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HEAD CAPSULE GROWTH IN *CULEX TERRITANS* WALKER

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ABSTRACT. The rate of growth of the head capsule in *Culex territans* Walker has been ascertained in 435 larvae from the population of a permanent marsh south of the Richelieu River, Quebec. The mean and range of head capsule widths have been determined for each larval instar. The rate of growth of the head capsule with larval instar follows Dyar's law. The exponential function $Y = 0.1939\text{-}1.5655^x$ was accorded with the data better than a linear function.

INTRODUCTION

As part of a bio-ecological study of *Culicidae* on the sector south of the Richelieu River, Quebec (Durand 1977) a natural population of *Culex territans* was sampled regularly. It was necessary to develop a quick and precise method for determining larval instars.

Head capsule width seems to have a constant relationship with larval stage, more so than any other variable. Dyar (1890) stated that the ratio of the head widths of 2 successive instars of caterpillars tended to be constant and that the rate of growth of this variable followed a geometric progression. Danks and Corbet (1973) also used this variable to distinguish *Aedes impiger* (Walker) larvae from those of *Ae. nigripes* (Zetterstedt).

MATERIALS AND METHODS

A total of 435 larvae were sampled from a permanent marsh at Ile-aux-Cendres on the sector south of the Richelieu River (45°10'N, 73°16'W). The specimens were fixed and preserved in

70% ethanol. Head width was measured on the dorsal aspect of the larvae using a 4X microscope equipped with a micrometer standard (1 micrometer unit = 0.036 cm).

RESULTS AND DISCUSSION

The data can be represented by a graph of frequency distribution (Fig. 1). The 4 larval instars are clearly delineated by the 4 peaks. The ranges observed for each instar are: L_1, 0.21–0.39 mm; L_2, 0.43–0.57 mm; L_3, 0.61–0.90 mm; L_4, 0.93–1.26 mm. These ranges are easily assigned to instars as long as there is no overlap; for example, it is easy to demarcate L_2–L_3 and L_3–L_4. To differentiate between L_1 and L_2, the presence of the "ruptor ovi," characteristic of L_1, was used to supplement the head width information (Dodge 1966).

The width of each peak (Fig. 1) increases with larval development. This is probably due to sexual dimorphism, since the male is generally smaller than the female.

The mean and standard deviation of head width for each larval instar in the sample are given in Table 1.

Because of the availability of considerable data (n = 435), growth could be expressed as a mathematical function, permitting the easy assignment of larval specimens to instars. Dyar (1890) found that increase in head width of certain caterpillars followed a geometric progression, with the constant given by the ratio between 2 successive larval instars. Several authors have since applied this approach to Hymenoptera (Miles, 1903; Taylor, 1931; Ghent, 1956; and De Oliveira, 1972). The last 2 found, however, that the growth of certain Tenthredinidae followed a linear rather than an exponential relationship.

A correlation analysis of head width and larval instar yielded a highly significant correlation coefficient ($r_{yx} = 0.94$, $p < 0.001$; d.f. 433). A comparison of

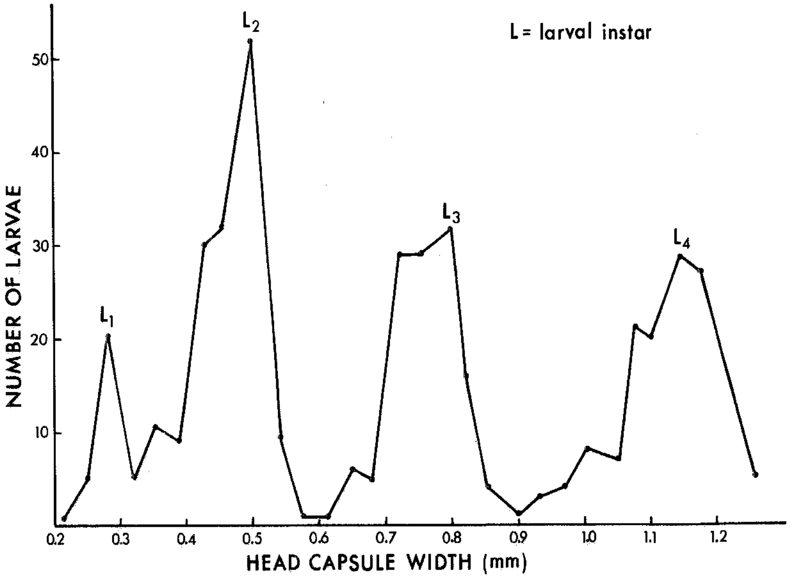

Fig. 1 Distribution of *Cx. territans* larvae according to head capsule width (mm).

