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CHARACTERISTIC SADDLE SPINES OF NORTHERN
MOSQUITO LARVAE

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Identification of larvae of closely related, variable species of northern *Aedes* depends on the skillful use of plastic key characters justly termed "general tendencies rather than absolute conditions" by Rempel (1950). Apparently only experience obtained by rearing the local variations can assure accurate determinations. During an apprenticeship of six years in Alaska the author frequently has had occasion to wish for less fluctuating diagnostic characters to supplement those in vogue. In the present paper he develops a little-used character dealing with integumentary spines and scales of the anal segment.

The sclerotized dorsal plate or anal saddle (Fig. 1) roofing or enclosing the anal segment of culicine larvae is ornamented with a pattern of folds and spines suggesting the imbricated scales of a fish. The folds (scale margins) are rarely naked or punctulate. Usually they bear pilose, spiculose, or spiny projections oriented posteriorad which may be homogeneous in size, shape, and distribution over the saddle. More often than not they become much larger and sparser near its posterior margin where the largest spines occupy a patch at either side of the apex. Modern authors not infrequently mention saddle spines in species descriptions. Less frequently they even use presence or absence of the apical saddle spines in keys (cf. Yamaguti & LaCasse, 1951, pp. 20, 22-25). The conventional practice in both these cases is to designate the saddle "spined posteriorly," or the equivalent, when the spines are plainly visible under the dissecting microscope. Contrasting species, unfortunately usually bearing minute spinules, are labeled "unspined." As a diagnostic character in keys saddle spines appear to be a last resort. Even very conspicuous ones, e.g. of *Aedes excrucians*, go unmentioned in most keys and descriptions. An exceptional, perhaps unique, instance where saddle

spines and scales were represented by an adequate figure is found in Natvig (1948, p. 175). The ornamentation of saddle areas other than the apical, while usually ignored altogether, is occasionally suggested in drawings by stippling or conventionalized spines out of scale. In the main, culicidologists are not making effective use of saddle spine characteristics.

MATERIALS AND METHODS

About 2500 larvae of 22 species (18 *Aedes*, 3 *Culiseta*, 1 *Culex*) from the Copper River, Juneau, Naknek, and McKinley Park areas, Alaska had been mounted, usually several per slide, unstained in Canada balsam or diaphane. The slides were re-sorted to check identifications, study intraspecific variability of saddle armature, and select typical fourth stage larvae for drawing. Each species was represented by several to many collections, except the rare *Aedes riparius*, which was collected from only two habitats several hundred miles apart. *A. nigripes* and *intrudens*, as well as *Culiseta incidens* and *maccrackenae* were omitted for lack of suitable Alaskan material.

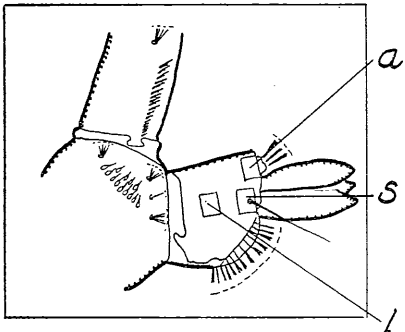
Three drawings representing corresponding saddle areas (Fig. 1: a, s, l) of the 22 species were prepared with the aid of an ocular micrometer masked with blinders of gummed paper to provide a rectangular field 16 by 23 small micrometer spaces. With 10X ocular and 43X objective this field represented an area of about 55 by 80 microns. For a convenient and economical scale one small micrometer unit (3.4 microns) equaled $\frac{1}{16}$ inch on the original drawing paper. The ocular was temporarily fixed by adhesive tape to the microscope tube with the micrometer lines set perpendicular to the dorsal edge of the saddle and parallel to four guide lines of the drawing ruled $\frac{1}{16}$ inch apart. Saddle ornamentation was rapidly sketched under more favorable lighting than the camera lucida provided. However, a comparison with a camera lucida sketch established that while the micrometer method afforded good spacing it sometimes led to exaggeration of spine length. Corrections were therefore made with the micrometer when the ocular had been freed after completion of the sketch. Since the spines are often viewed foreshortened the measurements given are *apparent* lengths in many instances. No intentionally idealized drawing was done nor are any of the drawings composite, but the minute granules marking scale margins were estimated rather than counted. Stippling was used to control contrast as well as to represent pigmentation. Once a typical example had been selected for drawing, thereafter individual

EXPLANATION OF FIGURES

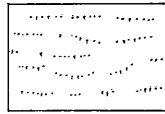
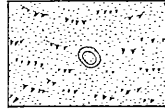
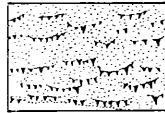
FIG. 1. Incomplete diagram out of scale, posterior extremity, *Aedes punctodes* fourth stage larva showing location of saddle areas: a-apical; s-setal; l-lateral drawn in Figs. 2-24.

