

Description of Immature Stages of *Berosus alternans* Brullé (Coleoptera: Hydrophilidae)

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ABSTRACT

Egg cases, larvae and pupae of *Berosus alternans* Leach, 1817 are described from Florencio Varela, Buenos Aires province, Argentina. Diagnostic characters of external morphology are discussed, and comparisons with other known *Berosus*, are made. A key to different instar larvae is provided.

KEY WORDS Aquatic Coleoptera, Hydrophilidae, *Berosus alternans*, egg case; larva; pupa.

INTRODUCTION

The worldwide genus *Berosus* Leach, 1817 includes 263 species (Hansen, 1999): 130 occur in the New World and 80 are recorded for South America (Archangelsky, 1999). Most descriptions are based on adult characters. There are only two larval description for Neotropical species (Archangelsky 1999), six for Nearctic species (Richmond 1920; Wilson 1923; Van Tasell 1966; Archangelsky 1994, 1997) and two for Palearctic regions (Böving and Henriksen, 1938). On the other hand, pupae of six species have been described from the USA (Wilson 1923; Archangelsky 1994).

The classification of *Berosus* was based on adult morphology. Archangelsky (1994), suggested that a world revision of the genus was needed, and characters of the immature stages could support the subdivision of *Berosus* into natural groups.

The *alternans*-group Oliva (1989, 1993) is composed by three Neotropical species: *B. alternans* (Brullé), *B. paraguayanus* Knisch and *B. stenocoptus* Jensen-Haarup. The former is endemic from Argentina (provinces of Tucumán, San Luis, Buenos Aires, Neuquén and Río Negro) (Fernández y Bachmann 1999). Egg cases, larval instars, and pupa from these three species were previously unknown. The purpose of this paper is to provide descriptions of the immature stages of *B. alternans*.

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MATERIALS AND METHODS

The species described herein was reared in an aquarium from adults collected in an ephemeral pool ($\approx 2 \times 1 \times 0.50$ m) located in Florencio Varela City ($34^{\circ} 46' 49''$ S; $58^{\circ} 16' 04''$) (Buenos Aires province, Argentina).

B. alternans adults were fed on algae and decaying plant material of *Alternanthera philoxeroides* (Mart.) Griseb. (Fam: Amaranthaceae), collected from the same pool. After laying, eggs cases were taken from the aquarium and placed into individual containers (30 ml) with fresh water. Hatched *B. alternans* larvae were reared individually. Culicid larvae were offered as prey, in proportion to the size of *B. alternans* instars.

When third instar larvae stopped feeding, they were transferred to another container provided with a sheet of wrinkled and wet paper towel, for pupation.

To study the morphology of instar larvae and pupae, specimens were killed and fixed by immersion in boiling water, and stored in 70% ethyl alcohol. For methods of study, and the terminology used we have followed Archangelsky (1997).

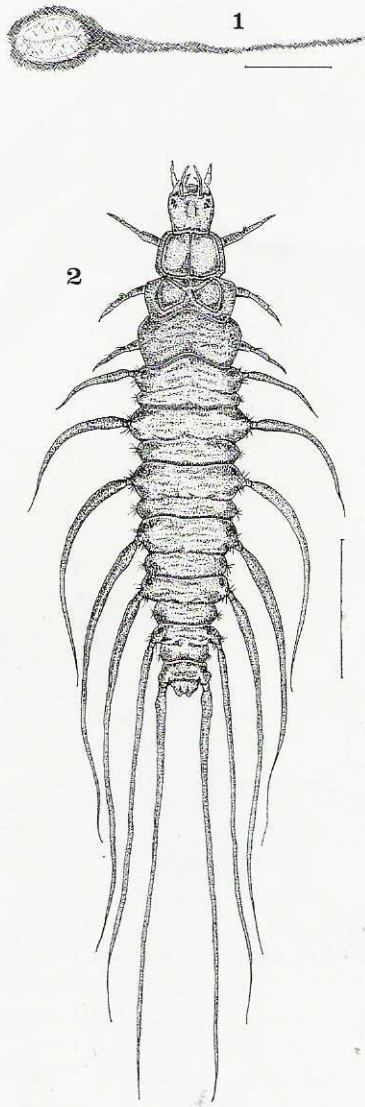
The descriptions are usually based on more than one specimen. Drawings were done with a stereoscopic microscope, usually prepared from a single specimen and then corrected to show the modal condition of several specimens for the taxonomically important features. Measurements from eggs cases, larva and pupa, were made with a micro scale with a precision of 0.1 mm.

