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Immature stages of nine species of genus *Dynamine* Hübner, [1819]: morphology and natural history (Lepidoptera: Nymphalidae, Biblidinae)

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Abstract

Morphological and natural history aspects of the immature stages of nine species in the genus *Dynamine* Hübner, [1819], from eleven different locations in Brazil, are presented with illustrations, photographs and scanning electron microscopy. The results are discussed and compared with other species of Biblidinae.
KEY WORDS: Lepidoptera, Nymphalidae, Biblidinae, *Dynamine*, larva, morphology, Neotropical.

Estados inmaduros de nueve especies del género *Dynamine* Hübner, [1819]: morfología e historia natural (Lepidoptera: Nymphalidae, Biblidinae)

Resumen

Se presenta la historia natural y morfología de los estados inmaduros de nueve especies de *Dynamine* Hübner, [1819], procedentes de once lugares diferentes en Brasil, se presentan ilustraciones, fotografías y microscopía electrónica. Se discuten los resultados y se comparan con otras especies de Biblidinae.
PALABRAS CLAVE: Lepidoptera, Nymphalidae, Biblidinae, *Dynamine*, larva, morfología, Neotropical.

Estágios Imaturos de nove espécies de *Dynamine* Hübner, [1819]: morfologia e história natural (Lepidoptera: Nymphalidae, Biblidinae)

Resumo

Aspectos morfológicos e de história natural dos imaturos de nove espécies de *Dynamine* Hübner, [1819], provenientes de onze diferentes localidades no Brasil, são apresentados através de ilustrações, fotografias e microscopia eletrônica de varredura. Os resultados são discutidos e comparados com outras espécies de Biblidinae.
PALAVRAS CHAVE: Lepidoptera, Nymphalidae, Biblidinae, *Dynamine*, larva, morfologia, Neotropical.

Introduction

Among all clades of Nymphalidae, the subfamily Biblidinae is recognized by the presence of the hypandrium, a posteroventral sclerotized structure near the male genitalia formed from the terminal sternite (JENKINS, 1990; HARVEY, 1991; BROWER, 2000; WAHLBERG *et al*., 2003; FREITAS & BROWN, 2004). Biblidinae was formerly considered as a tribe of Limenitidinae, until

morphological (FREITAS & BROWN, 2004) and molecular studies (BROWER, 2000; WAHLBERG *et al.*, 2003, 2009) confirmed the independence of this clade, and its status as a subfamily.

In Biblidinae, the morphological, behavioral and resource use diversity is quite high, but the internal clades within this subfamily appear to be well defined by adult and immature morphological characters (FREITAS *et al.*, 1997). One of these clades is the tribe Eubagini (= Subtribe Eubagina according to LAMAS, 2004), composed only of the genus *Dynamine* Hübner, [1819]. *Dynamine* has been defined by a few wing venation characters and by the color of the wings (PEÑALVER & GRIMALDI, 2006), and although some authors considered the genus as presenting a great morphological homogeneity, the genus is quite diverse in terms of wing pattern (DEVRIES, 1987; BROWN, 1992; NEILD, 1996; LEITE *et al*., in prep.). The genus has 41 described extant species (LAMAS, 2004; BRÉVIGNON, 2008; WILLMOTT & HALL, 2010) and one fossil species (PEÑALVER & GRIMALDI, 2006). With this species richness it shares with *Eunica* Hübner, [1819] the status of the most speciose genus within the Biblidinae.

Although many *Dynamine* are common throughout the Neotropical region, there is a general lack of information about the biology of the genus, and most available studies are simple distribution notes and food plant records (RILEY, 1975; DOYLE, 1979; DEVRIES, 1987; WETHERBEE, 1987; BROWN, 1992; NEILD, 1996; FREITAS *et al.*, 1997). Information on the immature stages is also incomplete, with the first available reference from the late nineteenth century (MÜLLER, 1886). Since then, few studies have been published with information about the biology of the genus, with most studies being incomplete and poorly documented (DEVRIES, 1987; WETHERBEE, 1987; but see LEITE *et al*., 2012).

According to the literature, the larvae of *Dynamine* feed on species belonging to the genera *Dalechampia* and *Tragia* (Euphorbiaceae), consuming leaves, floral structures, ovaries and pseudanthia, depending on the species (DEVRIES, 1987; NEILD, 1996; LEITE *et al*., 2012).

Since data of the immature stages have been shown to be important to complement taxonomic and phylogenetic studies in several groups of Lepidoptera (TYLER *et al*., 1994; HASENFUSS & KRISTENSEN, 2003; FREITAS & BROWN, 2004, 2008), the present study has the objective to describe the morphology and natural history of several Brazilian species of *Dynamine*, thus contributing to a greater understanding of this genus in particular, and of the Biblidinae as a whole.

Material and methods

The immature stages of the species studied were collected in the field within 11 different locations in Brazil, representing six states (Acre, Mato Grosso, Rio de Janeiro, São Paulo, Paraná and Rio Grande do Sul). The numbers of studied immature stages vary from one to 15 (see results).

Dynamine aerata aerata (Butler, 1877): Sincrotron Laboratory, Barão Geraldo, Campinas, São Paulo (22º 48’ S, 47º 03’ W, 610 m).

Dynamine anubis anubis (Hewitson, 1859): Reserva Extrativista do Alto Juruá, Marechal Thaumaturgo, Acre (9º 09’ S, 72º 29’ W, 282 m).

Dynamine artemisia artemisia (Fabricius, 1793): Reserva Florestal da Santa Genebra, Barão Geraldo, Campinas, São Paulo (22º 49’ S, 47º 06’ W, 650 m). Serra do Japi, Jundiaí, São Paulo (23º 13’ S, 46º 58’ W, 900 m).

Dynamine athemon athemaena (Hübner, [1824]): Rio Telles Pires, Alta Floresta, Mato Grosso (9º 39’ S, 55º 57’ W, 270 m). Parque Barigüi (25º 25’S, 49º 18’W, 911 m) and Centro Politécnico of the Universidade Federal do Paraná, Jardim das Américas (25º 26’S, 49º 13’W, 919 m), Curitiba, Paraná. Maromba, Parque Nacional do Itatiaia, Itatiaia, Rio de Janeiro (22º 26’ S, 44º 37’ W, 1100 m).

Dynamine coenus (Fabricius, 1793): Reserva Florestal da Santa Genebra, Barão Geraldo, Campinas, São Paulo (22º 49’ S, 47º 06’ W, 650 m).

Dynamine gisella (Hewitson, 1857): Reserva Extrativista do Alto Juruá, Marechal Thaumaturgo, Acre (9º 09’ S, 72º 29’ W, 282 m).

Dynamine myrrhina (Doubleday, 1849): Catuípe, Rio Grande do Sul (28º 15' S, 54º 0' W, 322 m).

Dynamine postverta postverta (Cramer, 1779): Reserva Florestal da Santa Genebra, Barão Geraldo, Campinas, São Paulo (22º 49' S, 47º 06' W, 650 m). Morro do Voturuá, São Vicente, São Paulo (23º 58' S, 46º 21' W, 150 m). Centro de Biologia Marinha da USP, São Sebastião, São Paulo (23º 49' S, 45º 25' W, 10 m). Parque Barigüi (25º 25'S, 49º 18'W, 911 m) and Centro Politécnico of the Universidade Federal do Paraná, Jardim das Américas (25º 26'S, 49º 13'W, 919 m), Curitiba, Paraná.

Dynamine tithia tithia (Hübner, [1823]): Reserva Florestal da Santa Genebra, Barão Geraldo, Campinas, São Paulo (22º 49' S, 47º 06' W, 650m). Parque Barigüi (25º 25'S, 49º 18'W, 911 m) and Centro Politécnico of the Universidade Federal do Paraná, Jardim das Américas (25º 26'S, 49º 13'W, 919 m), Curitiba, Paraná.

All details relating to procedures for the maintenance of the individuals in the laboratory along with the host plants, as well as for preparation of drawings and photographs, use of scanning electron microscopy, morphological terminology and deposition of voucher material, are as described by LEITE *et al*., (2012).

Shed head capsules, pupal exuviae, and the adults are deposited in the Museu de Zoologia "Adão José Cardoso" (ZUEC), Universidade Estadual de Campinas, Campinas, São Paulo, Brazil, and in the Universidade Federal do Paraná, Curitiba, Paraná, Brazil.

Results

Morphology and natural history of immature stages

Dynamine aerata aerata (Butler, 1877) (Figs 9, 10, 19-32).

Egg: 0.80 mm high x 0.54 mm in diameter; pale greenish yellow, truncated, conspicuous longitudinal ridges and inconspicuous transverse ridges (n = 1).

1st instar: Head: 0.51mm wide, pale yellowish brown, rounded, without scoli or ornamentation; mouthparts brown, stemmatal region blackish with stemmata arranged in a semicircle. Body: cream colored, thoracic and abdominal legs with same color as head, base of the setae whitish; dorsal setae from T2 to A8 darkened with dorsal end globose, hyaline and covered by a viscous liquid, remaining setae with the same color of the body, as well as the thoracic and anal plates (n = 1).

2nd-3rd instars: Head: pale yellow without ornamentations, setae cream colored, stemmata blackened. Body: yellowish, thoracic and abdominal legs pale yellow; setae cream colored with a hyaline distal portion in all segments (n = 1).

4th-5th instars: Head: fifth instar 2.06 mm wide, yellowish green, without ornamentations or scoli. Body: green, with narrow parallel dorsolateral longitudinal cream colored stripes, becoming arched at the level of the subdorsal scoli and directed ventrally; intersegmental regions cream colored; scoli translucent with slightly darkened distal portion. Body scoli short and branched with four to six spines ending in small apical viscose vesicles. Duration (n = 1): 1st instar: 2 days; 2nd instar: 2 days; 3rd instar: 3 days; 4th instar: 3 days; 5th (last) instar: 5 days (n = 1).

Pupa: Yellowish green with small brown spots irregularly distributed from the vertex to the distal margin of the wings; a brown median-dorsal stripe from the dorsolateral projections on the vertex to A8; a brown narrow median-ventral stripe from A4 to A8. General profile elongated; segments T2 and A2 with conspicuous dorsal projections; the projection at A2 with a foliaceous aspect and about three times larger than the projection on T2 (Fig. 29) (a condition not observed in the other *Dynamine* species). Tegument thin, smooth, and with sparse setae from A4 to A10; mobile abdominal segments Duration: 8 days (n = 1).

Natural History: The species uses *Tragia volubilis* L. (Euphorbiaceae) as its host plant in the study site in Campinas. It feeds on flower buds during the first two instars, and changes to leaves in later instars. When feeding on flower buds, the development time of each instar is about two days,

while feeding on leaves, the periods are extended. Adults are observed flying in open habitats and forest edges, and are usually attracted to mud and wet sand.

Dynamine anubis anubis (Hewitson, 1859) (Figs 3, 4, 142, 143, 150-152).

Egg: 0.80 mm high x 0.7 mm in diameter, cream colored, truncated, flattened upper pole, marked with longitudinal ridges and several inconspicuous transverse ridges (n = 2).

1st instar: Head: 0.3 mm wide, pale green without scoli or spines. Body: pale green; thoracic legs, abdominal legs and anal plate translucent green (n = 1).

2nd-5th instars: Head: second instar 0.4 mm wide, fourth instar 1.1 mm and fifth instar 1.7 mm (third instar not measured); completely green during all instars, without scoli or spines. Body: green during all instars, becoming darker during the last ones; thoracic and abdominal legs green. Body scoli short and branched with four to six spines ending in small apical viscose vesicles. Maximum length: 15 mm during the fifth (last) instar. In general, resembles the larvae of *Dynamine artemisia* and *Dynamine gisella* (n = 2).

Pupa: 14 mm long; light brown; general profile elongated; segments T2 and A2 with conspicuous dorsal projections, both distally bifurcated; mobile abdominal segments. Duration: 6-8 days (n = 2).

Natural History: Females lay their eggs singly in the leaf axils of *Dalechampia scandens* L. in Acre. The larvae eat part of the corium after hatching and were observed feeding preferentially on young leaves. The larvae usually remain on the adaxial surface of the leaf, even under direct sunlight.

Dynamine artemisia artemisia (Fabricius, 1793) (Figs 11, 12, 33-51, 136, 137, 153-155).

Egg: 0.86 mm high x 0.7 mm in diameter, cream colored, truncated, flattened upper pole, marked with longitudinal ridges, inconspicuous transverse ridges (n = 3).

1st instar: Head 0.36 mm wide; pale green; without spines or ornamentation. Body: pale green, thoracic legs, abdominal legs and anal plate translucent green, abdominal legs with seven crochets; prothoracic setae colorless, long (about 0.3 mm) compared to height of the segment (0.4 mm). Maximum length: 2.3 mm (n = 2).

