

Description of pupae of sap beetles *Epuraea* (*Dadopora*) *guttata* (Olivier, 1811) and *Meligethes* (*Clypeogethes*) *?ruficornis* (Marsham, 1802) (Coleoptera: Nitidulidae)

A.S. Kurochkin & A.G. Kirejtshuk

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Pupae of *Epuraea* (*Dadopora*) *guttata* (Olivier, 1811) and *Meligethes* (*Clypeogethes*) *?ruficornis* (Marsham, 1802), collected in Zhiguli Nature Reserve (Samara Prov.), are described for the first time and compared with descriptions and drawings available from previous publications. Pupal characters of the subfamilies of Nitidulidae are discussed, and those of the family as a whole are given.

A.S. Kurochkin, Samara State University, Akad. Pavlov str. 1, Samara 443011, Russia. E-mail: nitidula@mail.ru

A.G. Kirejtshuk, Zoological Institute, Russian Academy of Sciences, Universitetskaya nab. 1, St.Petersburg 199034, Russia. E-mail: AK3929@AK3929.spb.edu

Introduction

The pupa of the family Nitidulidae was characterized by Rozen (1963). However, he studied only few representatives of 4 subfamilies (Carpophilinae, Nitidulinae, Cillaestinae, Cryptarchinae) and neglected the descriptions of pupae of the subfamilies Meligethinae, Epuraeinae and Cybocephalinae published earlier (Heeger, 1854; Silvestri, 1910; Scott, 1920; Friederichs, 1921; Nuorteva, 1961; etc.). Nevertheless, J.G. Rozen in the mentioned paper used the terms in accordance with the recent morphological interpretations; these terms are mostly accepted by the authors of this publication.

Scott (1920) published a very detailed description of pupa of *Epuraea* (*Epuraea*) *aestiva* (Linnaeus, 1758) [as *E. (E.) depressa*]. Nuorteva (1961) briefly described pupa of *E. (E.) rufobrunnea* Sjöberg, 1939. Other published data on pupae of this genus are Perris' notes on the pupa of *E. (E.) biguttata* (Thunberg, 1784) without drawings [Perris, 1853; as *E. (E.) obsoleta*] and Hayashi's publication with notes on the pupa of *E. (E.) argus* Reitter, 1894 (Hayashi, 1960). The pupa of *Meligethes* Stephens, 1830 was studied by Osborne (1965), who published comprehensive descriptions and drawings of two species: *M. (Clypeogethes) aeneus* (Fabricius, 1775) and *M. (C.) viridescens* (Fabricius, 1787). However, pupa of the first species has been known since

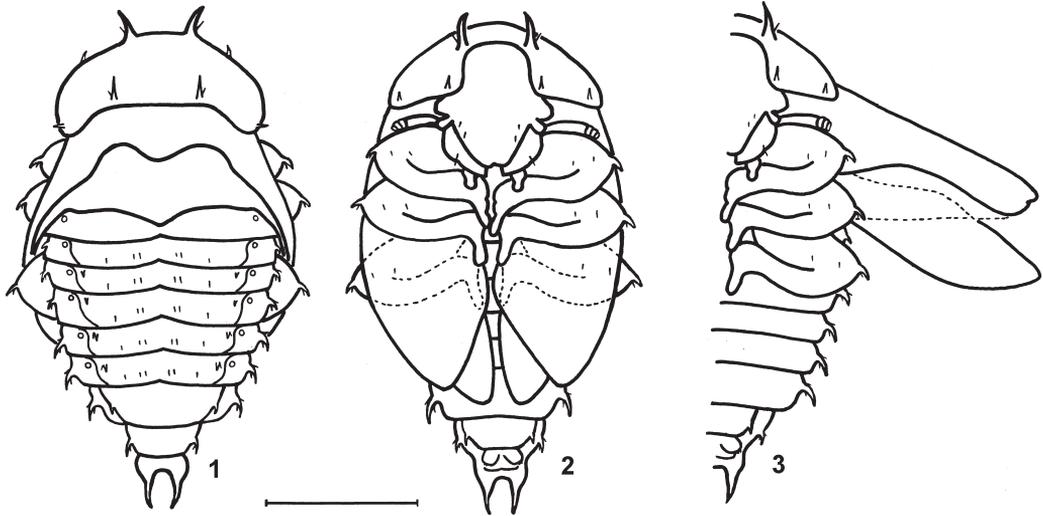
1854 (Heeger, 1854; Bogdanov-Kat'kov, 1920; Friederichs, 1921; Nolte, 1954). Other publications with descriptions and drawings of pupae of sap beetles (Mjöberg, 1905; Silvestri, 1910; Hinton, 1945; Gillogly, 1962; Kirejtshuk, 1996; etc.) show more or less uniform general structure of this stage in several groups of the family. Gillogly (1962) showed that, in contrast to other Nitidulidae, the pupa of *Brachypeplus ponapeus* Gillogly, 1962 has the head well exposed from under the anterior edge of pronotum and lacking the urogomphi at the apex of abdomen.

