Descriptions of the Final Instar Larvae of *Perithous septemcinctorius, Zatypota bohemani* and *Z. gracilis* (Hymenoptera: Ichneumonidae: Pimplinae)[1]

Josep Tormos,[2] Josep Daniel Asís, Severiano Fernández Gayubo and Jesús Selfa[3]

Unidad de Zoología, Facultad de Biología, Universidad de Salamanca, 37071-Salamanca, Spain

J. Entomol. Sci. 39(4): 475-482 (October 2004)

Abstract The exuviae of the final larval instar of three species of pimpline Ichneumonidae (Pimplinae: Delomeristini, Ephialtini), *Perithous septemcinctorius* (Thunberg), *Zatypota bohemani* (Holmgren) and *Z. gracilis* (Holmgren), are described. The mature larvae of *Perithous* Holmgren are characterized by presenting the maxillary and labial palpi with more than two sensilla. The exuviae of the different species that have been described in this genus, *Perithous divinator, P. scurra* and *P. septemcinctorius*, can be differentiated on the basis of the following characters: (a) presence/absence of spinules on the tegument, sensillum on antennal orbit, cardo; seta on posterior part of stipital sclerite; (b) presence/absence of number of setae on labrum, clypeus, maxilla, and postlabium, and sensilla on clypeus and labrum; (c) degree of development of epistoma; (d) number of sensilla of the maxillary and labial palpi (in the three species there are more than two sensilla), and (e) differentiation of the spinneret and salivary orifice. The most apparent differences between the exuviae of *Zatypota* Förster, *Zatypota bohemani, Z. gracilis* and *Zatypota* sp., are the expansion shown by the stipital sclerite at its lateral end and in the number, presence/absence and arrangement of the setae of the cranial sclerites (clypeus and labrum) and mouth parts (maxillae and labium). Descriptions of the cocoons of the two species of *Zatypota* and host records for all three species are reported.

Key Words Exuvia, final larval instar, *Perithous, Zatypota,* Ichneumonidae, Hymenoptera

The primary studies of the mature larva of Pimplinae (Hymenoptera: Ichneumonidae) have been conducted by Short (1959, 1978) and Finlayson (1967). The work presented herein addresses the morphology of the last larval stage of three species of Pimpliformes (Wahl and Gauld 1998, Gauld et al. 2002): *Perithous septemcinctorius* (Thunberg, 1822) (= *Hybomischos* Baltasar, 1961), *Zatypota bohemani* (Holmgren, 1860) and *Zatypota gracilis* (Holmgren, 1860). *Perithous septemcinctorius* was obtained as an ectoparasitoid of *Psenulus concolor* (Dahlbom, 1843) (Hymenoptera: Crabonidae) (Melo 1999) while the species of *Zatypota* Förster, 1869 were ectoparasitoids of spiders: *Z. bohemani* of *Anelosimus aulicus* (Koch) (Araneida: Theridiidae), pedotrophic material used by *Trypoxylon attenuatum* F. Smith, 1851 (Hymenoptera: Crabronidae), and *Z. gracilis* of *Thomisus onustus* Walckenaer (Areneida: Thomisi-

[1]Received 15 October 2003; accepted for publication 12 March 2004.

[2]Unidad de Zoología, Facultad de Biología, Universidad de Salamanca, 37071-Salamanca, Spain. (email: tormos@usal.es).

[3]Laboratori d'Entomologia. Departament de Biologia Animal. Universitat de València. Dr. Moliner, 50. 46100 (València) (Spain).

dae), pedotrophic material used by *Trypoxylon beaumonti* Antropov, 1991. Within *Perithous* Holmgren, 1859, only the mature larvae of *P. divinator* (Rossius, 1790) and *P. scurra* (Panzer, 1804) have been described (Danks 1970, Tormos et al. 1999). In *Zatypota,* only the exuviae of the last larval stage, of an undeterminate species, has been described (Short 1959). Additionally, a very brief description of the mature larvae of *Z. albicoxa* (Walker, 1874) was provided by Nielsen (1923), although he failed to describe the morphology in sufficient detail.

Materials and Methods

Host material was obtained from Crabronidae utilizing the trap nests made of stems of *Phragmites australis* (Cav.) Trin ex Stendel (Poales: Poaceae), which had been placed in the field in mid-spring of 1995 and remained there until the end of the fall when they were collected and returned to the laboratory. The methodology used in the preparation of the exuviae, as well as the terminology and organization used in the descriptions, follow Finlayson (1975) and Short (1978), with the modifications proposed by Wahl (1984, 1990). Pedotrophic material, on which the larvae of the host feed, was fixed and preserved in 70% EtOH for subsequent study. The systematics of Gauld et al. (2002) were followed. Voucher specimens are deposited at the Fundación Entomológica "Torres-Sala" (València, Spain).