RESULTS

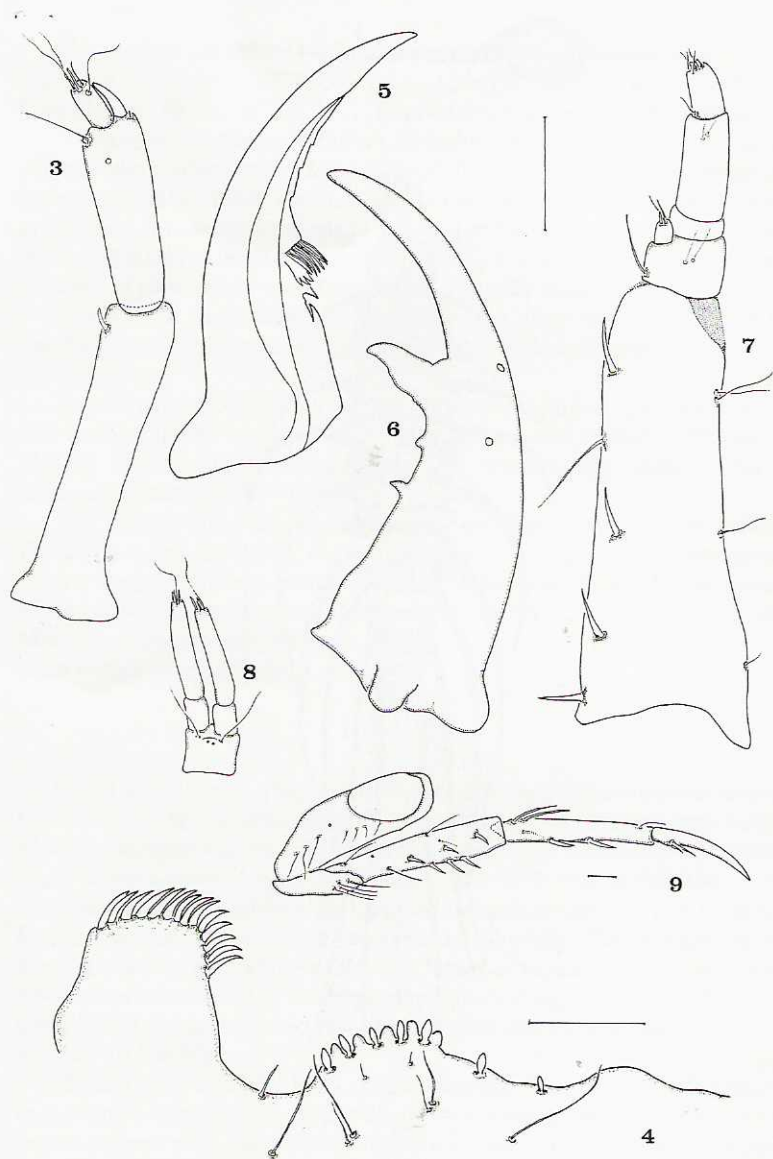
EGG CASE (Fig. 1). Silky, whitish, attached below the water surface to the stems and leaves of aquatic plants, and composed of three structures: a basal plate weaved onto the substrate, where eggs were laid; the convex cover (Base + cover = egg case: Length 1.40 - 2.10 mm, width 0.99 - 1.58 mm); and a prominent like-ribbon mast (length range: 1.17 to 6.60 mm). Ootheca without a mast were observed occasionally. The excision line of the egg case, for emergence of the first instar, is located around the cover where this is attached to the base. Two hyaline eggs (occasionally one) (length 0.86 - 1.10 mm) were placed in parallel, into the egg case, provided with an air bubble.