All studied pupae are kept in glycerin, and before examination they were cleared in 10% KOH. The study was carried out using a Leica DM E microscope provided with oculars "Leica PERIPLAN 10x/18" and lenses "Leica C PLAN 10x/0.22 PH 1, 20x/0.40 PH 1".

The subfamily classification of Nitidulidae in this paper follows the interpretation proposed by Kirejtshuk (1998a). All examined specimens are deposited in the collection of the Zoological Institute, St.Petersburg.

Epuraea (*Dadopora*) *guttata* (Olivier, 1811) (Figs 1-8)

Material. **Russia**, Samara Prov.: 6 pupae, Kinelsky Distr., Krasnosamarskoe forestry farm, quarter 58, broad-leaved forest, in upper soil layer slightly saturated with sap of oak (*Quercus robur*), 25.VII.2002, A.S. Kurochkin;



Figs 1-3. *Epuraea (Dadopora) guttata* (Oliv.), pupa. **1**, body, dorsal view; **2-3**, body, ventral view. Scale: 1 mm.

about 100 specimens (larvae, pupae and adults reared from eggs of adults collected on oozing sap of *Quercus robur*; see Notes), Stavropolsky Distr., Zhiguli Nature Reserve, quarter 20, herb meadow, A.S. Kurochkin (larvae were grown on a yeast/banana/sugar/water mixture and pupated 6.VII.2003 in soil).

Description of pupa. Length 3.10-3.65 mm (with urogomphi), width 1.45-1.70 mm. Coloration in life whitish with creamy shade, except longitudinal tubercles, all being light brownish; pro-, meso- and metanota strongly shining, head and legs moderately shining, elytra shining, abdomen matt. Head deflected ventrally, invisible from above (entirely covered by pronotum), with sparsely dispersed, hardly visible, very short erect setae, extremely finely punctured and without longitudinal tubercles. Pronotum extremely finely punctured and with sparsely dispersed, hardly visible, very short erect setae and 8-10 elongate tubercles each bearing a seta at base: 4-6 subequally disposed tubercles along anterior edge and 4 along posterior one (anteromedial and posteromedial tubercles largest). Elytra without setae, extended posterior to femorotibial articulation of hind legs, with outer edges curved apically and reaching the base of penultimate sternite. Meso- and metanota without setae. Antennae moderately long and oriented outwards between lateral edge of pronotum and anterior edge of profemur (position of antennae shows some variability). Labrum fused with frons, with emarginate anterior edge, bearing 4 fine, short setae in addition to small number of extremely short and sparse setae. Apices of maxillary palpi exposed from under lateral edge of mandibles. Outer edge of each mandible with a seta being about twice