Results

***Perithous septemcinctorius* (Thunberg).** Exuviae of the last larval stage was removed from cell 2 of a nest, with 6 cells, of *Psenulus concolor* established in Torneros de la Valdería (León). The trap nest was a stem of *Phragmites australis*. The mature larva had not constructed a cocoon.

Exuviae. Tegument (Fig. 1A) papillose, with scattered setae. Spiracles (Fig. 1B) with atrium round, separated from closing apparatus by a short section of trachea. Cranium (Fig. 1C) with antennae papilliform, with a sensillum on antennal orbit; epistoma very poorly developed; pleurostoma, hypostoma, hypostomal spur and stipital sclerite well sclerotized; cardo present; ventral zone of labial sclerite the same width as lateral zones; labral sclerite complete, well sclerotized; clypeus with two setae; labrum with two setae. Mouthparts: Mandibles well sclerotized, with wide base, large posteromedial tooth and blade with teeth on both dorsal and ventral surfaces; maxillae with one setae; labium with four setae; maxillary and labial palpi not protruding, with disc shapes and four sensilla on each; salivary orifice and spinneret undifferentiated; postlabium without setae.

Diagnosis. (a) ventral zone of labial sclerite the same width as lateral zones, (b) labrum, clypeus and maxillae with 2, 2 and 1 setae, respectively; (c) postlabium without setae, and (d) clypeus and labrum without sensilla.

Zatypota. *Zatypota bohemani* and *Z. gracilis* are ectoparasitoids of *Anelosimus aulicus* (Koch) (Theridiidae) and *Thomisus onustus* Walckenaer (Thomisidae), respectivley. Two exuviae of *Z. bohemani* were removed from cocoons in cells 4 and 5 of a nest, with 5 cells, of *T. attenuatum* established in Pinilla de la Valderia (León). An exuviae of *Z. gracilis* was obtained from a cocoon removed from cell 3 of a nest of *T. beaumonti* in Morla (León). In all cases, the trap nests were stems of *Phragmites australis*.

The coccons of the two species were similar to that described by Nielsen (1923)

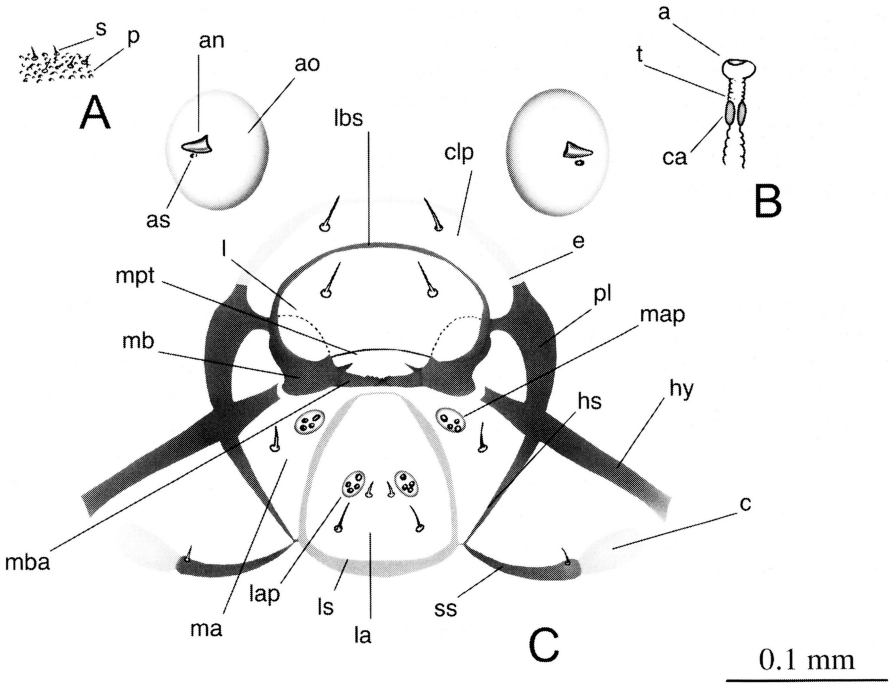

Fig. 1. Exuviae of final larval instar of *Perithous septemcinctorius*. (A). Tegument. (B). Spiracle. (C): Cranium in frontal view. Abbreviations used: antenna (an), antennal orbit (ao), antennal sensillum (as), atrium of spiracle (a), cardo (c), closing apparatus of spiracle (ca), clypeus (clp), epistomal sclerite (e), hypostoma (hy), hypostomal spur (hs), labium (la), labial sclerite (ls), labral sclerite (lbs), labrum (l), mandible (base = mb, posteromedial tooth = mpt, blade = mba), maxillae (ma), maxillary palpi (map), labial palpi (lap), papillae of tegument (p), pleurostoma (pl), section of trachea of spiracle (t), setae of tegument (s), stipital sclerite (ss).

