INDICES OF RELATIVE SIPHON LENGTH IN MOSQUITO LARVAE

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My attention has recently been drawn to paper by Senevet and Andarelli (1959), which a detailed comparison is made of vo different indices of siphon length in osquito larvae: (a) the classical "Siphon dex," which is the ratio of the length of e siphon to its breadth at the base (here ferred to as "L/B"), (b) the ratio of e length of the siphon to the dorsal ngth of the saddle ("L/S"), which was iginally proposed (Colless, 1957) as a eful secondary index. The authors (op. t., Table 1) set out the two indices, given mean, range, and standard deviation, r 80 series of larvae of 72 species in 25 neric or lower categories; they also score, the symbols "+," "—," "?," and qualiing terms, the "superiorité" of the L/S dex over the L/B index in 69 of the ries. No indication is given of the crion used in scoring, though it is implied the text that the standard deviation is volved, as a measure of variability. Inection of the results suggests that scorg has in fact been based on the standard viation, but that some account has also been taken of the number of specimens in the series.

The authors give no numerical analysis of the scores, but conclude that, although the L/S index is less variable in some cases, it is clearly more variable than the L/B index in an almost equal number of cases; and, in a greater number of instances, there is no obvious advantage to either index. They therefore see no advantage in replacement of the classical index. Accepting for the moment the scores given in their table, and treating all but a clear-cut "+" or "—" as "?," the count, by my own analysis, is as follows ("+" indicates "superiority" of the L/S index): 24+, 13—, 32?. Moreover, if all series of less than 10 larvae are excluded, and accuracy thereby improved, the count is then: 19+, 9—, 11?; i.e., the L/S index was superior in almost 50 percent of cases, and the L/B index in only 23 percent. It is difficult, then, to see how the authors' conclusions were reached; in fact, the figures seem to argue a significantly greater utility of the L/S index. This is confirmed by the appropriate statistical analysis of the author's figures. See Appendix.

TABLE 1.—Siphon indices, before and after flattening, in larval skins of *Aedes s. scutellaris*.

ecimen No.	L/B			L/S		
	a	b	c	a	b	c
1.	1.9	1.6	1.5	2.2	2.2	2.3
2.	2.3	1.6	1.7	2.5	2.4	2.7
3.	2.0	1.4	1.3	2.5	2.4	2.4
4.	2.0	1.7	1.4	2.3	2.3	2.3
5.	2.1	1.6	1.4	2.5	2.4	2.3
6.	1.9	1.6	1.3	2.3	2.3	2.4
ans	2.03	1.58	1.43	2.38	2.33	2.40

a = index before flattening;
b = index after moderate flattening;
c = index after complete flattening.

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I must stress here that the L/S index was originally proposed as a practical measure for deriving a satisfactory index from series of miscellaneous specimens, prepared by a variety of methods. One is frequently confronted with a series that may include well-fixed whole larvae plus balsam mounts of larvae and larval skins, flattened to various degrees. It is obvious that flattening of the siphon must increase the apparent breadth at the base; theoretically, by a factor of 1.57 ($\pi/2$) when a circular siphon-base is completely flattened. At the same time, there will be little corresponding increase in siphon length, and the derived ratio will therefore vary with the degree of flattening. The length of the saddle, however, is little affected by flattening, and the L/S index is therefore less subject to this type of error. As an example, I give below (Table 1) the ratios derived from a series of 6 larval skins of *Aedes scutellaris scutellaris,* before and after flattening. The skins were first measured lying free in an excess of clove oil, (a). They were then covered with a light cover-slip and measured again, (b); then completely flattened by withdrawal of fluid and again measured, (c). The figures need no further discussion, except to note that much of the variation in the L/S index is due to normal uncertainty of measurement.

In the above discussion, one importa point has not been considered; namel that the practical utility of any such ind as a taxonomic tool depends, not only *intraspecific,* but also on *interspecif* variability. There are statistical techniqu for estimating the true discriminato powers of the indices, but the comput tions are lengthy and it seems simpler offer the practical example shown in Tab 2. This gives the two indices, as fou in series of 10 specimens each (main larval skins), for 14 species of Malay *Culex,* subgenus *Lophoceraomyia* (Colle unpublished). Using the observed rang of each index, the species may be co pared in pairs in all possible combinatio and the number of complete discrimin tions counted for each index; i.e. the nu ber of pairs in which there is no overl whatever in the observed ranges of index. Using the figures shown, it found that the L/B index gives 10, a the L/S index 23, complete discrimin tions. The greater utility of the latter dex is thus again demonstrated.