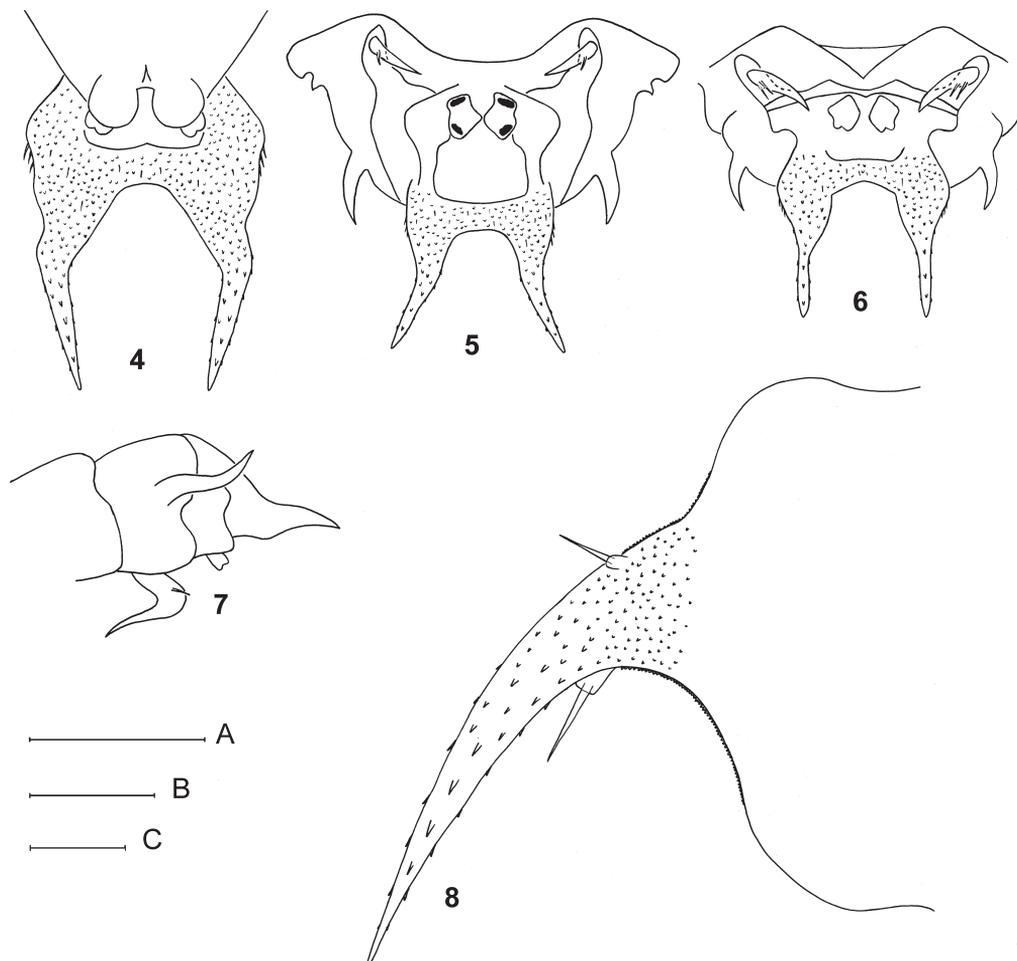
as long as that on labrum. Each of abdominal segments 2-8 with a long pleural tubercle at each side bearing 2 setae at base. Abdominal tergites III-IV on each side either with a short paralaralateral tubercle bearing a seta at base or without setae; tergites V-VI always with such a tubercle bearing a basal seta (on distal segments tubercles becoming slightly more sclerotized); tergites II-VI with 2 pairs of paramedial and a pair of paralaralateral small setae. Urogomphi of abdominal segment 9 of normal length, simple, slightly curved, sharply pointed and moderately separated. Underside of abdominal segments 8 and 9 with transformed sclerites and appendages, showing two types of structures corresponding to sexes (see Discussion). Each femorotibial articulation with a tubercle bearing a seta at base. Femora with 2 setae along posterior edge in distal half. Abdominal segments 1-6 with circular spiracles.

Female hypopygidium with two strongly prominent mammiform processes. Male hypopygidium without such processes.

Notes. Pupae of this species were first collected in 2002. In 2003, they were obtained from eggs laid by females collected in nature. The development had the following dynamics: 13-15.VI. 2003, capture of adults; 17.VI, appearance of eggs; 19.VI, appearance of first larvae; 28.VI, mature larvae left food substrate for soil; 3-6.VII, pupation.

One of specimens examined lacks the tubercle in the left anterior angle of the pronotum, another one has the pleural tubercle slightly bifurcated at the very apex.

The description of *Epuraea (Epuraea) biguttata* (Thunberg, 1784) by Perris (1863) is very short



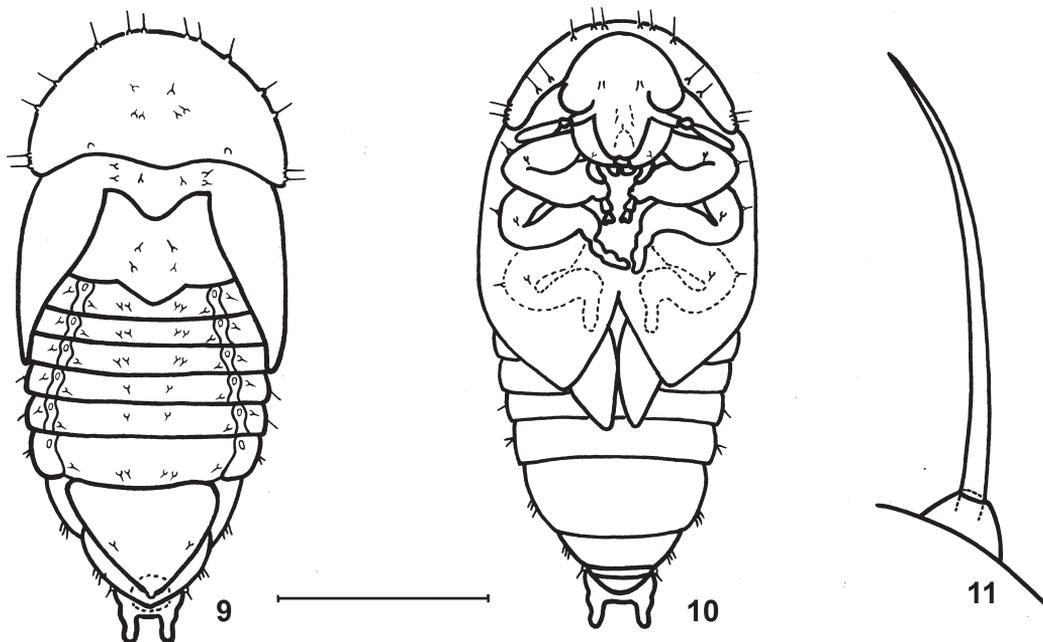
Figs 4-8. *Epuraea (Dadopora) guttata* (Oliv.), pupa. **4**, apex of female abdomen, ventral view; **5-6**, apex of male abdomen, ventral view; **7**, same, lateral view; **8**, pleural abdominal tubercle. All scales 0.25 mm: A, Fig. 7; B, Figs 4-6; C, Fig. 8.