THIRD INSTAR LARVA (Fig.2). Length from head to abdomen, excluding antennae and appendages is shown in the Table 1. Color cream-yellow with light brown sclerites, and before molting to pupa (prepupa) changing to green whitish. Body short, soft and flattened, with 7 pairs of tracheal gills. Larvae do not swim, but walk with slow movements, and hunt prey and feed underwater. Fully grown larva (third instar) leave the water to prepare pupal cells in moist earth.

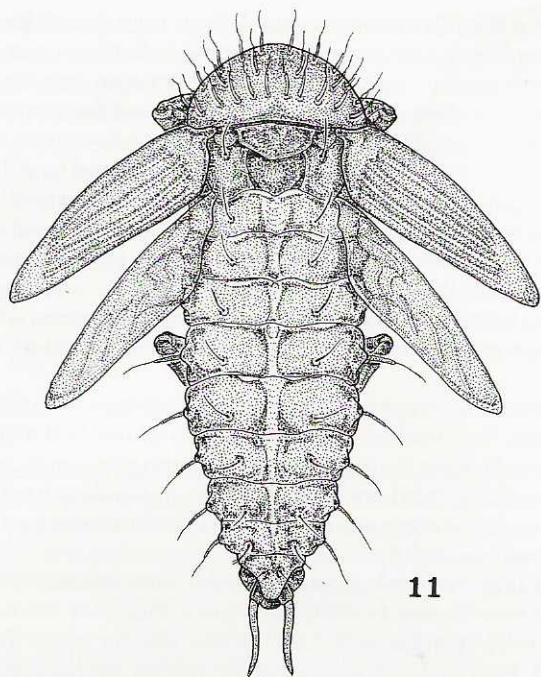
Head: subrectangular, length of the head in the midline, from the apex of the labroclypeus to foramen occipital border is shown in Table 1. Frontoantennal sutures not evident, present in first and second instars only, in both cases, lyre-like. Six stemmata occur in each ocular area. Larva without cervical sclerites in the neck.



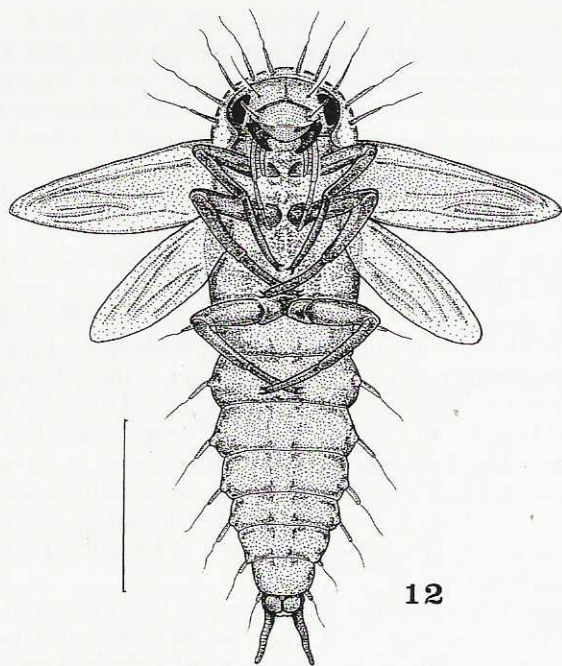
Figs. 1-2. *Berosus alternans* Brullé: 1, egg case; 2, habitus. (Scale bar = 1 mm).



Figs. 3-9. *Berosus alternans* Brullé (dorsal view): 3, antenna; 4, labroclypeus; 5, right mandible; 6, left mandible; 7, maxilla; 8, labium; 9, third right leg (latero posterior view). (Scale bar = 0,1 mm).



11



12

Figs. 11-12. *Berosus alternans* Brullé: 11, pupa (dorsal view); 12, pupa (ventral view). (Scale bar = 1 mm).