2nd-5th instars: Head: 0.56 mm wide during the second instar, third instar 0.76 mm, fourth instar 1.2 mm and fifth instar 1.7 mm; completely green during all stages, without scoli or spines. Body: green during all instars, becoming darker during the last stages, with a pair of dark green dorsolongitudinal stripes; thoracic and abdominal legs green. Body scoli short and branched with four to six spines ending in small apical viscose vesicles. Maximum length: 3 mm during the second instar, third instar 6 mm, fourth instar 11 mm and fifth instar 17 mm. Duration: 3-4 days on the second, third and fourth instars; fifth (last) instar 4-5 days (n = 2).

Pupa: 14 mm long; initially light green becoming darkened close to adult emergence; general profile elongated; segments T2 and A2 with conspicuous dorsal projections; mobile abdominal segments. Duration: 7-9 days (n = 4).

Natural History: In Campinas and Jundiaí, females lay their eggs singly in the leaf axils of *Tragia sellowiana* Müll. Arg., usually on young leaves at the plant apex. The larvae eat part of the corium after hatching and were observed feeding preferentially on young leaves. The larvae usually begin feeding near the petiole, causing an inclination of the leaf. Adults are common, and exhibit a low flight (1 to 4 m high), being usually observed along trails and shadowy forest edges where its host plant is abundant.

Dynamine athemon athemaena (Hübner, [1824]) (Figs 1, 2, 52-68, 147-149).

Egg: 0.8 mm high x 0.63 mm in diameter; truncated, marked with longitudinal ridges, inconspicuous transverse ridges (n = 6).

1st instar: Head: translucent pale amber, smooth, without scoli or ornamentations, hyaline setae; region of the mouthparts brown and the stemmatal region blackened. Body: T1, thoracic legs,

abdominal legs and A9-A10 hyaline, as well as all the setae, the rest of the body translucent pale yellow (n = 3).

2nd instar: Head similar to previous instar. Body cream colored with hyaline setae (n = 3).

3rd instar: Head olive green. Body translucent pale green with cream colored intersegmental regions; narrow dorsolongitudinal cream colored stripe from T2 to A9; scoli hyaline (n = 3).

4th instar: Head olive green. Body grayish green with cream colored intersegmental regions and a narrow transverse whitish stripe on the anterior margin of A1 to A9; scoli hyaline; prothoracic and anal plates similar in color to the head, as well as the thoracic and abdominal legs; greenish brown spiracles (n = 3).

5th (last) instar: Head: 1.7 mm wide, yellow ocher. Body: yellow ocher with a distinct dorsolongitudinal cream colored stripe from T2 to A9 and narrow transverse, or arched, or irregular cream colored stripes on all the segments of the body; scoli cream colored with a slightly darkened distal portion. Body scoli short and branched with four to six spines ending in small apical viscose vesicles. Maximum length: 16 mm. In general, resembles the larvae of *Dynamine anubis* and *Dynamine artemisia* (n = 5).

Pupa: 10 mm long, cream colored, anterior half with translucent aspect and the posterior half with small brown spots; light brown narrow ventral line from A4 to A8; general profile elongated; segments T2 and A2 with conspicuous dorsal projections; both distally bifurcated; mobile abdominal segments. Duration: 8 days (n = 5).

Natural History: The species uses *Dalechampia triphylla* Lam. (Euphorbiaceae) as a host plant in Itatiaia, and around Curitiba, feeding on the floral structures inside the pseudanthia, often seen with the head inside the structures while feeding (Fig. 53). They may also remain outside the pseudanthia in the involucral bracts or on young leaves and stems. Adults are locally common, and can be easily seen in forest gaps and forest edges, flying from 1 to 5 m high, usually nearby patches of its host plants. In Southeastern Brazil, this species is associated with humid areas in the forest.

Dynamine coenus (Fabricius, 1793) (Figs 5, 6, 69-74).

Egg: 0.63 mm high x 0.58 mm in diameter; truncated, marked with longitudinal ridges more dilated at the upper pole (Fig. 73), transverse ridges visible on the upper and lower thirds, however inconspicuous with respect to the longitudinal ones (n = 1).

Dynamine gisella (Hewitson, 1857) (Figs 17, 18, 75-80).

2nd-5th instars: Head: 1.9 mm wide during the fifth instar, green during all instars, without scoli or spines. Body: green during all instars, becoming darker during the last ones; thoracic and abdominal legs green. Body scoli short and branched with four to six spines ending in small apical viscose vesicles. Maximum length: 18 mm during the fifth (last) instar. In general, resembles the larvae of *Dynamine artemisia*, although it is larger (n = 3).

Pupa: 15 mm long; light brown; general profile elongated; segments T2 and A2 with conspicuous dorsal projections, both distally bifurcated, wings with conspicuous latero-distal ridges; mobile abdominal segments. Duration: 8 days (n = 2).

Natural History: The larvae were observed feeding on mature leaves of an unidentified *Dalechampia* species growing within the forest. Larvae usually remain on the upper leaf surface. In Acre, males of *D. gisella* were frequently observed puddling on sand on river banks, in mixed groups together with several species of Biblidinae (Nymphalidae), including *Callicore*, *Diaethria*, *Asterope* and other species of *Dynamine*.

Dynamine myrrhina (Doubleday, 1849) (Figs 7, 8, 81-84).

Egg: Pale greenish yellow, truncated, marked with longitudinal ridges, inconspicuous transverse ridges (n = 1).

1st instar: Head: pale yellowish brown, rounded, without scoli or ornamentation; region of the mouthparts brown and blackened stemmatal region. Body: yellowish ocher from T2 to A7; T1, A8-

A10, thoracic and abdominal legs pale yellow colored; base of setae whitish, setae of the body hyaline, with the dorsal and subdorsal being distally globose, other remaining setae of spiniform aspect (n = 1).

Natural History: Eggs were collected on mature leaves of an unidentified *Dalechampia* species. This species is typical of colder habitats, being common in montane forests, especially in South Brazil. Adults are common flying low in forest edges near its host plants.

Dynamine postverta postverta (Cramer, 1779) (Figs 15, 16, 85-107, 132-135, 144-146).

Egg: 0.63 mm high x 0.65 mm in diameter, white, truncated, flattened upper pole, marked with conspicuous longitudinal ridges, inconspicuous transverse ridges barely visible (n = 7).

1st instar: Head 0.36 mm wide; pale green; without scoli or spines. Body pale green, thoracic and abdominal legs and anal plate, light green; abdominal legs with five crochets; prothoracic setae without color, long (about 0.34 mm) compared to the height of the segment (0.30 mm). Maximum length of about 2.3 mm. Duration: 2-4 days (n = 5).

2nd-5th instars: Head: totally green during all instars (2.14 mm wide during the fifth instar), and without scoli or spines. Body: green with a cream colored dorsolongitudinal stripe from T2 to the anterior half of A9 during all stages, often becoming darker during the last instars, the fifth instar may be light green, dark green, brown or mottled, probably following the color of the substrate; thoracic and abdominal legs greenish. Body scoli short and branched with four to six spines ending in small apical viscose vesicles. Maximum length during the fifth (last) instar: 18 mm. Duration: 5-7 days (n = 15).

Pre-pupa: Cream colored; stemmatal region brownish; dorsoventrally curved, inferior region of the head in contact with the sixth abdominal segment. Duration: 1-2 days (n = 15).

Pupa: 15-17 mm long; initially pale green, becoming light brown 24-48 hours after forming; general profile elongated; segments T2 and A2 with conspicuous dorsal projections, both distally bifurcated; ocular buffers short and pointed; abdominal segments mobile. Duration 7-9 days (n = 12).

Natural History: Females lay their eggs individually on leaves and on the pseudanthia of *Dalechampia pentaphylla* Lam, *Dalechampia stipulacea* Müll. Arg. and *Dalechampia triphylla* Lam, in the region of Campinas, on the pseudanthia of *Dalechampia triphylla* Lam in Curitiba region, and on the pseudanthia of *Dalechampia leandrii* Baill. in the coastal plain. The eggs were observed on all the floral structures. After hatching, the larvae eat part of the corium and then feed preferentially on floral parts, including the ovary, styles, pollen and viscose resin present in various species of *Dalechampia*, although they may also feed on the young leaves of the host plant when flowers are not available. Camouflage appears to be the primary defensive strategy of the larvae; they change body color during each instar, depending on the substrate and, at times, adhere flower fragments and feces to the viscose vesicles present on the scoli. This is one of the most common species in Southeastern Brazil, and several adults can be easily observed flying from 1 to 10 m near patches of its host plants. This species can be found in several different habitats, from the pluvial forests of the coastal region to dry cerrado areas in the interior. Additionally, *D. postverta* is very tolerant to disturbance, being observed in disturbed secondary forests, open edges and urban parks.

Dynamine tithia tithia (Hübner, [1823]) (Figs 13, 14, 108-131, 138-141, 156-158).

4th instar: Head: 1.3 mm wide; without scoli or spines. Body: brown with a purple reflection depending on the light incidence, with cream colored dorsal stripes, slightly oblique dorsal-lateral stripes are more defined on the abdominal segments; lateroventral region cream colored only on the abdominal segments, brown thoracic legs, abdominal legs and anal plate cream colored. Body scoli strongly reduced, with spines arosing directly from the body, but also bearing the small apical viscose vesicles decribed for the other species of *Dynamine*. Maximum length: 14 mm (n = 10).

5th (last) instar: Head: 1.9 mm wide; ocher; without scoli or spines. Body: green with narrow dark brown transverse stripe on the anterior margin of A1; lateroventral region only cream colored on the abdominal segments, thoracic legs light brown, abdominal legs and anal plate green; body

scoli strongly reduced as in previous instar. The larvae change to green two days after molting, becoming yellowish olive green in the prepupal stage. Maximum length: 20 mm. Duration: 5-7 days (n = 10).

Pupa: 14 mm long, green, with conspicuous hairiness on the tegument, and with a more rounded profile; without the conspicuous projections on T2 to A2, observed in the other *Dynamine* species; abdominal segments mobile. Duration: 6-9 days (n = 8).

Natural History: The larvae were observed feeding only on floral parts in pseudanthia of *Dalechampia pentaphylla* Lam. in Campinas and *Dalechampia triphylla* Lam. in Curitiba. The larva begins feeding on the male flowers (including the abundant pollen), and then makes a hole in the flower to reach the ovary, where it feeds until it eats all the plant tissue. This larva is the most specialized for feeding inside flowers, and could be considered as endophagous. Pupation occurs outside the pseudanthia. The occurrence of the parasitoid *Microcharops* sp. (Ichneumonidae: Campopleginae) was observed, emerging through a circular hole on the tegument of the prepupa, which acquires a cream color and is smaller in size when parasitized. Adults are common near patches of the host plants, flying from 1 to 3 m high.

Natural History of the Adults

As commented above, the adults of *Dynamine* are frequently found flying erratically near patches of their host plants (*Tragia* and *Dalechampia* usually grow together in many places throughout the Neotropics), in forest edges, clearings, along rivers and other open sunny habitats. Males are often observed perching on leaves from 1 to 10 m high, and some species exhibit territorial behavior. About six to ten species of *Dynamine* can be observed flying in a single site, usually accompanied by other Biblidinae such as *Biblis* Fabricius, 1807; *Mestra* Hübner, [1825], *Myscelia* Doubleday, [1845]; *Ectima* Doubleday, [1848]; *Hamadryas* Hübner, [1806] and *Cybdelis* Boisduval, 1836 (all using *Tragia* and *Dalechampia* as host plants). Adults are seldom attracted to flowers or by decaying fruits (although many forest species are attracted to traps baited with rotting fish; K. R. Willmott, pers. comm.), but most males and some females are commonly found puddling on mud or wet sand, together with numerous individuals of other butterflies, being easily observed along riverbanks and muddy areas.

Discussion

The overall egg morphology described here is similar to those previously described for other *Dynamine* species, as previously recorded by LEITE *et al.*, (2012) with *Dynamine agacles agacles* (Dalman, 1823).

As previously described for *D. agacles* (LEITE *et al*., 2012), the first instar of all known species of *Dynamine* bears relatively long body setae (ratio between setal length/segment height usually about or over 1.0), a feature also shared with all known Biblidini and Eurytelini, and with the genera *Cybdelis* Boisduval, 1836 and *Sea* Hayward, 1950, though the setae in the last two genera are somewhat shorter (ratio about 0.7) (FREITAS *et al*., 1997). Another characteristic of first instars of *Dynamine* is the presence of less than eight crochets on the prolegs (FREITAS & BROWN, 2004; LEITE *et al*., 2012), and this could be considered an apomorphy of *Dynamine* within the Biblidinae.

