LARVAL HEAD-CAPSULE WIDTHS OF *DENDROCTONUS RUFIPENNIS* (KIRBY) (COLEOPTERA: SCOLYTIDAE)

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ABSTRACT

Widths of larval head capsules of **D. rufipennis** (Kirby) were measured and analysed. The frequency distribution had four distinct modes corresponding to the four larval instars. The change in mean head-capsule widths between instars showed agreement with Dyar's Rule.

Résumé

Les auteurs mesurèrent la largeur des capsules formant les têtes des larves de **D. rufipennis** (Kirby). La distribution de fréquences se divisa en quatre modes distincts qui correspondaient aux quatre stades larvaires. Le changement d'une largeur moyenne à l'autre de chaque stade concordait avec la règle de Dyar.

Introduction

Spruce beetles, *Dendroctonus rufipennis* (Kirby), normally have a 2-year life cycle (Massey and Wygant, 1954); however, due to variations in environmental conditions, 1- and 3-year cycles have been reported (Knight, 1961). Variation in length of the life cycle is due partly to the effects of different temperatures on the rate of larval development. In studies of the population biology of the spruce beetle, determination of larval instars is required to understand how far development has progressed toward maturity. Prebble (1933), Walters and McMullen (1956) and Reid (1962) have shown that larval instars of scolytids can be separated and identified by the head-capsule width, which remains constant for the duration of each instar. The presence of four instars has been cited for several other species in the genus *Dendroctonus*: *D. brevicomis* Lec. (Miller and Keen, 1960), *D. frontalis* Zimm. (Wood, 1963), *D. simplex* Lec. (Prebble, 1933) and *D. ponderosae* Hopk. (Reid, 1962). The current study was conducted to determine the number of instars of the spruce beetle and the corresponding mean head-capsule widths and their variability.

Methods

Spruce beetle larvae were collected from spruce (*Picea glauca* (Moench) Voss) in the Naver forest near Prince George, British Columbia, and preserved in 70% ethanol. Other larvae were reared in spruce logs at a constant temperature of 68°F (20°C) to obtain additional early-instar larvae for measurement. A dissecting microscope with ocular micrometer was used to measure the greatest width of each head capsule to the nearest micron.

The head capsule widths were grouped into 0.02 mm classes for the construction of a histogram (Fig. 1). This histogram had four distinct peaks corresponding to four instars. Because of the overlap of curves, the class marks with the four highest frequencies were taken as the mean head-capsule widths of the larval instars and the standard deviations were calculated as a function of the mean and range. The mean and range accurately represent the instar values because of the large number of samples and symmetry of the individual curves.

Results and Discussion

This study shows that there are four distinct larval instars in *Dendroctonus rufipennis* (Kirby) and that

