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The larva of *Mecistogaster amalia* (Odonata: Pseudostigmatidae)

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Abstract

The final larval stadium of *Mecistogaster amalia* is described and illustrated for the first time based on one female collected in a tree hole in Misiones province, Argentina, and compared with all known larvae of related genera. Larval morphology of Pseudostigmatidae is briefly discussed.

Introduction

Pseudostigmatidae include 17 species in five neotropical genera, i.e. *Anomisma* McLachlan, 1877, *Mecistogaster* Rambur, 1842, *Megaloprepus* Rambur, 1842, *Microstigma* Rambur, 1842, and *Pseudostigma* Selys, 1860. This family includes the longest species in the order Odonata, all of which as far as known breed exclusively in phytotelmata as does its East African sister group *Coryphagrion grandis* Morton, 1924 (Corbet 1999: 145; Clausnitzer & Lindeboom 2002; Fincke 2005; Groeneveld et al. 2007).

Final stadium larvae of *Mecistogaster linearis* (Fabricius, 1776), *M. modesta* Selys, 1860, *M. ornata* Rambur, 1842, *M. asticta* Selys, 1860, *Microstigma rotundatum* Selys, 1860, *M. maculatum* Hagen in Selys, 1860, *Megaloprepus caerulatus* (Drury, 1782), and *Pseudostigma aberrans* Selys, 1860 have been described so far (Calvert 1911; Novelo Gutiérrez 1993; Ramírez 1995, 1997; Westfall & May 1996; Hedström & Sahlén 2003; Sahlén & Hedström, 2005; Lencioni 2006; De Marmels 2007; Neiss et al. 2008).

Mecistogaster is the most speciose genus within Pseudostigmatidae including 10 species, three of which are recorded from Argentina: *M. amalia* (Burmeister, 1839) and *M. lucretia* (Drury, 1773) from the Paranaense forest in Misiones province, and *M. ornata* Rambur, 1842 from the Yungas forest in Salta and Jujuy prov-

inces (von Ellenrieder & Muzón 2008). *M. amalia* was also recorded from Rio de Janeiro and São Paulo states in Brazil (Lencioni 2005), and its larva is here described for the first time and compared with that of all other known related genera. Larvae of other zygopterans were examined as well to test if presence of branched and feather-like setae on larval tibiae and tarsi, which was proposed as probable synapomorphy for Pseudostigmatidae (Clausnitzer & Lindeboom 2002; Groeneveld et al. 2007), is exclusive to Pseudostigmatidae.

Material and methods

Study site

Study site is located next to a waterfall in the Iguazú National Park, Misiones province, northeast Argentina. Biogeographically, this area belongs to the Paranense province of the Neotropical region. Climate is subtropical with temperatures ranging from -4.9 to 40°C and an annual mean of 22°C; mean annual rainfall is 1,500-2,000 mm, with dry winters and wet summers (Servicio Metereológico Nacional 2009). Vegetation corresponds to a subtropical forest characterized by three strata; the highest composed by trees of 30 m, the middle one by minor trees, and the lowest by shrubs, bamboos, ferns, herbs, and epiphytes (Cabrera & Willink 1973).

Terminology

Mandibular formula follows Watson (1956).

Specimens studied

Mecistogaster amalia: 1 ♀ (reared) final larval stadium, Argentina, Misiones province, Iguazú National Park, tree hole (25°39'S, 54°18'W), 21 v 2007, leg. REC, E. Lestani.

Other species — *Hetaerina rosea* Selys, 1853: 1 ♀ (reared), Argentina, Buenos Aires province, Pergamino, Arroyo Maguire (33°57'46"S, 60°16'22"W), 09 i 2002, leg. JM, P. Pessacq. *Lestes spatula* Fraser, 1946: 1 ♀ (reared), Argentina, Corrientes province, Colonia Pellegrini (28°32'16"S, 57°11'12"W), 02-09 x 2004, leg. A. Garré, F. Lozano. *Lestes undulatus* Say, 1840: 1 ♂ (reared), Argentina, Buenos Aires province, RP 11, 18 km Magdalena (35°01'14"S, 57°40'35,7"W), 01 xi 1999, leg. JM, P. Pessacq, N. von Ellenrieder. *Homeoura chelifera* (Selys, 1876): 1 ♀ (reared), Argentina, Corrientes province, Ituzaingó, San Juan de Poriahú Ranch (27°42'51"S, 57°11'14"W), 01 x 2003, leg. S. Mazzucconi. *Homeoura lindneri* (Ris, 1928): 1 ♀ (reared), Argentina, Entre Ríos province, Pre Delta National Park,

