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SOME LIBELLULIDAE LARVAE FROM THE YUNGAS FOREST, ARGENTINA: *MACROTHEMIS HAHNELI* RIS, *BRECHMORHOGA NUBECULA* (RAMBUR) AND *DASYTHEMIS MINCKI CLARA* RIS (ANISOPTERA)

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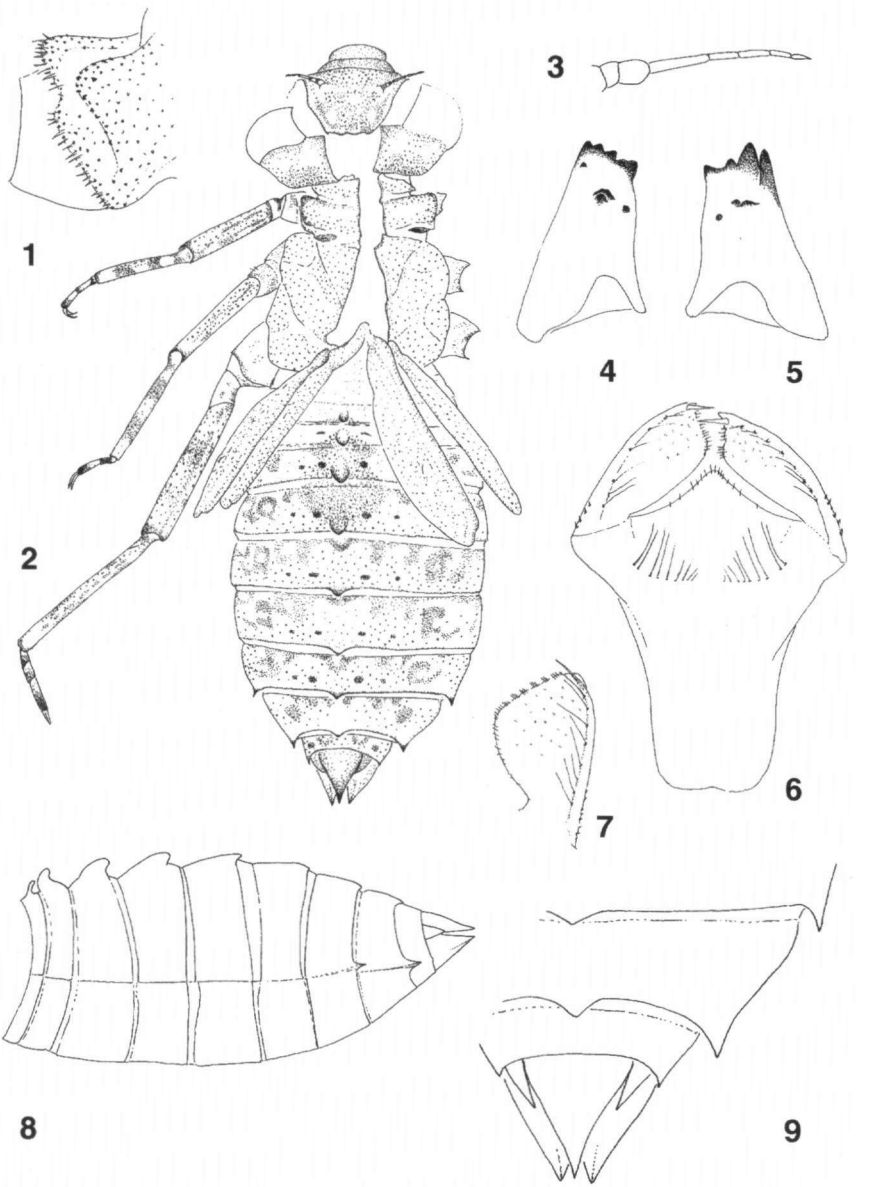
A first description of the larva of *M. hahneli* is provided. The larva of *B. nubecula*, previously described based on a single specimen of doubtful identity, is here redescribed based on bona fide specimens belonging to that sp. The larva of *D. mincki clara* is found to agree overall with that of *D. m. mincki*, differing only on some minor details probably due to geographic variation.