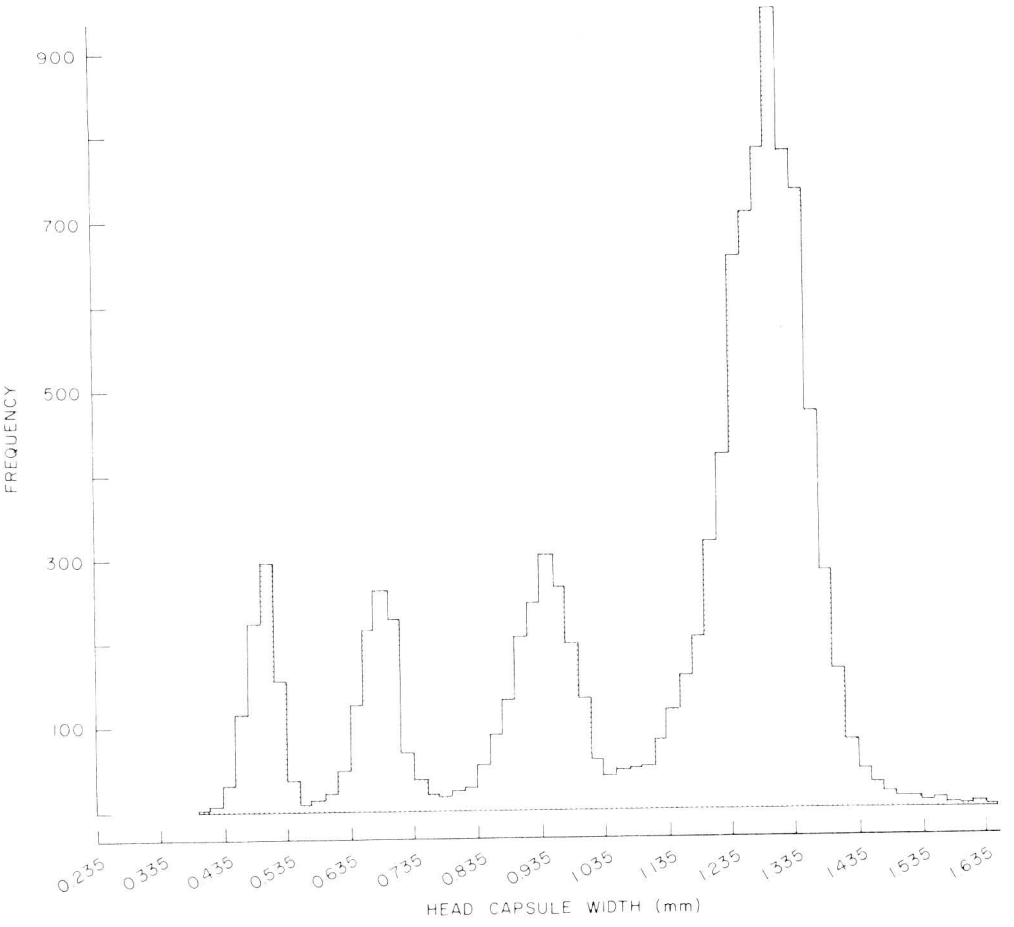

Fig. 1. Histogram of larval head-capsule widths of **Dendroctonus rufipennis** (Kirby)

the developmental stage of larvae can be established by measurement of head-capsule widths. The mean head-capsule widths of the four instars were significantly ($p = 0.05$) different from each other (Table I). Also, the

Table I. **Dendroctonus rufipennis** (Kirby) larval head-capsule widths

Instar	Sample Size	Range (mm)	Mean (mm)	Std. Dev. (mm)
I	878	0.396-0.615	0.505 ± 0.001[1]	0.022
II	1066	0.516-0.855	0.685 ± 0.002	0.034
III	1766	0.716-1.175	0.945 ± 0.002	0.046
IV	7218	0.956-1.655	1.305 ± 0.002	0.071

1 95% confidence belt

mean head-capsule widths of successive instars increase linearly with an average growth factor of 1.37x, which is in good agreement with Dyar's Rule (Dyar, 1890). For the purposes of instar identification, the range of each instar may be taken as falling between the lowest intermodal frequencies.

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BOOK REVIEW

Bionomics and Embryology of the Inland Floodwater Mosquito Aedes vexans. W. R. HORSFALL, H. W. FOWLER, JR., L. M. MORETTI AND J. R. LARSEN. University of Illinois Press, 1973.

This book is presented in two parts, the first part by Horsfall and Fowler deals with the bionomics of this major pest species, and the second part by Moretti and Larsen describes its embryology.

The section on bionomics contains a very large number of observations on the egg, larva, pupa and adult, treated rather as separate entities than as the continuous life history of a species. The tendency seems to have been to catalogue rather than to describe, and the summary (no discussion is presented in this section) does little to synthesize. However, the section does provide an excellent source of references for the student of aedine mosquitoes and it includes very useful instructions for colonization of the species in the laboratory.

The section on embryology provides the most detailed study of organogenesis in the genus *Aedes*, also it is the only detailed study of a mosquito which overwinters in the egg stage. It is straight forward histology using the light microscope. There are 96 photographs of various stages and organs during development, some of those taken at the earlier stages are good, but those taken during the later stages would have been better replaced by a few clear diagrams, or at least considerably enlarged. Interpretation of the illustrations is made more difficult by the way in which they are set up, at least six pages are arranged so that the book has to be turned in order to read the captions.

The book will be a useful reference work to all those engaged in the study of mosquitoes.

—*Anne Hudson*