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DESCRIPTIONS OF THE FINAL INSTAR OF *EURYTOMA NODULARIS* AND *E. HERIADI* (HYMENOPTERA: EURYTOMIDAE)

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ABSTRACT

The final instars of *Eurytoma nodularis* and *E. heriadi* are described and illustrated. Morphological structures of diagnostic value are discussed. The most salient character shown by the mature larvae of these two species lies in the mandibles, which are simple (unidentate), a feature that, according to current knowledge, is only shared with *E. verticillata*.

Key Words: larva, *Eurytoma*, morphology.

RESUMEN

Se describen, y dibujan, las larvas maduras de *Eurytoma nodularis* y *E. heriadi*. El carácter más relevante, sólo compartido con *E. verticillata*, radica en la presencia, en ambas especies, de mandíbulas unidentadas.

Translation provided by the author.

The family Eurytomidae includes some 1424 species in 88 genera (Noyes 2003). Included species display diverse larval feeding habits and are mainly parasitoids of Diptera, Coleoptera, Hymenoptera, and Lepidoptera (Gauld & Bolton 1988; Zerova & Fursov 1991), although phytophagy (Crosby 1909; Bugbee 1941, 1971, 1967) and entomophytophagy (Phillips 1917, 1927; Claridge 1961; Bugbee 1975) are known.

The genus *Eurytoma* Illiger, 1807, with 692 species, is the largest of the family Eurytomidae (Noyes 2003). This study addresses the larval morphology of two species of this cosmopolitan genus: *Eurytoma nodularis* Boheman, 1836, and *E. heriadi* Zerova, 1984. These species are parasitoids of Hymenoptera Aculeata that nest in hollow stems. Within *Eurytoma*, the main studies of mature larvae have been carried out by Roskam (1982), Henneicke et al. (1992) and Dawah & Rothfritz (1996).

MATERIALS AND METHODS

Material Examined

Eurytoma nodularis: SPAIN: Segovia: Iscar, 2 mature larvae from nest of Eumenidae December 1999, emerg. 1 female May 2000 (one mature larva was fixed and preserved in 70% ETOH for subsequent study and description); Cáceres: Mesas, 4 mature larvae from nest of Eumenidae December 1999, emerg. 2 females, 1 male May 2000 (one mature larva was stored in a vial with 70% ethanol for later study). *E. heriadi*: SPAIN: Ávila: Barco de Ávila, 2 mature larvae from nest of *Try-*

poxylon Latreille, 1796 (Hymenoptera, Apoidea: Crabronidae) December 1999, emerg. 1 female May 2000 (one mature larva was stored in a vial with 70% ethanol for later study). Voucher specimens are deposited at the: a) Fundación Entomológica "Torres-Sala" (València, Spain) (larvae), and b) Institute of Zoology of National Ukrainian Academy of Sciences (Ukraine) (adults).

In both cases, the larvae were obtained from nests established in stems of *Phragmites australis* (Cav.) (Poaceae), which had been placed in the field between April-December 1999 when they were collected and transported to the laboratory.

Nests were opened one week after collection to allow the development of possible natural enemies. The contents of each cell were transferred to glass vials and kept at 6-8°C over the winter. During the following spring (May 2000), the vials were transferred to a culture chamber at 28°C, 60-80% RH, to trigger emergence of the imagos, thus making it possible to identify the occupants of the nests and their parasitoids.

The methodology used in the preparation of mature larvae was similar to that employed by Evans (1987). Terminology and organization used in the ensuing descriptions fundamentally follow that of Henneicke et al. (1992). The following abbreviations have been used in the descriptions: A1-9 = abdominal segments; ADP = anterodorsal protuberances; AN = antennae; APP = anterior pleurosomal process; ATR = atrium of spiracle; AS = anal segment; BA = base of mandibles; BL = blade of mandibles; C = ventral articular process of mandible; CA = closing apparatus of spiracle; CLP = clypeus; CLPS = clypeal setae; D = dorsal setae; d