INTRODUCTION

The larvae of the three libellulid species dealt with here inhabit the same aquatic environments in the Argentine Yungas. *Macrothemis* Hagen, 1868 and *Brechmorhoga* Kirby, 1894 are primarily neotropical genera; *Macrothemis* contains 40 species and *Brechmorhoga* 16, whereas the exclusively South American *Dasythemis* includes only four (GARRISON et al., 2006). Only six larvae of *Macrothemis*, viz. *M. aurimaculata* Donnelly, 1984; *M. celeno* (Selys *in* Sagra, 1857); *M. inacuta* Calvert, 1898; *M. musiva* Calvert, 1898; *M. pseudimitans* Calvert, 1898 and *M. tessellata inequiunguis* Calvert, 1895, and seven of *Brechmorhoga*, viz. *B. mendax* (Hagen, 1861); *B. pertinax pertinax* (Hagen, 1861); *B. praecox praecox* (Hagen, 1861); *B. praedatrix* (Calvert, 1909); *B. rapax rapax* Calvert, 1898; *B. travassosi* Santos, 1946 and *B. vivax* Calvert, 1906, have been described so far (GARRISON et al., 2006). SANTOS (1969) provided a description for *B. nubecula* based on one larva from Guanabara, Brazil which was reared until emergence of the adult; he was however unsure about the specific identity of that female specimen.



Figs 1-9. Ultimate larval instar of *Brechmorhoga nubecula* (Ramb.): (1) left proepimeron, dorsal view; – (2) general aspect, dorsal view; – (3) right antenna, dorsal view; – (4) right mandible, inner view; – (5) left mandible, inner view; – (6) prementum, dorsal view; – (7) labial palp, dorsolateral view; – (8) abdominal segments 2-10, lateral view; – (9) abdominal segments 8-10, dorsal view.

Since his description does not fully agree with the exuviae of reared *bona fide Brechmorhoga nubecula*, a redescription of that species is presented here.

Two larvae of *Dasythemis* Karsch, 1889 were described to date: *D. venosa* (Burmeister, 1839) and *D. m. mincki* (Karsch, 1890) (CARVALHO et al., 2002). Here the larva of *D. mincki clara* Ris 1908 is compared with that of the nominate subspecies of *D. mincki*.

BRECHMORHOGA NUBECULA (RAMBUR, 1842)

Figures 1-9

M a t e r i a l. – (deposited in the Museo de Ciencias Naturales de Salta): Ultimate larval instar: Argentina, Jujuy province, El Pantanoso, 23°31'17"S, 64°35'13"W, 609 m.a.s.l., 3/4-XI-2005, von Ellenrieder leg., 1 exuviae (male emerged in laboratory), 2 larvae; Salta province: El Rey National Park, Arroyo La Sala, 24°43'41.2"S, 64°40' 16.7"W, 971 m.a.s.l., 30-XI-2005, von Ellenrieder leg., 2 larvae; Lesser, 1312 m.a.s.l., 9-I-2006, 24°40'57"S, 65°28'39"W, von Ellenrieder leg., 1 larva. Younger instars: Same localities; El Pantanoso: 1 larva; Lesser, 10-XI-05: 1 larva; Arroyo La Sala: 5 larvae; Salta province: Baritú National Park, rocky stream affluent to Río Baritú, 22°29'16.5"S, 64°45'36.4"W, 1490 m.a.s.l., 20-VIII-05: 2 larvae.

Larvae were found along rocky sections of rivers and streams, under stones.

DESCRIPTION. – Integument granulose and with few setae.

H e a d. – Trapezoidal, slightly more than twice as wide as long, narrowed posteriorly, with occipital margin straight, and cephalic lobes broadly rounded, not bulging (Fig. 2). Antenna 7-segmented, with third antennomere the longest (Fig. 3). Prementum (Fig. 6) almost as wide as long (ratio width/ length 0.95-1), with 7-9 lateral setae on dorsal surface, arranged as 2+5-2+7; ligula prominent; articulation prementum/ postmentum at level of anterior margin of mesocoxae. Labial palp with 6-8 long setae (Fig. 7); movable hook thick, sharply pointed, as long as palpal setae; distal margin of palp with 8-10 crenulations, each with 3-4 setae at base. Mandibles (Figs 4-5) with following formula (*sensu* WATSON, 1956): L 1234 0 abb', R 11'234 y abb'