for *Z. albicoxa*. They are more or less spindle-shaped, rounded at one end and pointed at the other. There is a circular hole at the rounded end. According to Nielsen (1923), the larval excrement is expelled through this hole. The only appreciable difference between both species is that *Z. bohemani* cocoons are whitish, while they are brown in *Z. gracilis*. The exit hole is practically circular, cleanly cut, and in the top of the cocoon.

Exuviae of *Zatypota bohemani* (Holmgren). Tegument (Fig. 2A) with setae longer than blade of mandible, and with hook-like spines on paired tubercles present on dorsal surface of some body segments. Spiracles (Fig. 2B) with atrium almost round, separated from closing apparatus by a short section of trachea. Cranium (Fig. 2C) with scattered setae; antennal orbit with papilla well differentiated; dorsal part of epistoma unsclerotized; pleurostoma lightly sclerotized; superior and inferior mandibular processes developed; labral sclerite incomplete, slightly sclerotized in its lat-

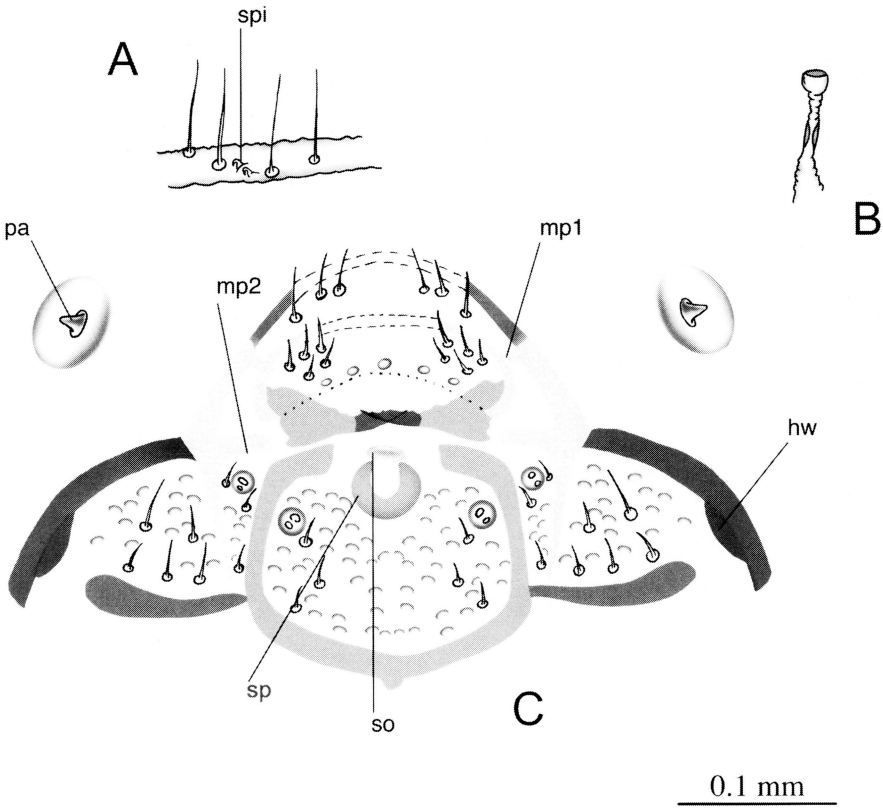

Fig. 2. Exuviae of final larval instar of *Zatypota bohemani*. (A). Tegument. (B). Spiracle. (C): Cranium in frontal view. Abbreviations used: antennal papilla (pa), expanded area of hypostoma (hw), mandibular processes (superior process = mp1, inferior process = mp2), silk press (sp), salivary orifice (so), hook-like spines (spi).

eral parts but unsclerotized dorsally; hypostoma well sclerotized, with expanded area along length, with hypostomal spur well differentiated and sclerotized; stipital sclerite well sclerotized and expanded at lateral end. Clypeus with six setae; labrum with ten setae and five sensilla. Mouthparts: Mandibles slender, normally sclerotized, with the base and blade clearly distinguished, and with numerous fine teeth on dorsal edge of the blade; labial sclerite sclerotized, almost square in shape, but with the ventral part pointed; maxillary and labial palpi roughly circular, with two sensilla—one highly developed and the other minute—; silk press and salivary orifice well defined. Maxillae with eight setae and numerous papillae; labium very papillose, with six setae; postlabium without papillae or setae.