(Scale same for Figs. 2-24.)

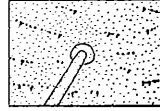
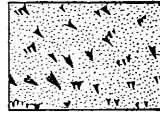
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|------------------------------------|-------------------------------|
| FIG. 2. <i>Aedes punctodes</i> | FIG. 7. <i>A. aboriginis</i> |
| FIG. 3. <i>A. punctor</i> | FIG. 8. <i>A. simulans</i> |
| FIG. 4. <i>A. hexodontus</i> | FIG. 9. <i>A. flavescens</i> |
| FIG. 5. <i>A. impiger</i> (Wlk.) | FIG. 10. <i>A. fitchii</i> |
| FIG. 6. <i>A. implicatus</i> Vock. | FIG. 11. <i>A. excrucians</i> |



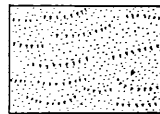
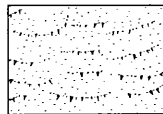
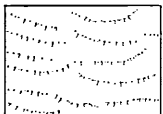
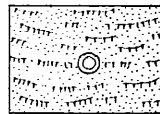
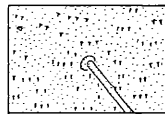
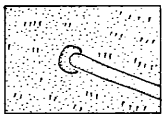
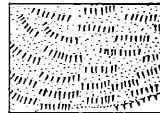
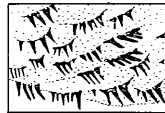
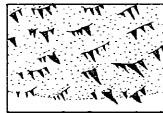
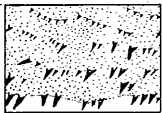
1. *Aperçu, A. punctodes*



2. *p'nct'd's*



3. *p'nct'r*

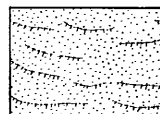
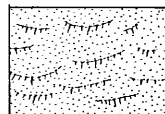
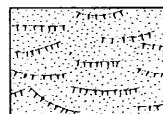
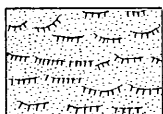
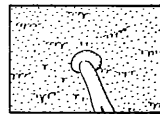
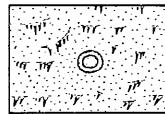
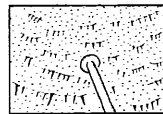
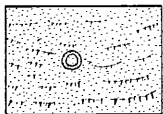
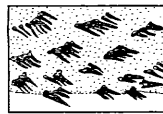
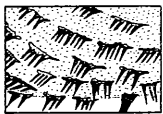


4. *hix'dnt's*

5. *mp'g'r*

6. *impl'ct's*

7. *br'gn's*



8. *st'm'll'ns*

9. *fl'v'sc'ns*

10. *f'tch''*

11. *xcr'c'ns*

(specimen) differences were reproduced as faithfully as diagnostic (species) differences.

RESULTS

Apical saddle spines alone provide distinctive recognition characters for at least seven of the 22 larvae studied, viz., *A. aboriginis*, *excrucians*, *cataphylla*, *pullatus*, *cinereus*, *Culiseta morsitans*, and *Culex territans*. Moreover, considering two or all three saddle areas, the spines and scales are not alike for any pair of the 22 larvae. The characteristic apical spines of *A. pullatus* obviate confusion of that species with *pioniops*, an annoying pitfall into which the author has fallen more than once. Of course, any character marking one species unmistakably often makes the determination of one or more additional species sure.

The principal findings are morphological details best gathered by inspection of the drawings in conjunction with a compendium of saddle spine key characters. This approach avoids repetitious verbal descriptions while emphasizing only characters seen on whole mounts (as distinguished from exuviae). The most striking characters should prove useful in keys. The compendium must not be misunderstood: it is utterly unserviceable by itself as a diagnostic key; better characters, or combinations of them, are available and certainly needed for most of the species separations, e.g. of *A. communis* and *pioniops*, *punctor* and *hexodontus*, and *C. alaskaensis* and *impatiens*.