T h o r a x. – Lateral margins of neck membrane strongly sclerotized, rounded, bearing long setae. Row of stout, stiff setae along anterior margin of proepisternum and inferior margin of propleuron; lateral margin of proepimeron straight (Fig. 1). Wing pads extending to posterior margin of abdominal segment 5 or midlength of 6. Legs short (hind leg not surpassing distal margin of anal pyramid when extended to sides of body); femora with three dark bands, sometimes diffuse; tibiae with three dark bands and tarsi with dark apexes (Fig. 2).

A b d o m e n. – Color pattern as shown in Figure 2. Segments 2-9 with blunt mediodorsal projections; those on segments 2-6 well developed, on 7-9 almost imperceptible laterally (Fig. 8). Lateral spines of segments 8 and 9 shorter than half of middorsal length of their segments; posterior margin of sternite 10 not visible in dorsal view; cerci as long as 0.4-0.5 of epiproct (Fig. 9).

M e a s u r e m e n t s (in mm; average and standard deviation; range in square brackets; N = 6

unless indicated otherwise). – Head mediodorsal length: 2.59 ± 0.23 [2.3-2.85] (N = 5); head max. width: 5.92 ± 0.18 [5.6-6] (N = 5); head width/ length: 2.3 ± 0.25 [1.96-2.61] (N = 5); prementum length: 4.35 ± 0.14 [4.2-4.5]; prementum max. width: 4.2 ± 0.14 [4-4.4]; prementum max. width/ length: 0.97 ± 0.02 [0.95-1]. Femur I: 2.88 ± 0.17 [2,7-3.2]; II: 3.66 ± 0.13 [3.5-3.8] (N = 5); III: 4.96 ± 0.19 [4.8-5.3] (N = 5). Tibia I: 3.45 ± 0.19 [3.2-3.7]; II: 3.98 ± 0.15 [3.8-4.2] (N = 5); III: 5.52 ± 0.18 [5.2-5.6] (N = 5). Inner wing pads: 7.14 ± 0.05 [7.1-7.2] (N = 5); external wing pads: 6.86 ± 0.18 [6.6-7.10] (N = 5). Abdomen length with appendages: 13.84 ± 0.46 [13.2-14.5] (N = 5); lateral spine on S8 length: 0.51 ± 0.08 [0.4-0.6]; lateral spine on S9 length: 0.47 ± 0.05 [0.4-0.5]; epiproct length: 1.66 ± 0.07 [1.6-1.75]; cercus length: 0.72 ± 0.04 [0.7-0.8]; cercus /epiproct length: 0.43 ± 0.04 [0.4-0.5]; paraproct length: 1.67 ± 0.14 [1.5-1.8]. Total length with appendages: 21.68 ± 0.77 [20.9-22.9] (N = 5).

YOUNGER INSTARS. – Differ from ultimate instar as follows: mediodorsal projections well developed on abdominal segments 1-9; fewer number of setae on labial palp and prementum; fewer number of crenulations on distal margin of prementum; color pattern with abdominal segments 1-4 dark, and fewer number of dark bands on legs (2 or 1, depending on size).

DIAGNOSIS. – The larva of *B. nubecula* differs by the straight lateral margin of the proepimeron from *B. rapax* (with a digitiform process in *B. rapax*; NOVELO-GUTIERREZ, 1995b), by the lateral spines on abdominal segments 8-9 of equal length from *B. pertinax* (that on 8 about twice as long as the one on 9 in *B. pertinax*; NOVELO-GUTIÉRREZ, 1995a), and shorter than middorsal length of segment 9 from *B. mendax* (as long as it in *B. mendax*; NOVELO-GUTIERREZ, 1995b), by the mediodorsal projections on abdominal segments 2-5 convex from *B. praecox* (with straight dorsal margins, parallel to body axis in *B. praecox*; NOVELO-GUTIÉRREZ, 1995b), on segments 6-9 blunt and low in lateral view from *B. praedatrix* (well developed and acute in *B. praedatrix*; FLECK, 2004), and by the number of premental setae and mandibular formula from *B. travassosi* (7-9 premental setae in *B. nubecula*, 11 in *B. travassosi*; mandibles with three molars in *B. nubecula*, lacking molars in *B. travassosi*; SANTOS & COSTA, 1999). It can be distinguished from that of *B. vivax*, the only sympatric species of the genus in the Argentine Yungas, by the dorsal projection on abdominal segment 3 clearly shorter and narrower than that on 4 (Fig. 8, which is almost equal to that on 4 in *B. vivax*), and by the number of premental setae (7-9 in *B. nubecula*, and 12-13 in *B. vivax*; NOVELO-GUTIÉRREZ, 1995b).