23-26 xi 2006, leg. A. Garré, J. Lambruschini, F. Lozano, L. Ramos, SWM. *Argentagrion ambiguum* (Ris, 1904): 1 ♂ (reared), Corrientes province, Santo Tomé (28°31'52"S, 56°03'10"W), 21 ix 2005, leg. JM, L. Ramos & SWM. *Acanthagrion aepiolum* Tennessen, 2004: 1 ♂ (reared), Argentina, Corrientes province, Mercedes (29°01'41"S, 58°10'28"W), 09-11 x 2004, leg. P. Pessacq. *Ischnura fluviatilis* Selys, 1876: 1 ♂ (reared), Argentina, Buenos Aires province, Castelli, Laguna La Rosita (36°05'54"S, 57°47'23"W), 24 x 2005, leg. M. Ardohain. *Oxyagrion hempeli* Calvert, 1909: 1 ♂ (reared), Argentina, Buenos Aires province, Balcarce (37°39'42"S, 58°33'11"W), 20 xii 1999, leg. N. von Ellenrieder. *Oxyagrion rubidum* (Rambur, 1842): 1 ♂ (reared), Argentina, Córdoba province, Mayu Sumaj (31°27'04"S, 64°32'55"W), 01-16 ii 2007, leg. JM, *Oxyagrion terminale* Selys, 1876: 1 ♀ (reared), Argentina, Buenos Aires province, Punta Lara, 17 xii 1996, leg. N. von Ellenrieder. *Telebasis willinki* Fraser, 1948: 1 ♀ (reared), Argentina, Corrientes province, Colonia Pellegrini (28°32'16"S, 57°11'12"W), 02-09 x 2004, leg. A. Garré & F. Lozano.

All specimens are deposited in the collection of the Departamento Entomología, Museo de La Plata:

Description of the female larva of *Mecistogaster amalia* (Figs 1, 2)

Head: Almost 2.30x as wide as long; posterior margin concave. Pale brown, except anteclypeus, labrum, and antennae, which are dark; anteclypeus with two central pale narrow stripes. Antennae seven-segmented, the third antennomere the longest, distal portion of each antennomere with setae (Fig. 1a). Mandibular formula (Figs 1c-d): L 1234 y abd / R 1234 y ab. Prementum trapezoidal (Fig. 1b), 1.14x as long as wide; lateral margin with 15-16 setae on distal 0.5 and 8-10 setae on palpal articulation; ligula prominent, 0.16x as high as maximum width of prementum, free margin convex, slightly crenulated, with one stout seta in each concavity. Labial palp with seven setae, the proximal two short; external margin with ca 20 short setae. Palp distal margin finely crenulated from base of movable hook to inner recurved hook; this margin, with one seta at each crenulation, ending at an acute tooth near recurved hook; inner recurved hook smooth; movable hook approximately 0.6x as long as external margin of palp.

Thorax: Brownish. Wing pads dark brown, reaching to mid-length of S4; legs pale without dark pattern; femora I and II with spines on entire extensor margin; spines on femur III restricted to distal 0.3 of extensor margin. Branched setae on tibiae and tarsi: > 30 / > 15 (leg I), > 40 / > 15 (leg II) and > 40 / > 15 (leg III). Feather-like setae on tibiae and tarsi: > 15 / > 30 (leg I), > 15 / > 40 (leg II) and > 20 / > 40 (leg III).