Table 1. Comparison of observed head capsule widths of *Cx. territans* larvae with head capsule widths calculated using Dyar's law and regression analysis.

Larval instars	Observed width (mm)	Exponential function (Dyar) Calculated width	Exponential function (Dyar) % error	Regression Calculated width	Regression % error
L_1	0.320 ± 0.007	0.304	5.0	0.229	28.4
L_2	0.481 ± 0.028	0.475	1.2	0.517	7.4
L_3	0.766 ± 0.011	0.744	2.8	0.805	5.0
L_4	1.133 ± 0.007	1.165	2.6	1.093	19.4
			11.6		60.3
	$\bar{x} = 0.656$				
$r_{yx} = 0.94$		$Y = 0.1939 \cdot 1.5655^x$		$Y = 0.288X - 0.059$	

methods (Table 1) therefore permits us to decide whether a linear or exponential function better describes larval growth in *Cx. territans.* The linear regression equation is $Y = 0.228X - 0.059$ where $Y =$ head width (mm) and $X =$ larval instar, while the exponential equation is $Y = 0.1939 \cdot 1.5655^x$. With both expressions it is possible to arrive at a predicted head width for the 4 instars (Table 1), and we observe that a better fit is given by the exponential equation (Fig. 2). The percent errors for linear and exponential predictions are respectively 11.6% and 60.3%.

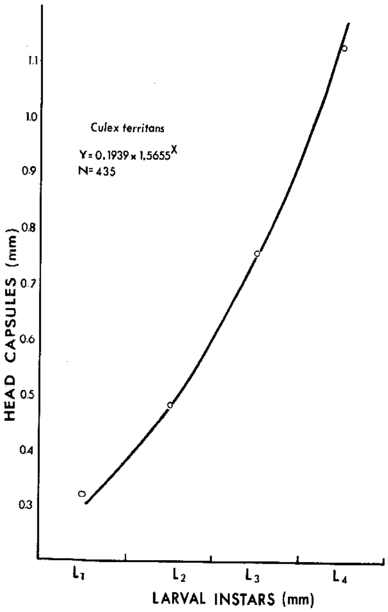

Fig. 2 Head capsule growth in relation to larval development.

CONCLUSION

Dyar's law appears to express head width increase in *Cx. territans.* Using an exponential function it is possible to use head width to determine the instar of specimens gathered in the field. Despite some limitations due to environmentally induced intraspecific variability, this method permits determination of age structure of larval populations. Thus mortality rates could be calculated indirectly, facilitating studies of populations dynamics.

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THE CHROMOSOMES OF *ANOPHELES CULICIFACIES*

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ABSTRACT. A polytene chromosome map has been prepared from the ovarian nurse cells of female adults in *Anopheles culicifacies.* These chromosomes are distinct and well-banded when prepared approximately 23–25 hr after a blood meal. No naturally occurring aberrations were observed in the polytene chromosomes from a laboratory strain, but differences in the mitotic X-chromosomes were found.

Genetic and cytogenetic studies have been initiated in our laboratory with *Anopheles culicifacies* Giles, one of the principal vectors of malaria in the Indo-Pakistan subcontinent. One sex-linked eye mutant, *rose eye,* showing an X-Y sex determination has been reported (Sakai et al. 1977), and a number of additional morphological and isozyme variants are under investigation. The discovery of these variants along with chromosomal studies of the mitotic and polytene chromosomes have made possible the induction and isolation of inversions and translocations which may be useful in the control of this species.

This paper presents a polytene chromosome map of *An. culicifacies* prepared from adult ovarian nurse cells. As has been demonstrated by Coluzzi (1968) for the Gambiae complex, these cells contain distinct, well-banded polytene chromosomes. With the techniques used in our laboratory these cells provide better polytene chromosome preparations than those of the larval salivary glands. The karyotype of *An. culicifacies* has been previously described by Aslamkhan and Baker (1969). Recent additional studies described below have shown variation in the relative length of the X-chromosomes in comparison to the autosomes.

MATERIALS AND METHODS

The ovarian polytene chromosome map was prepared from the Sattoki laboratory strain colonized in 1975 (Ainsley 1976). This colony, which is maintained by a circular mating scheme (Sakai et al., 1977), is very vigorous and may represent a "standard" reference strain for future