MACROTHEMIS HAHNELI RIS, 1913

Figures 10-18

M a t e r i a l. – (deposited in the Museo de Ciencias Naturales de Salta): Ultimate larval instar: Argentina, Jujuy province, El Pantanoso, 23°31'17"S, 64°35' 13"W, 609 m.a.s.l., 3/4-XI-2005, von Ellenrieder leg., 1 larva; Salta province: Lesser, 1312 m.a.s.l., 09-I-2006, 24°40'57"S, 65°28'39"W, von Ellenrieder leg., 4 exuviae (1 male, 3 females emerged in laboratory), 1 larva; same but 11/13-X-2005, 2 larvae. Younger instars: same locality: Lesser, 13-X-2005, 2 larvae. Jujuy province: La Angostura, 24°27'01.4"S, 65°22'43.7"W, 1511 m.a.s.l., 8-XII-2005, col. von Ellenrieder: 1 larva; Arroyo en Rta 6 a Palma Sola, 23°52'12"S, 64°22'4"W, 534 m.a.s.l., 5-XI-2005, col. von Ellenrieder: 1 larva. Salta province: Baritú National Park, rocky stream affluent to Río Baritú, 22°29'16.5"S 64°45'36.4"W,

1490 m.a.s.l., 20-VIII-05: 2 larvae; El Rey National Park, stream on way to Pozo Verde, 24°44'28.8"S, 64°40'35.8"W, 1029 m.a.s.l., 20-VIII-05: 1 larva.

Larvae were found at river and stream margins, in areas of abundant aquatic vegetation.

DESCRIPTION. – Integument covered with small spiniform setae.