From the second to the last instar, the larvae of *Dynamine* are entirely different from all other known Biblidinae because they lack head scoli (although some *Eunica* present strongly reduced head scoli, FREITAS *et al*., 1997), and also due to their distinct larval appearance, very similar to Lycaenidae larvae, many of which also feed on floral structures (MONTEIRO, 1991; DUARTE *et al.*, 2005; KAMINSKI *et al*., 2012). The genus *Neptidopsis* Aurivillius, 1898, also known to feed on floral structures (VAN SON, 1979; ARMBRUSTER & MZIRAY, 1987), appears to have an intermediate condition between *Dynamine* and the remaining Biblidinae, also presenting a distinct larval appearance, and short head scoli (A. V. L. FREITAS, unpublished). Among all studied species,

Dynamine tithia tithia is the most distinctive concerning the larval morphology, presenting the most extreme adaptations for feeding inside floral structures, including the great reduction in body scoli. This species appears to be the most specialized species for living inside pseudanthia, feeding exclusively on floral structures, whereas in the other species the exclusively endophagous habit is not observed, and the larvae can feed on other parts of the host plant (DEVRIES, 1987; NEILD, 1996; LEITE *et al*., 2012).

DEVRIES (1987) described the *Dynamine* pupa as being like a miniature pupa of *Diaethria*, but with more prominent dorsal projections of T2 and A2. The size and shape of these projections are variable within the genus, and based on the present results, four groups can be defined: Group 1: in *D. athemon*, *D. postverta*, *D. gisella* and *D. anubis*, these projections are conspicuous and distally bifurcated; Group 2: in *D. aerata* and *D. artemisia*, they are long with a single point, although the dorsal projection of A2 in *D. aerata* is larger than in *D. artemisia*, and with a foliaceous appearance; Group 3: *D. agacles* has also simple projections, but these are much more reduced compared with *D. aerata* and *D. artemisia*; and Group 4: in *Dynamine tithia tithia* the pupa show no conspicuous projections. *Dynamine tithia* is the most distinct with respect to pupal morphology, not only by lacking the above projections, but also differing from all other species by lacking the lateral projections in the apex and by presenting an integument covered by numerous setae. Whether these characteristics are exclusive to *D. tithia* or not depends on additional knowledge of immature stages of other *Dynamine* species. It would be interesting to know the immatures of species with similar external adult characters which are possibly closely related to *Dynamine tithia*, such as *Dynamine sara* (H.W. Bates, 1865), *D. racidula* (Hewitson, 1852), *D. colombiana* Talbot, 1932 and *D. intermedia* Talbot, 1932.

Although Biblidinae larvae are known to feed on many different plant families, most clades are restricted to the Euphorbiaceae (ACKERY, 1988; ACKERY & RAJAN, 1988; LARSEN, 1991; ARMBRUSTER, 1994, BECCALONI *et al*., 2008). The exceptions are the genus *Eunica,* which feeds on several plant families, and the tribes Epiphilini and Callicorini, which use mainly Sapindaceae (FREITAS & OLIVEIRA, 1992, BECCALLONI *et al*., 2008). The genus *Dynamine* follows the more common pattern of using Euphorbiaceae, and all reliable records are in the genera *Dalechampia* and *Tragia* (LEITE *et al*., 2012). Additional records on other genera of Euphorbiaceae or on different plant families require confirmation (BIEZANKO *et al.*, 1974; BECCALONI *et al*., 2008).

Different species of *Dynamine* are apparently specialized on using different plant structures. It is remarkable that some species feed on the floral structures inside pseudanthia, and use those as primary food sources. These behaviors could, in part, explain why *Dynamine* immatures (especially larvae) are so divergent from the remaining Biblidinae, as well as explain some of the morphological variation observed within the genus. In this respect, *Dynamine tithia tithia* could be considered the most specialized in using floral parts compared to other species (see above).

The unique structure of the body scoli, with small apically viscose vesicles in the apex of the spines (a possible synapomorphy of the genus, see MULLER, 1886 and LEITE *et al*., 2012), could also be related to the use of *Dalechampia* as host plant. Although the function and chemical composition of the viscose substance are both unknown, the consistency is very similar to that of the resin found in the *Dalechampia* flowers. It was observed that the larvae usually adheres variable amounts of pollen, feces or even other floral fragments to these vesicles, giving them a camouflaged appearance inside the pseudanthia, and consequently concealing their location.

The present study showed that *Dynamine* immatures are slightly more variable among species than the adults (LEITE *et al*., in prep.), and can be an important source of information for taxonomic, phylogenetic and ecological studies. Based on the immature stages, the genus is so divergent from all other genera of Biblidinae, however, that direct comparative studies are difficult. Although several morphological traits of *Dynamine* larvae could be related to adaptations to facilitate movement and feeding inside buds and flower parts (as suggested by LEITE *et al*., 2012), it is worth noting that

most of these morphological traits are common to all known species in the genus, including those that feed only on leaves.

Two hypotheses are possible to explain the evolution of some of the morphological traits of *Dynamine* immature stages: 1) the habit of feeding on *Dalechampia* flowers is ancestral in *Dynamine*, and most of the unique morphological traits (small size, lack of head horns and distinct larval appearance) are adaptations to feeding on or inside flower parts, and these traits were retained even in those species which switched to feeding on leaves; or 2) the ancestor of *Dynamine* fed primarly on leaves, occasionally feeding on flower parts, such as *Neptidopsis* and *Vila* (ARMBRUSTER & MZIRAY, 1987; FREITAS & BROWN, 2008), and some species successfully became specialists on flowers due to their small size, lack of head horns and reduced body scoli.

The answer to which hypothesis is more plausible, however, will be possible only after obtaining a well-supported phylogeny for the genus, and with additional information of immature stages of other *Dynamine* species. As previously stated by LEITE *et al*., (2012), a broad study mapping natural history and morphology in a phylogenetic framework, could help us to understand the evolution of such life history traits in *Dynamine* butterflies in particular, and the association between body size and specialized feeding habits in general.

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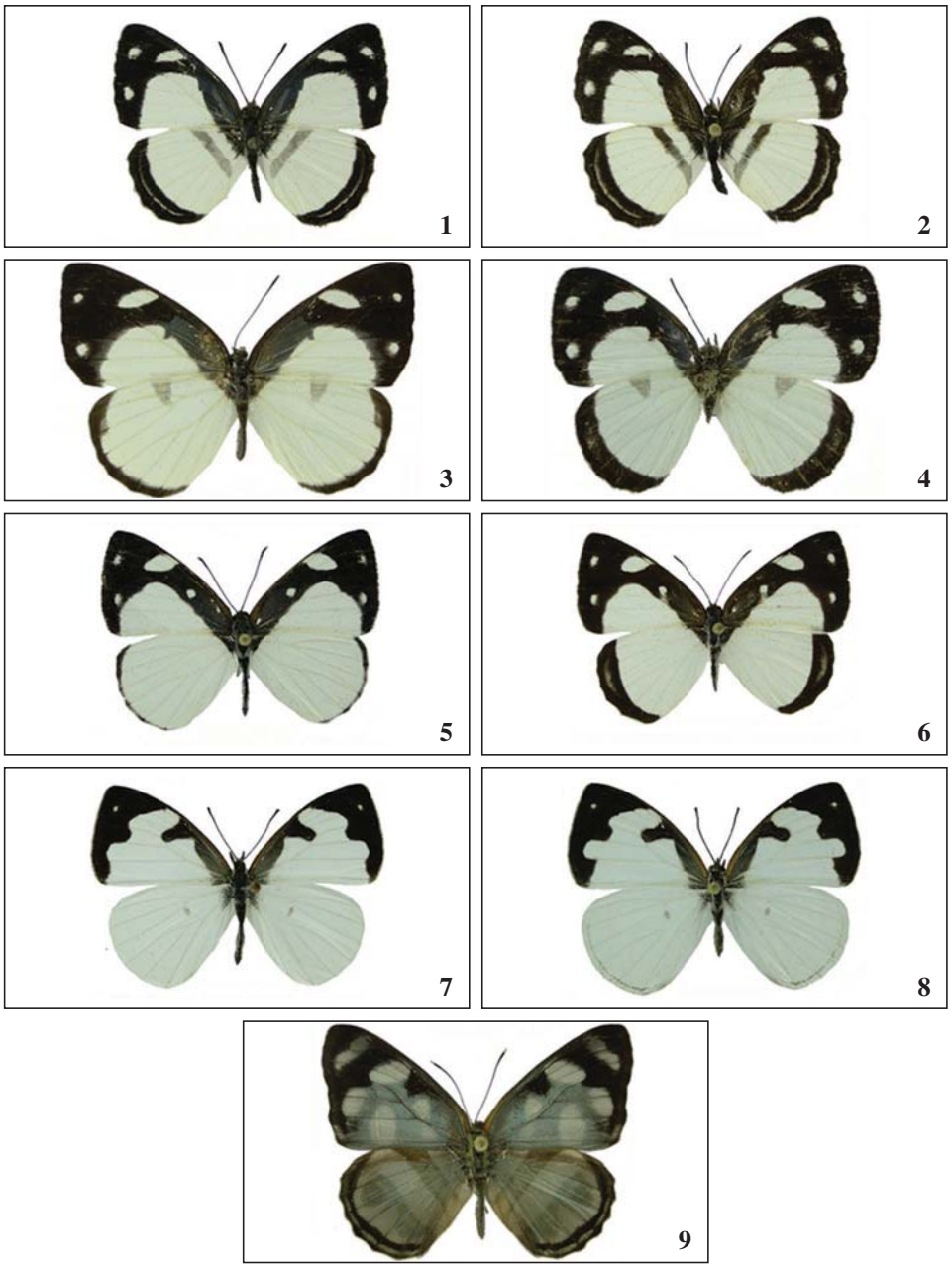
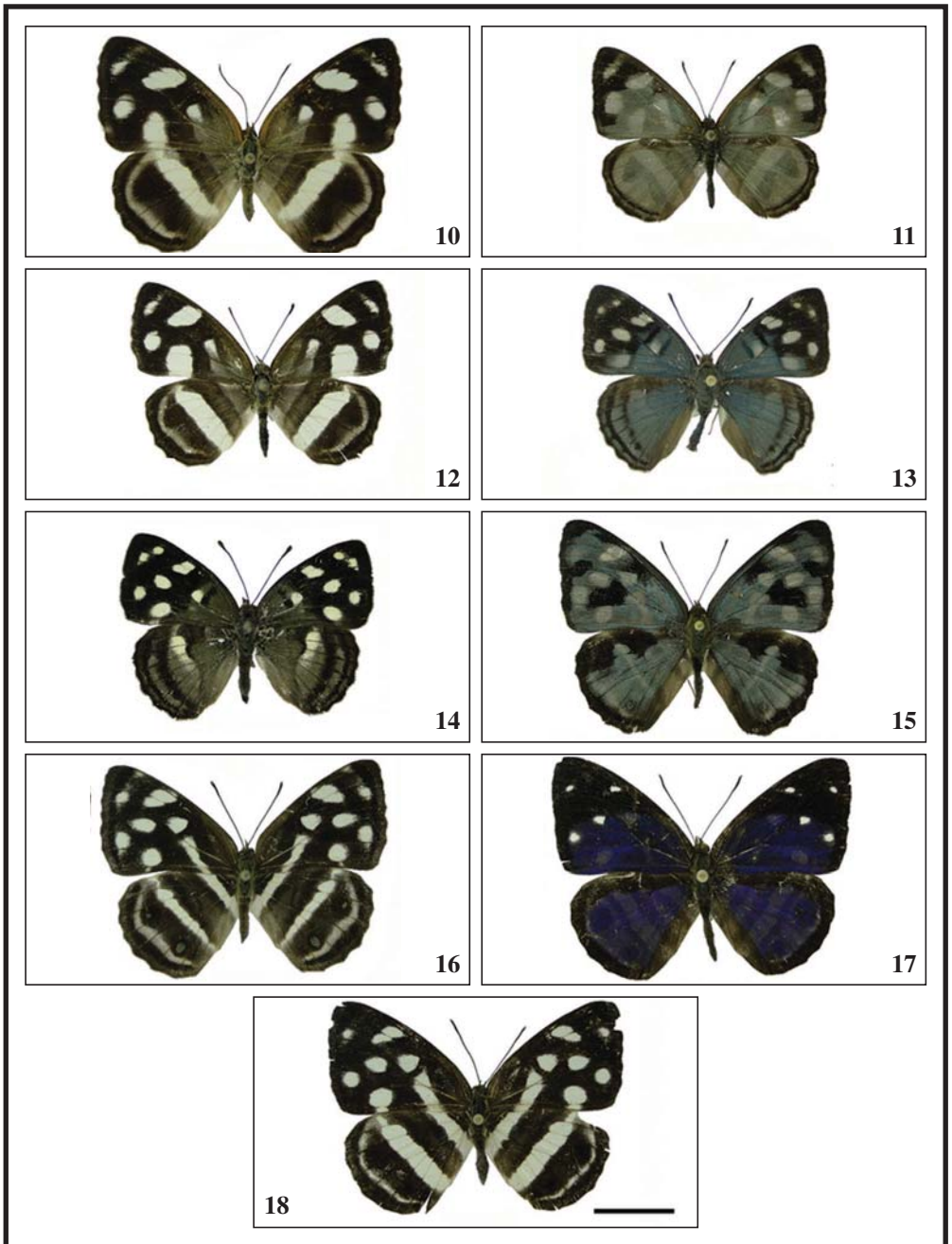
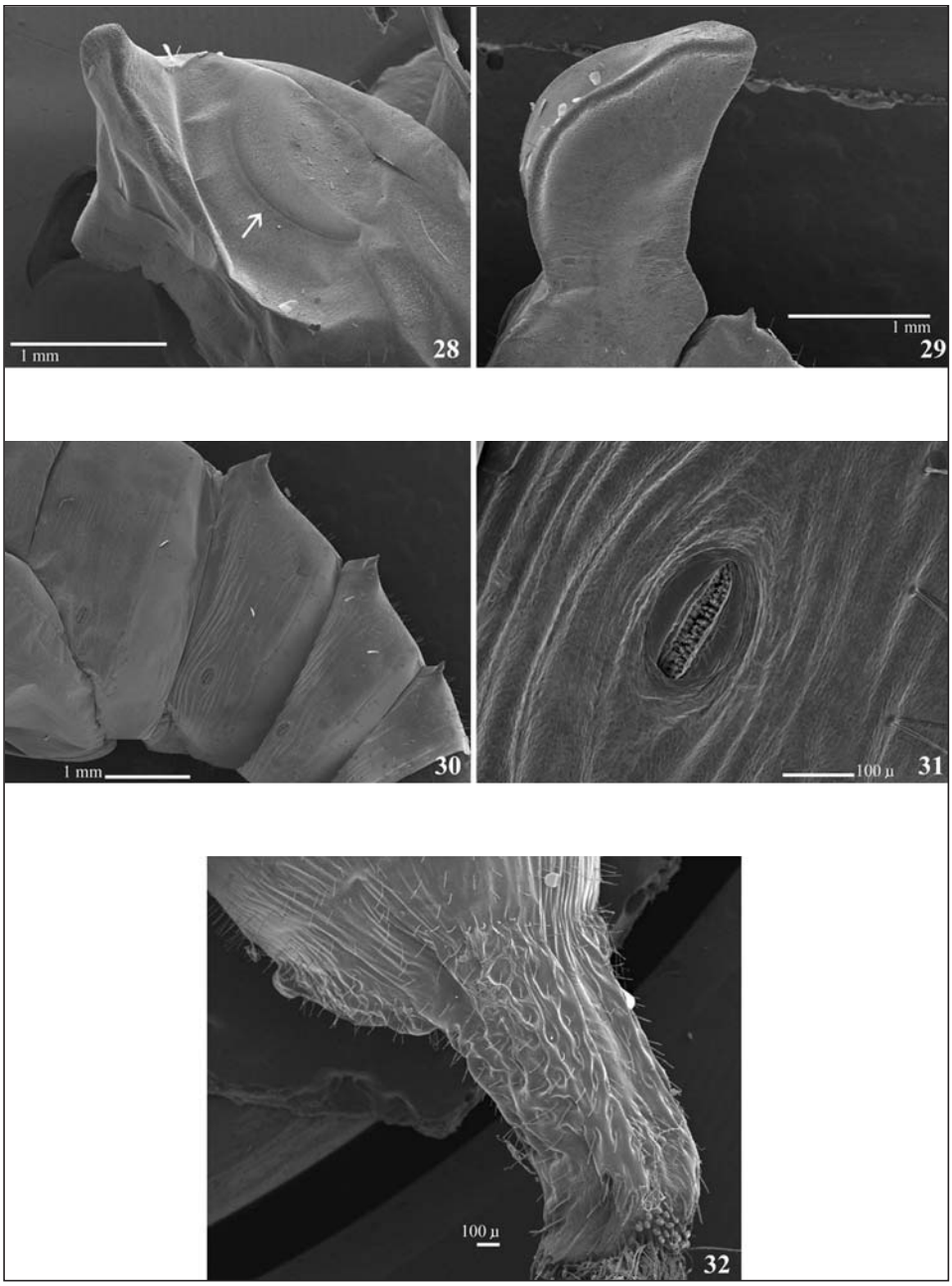