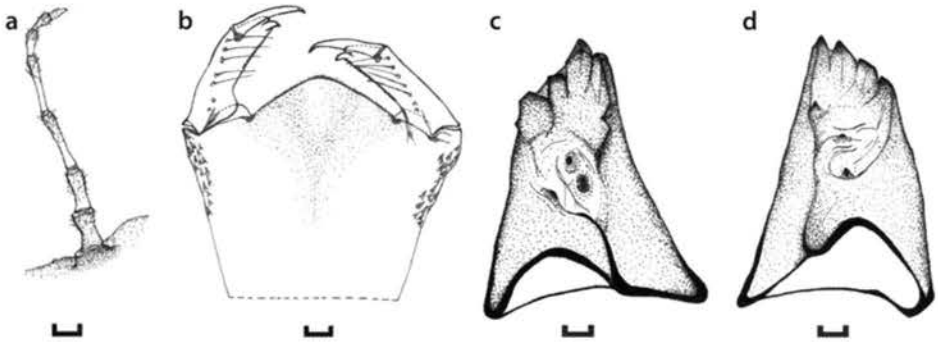

Figure 1: Final stadium larva of *Mecistogaster amalia* — (a) antenna; (b) prementum, dorsal view; (c) left mandible, internal view; (d) right mandible, internal view. Scale lines: 0.5 mm.

Abdomen: Brownish, progressively darkened caudad. Valves of ovipositor (Fig. 2a) 2.26x as long as the length of S10, reaching S10 distal margin. Cerci 0.5x as long as the length of S10. Caudal lamellae (Figs 2b-c) blackish with minute pale spots, foliated and petiolated (width at ventral nodus to maximum width of caudal lamella ratio 0.42); tracheae poorly dichotomized. Lateral caudal lamellae (paraprocts) approximately 1.44x as long as wide; nodus at 0.23 (ventral) and 0.15 (dorsal) proximal; dorsal and ventral series of antenodal spines with 5 and 14 spines respectively. Medial caudal lamella (epiproct), 1.36x as long as wide; nodus in dorsal margin at basal 0.25 and in ventral margin at basal 0.16, series of antenodal spines at dorsal and ventral margins with 11 and 5 spines respectively.

Measurements [mm]: Total body length (without caudal lamellae): 24.8; head maximum length: 2.4; head maximum width: 5.5; prementum maximum length: 3.3; prementum maximum width: 2.9; length of movable hook of labial palp: 0.5; length of femur I: 2.8; femur II: 3.6; femur III: 4.2; length of tibia I: 3.3; tibia II: 4.0; tibia III: 4.7; inner wing pads: 8.6; outer wing pads: 8.8; abdomen maximum length: 17.4; length of S8: 1.7; S9: 1.4; S10: 1.2; cercus length: 0.5; ovipositor length: 1.8; lateral caudal lamellae length: 3.8; lateral caudal lamellae maximum width: 2.7; medial caudal lamella length: 3.7; medial caudal lamella maximum width: 2.8.

Diagnosis

M. amalia can be distinguished from its congeners by:

- distal portion of each antennomere with setae as in *M. modesta* (without in *M. asticta*, *M. linearis*, and *M. ornata*);

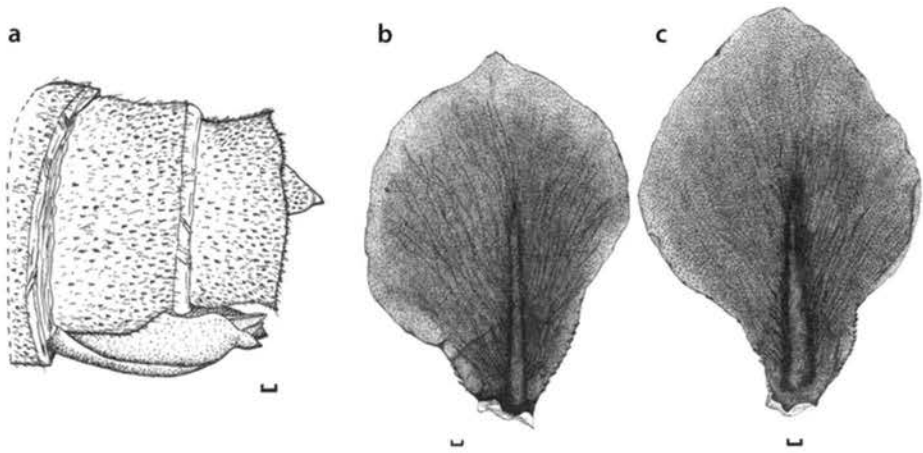

Figure 2: Final stadium larva of *Mecistogaster amalia* — (a) S9-10, lateral view; (b) epiproct, lateral view; (c) paraproct, lateral view. Scale lines: 0.5 mm.