= diameter; DAP = dorsal articular process of mandible; DT = dorsal terminal seta; EPST = epistomal arc; EPX = epipharynx; FI = inferior frontal setae; FS = superior frontal setae; GE = setae on the gena; h = height; HY = hypostomal setae; l = length; LM = labrum; LMS = labral setae; LS = prelabial sensilla; LUM = labium; MD = mandibles; MS = maxillary setae; MX = maxillae; n = number of specimens; P = pleural setae; PLOS = lateral postlabial setae; PLST = pleurostoma; POS = postlabial setae; PPA = maxillary papilla; PPP = posterior pleurostomal process; PRLS = lateral prelabial setae; PRMS = middle prelabial setae; SP = spiracles; ST = spiracular trachea; TH1-3 = thoracic segments; V = ventral setae, and w = width.

DESCRIPTIONS OF MATURE LARVAE

Eurytoma nodularis Boheman General aspect (Fig. 1)

Body l = 6.6-7.2 mm (\bar{x} = 6.9), maximum w = 1.7-2.1 mm (\bar{x} = 1.9) (n = 2), shape varying between barrel-shaped and cylindrical, slightly broader in mid region, ADP present on TH3-A9, with three thoracic and ten abdominal segments, tapering anteriorly and more strongly curved posteriorly. Color yellowish. Weakly sclerotized, except for MD, SP and setae. Anus small, subterminal, transverse. Pleural lobes very scarcely developed. Tegument setose, with: a) D (l = 180-410 μ m): three pairs on TH1-A2; two pairs on A3-A7; a pair on the A8 and A9; b) DT (l = 90 μ m) two pairs; c) P (l = 170-425 μ m): four pairs on TH1-AS2; two pairs on A3-A9; d) V (l = 150-420 μ m): one pair on TH1-A9. SP (Fig. 3) on TH2, TH3, and on A1-A7; ATR (l = 70 μ m, d maximum = 30 μ m) funnel-shaped, with approximately fourteen chambers; CA (l = 20 μ m; w = 9 μ m) adjacent to ATR.

Cranium (Fig. 4)

Cranium 0.5 \times as high as broad (w = 657 μ m, h (from apex of cranium to base of MD) = 335 μ m), narrower than TH1, very weakly sclerotized, with four pairs of long setae (l = 11.5-13.5 μ m): FI (l = 11.5 μ m), FS (l = 13 μ m), GE (l = 12.5 μ m), HY (l = 13.5 μ m). AN approximately 2.5 \times as long as broad, located below middle of cranium, with three small sensilla on apex. CLP and LM without setae or sensilla; EPX with two pairs of small sensilla (a). Tentorium (Fig. 5) with the PLST and its APP and PPP sclerotized and differentiated. EPST almost indistinct, and very weakly sclerotized.

Mouthparts

Mandibles (MD) (Figs. 4, 5) (l = 10.25 μ m, w = 6.25 μ m) sclerotized, more heavily sclerotized at their BL, unidentate, with a wide BA, with prominent DAP and C; MX and LUM completely fused

(Fig. 6): MX with a pair of short MS (l = 9.5 μ m) and a protuberant PPA (9 \times 5.5 μ m); LUM with a pair of PRMS (l = 20 μ m), one pair of PRLS (l = 9 μ m), and three pairs of LS (d = 2 μ m) on the prelabial membrane, postlabial membrane with one pair of long POS (l = 23.5 μ m) at center and two pairs of small PLOS (l = 9 μ m).

Diagnosis

The mature larva of *E. nodularis* can be characterized and distinguished from the mature larvae of other known *Eurytoma* spp. by the combination of the following characters: a) antennae located below middle of cranium; b) the presence of more than four rows of setae dorsally and pleurally; c) segment A1 with one pair of ventral setae; d) more than two dorsal setae present on abdominal segments A6-8; e) mandibles simple, crescentic, with one acute tooth.