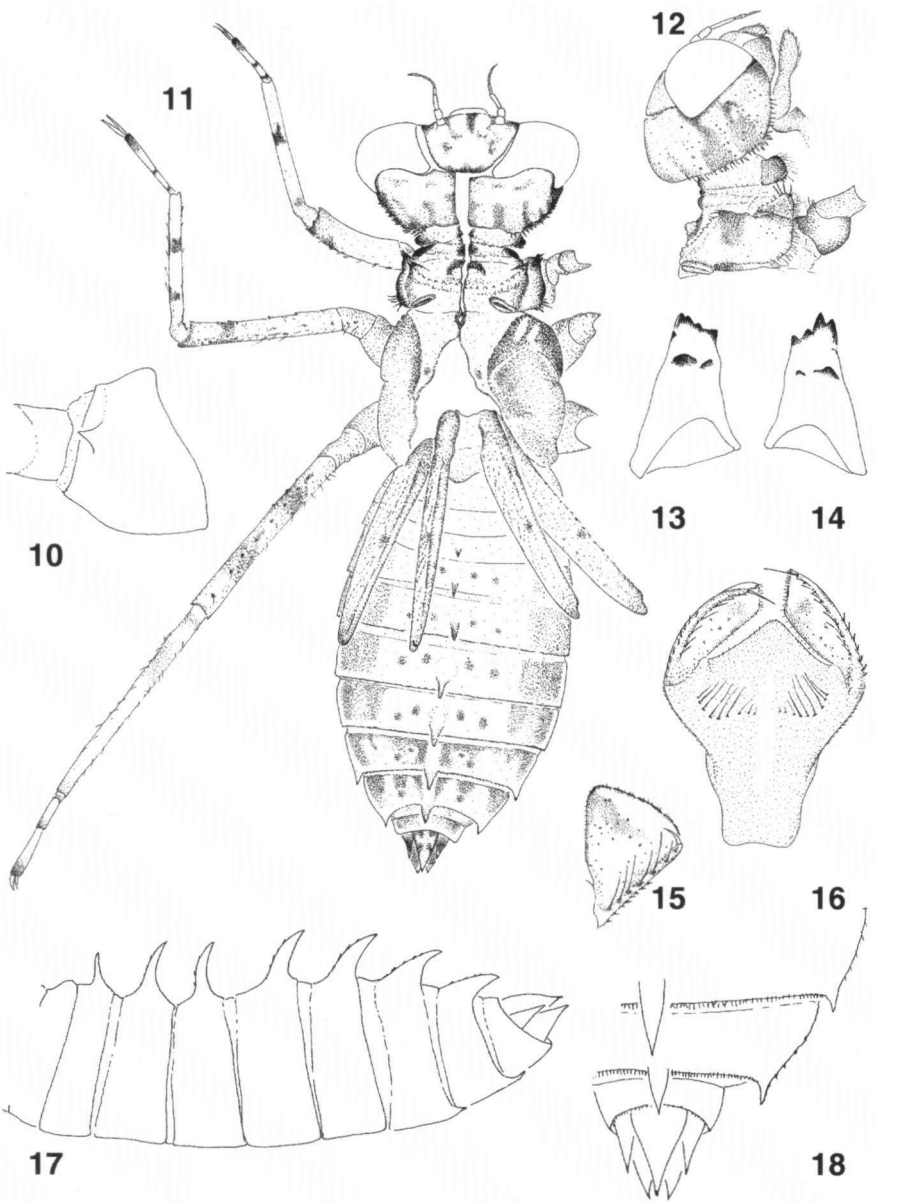
H e a d. – Trapezoidal, about twice as wide as long, narrowed posteriorly, with occipital margin slightly concave, and cephalic lobes broadly rounded, not bulging, covered with minute spiniform setae and a few stout long setae (Figs 11-12). Antenna 7-segmented, with third antennomere the longest. Prementum (Fig. 16) almost as wide as long (ratio width/ length 0.92-1), with 8-9 lateral setae on dorsal surface; ligula prominent, finely crenulated along margin; articulation prementum/ postmentum at level of anterior margin of mesocoxae. Labial palp with 6-8 long setae (usually 7); movable hook thick, sharply pointed, as long as palpal setae; distal margin of palp with 8-10 obsolete crenulations, with very shallow notches between them (Fig. 15). Mandibles (Figs 13-14) with following formula (*sensu* WATSON, 1956): L 1234 0 abb', R 123+4 y ab

T h o r a x. – Lateral margins of neck membrane strongly sclerotized, rounded; row of stout, stiff setae along anterior margin of proepisternum, inferior margin of propleuron, and dorso-lateral margins of pronotal disk (Figs 11-12). Pronotal disk with dark inverted 'V-shaped' spot and a central tubercle bearing spines (Figs 11-12). Wing pads extending to midlength of abdominal segment 5 to 6. Legs long (hind leg surpassing distal margin of anal pyramid when extended to sides of body); femora with a row of long stiff setae along dorsal margin; femora with three and tibiae with two dark bands, sometimes incomplete or diffuse, and tarsi with dark apexes (Fig. 11). Metacoxa with triangular ventrolateral process (Fig. 10).

A b d o m e n. – Color pattern as shown in Figure 11. Segments 3-9 with well developed spine like mediodorsal projections; that on segment 3 vertical, remainder progressively declining posteriorly (Fig. 17). Lateral spines of segments 8 and 9 shorter than half of middorsal length of their segments; posterior margin of sternite 10 not visible in dorsal view; cerci as long as 0.55-0.65 of epiproct (Fig. 18).