I am not here advocating that the cla cal index should be entirely replaced the L/S index. The former is well est lished in the literature and is all we h for many species, while in some gen the saddle is rudimentary or for oth reasons variable in length. I do ur

TABLE 2.—Siphon indices, of 14 species of Malayan *Culex (Lophoceraomyia).*

Species	L/B		L/S	
	Range	Mean	Range	Mea
A	6.1–9.6	8.2	4.4–5.5	5.(
B	8.3–11.6	9.5	5.0–6.1	5.8
C	7.1–8.7	7.9	4.0–4.8	4.4
D	6.8–8.7	7.7	4.0–4.5	4.3
E	6.0–7.6	6.6	3.6–4.5	4.1
F	7.0–9.1	8.2	4.2–5.8	4.9
G	6.6–7.2	6.9	3.7–3.9	3.8
H	7.4–9.5	8.2	4.6–5.9	5.(
I	7.0–9.3	7.9	4.2–5.4	4.7
J	6.1–8.0	7.3	3.8–4.5	4.1
K	8.4–11.9	9.7	4.9–7.2	5.(
L	6.7–8.8	7.7	3.7–4.6	4.1
M	7.7–10.2	8.5	4.0–5.0	4.3
N	7.6–10.2	9.1	4.3–5.6	5.1

however, that, in taxonomic studies of genera such as *Culex,* the L/S index is very useful tool and should therefore be included in larval descriptions.

References

COLLESS, D. H. 1957. Notes on the Culicine mosquitoes of Singapore. II. The *Culex vishnui* group. Ann. trop. Med. Parasitol. 51:87.

SENEVET, G., and ANDARELLI, L. 1959. Un nouveau caractère pour la diagnose des larves de *Culex.* Arch. Inst. Pasteur Algerie. 37:447.

APPENDIX

It is pointed out that absolute values of the standard deviation cannot be validly used for comparing the "variability" of the two indices. Where, as is frequently the case, the two means differ in magnitude, their standard deviations are measured in different scales. To take an extreme example, a standard deviation of cm. of stature would indicate remarkable uniformity in a herd of elephants but considerable variability in a swarm of bees. If such comparisons are to be made, the relevant statistic is the Coefficient of Variation (Relative Standard Deviation), which is the standard deviation divided by the mean, usually expressed as a percentage. Applying this method to the authors' figures, omitting series of less than 10 larvae, we find:

Coefficient greater for L/B in 23 cases.
" " " L/S " 10 "
Coefficients equal " 6 "

Moreover, if we count only those cases where the coefficients differ by 5 percent or more, we find:

Coefficient greater for L/B in 16 cases.
" " " L/S " 3 "
Coefficients differ by less than 5 percent in 20 cases.

Once again, there is a clear indication that the L/S index is inherently less variable than the L/B index.

SUPERGENERIC GROUPS OF MOSQUITOES

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True mosquitoes comprise the family Culicidae. For practical purposes there are two groups (subfamilies), the Anophelinae and the Culicinae. They may be distinguished by the novice by the attitudes assumed by the larvae and adults. Anopheline larvae lie parallel to the surface of the water whereas culicine larvae hang from the surface by their air tubes. Anopheline adults "stand on their heads," the proboscis and body forming a straight line at an angle to the surface upon which they are resting or biting, whereas culicine adults stand with the body more nearly parallel to the surface.

Actually there are three easily recognized subfamilies of mosquitoes and the largest of these, the Culicinae, is divisible into four tribes. They may be identified and separated in most stages of their development by the accompanying key.

KEY TO MAJOR GROUPS OF MOSQUITOES

1. EGG boat-shaped, with lateral floats, darkening soon after being laid;
LARVA without air tube; with palmate hairs on certain body segments;
PUPA with peg-like setae at hind