Figures 1-9.– *Dynamine* dorsal view. **1-2.** *Dynamine athemon athemaena*: (1) male; (2) female. **3-4.** *Dynamine anubis anubis*: (3) male; (4) female. **5-6.** *Dynamine coenus*: (5) male; (6) female. **7-8.** *Dynamine myrrhina*: (7) male; (8) female. **9.** *Dynamine aerata aerata*: male. Scale bar: 1cm.

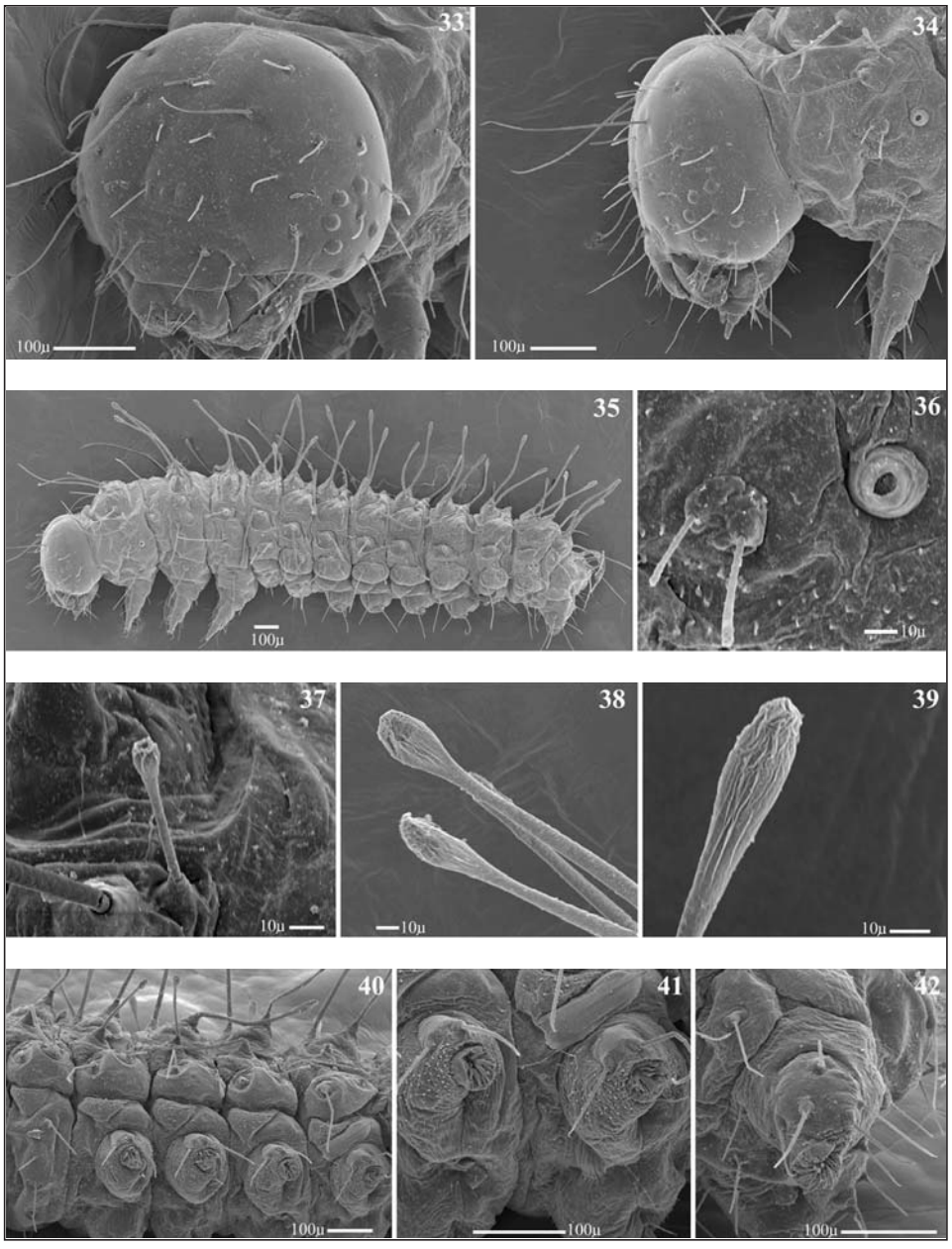


Figures 10-18.– 10. *Dynamine aerata aerata*: female. **11-12.** *Dynamine artemisia artemisia*: (11) male; (12) female. **13-14.** *Dynamine tithia tithia*: (13) male; (14) female. **15-16.** *Dynamine postverta postverta*: (15) male; (16) female. **17-18.** *Dynamine gisella*: (17) male; (18) female. Scale bar: 1cm.

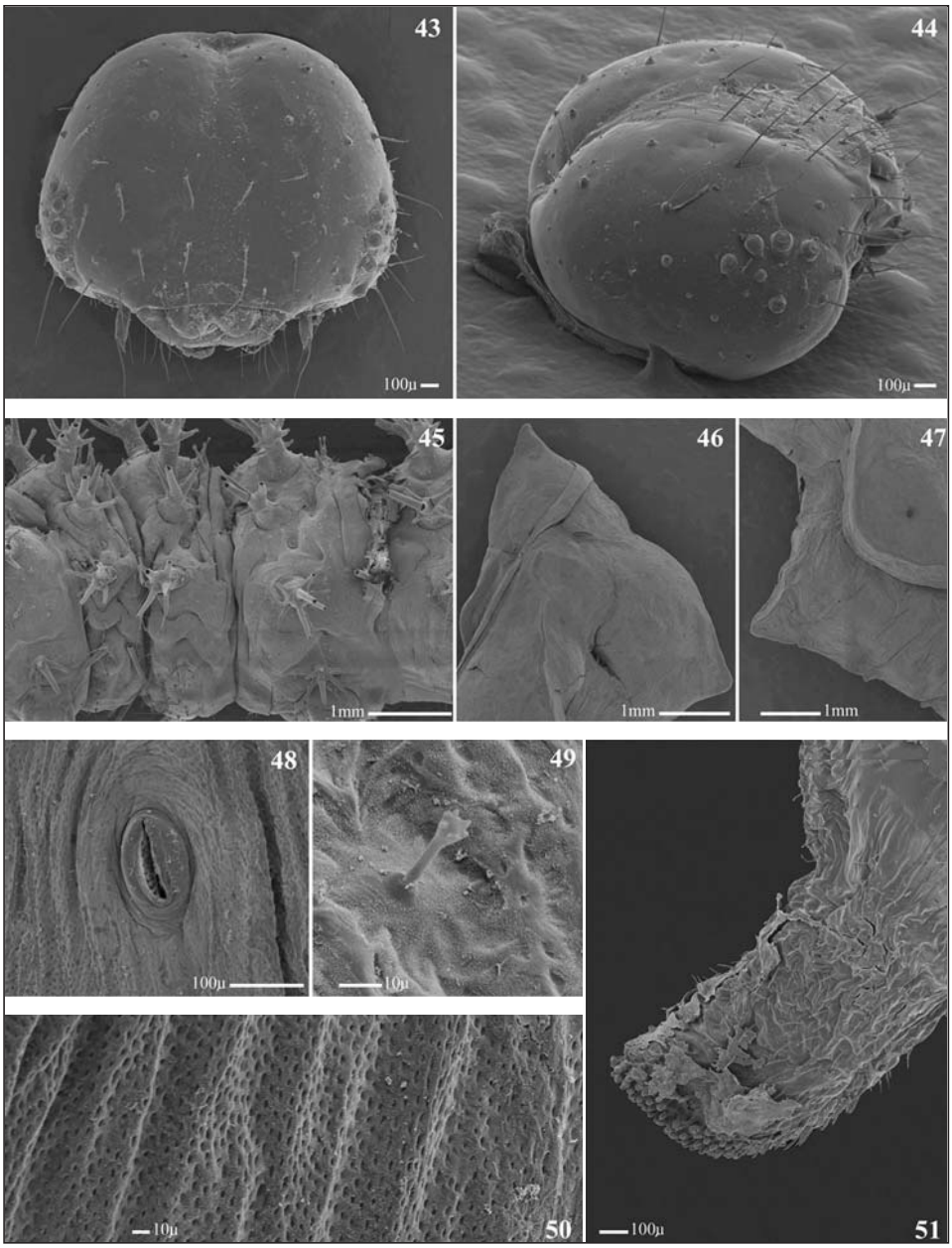
Figures 19-27.– 19. *D. aerata aerata*. Egg. **20-24.** Larvae: (20, 21) 1st instar; (22) 3rd instar; (23) 4th instar; (24) 5th instar. **25-27**. Pupa: (25) dorsal view; (26) lateral view; (27) ventral view. Scale bar: 1.5 mm.