M e a s u r e m e n t s (in mm; average and standard deviation; range in square brackets; N = 8 unless indicated otherwise). – Head mediodorsal length: 2.15 ± 0.22 [2-2.6] (N = 7); head max. width: 4.26 ± 0.18 [4-4.55] (N = 7); head width/ length: 1.99 ± 0.17 [1.75-2.15] (N = 7); prementum length: 3.13 ± 0.1 [3.05-3.35]; prementum max. width: 3.01 ± 0.07 [2.95-3.1]; prementum max. width/ length: 0.96 ± 0.03 [0.92-1]. Femur I: 2.44 ± 0.13 [2.25-2.65]; II: 3.29 ± 0.21 [3-3.6]; III: 4.19 ± 0.14 [4-4.3]. Tibia I: 2.81 ± 0.17 [2.55-3.1]; II: 3.54 ± 0.13 [3.35-3.75]; III: 5.08 ± 0.23 [4.75-5.4]. Inner wing pads: 5.1 ± 0.14 [4.9-5.25] (N = 7); external wing pads: 4.93 ± 0.08 [4.8-5] (N = 7). Abdomen length with appendages: 8.56 ± 0.42 [8.15-9.5]; lateral spine on S8 length: 0.19 ± 0.04 [0.15-0.25]; lateral spine on S9 length: 0.24 ± 0.05 [0.2-0.35]; epiproct length: 0.89 ± 0.05 [0.85-1]; cercus length: 0.54 ± 0.02 [0.5-0.55]; cercus /epiproct length: 0.61 ± 0.03 [0.55-0.65]; paraproct length: 0.78 ± 0.04 [0.68-0.8]. Total length with appendages: 14.41 ± 0.51 [13.4-14.96] (N = 7).

YOUNGER INSTARS. – Differ from ultimate instar as follows: fewer number of



Figs 10-18. Ultimate larval instar of *Macrothemis hahneli* Ris: (10) left metacoxa, ventrolateral view; – (11) general aspect, dorsal view; – (12) head and prothorax, lateral view; – (13) right mandible, inner view; – (14) left mandible, inner view; – (15) labial palp, dorsolateral view; –(16) prementum, dorsal view; – (17) abdominal segments 2-10, lateral view; – (18) abdominal segments 8-10, dorsal view.

setae on labial palp and prementum; fewer number of crenulations on distal margin of prementum.

DIAGNOSIS. – The larva of *M. hahneli* can be distinguished from those of *M. aurimaculata* and *M. inequiunguis* by the absence of a dorsal protuberance on abdominal segment 2 (present in these two species), and from those of *M. musiva*, *M. pseudimitans*, *M. celeno* and *M. inacuta* by the presence of 7-8 palpal setae (4-6 in these other species) and obsolete crenulations on distal margin of labial palp (deep crenulations in these species, RAMÍREZ & NOVELO-GUTIÉRREZ, 1999). It further differs from *M. pseudimitans* and *M. inacuta* by the triangular ventrolateral metacoxal process (absent in *M. pseudimitans*, digitiform in *M. inacuta*; NOVELO-GUTIÉRREZ & RAMÍREZ, 1998), from *M. pseudimitans* by the thick movable hook of labial palp (thicker than 3 times the width of preceding setae, narrower than twice width of preceding setae in *M. pseudimitans*) and from *M. inacuta* by the dorsal protuberance on segment 3 distinclty shorter than that on 4 (of about the same height in *M. inacuta*) and the presence of only 2 molars on mandibles (three in *M. inacuta*; NOVELO-GUTIERREZ & RAMIREZ, 1998). In the Argentine Yungas *M. hahneli* is sympatric with *M. inacuta* and *M. imitans*. *M. inacuta* has, however, a different larval habitat, breeding in the muddy shores of lentic environments such as ponds and lagoons. The larva of *M. imitans*, adults of which are found at the same streams and rivers where *M. hahneli* breeds, is still unknown.