Antennae (Fig. 3): three-segmented. Basal segment longer than other two combined, with a strong subapical spine on the inner margin. Second segment with two sub-apical setae on inner margin, one short and one long; also with a short setae on outer margin near the long and narrow sensory appendage, slightly shorter than the last segment of antenna. Third segment very short, bearing four apical setae and long dorsal setae.

Labroclypeus (Fig. 4): asymmetrical, with five (occasionally six) blunt teeth, bases of them with five short and strong setae. Lateral lobes of the epistosome asymmetrical, the right one almost straight and with two strong setae; and the left one exceeding the nasale, strongly projected towards the front, with 13 or 14 strong and curved spines; seta on left of nasale longer and more slender than both setae inserted on the right of nasale.

Mandibles (Fig. 5 and 6): asymmetrical. Right one with three teeth on inner margin, the distal tooth larger than the others. Left mandible with four teeth on the inner margin, basal one pointing upwards; second tooth pointing medially, third one irregularly tri- or tetra-furcated, and distal tooth triangular, bearing a group of stout comblike spines. Distal inner edge of mandible slightly serrate.

Maxilla (Fig. 7): five-segmented, longer than antenna. Stipes longer than other four segments combined. Inner marginal border with five setae and outer margin with four or five slender setae. Palpus four-segmented. First segment with a curved seta on the basal inner margin and two slender setae on the ventral side. It also has a small and sclerotized appendage on the apical inner margin, which bear three setae. The shortest (second) segment of the palpus, lacks a seta. The longest with two sub-apical setae on the ventral side is the third. Last segment with one basal seta on the inner margin and on the distal part, four slender and two thick setae.

Labium (Fig. 8): slender. Prementum small and sub-quadrangular, with reduced ligula on dorsal side, and two long setae on both side of the ligula. Palpus two segmented, the basal one short, and the distal one bearing apical setae, approximately three times as long as basal segment.

Thorax: pronotum and prosternum sclerotized, subdivided by a thin sagittal line. Mesonotum with two pairs of subtriangular sclerites. Inner sclerites smaller than outer sclerites. Sclerites of mesosternum absent. Meso- and metathoracic segments bear two lateral tubercles. Legs five-segmented (Fig. 9), all pairs with similar morphology. First pair the shortest, and third the longest. Setae distribution as in Figure 9. Coxa widely separated and elongate; trochanter small, subtriangular; femur approximately as long as coxa, but slender; tibiotarsus slender, hardly shorter than femur; tarsal-claw long and slender, curved inwards and with two subbasal spines.

Abdomen: ten-segmented and pubescent. First to seventh segments subdivided by a transverse fold. Every segment carries a lateral pair of threadlike tracheal gills inserted on a conical tubercle. Eighth segment small, ninth and tenth strongly reduced.

PUPA (Fig. 10 and 11). Color white immediately after molt, changing

to green, and finally dark before molt to adult. The length of the pupa measured along the dorsal midline, from the anterior margin of head to the most posterior points of ninth tergum, given in Table 1.

Head: two pairs of styli on the inner side of the both eyes. Clypeus and labrum covering base of mandibles, and maxillary palpus long and reaching the mesosternum.

Thorax: Pronotum with 24 styli, ten on anterior margin, four on disc of pronotum, and the remainder on the posterior margin. Mesonotum and metanotum bear a pair of styli.

Abdomen: First abdominal segment with a pair of styli, second to seventh with four styli; eighth with a small pair close to the midline, and the ninth segment bears the cerci.