In the compendium the apical, setal, and lateral saddle areas mentioned are shown in Fig. 1; spine measurements refer in microns to apparent (foreshortened) length; unspecified Arabic numerals refer to lengths, never counts, of spines; spine ridges designate linear prominences of the scale at right angles to its margin.

COMPENDIUM OF SADDLE ARMATURE KEY CHARACTERS

1. Apical spines obsolescent, represented by small, flat, nearly blunt, pigmented prominences of the scale margin..... 2
Apical spines developed either as crowded spinules or as sparser, thornlike spines..... 3
2. Lateral area scale margins spiculose; apical area scale margin bearing one (rarely two) pigmented swellings; Fig. 21..... *Culiseta alaskaensis* (Ludl.)
Lateral area smooth; apical area scale margins bearing mostly 2-4 pigmented swellings; Fig. 22..... *C. impatiens* (Wlk.)
3. Spines of the three areas similar, linear, crowded in single rows along scale margins, almost a continuous network..... 4
Spines of apical area heterogeneous, the larger often thornlike; scale margins usually obsolescent, indicated by spines..... 7
4. Spines alike, subequal on all three areas..... 5
Spines much larger on apical than on lateral area..... 6
5. Apical scale margins short, distinctly separated laterally, heavily sclerotized; setal and lateral area scale margins similarly separated but not noticeably sclerotized; Fig. 17..... *Aedes pioniops* Dyar
Apical, setal, and lateral area scale margins long, tending toward confluence laterally, not markedly sclerotized; Fig. 16..... *A. communis* (DeG.)
6. Apical spines larger, ranging 8-17; lateral area spines 3.5-5; Fig. 18
..... *A. pullatus* (Coq.)
Apical spines much smaller, 3.5-5; lateral area spines 1.5-3; Fig. 7
..... *A. aboriginis* Dyar

7. Setal area unspined, either with characteristic spine ridges (Fig. 19) or prominent, regular scale margins (Fig. 23)..... 8
Setal area spined variously; when setal area spines minute, inconspicuous, neither spine ridges nor scale margins distinct in setal area..... 9
8. Lateral area spineless, ornamented like the other areas with a characteristic pattern of scale margins and spine ridges; apical spines small, 2-4; Fig. 19.....
..... *A. cinereus* Mg.
Lateral area bearing heterogeneous spines, 1-7; apical spines large 5-10, thornlike, isolated, (a few in twos or threes smaller), arising from conspicuous scale margins; Fig. 23..... *Culiseta morsitans* (Theob.)
9. Apical spines (disregarding scattered largest at edge of saddle) subequal, in comblike or serrate groups of three to six..... 10
Apical spines (disregarding scattered largest at edge of saddle) of markedly variable size, often isolated..... 14
10. Apical spines small, 2-4, subequal, largest not restricted to saddle edge; Fig. 2.....
..... *A. punctodes* Dyar
Apical spines longer, largest 10-32, in first or second row at saddle edge..... 11
11. Apical spines very coarse and long, the largest at edge of saddle 25-32; Fig. 11.....
..... *A. excrucians* (Wlk.)
All apical spines smaller, the largest less than 15..... 12
12. Lateral area spines inconspicuous, heterogeneous, the largest less than 2; apical area spine groups serrate, i.e. the spines thornlike, abruptly narrowed from a wide base, grouped; Fig. 6.....
..... *A. implicatus* Vock.
Lateral area spines alike, evident, 2.5-3; apical area spine groups comblike, i.e. spines more attenuate, grouped..... 13
13. Largest apical spines less than 10.5; apical spines mostly in groups of four to six; setal area spines not exceeding 3.5; Fig. 8.....
..... *A. stimulans* (Wlk.)
Largest apical spines exceeding 13; number of apical spines per group more variable, two to nine; Fig. 9.....
..... *A. flavescens* (Müller)
14. Apical spines of various shapes, longer, the longest usually much exceeding 10... 17
Apical spines thornlike, shorter, longest not exceeding 10..... 15
15. Apical spines of first three or more rows at saddle margin disorderly, frequently isolated; lateral area spines minute, 1-2, subequal..... 16
Apical spines of first three or more rows in regular, serrate groups, and isolated spines limited to first row; lateral area spines heterogeneous, largest exceeding 3; Fig. 5.....
..... *A. impiger* (Wlk.)
16. Apical area with fewer (usually only three) rows of mixed large and small spines; setal area spine groups of one to four (averaging three) spines; Fig. 4.....
..... tundra variety, *A. hexodontus* Dyar
Apical area with more (frequently five or six) rows of mixed large and small spines; setal area spines in groups of two to nine (averaging four and one-half) spines; Fig. 3.....
..... tundra variety, *A. punctator* (Kby.)
17. Spines of apical area characteristically isolated and orderly, increasing in size proximad on saddle for about 10 rows; Fig. 24.....
..... *Culex territans* Wlk.
Spines of apical area more or less irregularly arranged, the largest within the first five rows or on the saddle margin..... 18
18. Apical spines, especially the largest, slender, long, and curved saberlike; Fig. 15.....
..... *A. cataphylla* Dyar
Apical spines straight or nearly so, stout if long, less than 20..... 19
19. Longest saddle spines of corresponding areas smaller: apical not exceeding 10; setal less than 2; lateral less than 1; Fig. 12.....
..... *A. diantaeus* H., D., & K.
Longest saddle spines of corresponding areas larger: apical exceeding 13; setal and lateral at least 3..... 20
20. Setal area spine groups of one to five (averaging three and one-half or less) heterogeneous spines; the largest apical spines isolated..... 21
Setal area spine groups of one to seven (averaging five) homogeneous spines; the largest apical spines smaller, usually flanked by minor spines; Fig. 14.....
..... *A. riparius* D. & K.
21. Apical spines coarser, generally cleft at base, the largest commonly reaching 20; Fig. 10.....
..... *A. fitchii* F. & Y.
Apical spines smaller, conelike, seldom cleft at base, rarely as long as 13; Fig. 13.....
..... *A. pseudodiantaeus* Smith