Diagnosis. (a) clypeus with six setae, (b) labrum with ten setae and five sensilla, (c) maxillae with eight setae and numerous papillae, (d) labium very papillose, with six setae, (e) maxillary and labial palpi with two sensilla, (f) stipital sclerite well sclerotized and expanded laterally, and (g) labial sclerite sclerotized, roughly square in shape.

Table 1. Morphological differences between the exuviae of *P. scurra* (Panzer), *P. divinator* (Rossi) and *P. septemcinctorius*

Character	*P. scurra*	*P. divinator*	*P. septemcinctorius*
Spinules on tegument*	+	–	–
Sensillum of antennal orbit*	+	–	+
Cardo*	–	+	–
Seta on posterior part of stipital sclerite*	–	+	–
Number of setae on labrum	8	8	2
Number of setae on clypeus	6	4	2
Number of setae on maxillae	6	¾	1
Number of setae on postlabium	4	2	–
Number of sensilla on clypeus	6	4	–
Number of sensilla on labrum	18	2	–
Number of sensilla on maxillary and labial palpi	4	3	4
Development of epistoma	completely developed	more or less reduced	more or less reduced
Differentiation of spinneret	differentiated	undifferentiated	differentiated
Width of the ventral zona of labial sclerite	different of lateral zones	different of lateral zones	the same of lateral zones

* Presence (+)/absence (–).

Exuviae of *Zatypota gracilis* (Holmgren). Only one cast exuviae was available for study. In this description, the unmentioned structures are assumed to be similar or of the same order as those of the previous species. The only differences detailed are: (a) clypeus with eight setae, (b) labrum with eight setae and eight sensilla, and (c) maxillae and labium with four setae, without papillae.

Diagnosis. (a) clypeus with eight setae, (b) labrum with eight setae and eight sensilla, (c) maxillae with four setae and without papillae, (d) labium without papillae, with four setae, (e) maxillary and labial palpi with two sensilla, (f) stipital sclerite well sclerotized and expanded at lateral end, and (g) labial sclerite sclerotized, roughly square in shape.

Discussion

As in previous descriptions of *Perithous* larvae (Danks 1970, Short 1978, Tormos et al. 1999), *P. septemcinctorius* displays more than two sensilla on maxillary and labial palpi. As in other ectoparasitoid species, the mandibular blades have teeth and a broad unarmed projection in the form of a tooth on the base and blade of the mandibles and an undifferentiated spinneret. The presence of more than two sensilla on the maxillary and labial palpi represents the only character that allows, in light of current knowledge, a definition of the final larval instar of *Perithous*.

The three species described in the genus, *P. scurra* (Tormos et al. 1999), *P. divinator* (Danks 1970, Short 1978) and *P. septemcinctorius,* can be differentiated on the basis of the following characters (Table 1): (a) presence/absence of spinules on tegument, sensillum on antennal orbit, cardo, and seta on posterior part of stipital sclerite; (b) presence/absence or number of setae on labrum, clypeus, maxillae, and postlabium, and sensilla on clypeus and labrum; (c) degree of development of epistoma; (d) number of sensilla of maxillary and labial palpi (although in all three species there are more than two sensilla); and (e) differentiation of a spinneret and salivary orifice. The characters presence/absence of cardo and seta of posterior part of stipital sclerite were reported by Short (1978), although Danks (1970) did not include them in his description.

The exuviae of *Z. bohemani* and *Z. gracilis* show the two autapomorphies that define the final larval instar of the Polysphincta genus-group (= Polysphinctini *sensu* Hellén 1915): (a) body setae longer than mandible blade and (b) dorsal surface of some body segments with hook-like spines on paired tubercles. Other characters shared with the last larval instar of Polysphincta genus-group are: (a) pleurostoma very slightly sclerotized, (b) hypostomal spur well sclerotized, resting on medial end of stipital sclerite, where it touches the labial sclerite (autapomorphy of Pimpliformes), (c) mandible with the base and blade clearly distinguished, slender, and with numerous fine teeth on the dorsal edge of the blade, and (d) a long stipital sclerite.