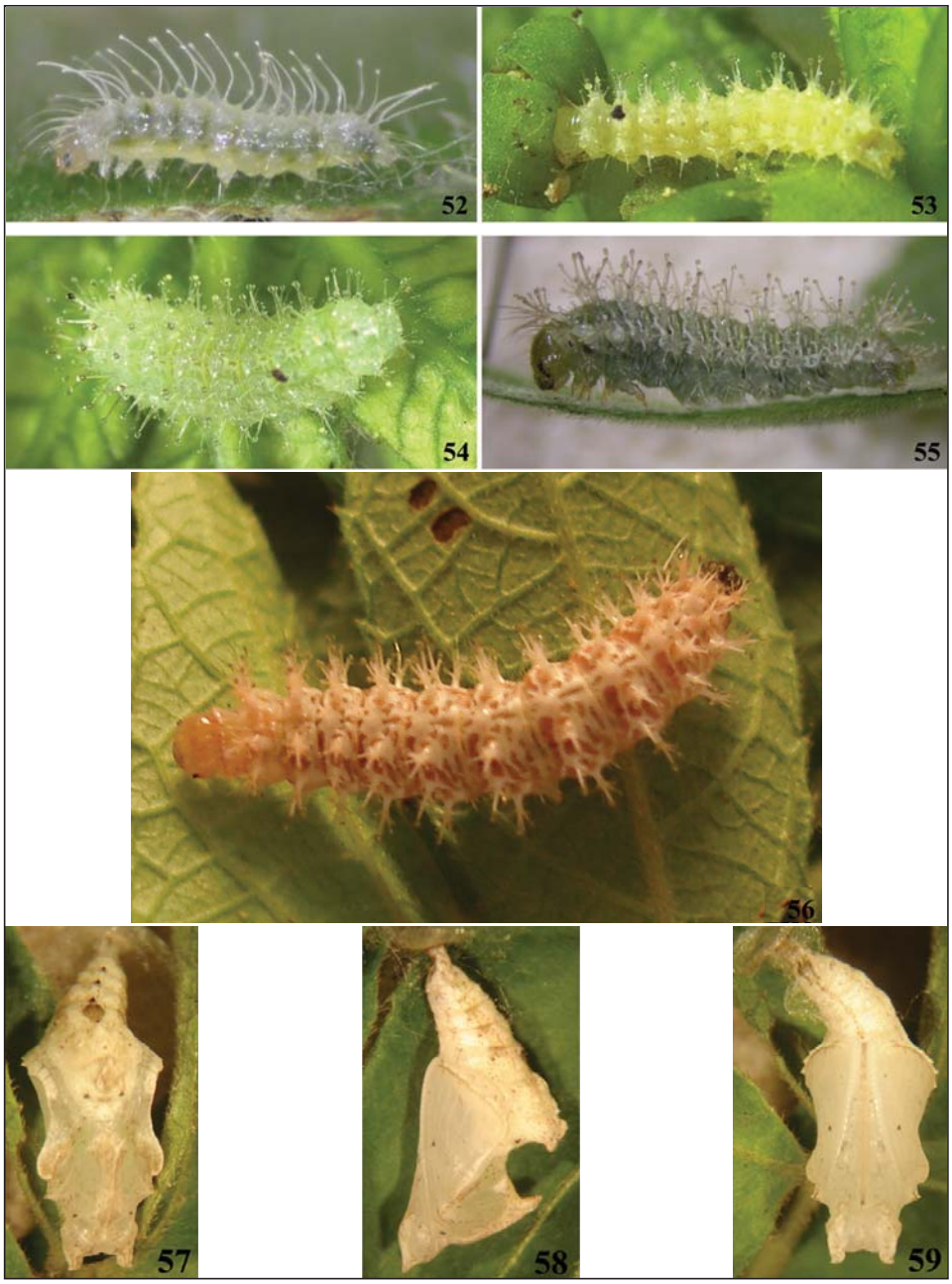
Figures 28-32.– *D. aerata aerata* Pupa. **28.** head with indication of the eye; **29.** A2 projection; **30.** A3-A5 lateral view; **31.** abdominal spiracle; **32.** A9, A10 and cremaster.



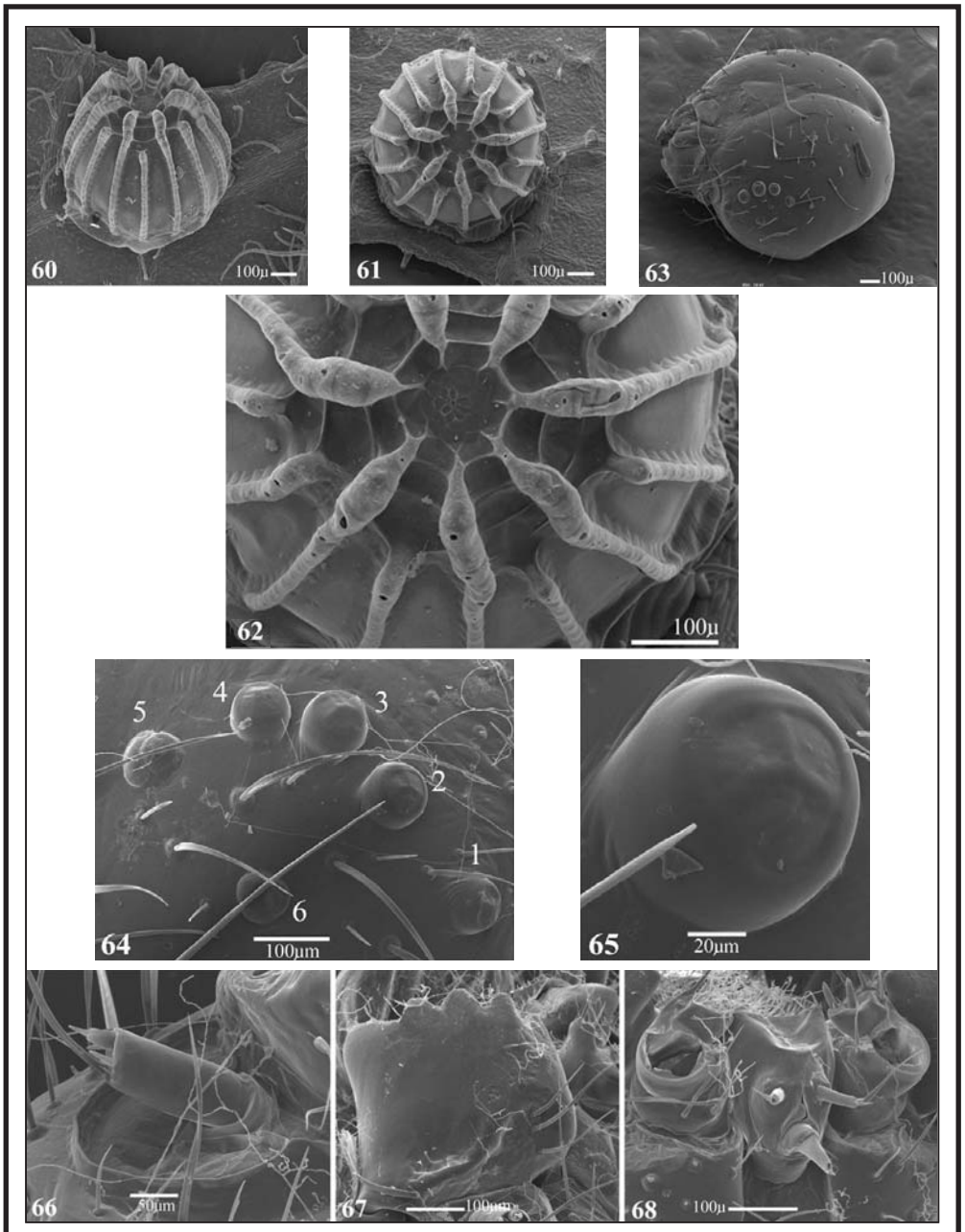
Figures 33-42.– *D. artemisia artemisia* 1st instar larva. **33.** head; **34.** head and T1 in lateral view; **35.** larva in lateral view; **36.** lateral bristles and spiracle on T1; **37.** subdorsal setae on T2; **38-39.** distal portion of the dorsal scoli; **40.** A2-A6 lateroventral view; **41.** legs and crochets on A4 and A5; **42.** leg and crochets on A10.



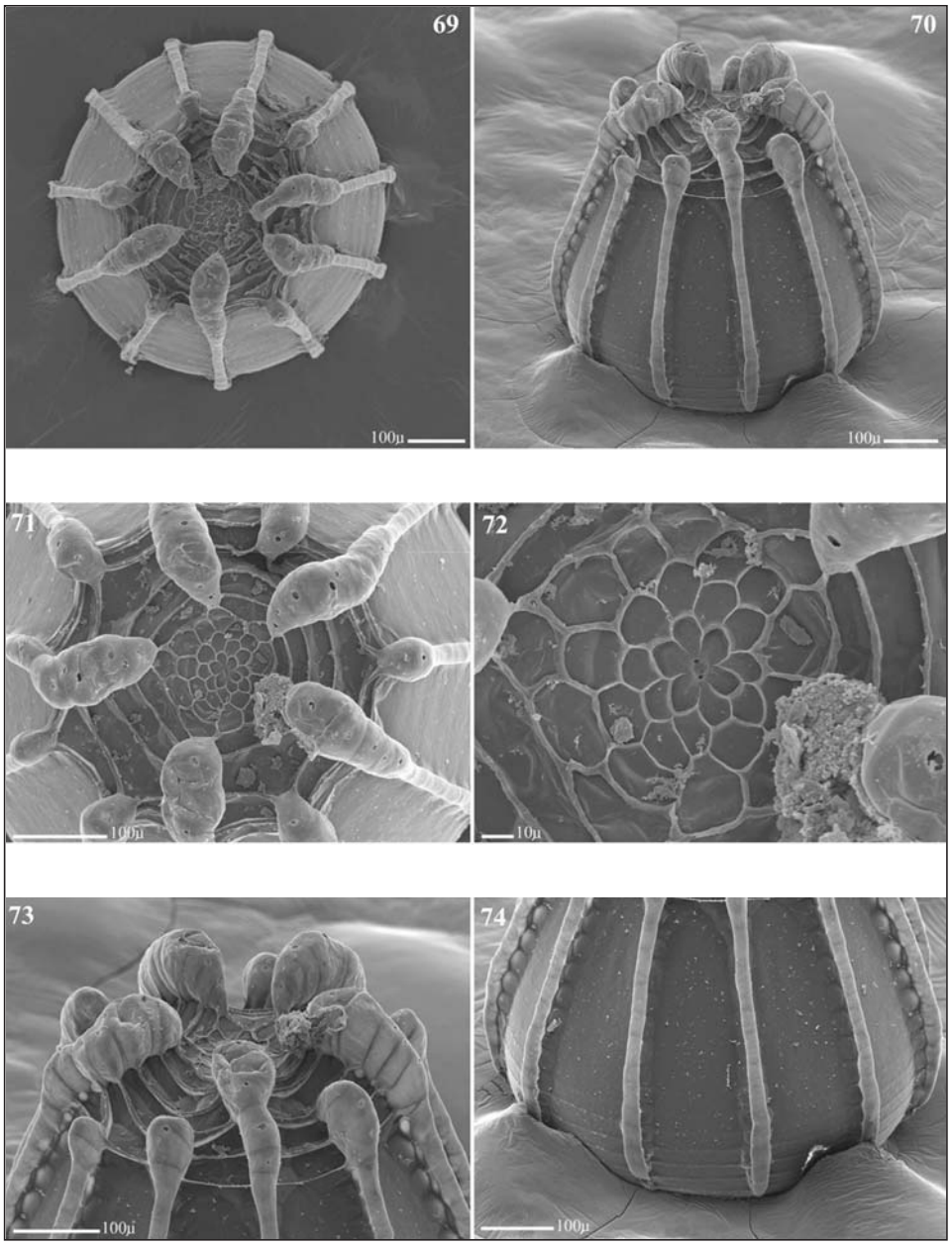
Figures 43-51.– *D. artemisia artemisia*. **43-45.** 5th instar larva: (43) head frontal view; (44) head lateral view; (45) A1-A3 lateral view. **46-51**. Pupa: (46) head, T1 and T2 lateral view; (47) dorsal projection on A2 in lateral view; (48) abdominal spiracle; (49) dorsoposterior scoli; (50) detail on the integument; (51) A10 and cremaster.