DASYTHEMIS MINCKI CLARA RIS, 1908

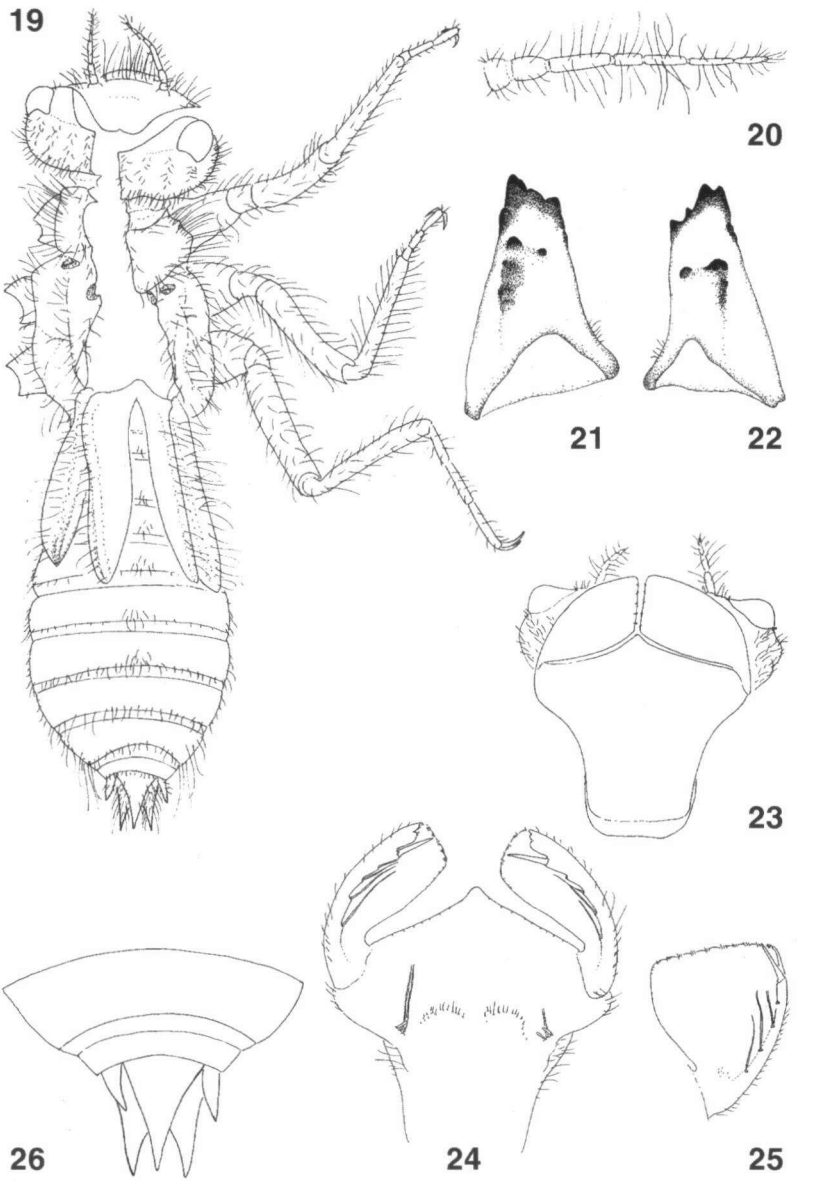
Figures 19-26

M a t e r i a l. – (deposited in the Museo de Ciencias Naturales de Salta): Ultimate larval instar: Argentina, Salta province: Lesser, 1312 m.a.s.l., 12-XI-2005, 24°40'57"S, 65°28'39"W, Garrison leg., 1 exuviae (1 female emerged in laboratory).

Larva was found burrowing in mud at a swampy area near a creek.

DESCRIPTION. – Integument uniformly reddish brown, covered with abundant long setae.

H e a d. – Rectangular, about one and a half times as wide as long, with occipital margin approximately straight, and cephalic lobes broadly rounded, not bulging (Fig. 19); eyes protruding laterally and dorsally (Fig. 23). Antenna 7-segmented, with third antennomere the longest (Fig. 20). Prementum (Figs 23-24) slightly longer than wide (ratio width/ length 0.86), with 3 long external premental setae and an internal curved row of 13-15 very short setae (Fig. 24); ligula prominent, finely crenulated along margin; articulation prementum/ postmentum at level of posterior margin of procoxae. Labial palp with 4 long setae (Fig. 25); movable hook thick, sharply pointed, as long as palpal setae; distal margin of palp with 10-11 crenulations, with three to four short setae on the base of each one of them. Mandibles (Figs 21-22) with following formula (*sensu* WATSON, 1956): L 1234



Figs 19-26. Ultimate larval instar of *Dasythemis mincki clara* Ris: (19) general aspect, dorsal view; – (20) right antenna, dorsal view; – (21) right mandible, inner view; – (22) left mandible, inner view; – (23) head, ventral view; – (24) prementum, dorsal view; – (25) labial palp, dorsolateral view; – (26) abdominal segments 9-10, dorsal view.

y abd, R 123+4 xy abcd – there are large sclerotized areas surrounding accessory teeth d on left mandible and cd on right mandible.