- labial palp with seven setae (six in *M. ornata*, six to seven in *M. linearis*, and two in *M. asticta*);
- incisives of left mandible 1 < 2 < 4 < 3 (same size in *M. ornata*);
- valves of ovipositor reaching posterior margin of abdomen as in *M. linearis* and *M. modesta* (reaching half-length of S10 in *M. asticta* and *M. ornata*); however, this character seems to be variable in *M. modesta* since Calvert (1911) mentioned three specimens where the valves of ovipositor reach from anterior 0.5 to 1.125 of the length of S10;
- caudal lateral lamellae nearly 1.5 longer than wide as in *M. ornata* (1.4x in *M. amalia*, ca 1.6x in *M. ornata*, ca 2x in *M. modesta* and *M. linearis*, and 2.7x in *M. asticta*).

Comparison with other odonate larvae

Common characteristics of *M. amalia* with other pseudostigmatid larvae are:

- 7-segmented antennae with the third antennomere the longest;
- four to five mandibular incisives;
- prementum without premental setae, trapezoidal, maximum length to maximum width ratio: 1.2 in *Microstigma* and *Pseudostigma*, 1.6 in *Megaloprepus*, and 1.1 (*M. asticta*) to 1.5 (*M. ornata*) in *Mecistogaster*;
- ligula without medial cleft, height to maximum premental width ratio variable, from 1.0 in *M. asticta* to 2.3 in *M. modesta*;
- distal margin of labial palp with two teeth, the superior acute or truncated, the inferior recurved and acute, larger than the superior (equal in *M. caerulatus*);

- palpal setae variable: five to six in *Microstigma*, six to seven in *Megaloprepus* and *Mecistogaster* (except in *M. asticta* with only two), seven to eight in *Pseudostigma*;
- type D caudal lamellae (sensu Corbet 1999: 604), maximum length to maximum width ratio variable, from 1.3 in *Pseudostigma*, 1.7 in *Microstigma* and *Megaloprepus*, to 1.4 (*M. amalia*) and 2.7 (*M. asticta*) in *Mecistogaster*;
- petiolation variable: width at nodus to maximum width of caudal lamella ratio approximately 0.4 in *Megaloprepus* and *Pseudostigma*, 0.56 in *Microstigma* and 0.25 (*M. linearis*) to 0.56 (*M. asticta*) in *Mecistogaster*.

We found branched and feather-like setae in non phytotelmata-dwelling Zygoptera: branched and feather-like setae are present on tibiae and tarsi in *Hetaerina rosea* (Calopterygidae), *Homeoura chelifera*, *Ischnura fluviatilis*, and *Telebasis willinki* (Coenagrionidae); branched setae on tibiae and branched and feather-like setae on tarsi in *Lestes spatula* and *L. undulatus* (Lestidae), *Acanthagrion aepiolum*, *Argentagrion ambiguum*, *Homeoura chelifera*, *H. lindneri*, *Oxyagrion hempeli*, and *O. terminale* (Coenagrionidae).

Discussion

Pseudostigmatid larvae inhabit different kinds of phytotelmata, primarily tree holes (Fincke 2005), being those preferred by the genus *Mecistogaster* the most diversified, e.g. tree holes, bamboo internodes, and bromeliads. Congruently with its speciosity, *Mecistogaster* shows the greatest morphological disparity among Pseudostigmatidae, being the larva of *M. asticta* the most distinctive because of its fewer palpal setae and more lanceolated caudal lamellae. Due to the fact that many of the available larval descriptions were based on a few specimens, or only one sex is known, the presentation of an identification key, except for regional purposes (e.g. Ramírez 1995; Lencioni 2006), would be premature.

Branched and feather-like setae on larval tibiae and tarsi are present in other non phytotelmata-dwelling Zygoptera, therefore they do not constitute a synapomorphy for Pseudostigmatidae as previously suggested (Clausnitzer & Lindeboom 2002; Groeneveld et al. 2007).

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