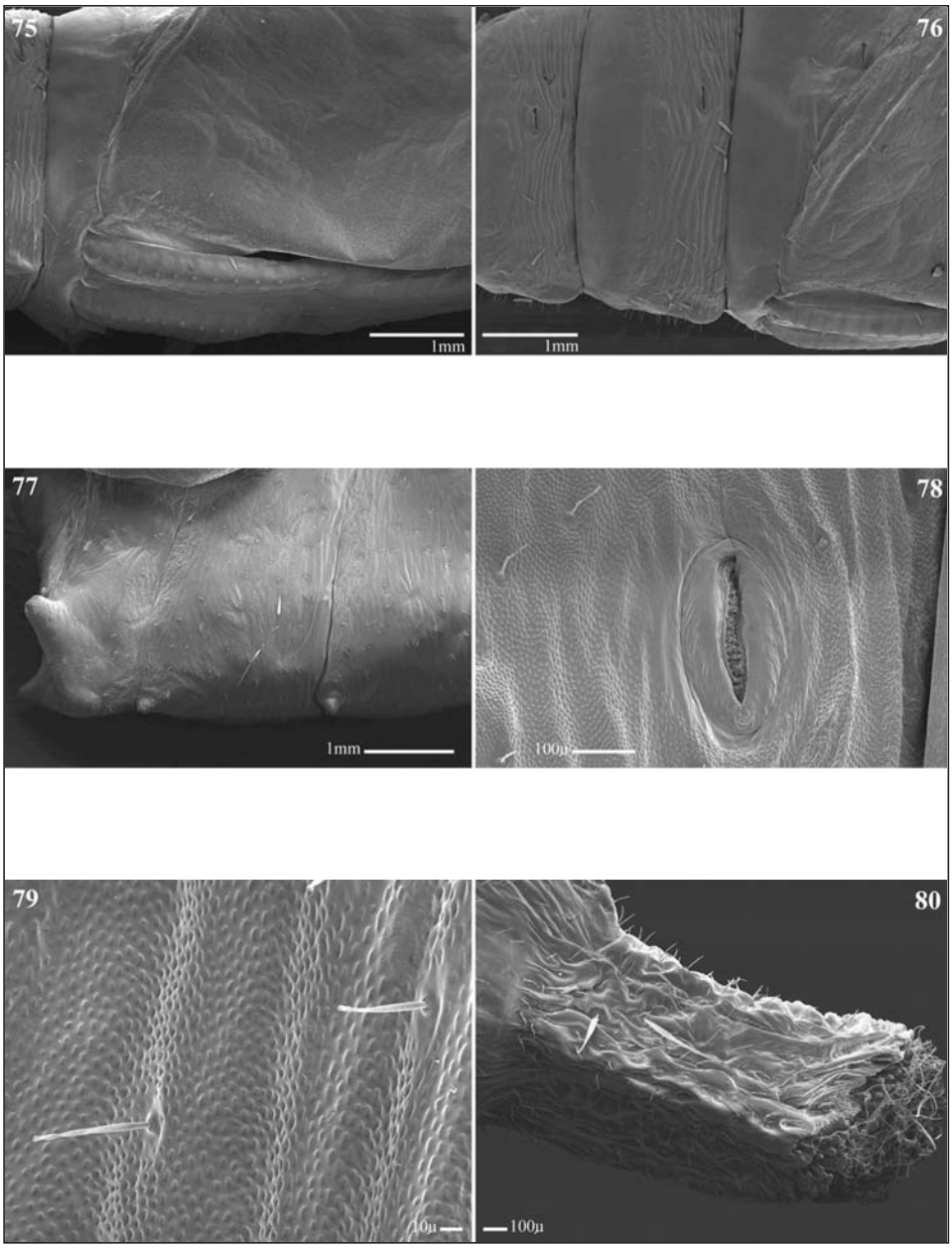
Figures 52-59.– *D. athemon athemaena*. **52-56.** Larvae: (52) 1st instar; (53) 2nd instar; (54) 3rd instar; (55) 4th instar; (56) 5th instar. **57-59.** Pupa: (57) dorsal view; (58) lateral view; (59) ventral view.



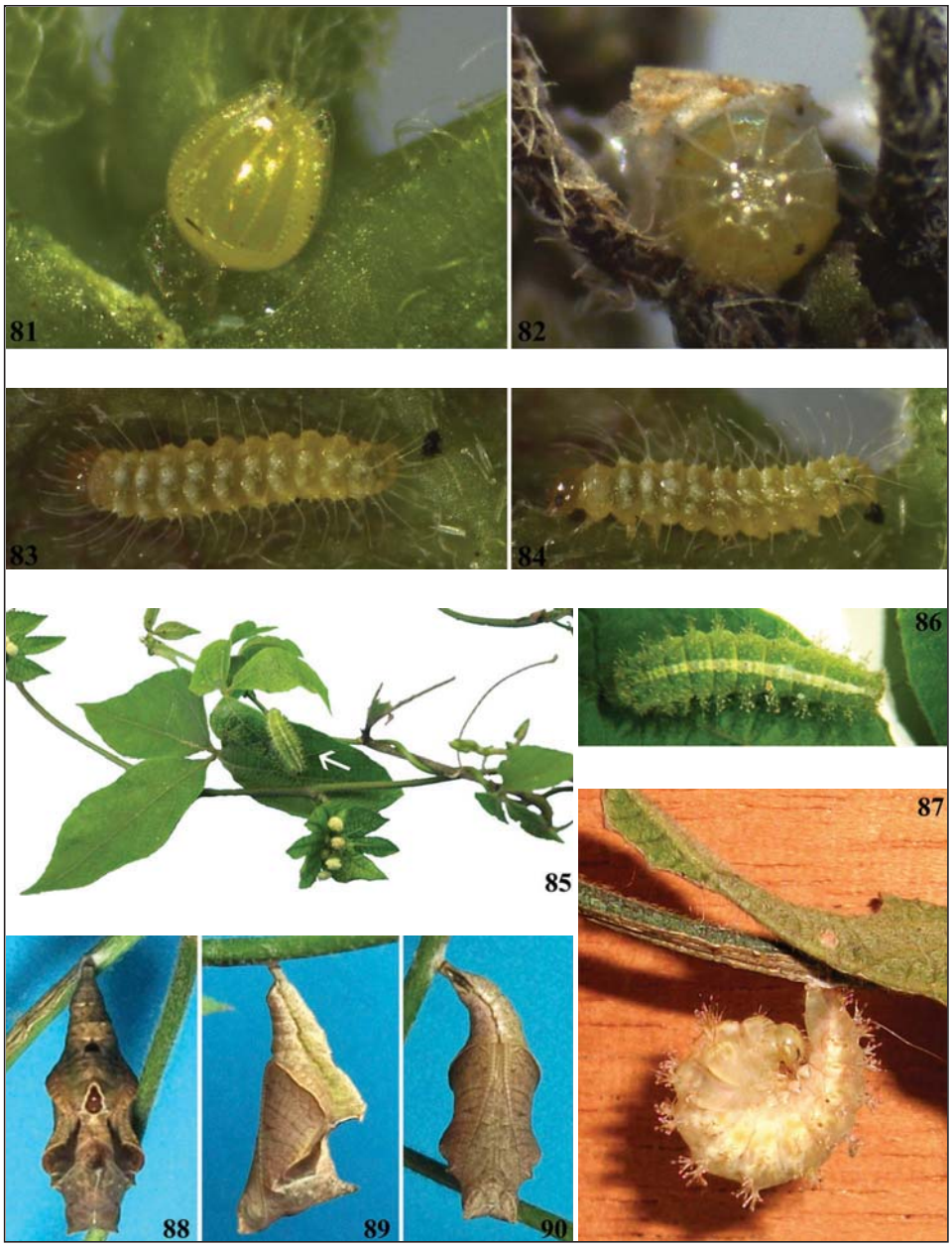
Figures 60-68.– *D. athemon athemaena*. **60-62.** Egg: (60) lateral view; (61) dorsal view; (62) approximate view of the upper pole. **63-68.** 5th instar larva: (63) head capsule lateral view; (64) stemmatal region; (65) stemmata; (66) antenna; (67) mandibule; (68) spinneret.



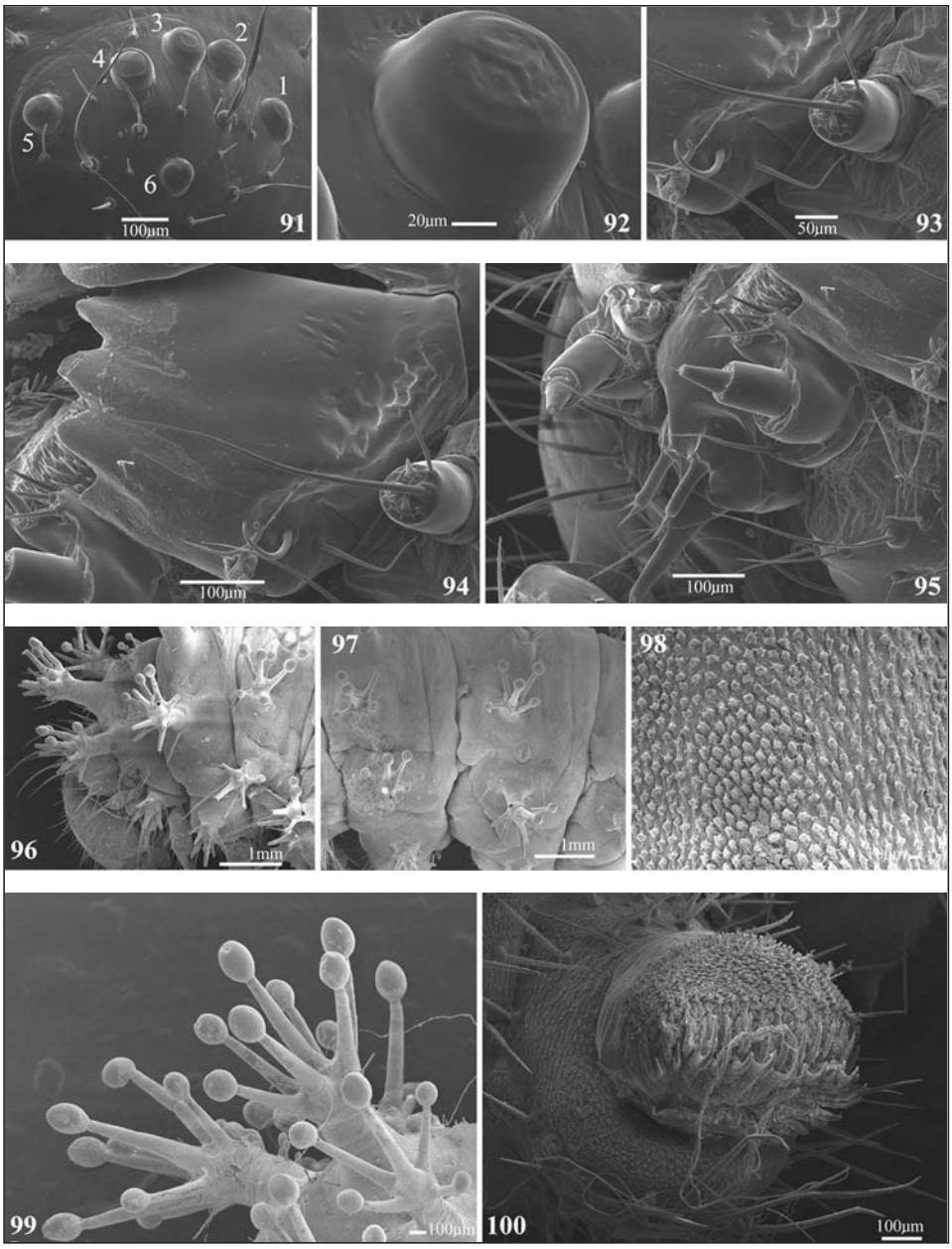
Figures 69-74.– *D. coenus* Egg: (69) dorsal view; (70) lateral view; (71) approximate view of the upper pole; (72) micropilar region; (73) approximate superior half in lateral view; (74) approximate inferior half in lateral view.