Eurytoma heriadi Zerova General aspect (Fig. 2)

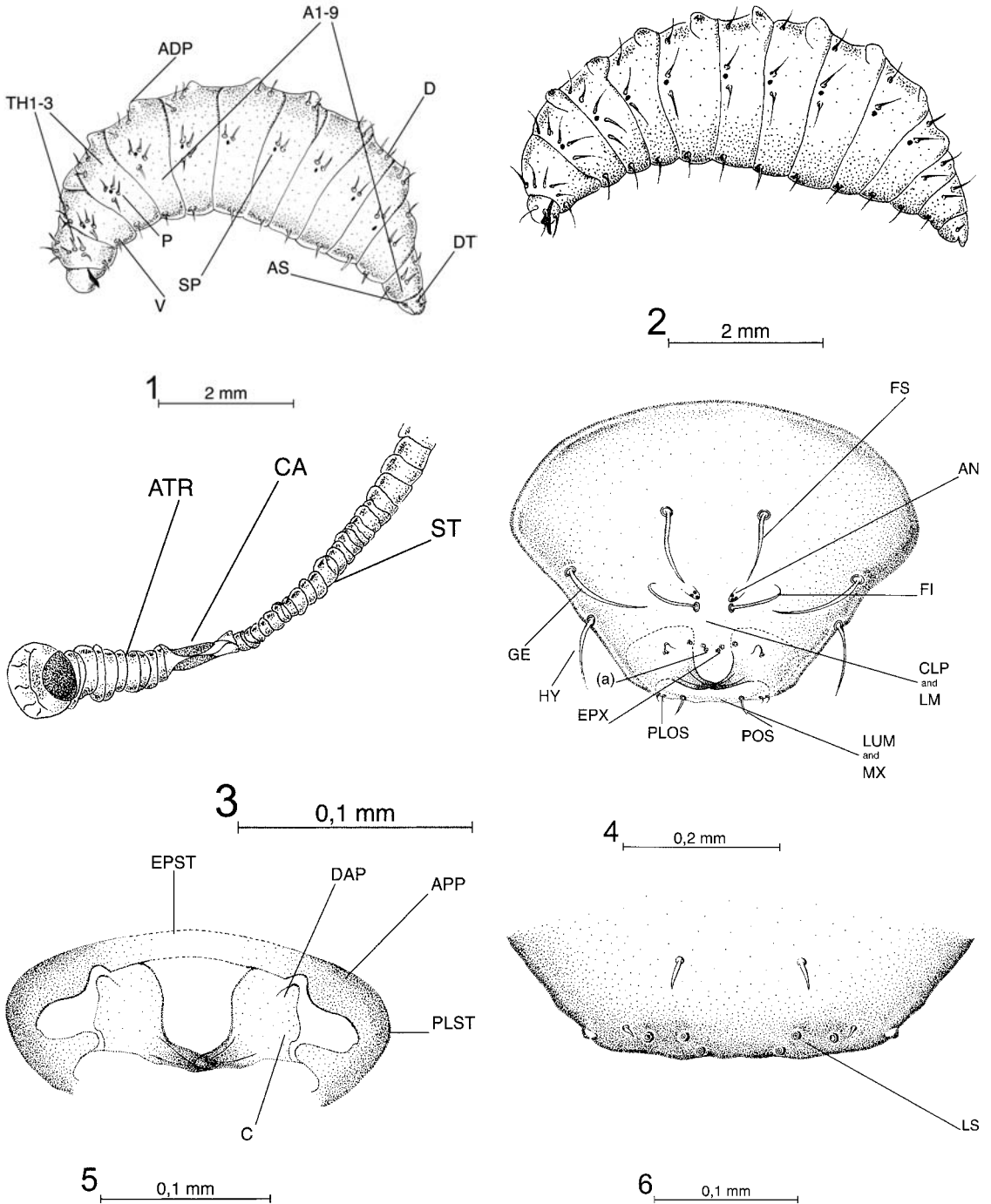
Body (l = 5.2 mm, maximum w = 1.8 mm) shape varying between barrel-shaped and cylindrical, slightly broader in mid region, ADP present on TH3-A8, with three thoracic and ten abdominal segments, tapering anteriorly and more curved posteriorly. Color yellowish. Weakly sclerotized, except for MD, SP and setae. Anus small, subterminal, transverse. Pleural lobes very scarcely developed. Tegument setose, with: a) D (l = 190-415 μ m): two pairs on each of the TH1-3; a pair on A1-A9; b) DT (l = 85 μ m) one pair; c) P (l = 180-440 μ m) three pairs on each of the TH1-3; two pairs on A1-A5; a pair on A6-A9; d) V (l = 160-435 μ m) one pair on TH1-A9. SP on TH2, TH3, and on A1-A7; ATR (l = 60 μ m, d maximum = 22 μ m) funnel-shaped, with approximately ten chambers; CA (l = 15 μ m; w = 6 μ m) adjacent to ATR.