The most apparent differences between the previously described exuviae of *Zatypota* sp. (Short 1959) and the exuviae of *Zatypota* species described here, *Zatypota bohemani* and *Z. gracilis,* are the expansion displayed by the stipital sclerite at its lateral end. This fact annuls, upon conferring variability, as a character that defines *Zatypota* and possible apomorphy of this genus, the character: stipital sclerite well sclerotized and not expanded at lateral end. Other appreciable differences between them and with the already described species, lie in the number, presence/absence and arrangement of the papillae, sensilla and setae of the cranial sclerites (clypeus and labrum) and mouth parts (maxillae and labium).

Table 2. Morphological differences between the exuviae of *Zatypota bohemani, Z. gracilis* and *Zatypota* sp.

Character	*Z. bohemani*	*Z. gracilis*	*Zatypota* sp.
Stipital sclerite with an expansion at its lateral end*	+	+	–
Papillae on maxillae*	+	–	+
Labium	+	–	+
Number of setae on clypeus	6	8	4
Number of setae on labrum	–	8	6
Number of setae of maxillae	5	4	3
Number of setae of labium	6	4	4
Number of sensilla on labrum	–	8	4

* Presence (+)/absence (–).

Acknowledgments

We are indebted to Thelma Finlayson (Simon Fraser University, Burnaby, Canada), Mark Shaw (National Museums of Scotland, Edinburgh, Scotland), and David Wahl (The American Entomological Institute, Gainesville, FL) for their observations and critical reading of the manuscript and J. A. Barrientos (Universitat Autònoma de Barcelona, Spain) for the identification of spiders. Financial support for this paper was provided from the Junta de Castilla y León (project SA001/03).

References Cited

Beirne, B. P. 1941. A consideration of the cephalic structures and spiracles of the final instar larvae of the Ichneumonidae (Hym.). Trans. Soc. British Entomol. 7: 123-190.

Danks, H. V. 1970. Biology of some stem-nesting aculeate Hymenoptera. Trans. Royal Entomol. Soc. London 122(11): 323-399.

Finlayson, T. 1967. A classification of the subfamily Pimplinae (Hymenoptera: Ichneumonidae) based on final-instar larval characteristics. Can. Entomol. 99: 1-8.

1975. The cephalic sclerites and spiracles of the final-instar larvae of the subfamily Campopleginae, tribe Campoplegini. Mem. Entomol. Canada 94: 1-137.

Finlayson, T. and K. Hagen. 1979. Final-instar larvae of parasitic Hymenoptera. Pestology Centre. Depart. Biological Sciences. Simon Fraser Univ. Burnaby.

Gauld, I. D., Wahl, D. B. and G. R. Broad. 2002. The suprageneric groups of the Pimplinae (Hymenoptera: Ichneumonidae): a cladistic re-evaluation and evolutionary biological study. Zool. J. Linn. Soc. 136: 421-485.

Hellén, W. 1915. Beitrage zur Kenntnis der Ichneumoniden Finlands. I. Subfamily Pimplinae. Acta Societatis pro Fauna et Flora Fennica 40(60): 1-190.

Melo, G. A. R. 1999. Phylogenetic relationships and classification of the major lineages of Apoidea (Hymenoptera), with emphasis on the crabronid wasps. Sci. Pap. Nat. Hist. Mus., Univ. Kansas 14: 1-55.

Nielsen, E. 1923. Contributions to the life history of the pimpline spider Parasites (*Polysphincta, Zaglyptus, Tromatobia*). (Hym. Ichneum.). Entomologiske Meddelelser XIV: 137-205.

Short, J. R. T. 1959. A description and classification of the final instar larvae of the Ichneumonidae (Insecta, Hymenoptera). Proc. National Mus. 110: 391-511.

1978. The final larval instars of the Ichneumonidae. Mem. Am. Entomol. Inst. 25: 1-508 pp.

Tormos, J., J. D. Asís and J. Selfa. 1999. Description of the final instar of *Perithous scurra* with comments on its morphological characters (Hymenoptera: Ichneumonidae, Pimplinae, Delomeristini). Florida Entomol. 82: 333-339.

Wahl, D. B. 1984. An improved method for preparing exuviae of parasitic Hymenoptera. Entomol. News 95(5): 227-228.

1990. A review of the mature larvae of Diplazontinae, with notes on larvae of Acaenitinae and Orthocentrinae and proposal of two new subfamilies (Insecta: Hymenoptera, Ichneumonidae). J. Nat. Hist. 24: 27-52.

Wahl, D. B. and I. D. Gauld. 1998. The cladistics and higher classification of the Pimpliformes (Hymenoptera: Ichneumonidae). System. Entomol. 23: 265-298.