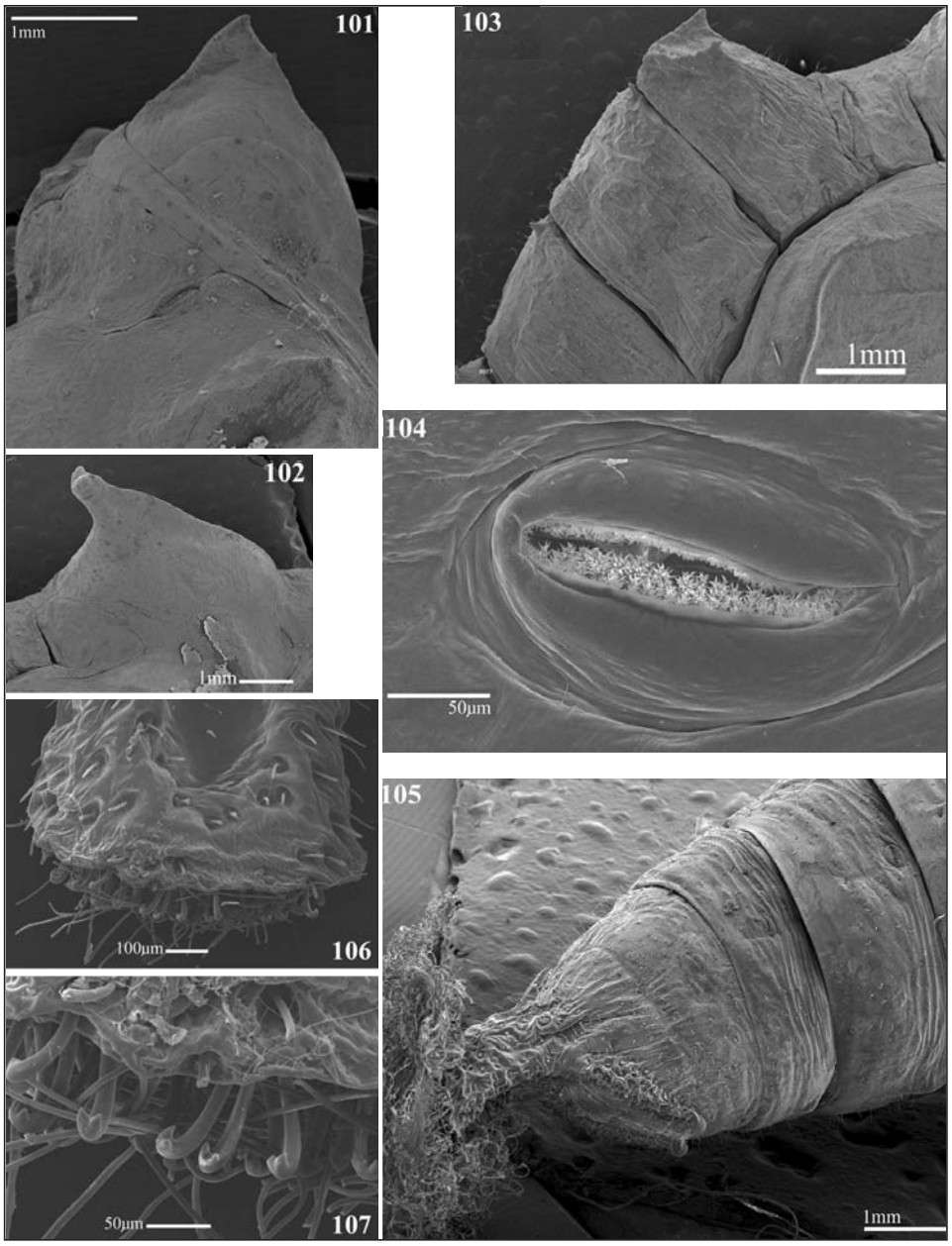
Figures 75-80.– *D. gisella* Pupa: (75) distal portion of the wing and galea in lateral view; (76) A4-A6 lateral view; (77) A2-A4 dorsolateral view; (78) abdominal spiracle; (79) detail of the integument and bristles around the spiracle; (80) A10 and cremaster.



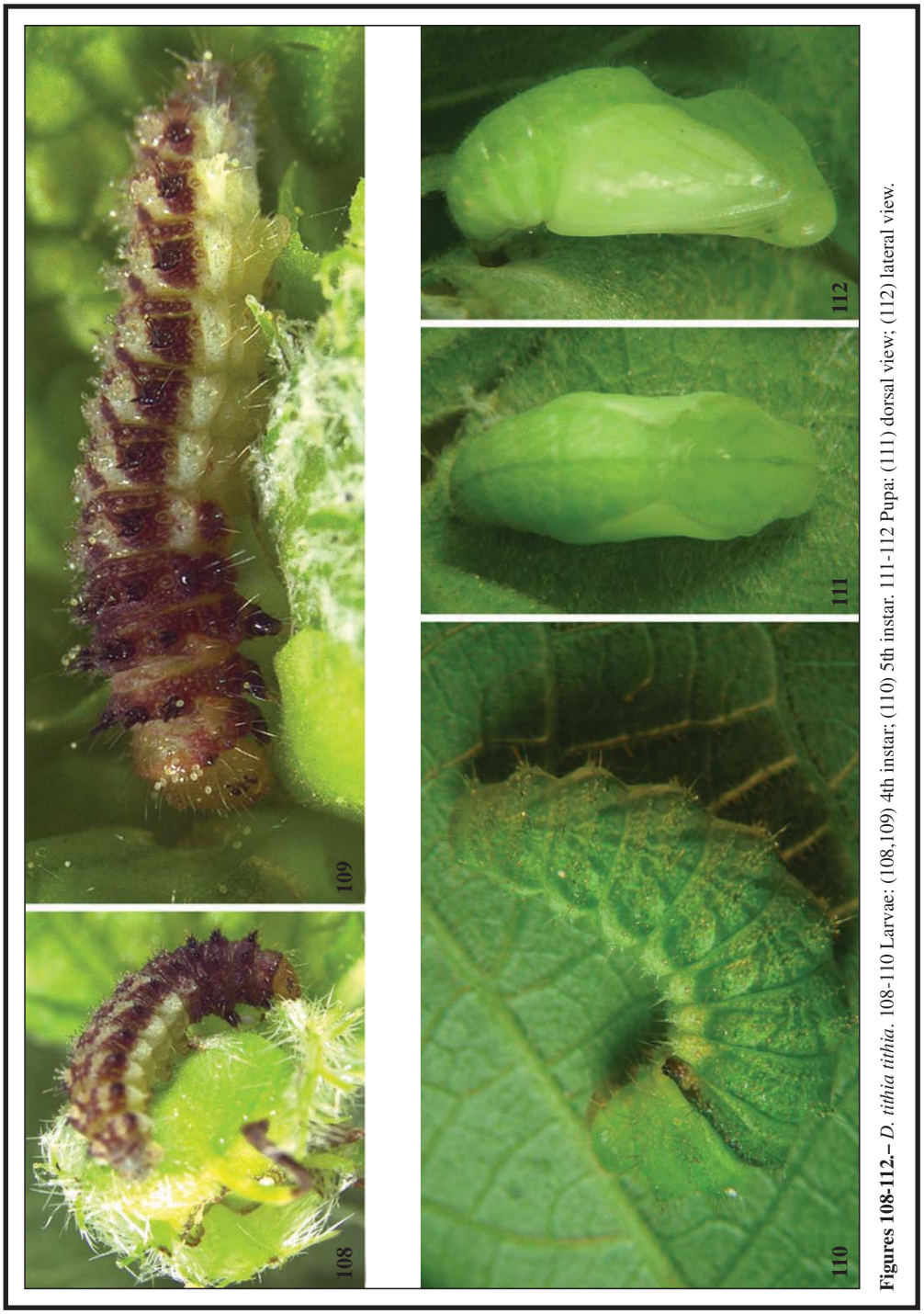
Figures 81-90.– 81-84. *D. myrrhina*. **81-82.** Egg: (81) lateral view; (82) dorsal view. **83-84.** 1st instar larva: (83) dorsal view; (84) lateral view. **85-90.** *D. postverta postverta*. (85-86.) 5th instar. (87) pre-pupa in lateral view. **88-90.** Pupa: (88) dorsal view; (89) lateral view; (90) ventral view.



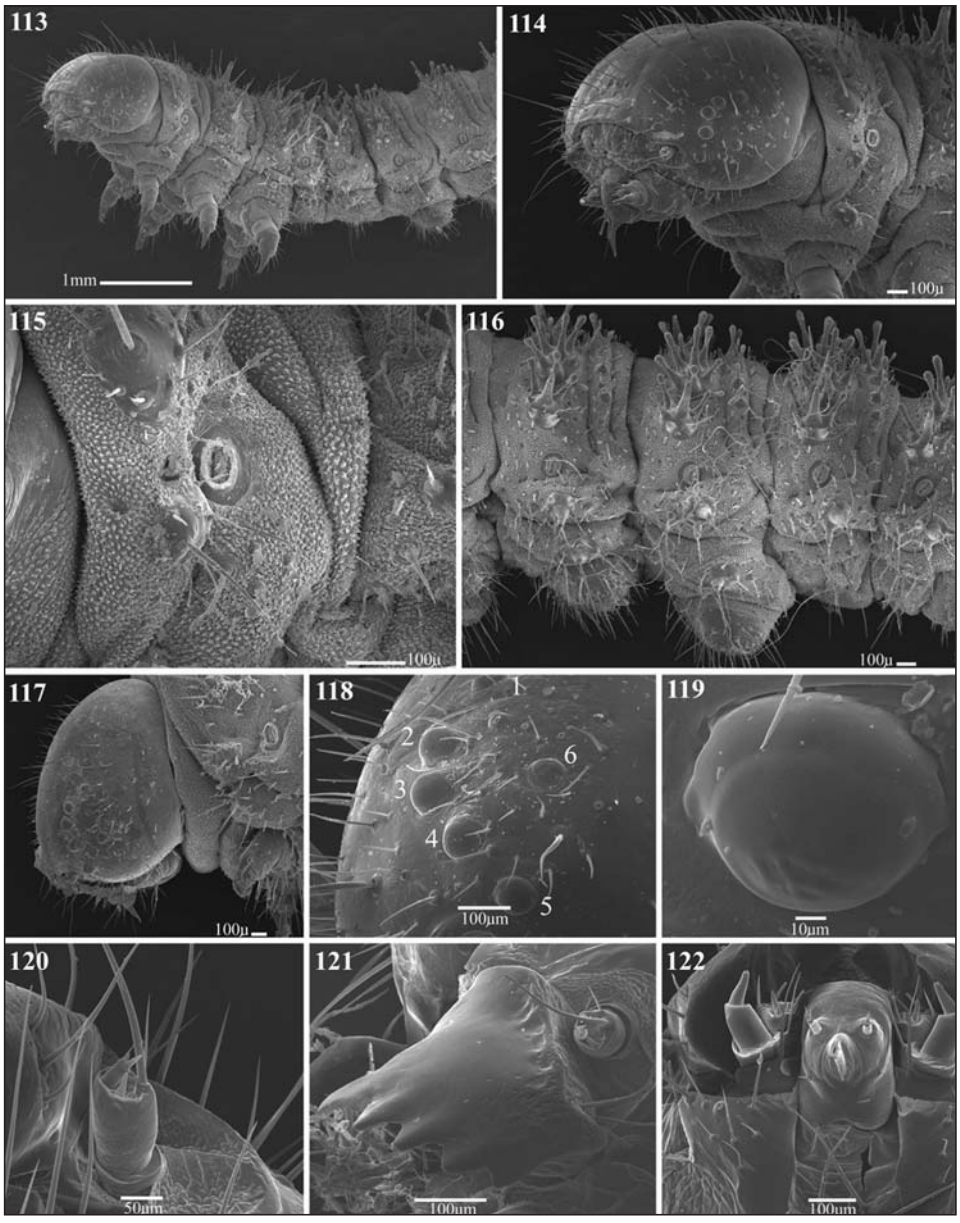
Figures 91-100.– *D. postverta postverta* 5th instar. (91) stemmatal region; (92) stemmata; (93) antenna; (94) mandibule; (95) spinneret; (96) thoracic segments in lateral view; (97) A3-A4; (98) detail of the integument; (99) detail of the dorsal scoli; (100) crochets on A3.