DISCUSSION

In their key to North American *Aedes*, Yamaguti & LaCasse (1951) apparently are in error on p. 23, couplet 35: "Saddle unspined, without detached acus . . . *stimulans*." In Alaskan *stimulans* the apical spines are prominent (Fig. 8). Rempel (1950) also indicates them as coarse in his Fig. 16B. Indeed, it appears that coarse apical spines characterize the entire *stimulans* group of banded-leg *Aedes*. However, the Alaskan *stimulans* larvae deviate from the typical form of the United States (and also from the one studied by Rempel in Saskatchewan) in several fluctuating setal characters, including head hair branches and prothoracic hair formulas. Stateside workers will find it desirable to re-examine the saddle armature of typical *stimulans*.

The data on saddle spines of *A. punctor*, *hexodontus*, and *punctodes* are tentative. The *punctodes* collections came from Mendenhall Flats in the Juneau area; specimens from other salt marshes as much as 1500 miles to the northwest have not yet been studied. Mounted specimens of the other two species of this complex included were available in long series only for their tundra varieties. The typical varieties of both *punctor* and *hexodontus* have heavily pigmented saddles, almost opaque, necessitating treatment with potassium hydroxide or study of exuviae. Exuviae were excluded in the present study, the object of which was to test a character to assist in identifying larval collections.

As discussed by Smith (1952), *A. pseudodiantaeus* was long confused with the rather different *diantaeus*. In the compendium the two species are not contrasted in a couplet; they may be distinguished by the larger saddle spines of all three areas in *pseudodiantaeus*.