T h o r a x. – Wing pads extending to posterior margin of abdominal segment 5.

A b d o m e n. – Lacking lateral spines; posterior margin of sternite 10 not visible in dorsal view; cerci shorter than a third of epiproct (Fig. 26).

M e a s u r e m e n t s (in mm; N = 1). – Head mediodorsal length: 5.1; head max. width: 33.5; head width/ length: 0.69; prementum length: 4.4; prementum max. width: 3.8; prementum max. width/ length: 0.86; antenna total length: 2.2; antennomere I: 0.2; II: 0.25; III: 0.5; IV: 0.2; V: 0.3; VI: 0.45; VI: 0.3. Femur I: 3; II: 3.5; III: 4.2. Tibia I: 3.3; II: 3.5; III: 4.7. Inner wing pads: 5.7; external wing pads: 5. Abdomen length without appendages: 10.1; abdomen maximum width: 5.3; epiproct length: 1.3; cercus length: 0.35; cercus/ epiproct length: 0.27; paraproct length: 1.25. Total length with appendages: 19.4.

DIAGNOSIS. – The larva of *D. mincki clara* studied here differs from that of *D. m. mincki* only by the number of crenulations along distal margin of labial palp (11, versus 12 in *D. m. mincki*), and by the less defined accessory molars of the mandibles (consisting on heavily sclerotized areas rather than individual teeth as shown for *D. m. mincki* by CARVALHO et al., 2002). They agree overall on structural characters and measurements. Both differ form *D. venosa*, the only other know larva from the genus, by the absence of lateral spines on abdominal segments 8-9.

DISCUSSION

SANTOS' (1969) description of *B. nubecula* states that the color pattern of that larva is uniformly pale reddish brown, and that the tibiae have an indistinct apical dark band. According to the material studied here, the color pattern includes several dark spots on body and distinct bands on tibiae (Fig. 2). The measurements he provided for wing pads, head length, epiproct length, and length and width of prementum do not agree with the ones found here either. Either he had a different species of *Brechmorhoga* in hand, or his description was inaccurate, and since he did not include an illustration or description of the diagnostically important abdominal mediodorsal projections it is not possible to determine the identity of that specimen without examining it.

NOVELO-GUTIERREZ & RAMIREZ (1998) provided the first diagnoses for the genera *Brechmorhoga* and *Macrothemis* based on larval characters. However, they later found (RAMÍREZ & NOVELO-GUTIÉRREZ, 1999), that several of the characters thought diagnostic for *Brechmorhoga* also occurred in some species of *Macrothemis* larvae, such as dorsal projections on abdominal segments 2-9 (in *M. aurimaculata* and *M. inequiunguis*); dorsal projections reduced and bluntly tipped on posterior segments (in *M. aurimaculata*); and body lacking long, delicate setae (in *M. aurimaculata* and *M. inequiunguis*).

The larva of *M. hahneli* differs further from the generic larval diagnosis of *Macrothemis* (NOVELO-GUTIÉRREZ & RAMÍREZ, 1998; RAMÍREZ &

NOVELO-GUTIERREZ, 1999) by its abdominal segment 10 and anal pyramid not hidden laterally by the lateral spines of segment 9, posterior margin of sternite 10 not visible in dorsal view, and ratio cerci / epiproct of 0.55-0.65 (all mentioned as generic characters for *Brechmorhoga*; RAMIREZ & NOVELO-GUTIERREZ, 1999).

The fact that more character sets previously thought diagnostic for these two genera are found to overlap as more larvae become known seems to indicate, as does also the analysis of adult characters (GARRISON & VON ELLENRIEDER, 2006), that these two genera are probably artificial, and that a phylogenetic analysis encompassing all described species and both adult and larval characters will be necessary in order to resolve their relationships and assess their status.

The few differences shown by the larva of *Dasythems mincki clara* from that of the nominal subspecies are minor and are likely the expected result of geographic variability.

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