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SHORT COMMUNICATIONS

ASPECTS OF LARVAL DEVELOPMENT OF *LIMNETRON DEBILE* (KARSCH), IN A MOUNTAIN STREAM OF RIO DE JANEIRO STATE, BRAZIL (ANISOPTERA: AESHNIDAE)

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Quantitative and qualitative samplings performed in a first order mountain stream in the State of Rio de Janeiro, southeastern Brazil, provided 121 larval specimens in the 6 last instars. The total number of larval instars estimated, using Dyar's rule, is 13, based on head width measurements. There was no significant difference between the number of ♂♂ and ♀♀.

INTRODUCTION

Despite the great species diversity and wide distribution of the Odonata, life history studies are almost always based on species of the Northern Hemisphere, such as *Anax imperator* Leach (e.g. CORBET, 1957), *Sympetrum danae* (Sulz.) (e.g. WARINGER, 1983), *Tetragoneuria cynosura* Say (e.g. LUTZ, 1974a, 1974b), and *Lestes sponsa* (Hans.) (e.g. LAWTON, 1972). There are relatively few studies of the biology of the neotropical odonate fauna and most larvae of the recorded species still remain unknown. Although 96 aeshnid species occur in South America*, information on larval development is only available for *Aeshna bonariensis* Ramb.

* Information available at the internet site "*List of the Odonata of South America, by country*", by Dennis R. Paulson (http://www.ups.edu/biology/museum/ODofSA.html)

(RODRIGUEZ-CAPITULO, 1980) and *Coryphaeschna perrensi* (McL.) (CARVALHO, 1992).

The aim of this study is to provide an estimate of the number of larval instars and the size ranges of maximum head capsule width and wing pad length for *Limnetron debile* (Karsch), a species found in mountain streams of southern and southeastern Brazil, Paraguay, and Argentina. The knowledge of this species is limited to morphological descriptions of the adults, larvae, and collecting sites (SANTOS, 1970).

METHODS

Larvae were obtained in a section of a first order stream, Rio Paquequer, in the municipality of Teresópolis, State of Rio de Janeiro, Brazil (22° 27'S / 42° 56'W). This site is located in an area of primary Atlantic Forest, at 1100m a.s.l. The river bed is composed mainly of coarse sand, pebbles, and rocks, and at several points there are deposits of allochthonous organic matter. Mean annual temperature and pluviosity are, respectively, 17.8°C and 105,0 mm, the driest period between May and September.

The specimens were obtained by means of quantitative samplings performed in April, July and October 1991, and February 1992, plus sparse qualitative samplings between 1987 and 1996. The samples were taken with nets (28 x 33 cm and 1 mm mesh size), Surber samplers (25 x 25 cm and 0.33 mm mesh size), and sieves (1 mm mesh size). Larvae were fixed in the field with 4% formaldehyde, and preserved in 80% ethanol.

Maximum head capsule width (HW) across the compound eyes and the length of the posterior right wing pad (WL) from the tip to the anterior limit of the costal border were measured under a stereoscopic microscope with the aid of an eyepiece micrometer scale. These measures are usually employed to express growth in dragonflies (e.g. LUTZ, 1968; PICKUP et al., 1984; FERRERAS-ROMERO, 1997). The HW values were used to estimate the total number of instars for this species, assuming that its growth follows Dyar's rule. This rule is expressed by the equation $\log y = \log a + (x-1) \log b$, in which "x" is a certain instar, "a" is the size of the second instar (considering the first instar as the prolarva), "y" is the size of instar x, and "b" is growth rate.

The growth rate was obtained from the mean HW values of the six last instars, which are distinct on the plot of WL values against HW. The mean HW values were displayed on a logarithmic scale and plotted against the corresponding instars.

Since no second instar larva was obtained, the HW of this instar was estimated as the mean of the recorded mean values for other species of the family: *Aeshna bonariensis* (RODRIGUEZ-CAPITULO, 1980), *Gomphaeschna furcillata* (Say) (KENNEDY, 1936), *Nasiaeschna pentacantha* (Ramb.) (DUNKLE, 1985), *Coryphaeschna perrensi* (CARVALHO, 1990), *Anax junius* (Dru.) (CALVERT, 1934), and *Remartinia luteipennis florida* (Hag.) (CALVERT, 1956).

The instars were numerically assigned following LUTZ (1968): last or ultimate instar, F; penultimate, F-1; antepenultimate, F-2, and so on.