Cranium (Fig. 7)

Wider than high (w = 448 μ m, h (from apex of cranium to base of MD) = 255 μ m), narrower than TH1, very weakly sclerotized, with three pairs of long setae (l = 10-12 μ m): FS (l = 11 μ m), GE (l = 10 μ m), HY (l = 12 μ m). AN approximately 2.5 \times as long as broad, located in the middle or above the middle of cranium, with three small sensilla on apex. CLP and LM with a pair of short CLPS and LMS, respectively; EPX with two pairs of small sensilla (a) (Fig. 4). Tentorium with the PLST and its APP and PPP sclerotized and differentiated. EPST almost indistinct, and very weakly sclerotized.

Mouthparts

MD (l = 8 μ m, w = 4 μ m) sclerotized, more heavily sclerotized at their BL, unidentate, with a



Figs. 1-6. Mature larvae of *Eurytoma nodularis* Boheman and *E. heriadi* Zerova. *E. nodularis*: (1) General aspect. (3) Spiracle. (4) Cranium. (5) Tentorium and mandibles. (6) maxillae and labium. *E. heriadi*: (2) General aspect. (Abbreviations: A1-9 = abdominal segments; ADP = anterodorsal protuberances; AN = antennae; APP = anterior pleurostomal process; ATR = atrium of spiracle; AS = anal segment; C = ventral articular process of mandible; CA = closing apparatus of spiracle; CLP = clypeus; D = dorsal setae; DAP = dorsal articular process of mandible; DT = dorsal terminal seta; EPST = epistomal arc; EPX = Epipharynx, (a) = sensilla; FI = inferior frontal setae; FS = superior frontal setae; GE = setae on the genae; HY = hypostomal setae; LM = labrum; LS = prelabial sensilla; LUM = labium; MX = maxillae; P = pleural setae; PLOS = lateral postlabial setae; PLST = pleurostoma; POS = postlabial setae; SP = spiracles; ST = spiracular trachea; TH1-3 = thoracic segments; V = ventral setae, and w = width.)

wide BA, with prominent DAP and C; MX and LUM completely fused: MX with a pair of short MS ($l = 8 \mu\text{m}$) and a protuberant PPA ($8.5 \times 5 \mu\text{m}$); LUM (Fig. 8) without setae, with a pair of small LS.

Diagnosis

The mature larva of *E. heriadi* can be characterized and distinguished from mature larvae of

other known *Eurytoma* spp. by the combination of the following characters: a) cranium without FI setae; b) the presence of more than four rows of setae dorsally and laterally; c) segment A1 with one pair of ventral setae; d) mandibles simple, crescentic, with one acute tooth.