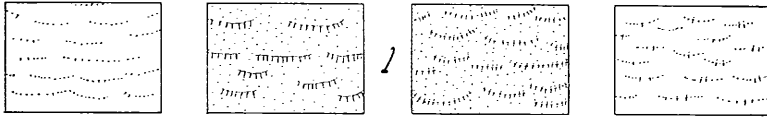
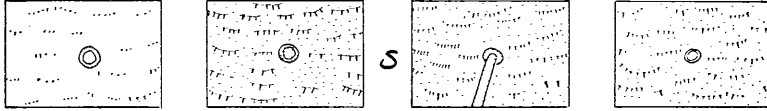
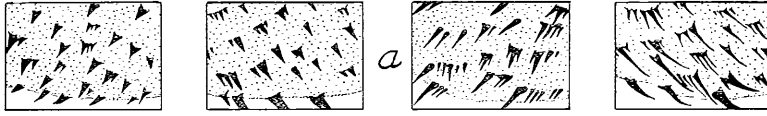
Culiseta maccrackenae D. & K., a Californian species reported by Frohne & Sleeper (1951) from Wrangell, Alaska, was identified by Dr. Alan Stone who remarked: "I can find no disagreement with larvae from California." Wrangell has not been re-collected, and no additional *maccrackenae* larvae have been identified from Alaska. The apical spines of the Wrangell collection closely resemble those of *C. impatiens* (Fig. 22). Since Yamaguti & LaCasse (1951, key to *Culiseta*, p. 54) unequivocally state: "distinctly spined apicodorsally . . . *maccrackenae*," identity of the Wrangell *Culiseta* remains in doubt.

In short, an obvious integumentary armature of spines and scales is present on the anal saddle of northern culicine larvae which differs from species to species but is relatively stable intraspecifically. For taxonomic purposes, it would seem, statements describing the size, shape, and arrangement of saddle spines and scales routinely are much preferred to occasional references to mere presence or apparent absence of apical spines.

It is a pleasant duty to acknowledge the painstaking microtechnic of Patsy Avery, Anchorage High School student.

EXPLANATION OF FIGURES

- | | |
|------------------------------------|--------------------------------------|
| FIG. 12. <i>A. diantaeus</i> | FIG. 18. <i>A. pullatus</i> |
| FIG. 13. <i>A. pseudodiantaeus</i> | FIG. 19. <i>A. cinereus</i> |
| FIG. 14. <i>A. riparius</i> | FIG. 21. <i>Culiseta alaskaensis</i> |
| FIG. 15. <i>A. cataphylla</i> | FIG. 22. <i>C. impatiens</i> |
| FIG. 16. <i>A. communis</i> | FIG. 23. <i>C. morsitans</i> |
| FIG. 17. <i>A. pionips</i> | FIG. 24. <i>Culex territans</i> Wlk. |

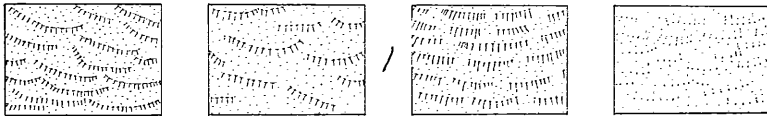
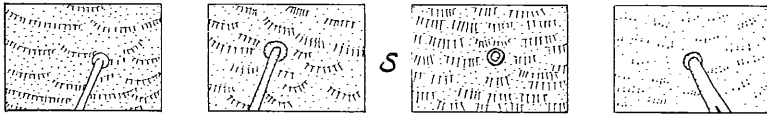
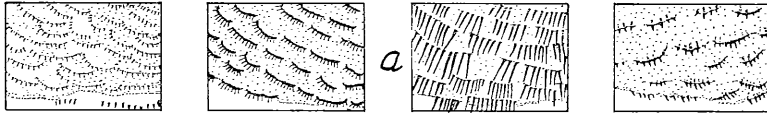


12. d'nt's

13. psd'd'nt's

14. r'p'r's

15. c't'ph'll'

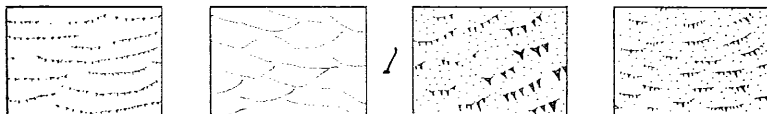
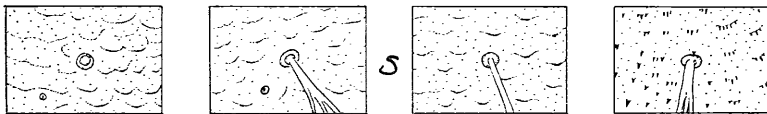


16. c'mm'n's

17. p'n'ps

18. pll't's

19. c'n'r's



21. 'sk'ns's

22. 'mpt'ns

23. m'rs't'ns

24. t'rr't'ns

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