RESULTS AND DISCUSSION

The samples provided 121 specimens of *L. debile* (58 females, 33 males, and 30 not sexed). The identification of the sexes was made possible by the observation of the gonapophyses (present only in females), and of the basal projection of the epiproct (found only in males), common structures found in all Aeshnidae. In very young individuals such structures were not distinct. While these structures allow

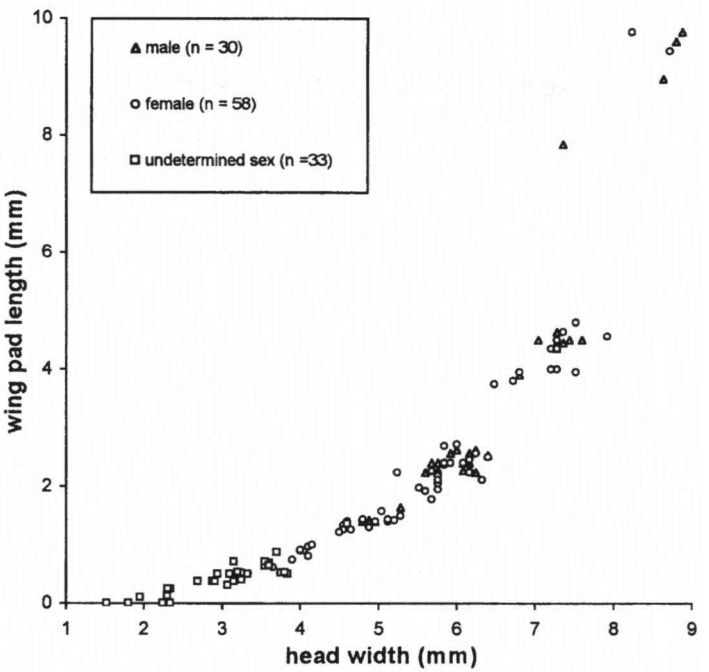

Fig.1. Plot of wing pad length against head width of *Limnetron debile* specimens.

reliable female identification from F-4 on, those that identify the males are distinct only in F-3 or later instars. In this way, if the presence of gonapophyses was used to distinguish the sexes, the number of males would be overestimated, as reported by LAWTON (1972). Thus, reliable separation of the sexes is only possible in specimens with HW values greater than 4.6 mm, although some females may be recognised from 3.5 mm on.

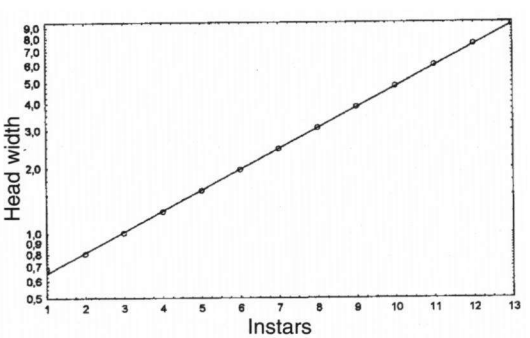

Fig. 2. Plot of mean head width values of *Limnetron debile* specimens against instar.

The plot of WL against HW (Fig. 1) showed gaps that probably correspond to the six last instars. The mean HW values (on a log scale), plotted against the corresponding instars, result in a straight line that provides an estimate of about thirteen larval instars for this species, excluding the prolarva (Fig. 2). This value is included within the interval recorded for the members of

Table I

Theoretical values for maximum head width of the larval instars of *Limnetron debile*, determined by application of Dyar's equation

Instar	Head width (in mm)
F	$8.31 < x \leq 10.3$
F-1	$6.65 < x \leq 8.31$
F-2	$5.32 < x \leq 6.65$
F-3	$4.25 < x \leq 5.32$
F-4	$3.40 < x \leq 4.25$
F-5	$2.72 < x \leq 3.40$
F-6	$2.17 < x \leq 2.72$
F-7	$1.74 < x \leq 2.17$
F-8	$1.39 < x \leq 1.74$
F-9	$1.11 < x \leq 1.39$
F-10	$0.89 < x \leq 1.11$
F-11	$0.71 < x \leq 0.89$
F-12	$0.65 < x \leq 0.71$

the order, which varies from nine to fifteen instars, with some variation in each species (CORBET, 1983). Dyar's equation has also established theoretical limits of HW values for each instar of *L. debile* (Tab. I). Figure 1 also shows that males and females are mixed within each group, suggesting that there are no marked differences in size between the sexes. The use of Dyar's rule to estimate the instar number in hemimetabolous aquatic insects has been criticised by some authors like FINK (1984), who recommends the rearing of a large number of specimens from egg to adult in order to solve this problem. This task is impracticable for many odonate species like *L. debile*, which are always found in small numbers, are very demanding in relation to the environmental conditions, and exhibit a long life cycle.

As observed in other species of the family, such as *Anax imperator* (CORBET, 1957) and *Coryphaeschna perrensi* (CARVALHO, 1992), *L. debile* exhibits a sex-ratio that does not depart significantly from one: 33m/43f ($p = 0.188$), above 4.6 mm HW, although the number of specimens is low. It was not possible to collect the final instar exuviae or adults to evaluate if this condition is also observed in the adult stage.

There is more variation associated with wing pad growth than with head width growth. Wing pads appear for the first time in instar F-6, and grow rapidly in the last two instars. In the ultimate instar, wing pad length exceeds head width, as recorded for *Boyeria irene* (Fonsc.) by FERRERAS-ROMERO (1997). This seems to be a good indicator of this instar in the Aeshnidae.

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