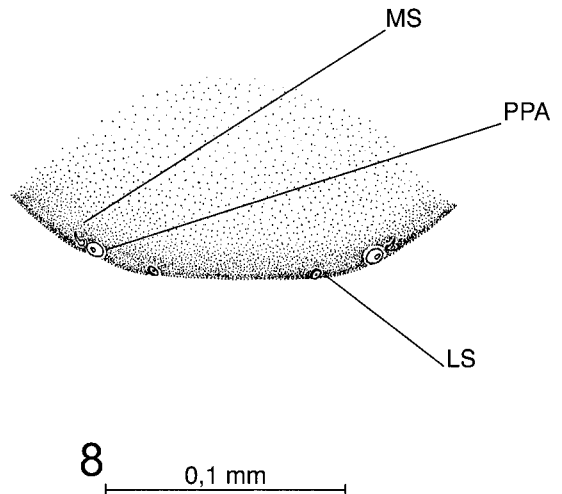
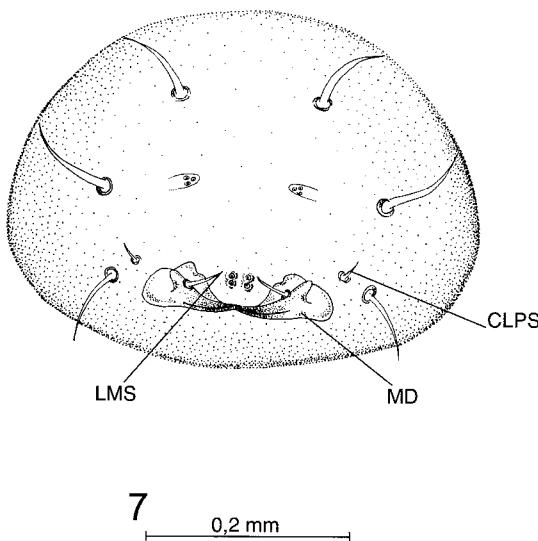
Taxonomic position. The mature larvae of these two species can be inserted in the key of Henneicke et al. (1992) as follows:

- 1. Hypostomal setae (Hy) shorter than half the width of labrum
 *Sycophila mellea* (Curtis, 1831), *Tetramesa* Walker, 1848
- Hypostomal setae longer or about as long as half the width of labrum (Figs. 4, 7) 2
- 2. More than two dorsal setae (D) present on abdominal segments A6-8 (Fig. 1) 3
- At least one of abdominal segments A6-8 with only two dorsal setae (Fig. 2) 4
- 3. Mandibles bidentate *E. (Ahtola) atra* (Walker, 1832)
- Mandibles unidentate (Figs. 4, 5) *E. nodularis* Boheman
- 4. Mandibles bidentate *Eurytoma appendigaster* group
- Mandibles unidentate (Fig. 7) *Eurytoma heriadi* Zerova

DISCUSSION

The mature larvae of *E. nodularis* and *E. heriadi* share the following characters with other *Eurytoma*: a) body mainly barrel-shaped, broader in mid-region; b) head hemispherical, without pronounced clypeus, with hypostomal setae longer or about as long as half the width of labrum, and with inconspicuous and unpigmented craneal sclerites; c) integument with setae arranged in distinct rows along all body segments, and with ventral setae

arranged in paired rows; d) atrium of spiracle long. However, the following characters differentiate these larvae from most other known larvae of the genus: a) the presence of more than four rows of setae dorsally and laterally; b) segment A1 with one pair of ventral setae; c) mandibles simple, crescentic, with one sharp/acute tooth. Additionally, *E. nodularis* has the antennae located below middle of cranium, and more than two dorsal setae present on abdominal segments A6-8, and in *E. heriadi* the cranium is without FI setae.



Figs. 7-8. Mature larvae of *E. heriadi* Zerova: (7) Cranium. (8) Maxillae and labium. (Abbreviations: CLPS = clypeal setae; LMS = labral setae; LS = prelabial sensilla; MD = mandibles; MS = maxillary setae; PPA = maxillary papilla.)

The most salient character shown by the mature larvae of these two species lies in the mandibles, which are simple, a feature that, according to current knowledge, is only shared with *E. verticillata* (F., 1798) (Zerova 1983). In this respect, it should be noted that Danks (1970) described a mature larva of an indeterminate species of *Eurytoma*, a parasitoid of rubicolous aculeates, indicating that it was probably *E. nodularis*. This larva had unidentate mandibles.

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