KEY TO INSTAR LARVAE

- 1 Frontoantennal suture absent. Basal segment of antenna longer than length of second plus third segment. Stout apical seta on second antennal segment almost as long as last segment Instars III
- 1' Frontoantennal suture present, and lyriform. Basal segment of antenna, equal or less that length of second and third segment joint. Stout apical seta on second antennal segment half the length of last segment 2
- 2 Basal segment of antenna wide, two times as long as wide. Length of abdomen / length tracheal gills, equal or less 1. Width maximum of the head less 0.38 mm Instars I
- 2' Basal segment of antenna four times as long as width. Length of abdomen / length tracheal gills, more than 1. Width maximum of the head higher than 0.44 mm Instars II

DISCUSSION

The number of eggs in ootheca of *Berosus* species ranges from 1 to 25. However, most species lay between 2 and 5 eggs per case. *B. pugnax* Le Conte, has the highest number of eggs per case (10-25 eggs) (Archangelsky, 1994). Our results show that *B. alternans* laid two eggs per ootheca, and occasionally one. The egg case usually has a mast like ribbon, except in *B. corrini* which lacks a mast (Archangelsky, 1994).

In the larvae, the labroclypeus and the mandibles are more variable in their morphology (Archangelsky, 1997). The number of teeth on the nasale of *Berosus* spp. is usually 3 to 7, however, *B. hoplites* Sharp has nasale with many small and irregular teeth along the right epistomal lobe. *B. alternans* shares with *B. aulus* Orchymont and *B. corrini* Wooldridge five teeth in the nasale. However, in *B. aulus* the nasale is narrower and projected further than in the other two species. Furthermore, the right mandible of *B. aulus* has two teeth on the inner margin, while that *B. alternans* and *B. corrini* have three. *B. auriceps* Boheman differs from all species in that the nasale does not project forward of the right epistomal lobe, with only three blunt teeth.

In *B. alternans*, the stemmata are close to the base of the antenna, as in the other species, except *B. striatus* (Say), which has the stemmata on the basal half of the head capsule. Comparison with *B. pantherinus* Le Conte

is not possible because the descriptions and illustrations performed by Wilson (1923) are not clear or complete.

Another variable structure is the number of the tracheal gills. There are usually seven pairs, except in *B. pugnax*, which has four (Archangelsky, 1997).

Pupa: Archangelsky (1994) and Wilson (1923), described the pupae of *B. hoplites*, *B. corrini*, *B. pantherinus*, and *B. striatus*, *B. peregrinus*, and the characters most relevant for distinguishing these species were body size, and the number of styli in the head, pronotum and abdomen.

The pupa of *B. alternans* has 24 pronotal styli, while other known pupae, except *B. peregrinus*, have 26 styli.

On first abdominal segment, *B. seriatus* and *B. pantherinus* has one pair of styli; *B. alternans*, *B. corrini*, *B. pugnax*, and *B. peregrinus* have two pairs; while *B. hoplites* has three pairs. From the second to seventh segments all species have two pairs of styli, except *B. hoplites*, which has three pairs; and in the eighth segment, *B. alternans* has one pair like the other species, except *B. hoplites* and *B. peregrinus* which have two pairs of styli in this abdominal segment.

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Table 1. Descriptive statistics of measured variables (in millimeters) of *Berosus alternans* stages.

Variable	Stages							
	Instar I (n = 6)		Instar II (n = 6)		Instar III (n = 6)		Pupa (n = 5)	
	Mean(SD)	Min-Max.	Mean(SD)	Min-Max.	Mean(SD)	Min-Max.	Mean(SD)	Min-Max.
Length of body	2.35(0.21)	2.03-2.57	4.65(0.40)	4.07-5.15	6.22(0.25)	5.90-6.50	6.22(0.25)	5.90-6.5
Width maxim of body	0.49(0.06)	0.40-0.54	0.77(0.07)	0.67-0.85	1.47(0.14)	1.28-1.62	1.98(0.12)	1.90-2.17
Length of head	0.28(0.01)	0.27-0.29	0.39(0.02)	0.36-0.40	0.54(0.04)	0.48-0.58		
Width of head	0.35(0.01)	0.34-0.37	0.49(0.03)	0.45-0.54	0.66(0.05)	0.58-0.72		
Width of pronotum	0.44(0.03)	0.40-0.49	0.77(0.07)	0.67-0.85	1.47(0.14)	1.28-1.62		