle edge in the 3rd. It is therefore quite distinct from dorsalis, perhaps intermediate between Groups B and G, but distinctly closer to B than to the majority of species in G.

A. trivittatus (Group F) reportedly retains the primitive hair condition in both instars (Abdel-Malek 1949).

In G, the largest group in the genus, the species abserratus, punctor, and communis, and also decticus, diantaeus, and intrudens, show a more advanced positioning of the saddle hair than those in Group B. In the 3rd instar, the saddle location predominates, with few if any hairs located on the membrane; in the 2nd, the typical position is on the saddle edge, but other positions may occur. In aurifer, all observed hairs were on the saddle; more 2nd instar material is needed, but the species obviously belongs here. A. implicatus also needs further study, since the few 3rd instar specimens examined possessed hairs on the saddle edge rather than on the saddle itself. Although not occurring in the New England area, a few specimens of A. hexodontus Dyar and pionips Dyar, also members of Group G, were examined, and agreed essentially with the local species, having the saddle or saddle-edge position predominant in both instars.

Of the species assigned to Group G by Edwards, sticticus appears to differ radically from all the others by retaining the primitive membrane position in the 3rd instar, although more material is needed for verification. If so, then this hair character supports Rohlf's (1963b) removal of this species from Group G.

A. trichurus, placed in Group H by Edwards, but by some writers included in the communis group (G)(Steward 1968), or in a group of its own (Rohlf 1963b), or in a separate subgenus Feltianus (see Steward 1968; Barr and Chapman 1964), possesses an arrangement close to that of the communis group.

Further studies are needed along the lines of this investigation. First, adequate information is not available for a number of the species, and these gaps need to be filled. Furthermore, studies of these species in other areas may reveal that populations vary in this character, making it of questionable value. But of greatest interest and perhaps importance would be the study of other species of Aedes, as well as those not adequately covered in this paper, and further analysis of this character in respect to species relationships within the genus.

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Saddle Hair Locations in New England Aedes Larvae
(in percentages)

NAME	INSTAR II				INSTAR III			
	#	M	E	S	#	M	E	S
Subgenus Aedes								
cinereus Mg.	(23)	96	4	-	(28)	100	-	-
Subgenus Aedimorphus								
vexans (Mg.)	(7)	100	-	-	(5)	100	-	-
Subgenus Finlaya								
atropalpus (Coq.)	(many)	100	-	-	(many)	100	-	-
triseriatus (Say)	(7)	86	14	-	(16)	44	56	-
Subgenus Ochlerotatus								
Group A (or Subgenus Culiselsa or Taeniorhynchus)								
mitchellae (Dyar)	(0)	-	-	-	(1)	-	100	-
sollicitans (Wlk.)	(4)	50	50	-	(28)	18	78	4
taeniorhynchus (Wd.)	(0)	-	-	-	(1)	-	-	100
Group B								
cantator (Coq.)	(1)	-	100	-	(35)	-	100	-
excrucians (Wlk.)	(26)	62	38	-	(54)	37	56	7
fitchii (F. & Y.)	(7)	86	14	-	(14)	64	29	7
grossbecki D. & K.	(0)	-	-	-	(0)	-	-	-
stimulans (Wlk.)	(49)	82	18	-	(68)	7	78	15
Group E								
canadensis (Th.)	(34)	56	32	12	(59)	5	69	26
dorsalis (Mg.)	(0)	-	-	-	(0)	*		
Group F								
trivittatus (Coq.)	(0)	**			(0)	**		
Group G								
abserratus (F. & H.)	(19)	11	68	21	(31)	-	23	77
aurifer (Coq.)	(2)	-	-	100	(10)	-	-	100
communis (DeG.)	(15)	7	80	13	(48)	-	38	62
decticus H.D. & K.	(0)	-	-	-	(3)	-	33	67
diantaeus H.D. & K.	(15)	13	87	-	(43)	-	23	77
implicatus Vock.	(0)	-	-	-	(4)	-	100	-
intrudens Dyar	(14)	18	82	-	(12)	8	25	67
punctor (Kby.)	(15)	20	80	-	(23)	-	9	91
sticticus (Mg.)	(0)	-	-	-	(7)	100	-	-
Group H (or Subgenus Feltianus)								
trichurus (Dyar)	(2)	-	100	-	(20)	-	50	50

- number of individuals examined by author, one side only; M - on membrane; E - at edge of saddle; S - on saddle, removed from edge; * - Barr 1958; ** - Abdel-Malek 1949; underlining - highest percentage for that instar.