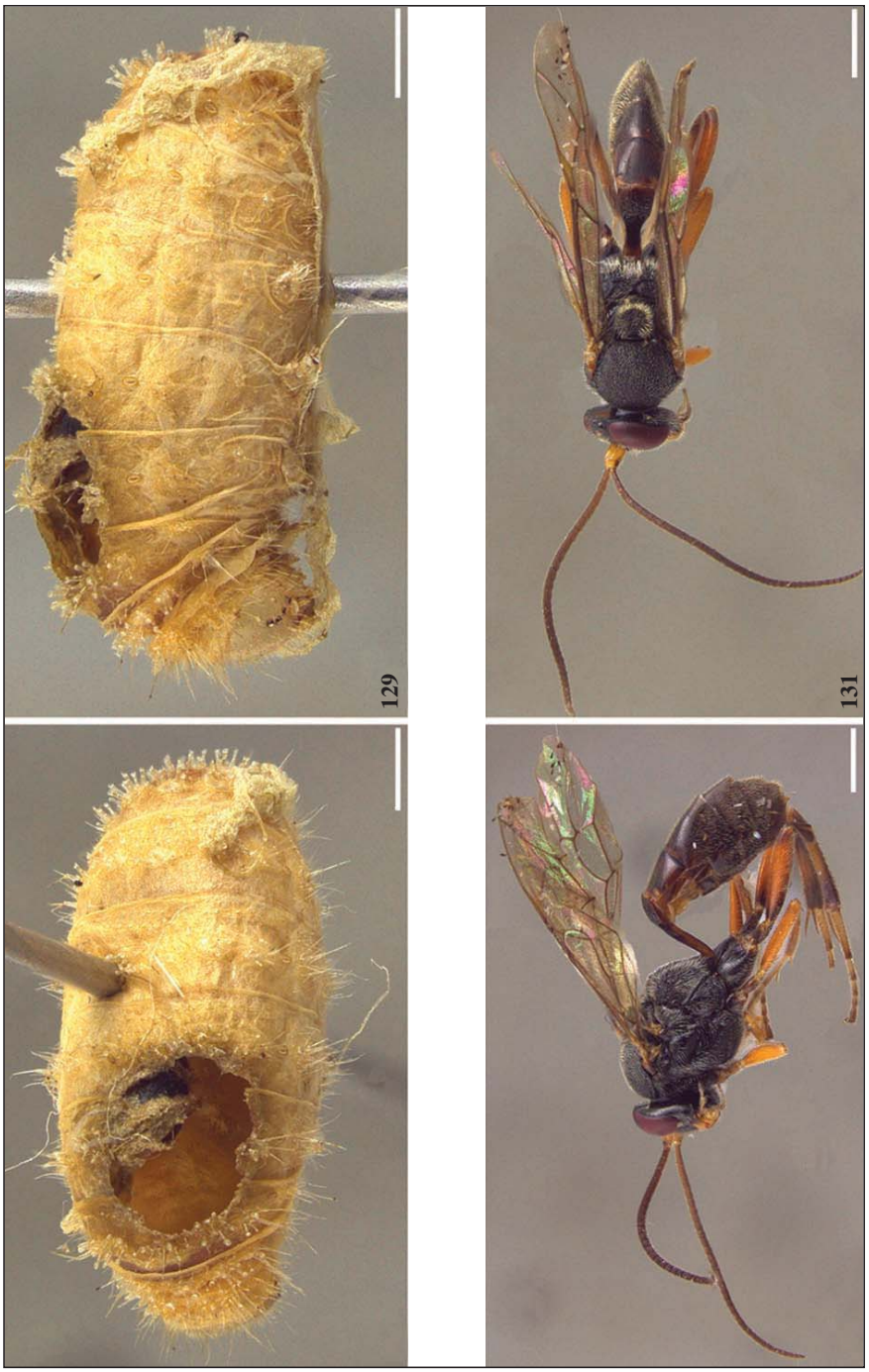
Figures 101-107.– *D. postverta postverta* Pupa. (101) initial third in lateral view; (102) dorsal projection on T2; (103) dorsal projection on A2; (104) abdominal spiracle; (105) posterior third in lateral view; (106) A10 and cremaster; (107) detail of the hooks on cremaster.



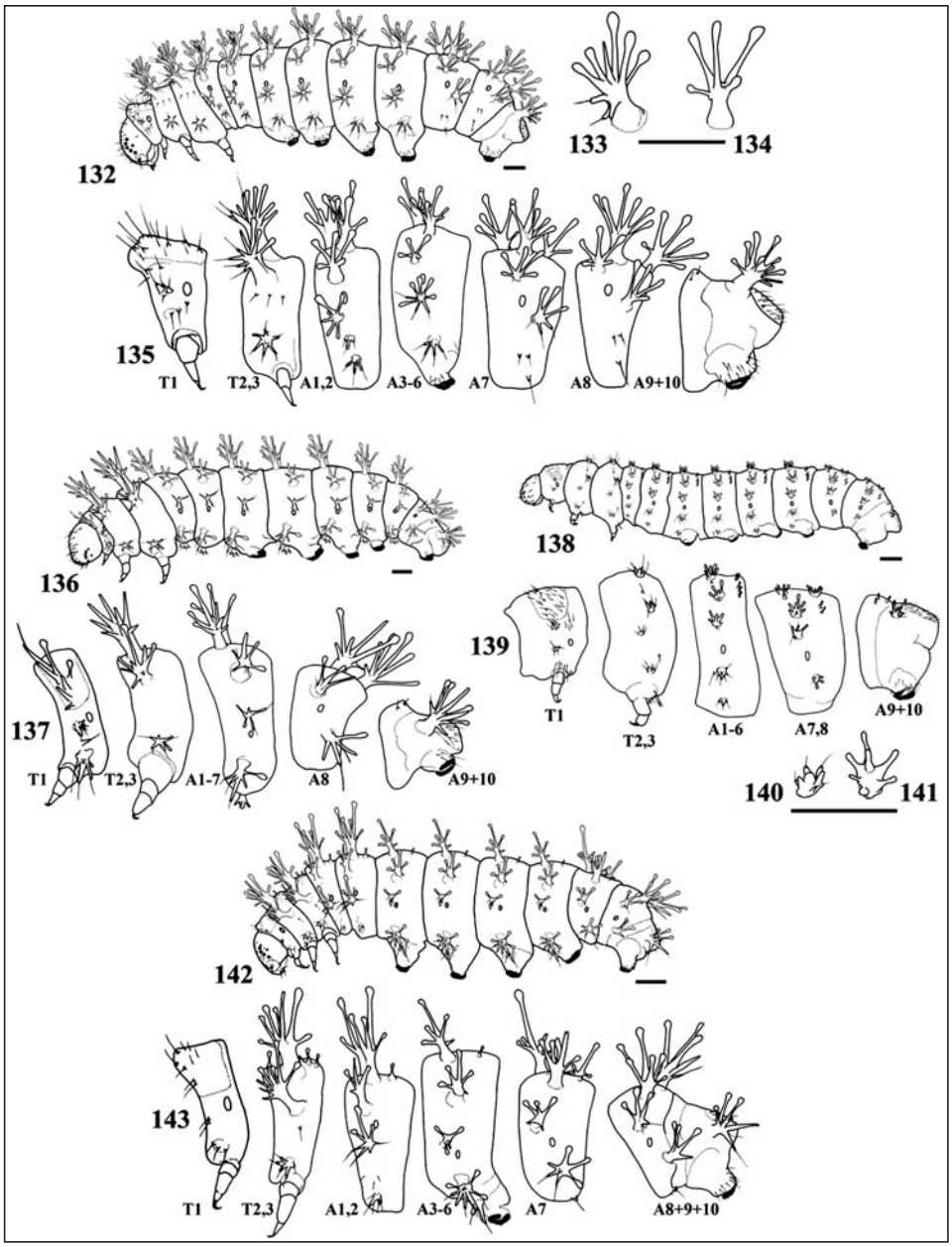
Figures 108-112.– *D. tithia tithia*. 108-110 Larvae: (108,109) 4th instar; (110) 5th instar. 111-112 Pupa: (111) dorsal view; (112) lateral view.



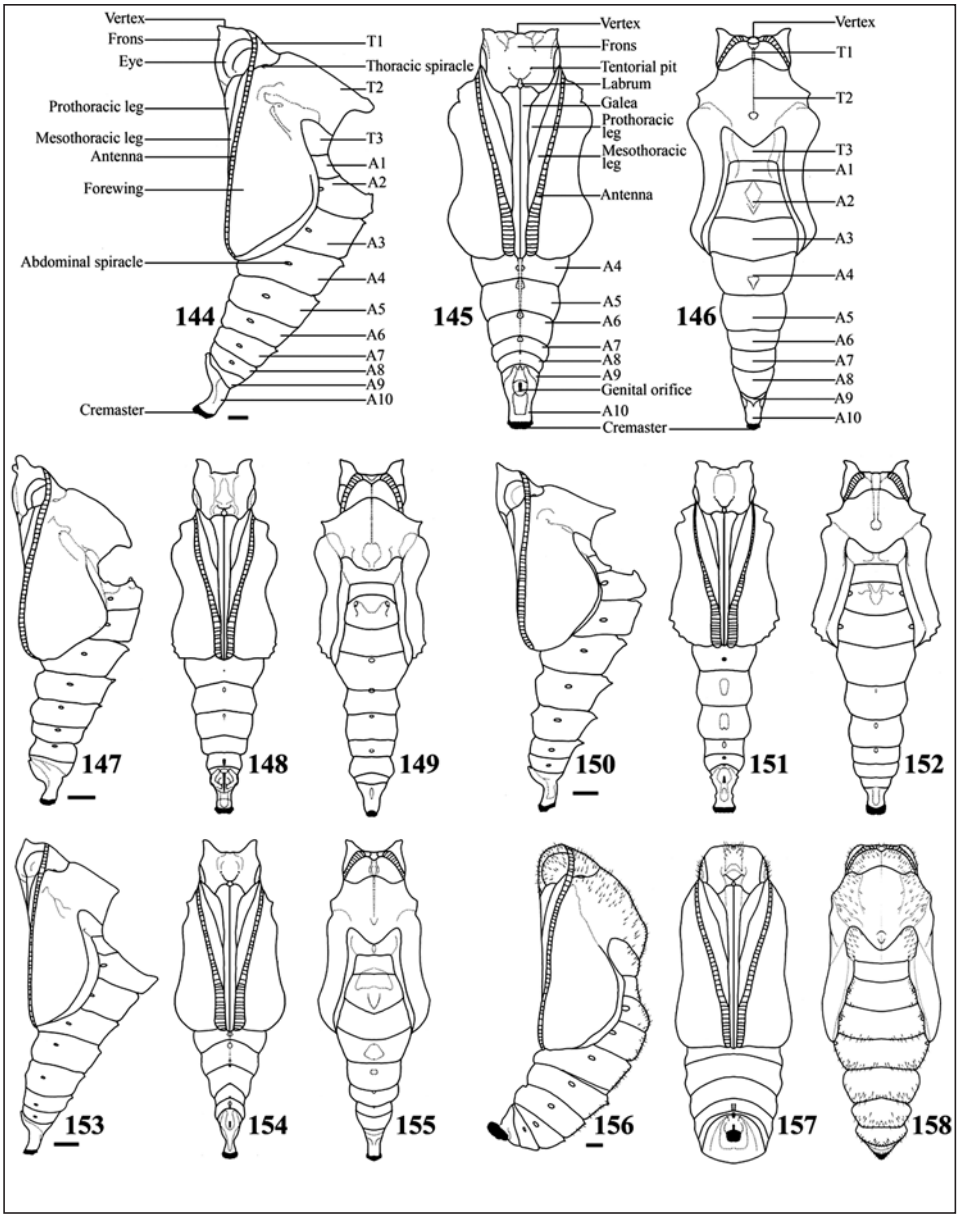
Figures 113-127.– 113-122. *D. tithia tithia*. **113-116.** 2nd instar: (113) lateral view; (114) head lateral view and T1; (115) thoracic spiracle; (116) lateral view of A5-A7. **117-122.** 5th instar: (117) head and T1 in lateral view; (118) stemmatal region; (119) stemmata; (120) antenna; (121) mandibule; (122) spinneret. **123-127.** *D. tithia tithia* Pupa: (123) lateral view; (124) head and thorax in lateral view with indication of the thoracic spiracle; (125) abdominal spiracle; (126) dorsal projection of the abdominal segment; (127) cremaster.



Figures 128-131.– 128-129. *D. tithia tithia*. Pre-pupa with parasitoid exit hole: (128) dorsal view; (129) lateral view. **130-131.** Parasitoid: *Microcharops* sp. (Ichneumonidae: Campopleginae). (130) lateral view; (131) dorsal view. Scale bar: 1mm.



Figures 132-143.– Last instar of some *Dynamine* spp. **132-135.** *D. postverta postverta*: (132) lateral view; (133) scoli T2,3; (134) scoli A1-6; (135) chaetotaxy. **136-137.** *D. artemisia artemisia*: (136) lateral view; (137) chaetotaxy. **138-141.** *D. tithia tithia*: (138) lateral view; (139) chaetotaxy; (140) scoli T2,3; (141) scoli A1-6. **142-143.** *D. anubis anubis* 5th instar: (142) lateral view; (143) chaetotaxy. Scale bar: 1mm.



Figures 144-158.– 144-146. *D. postverta postverta* Pupa: (144) lateral view; (145) ventral view; (146) dorsal view. **147-149.** *D. athemon athemaena* Pupa: (147) lateral view; (148) ventral view; (149) dorsal view. **150-152.** *D. anubis anubis* Pupa: (150) lateral view; (151) ventral view; (152) dorsal view. **153-155.** *D. artemisia artemisia* Pupa: (153) lateral view; (154) ventral view; (155) dorsal view. **156-158.** *D. tithia tithia* Pupa: (156) lateral view; (157) ventral view; (158) dorsal view. Scale bar: 1mm.