and cannot be used for a diagnosis. The paper by Hayashi (1960) with notes on the pupa of *E. (E.) argus* Reitter, 1894 remains unknown to us. Thus, presently we can compare the pupa of *E. (Dadopora) guttata* only with those of *E. (Epuraea) aestiva* (Linnaeus, 1758) [as described by Scott (1920)] and *E. (E.) rufobrunnea* Sjöberg, 1939 [as described by Nuorteva (1961)]. The pupa of *E. guttata* is distinct from both in the lack of longitudinal tubercles on the head, shorter longitudinal tubercles on the pronotum and abdomen, and thickened base of urogomphi; it also differs from the former in the lack of traces of compound eyes and clearly transversely truncate posterior edge of the pygidium. In addition, nobody of the cited researchers mentioned that the

body of *Epuraea* species studied by them has short fine setae on legs and tergites. This difference in descriptions could be associated not with characters of the species but with the attention of researches. Nevertheless, Nuorteva drew small setae at base, at the middle, or at apex of some longitudinal tubercles on abdominal segments.

Meligethes (Clypeogethes) ?ruficornis
(Marsham, 1802)
(Figs 9-11)

Material. **Russia, Samara Prov.:** 1 pupa, Stavropolsky Distr., Zhiguli Nature Reserve, quarter 7, broad-leaved forest, wet glade, in remains of ovary of *Ballota nigra* L. (Lamiaceae), 18.VII.2001, A.S. Kurochkin.



Figs 9-11. *Meligethes (Clypeogethes) ?ruficornis* (Marsh.), pupa. **9**, body, dorsal view; **10**, body, ventral view; **11**, submarginal pronotal seta. Scale: 1 mm.

Description of pupa. Length 1.9 mm (with urogomphi), width 0.8 mm. Coloration in life light green (after KOH these parts became lighter and somewhat translucent) except pronotum, which is dark brownish, heavily pigmented and finely punctured. Dorsum with short, rare and fine setae concolorous with integument. Head deflected ventrally and invisible from above (completely covered by pronotum), with 11 hardly visible setae: 2 pairs near eyes, 5 pairs on frons and 1 pair at outer edge of each mandible. Pronotum with 16 larger submarginal setae: 2 paramedial pairs at the middle of anterior edge, a pair at each of anterior and posterior angles, an additional pair between paramedial and anterolateral pairs and a paramedial pair between posterolateral pairs; pronotal disc with 3 pairs of smaller setae. Elytra covering metafemorotibial articulations; hind wings reaching the middle of abdominal segment 3. Mesonotum with 3 or 4 small setae on each half. Metanotum with 2 paramedial pairs of small setae. Abdominal segments with exposed lateral edges with 1-3 lateral setae in posterior half (segments 4 and 5 with one seta, segment 6 with two setae, segments 7 and 8 with three setae). Each of abdominal tergites I-III with 2 pairs of short paramedial setae near the middle, tergites IV-V with a pair of very short paramedial setae near the middle, and tergite VI bears 2 paramedial

pairs of small setae at posterior edge. Abdominal segments 1-5 have a pair of paralateral setae at both inner and outer sides of spiracles (segment 6 with a visible seta only at inner side of spiracle). Abdominal segment 7 with a seta at the middle of each tergal lateral edge. Urogomphi moderately developed, simple, widely separated, slightly curved outwards and with blunt apices. Antennae moderately long and oriented outwards between edge of pronotum and anterior edge of profemur. Labrum fused with frons; anterior edge of labrum emarginate. Apices of maxillary palpi exposed from under lateral edge of mandible. Apices of labium and labial palpi visible behind anterior edges of labrum and mandibles. All femora with a seta at apex and a posterior seta at inner edge. Abdominal segments 1-6 with elongate oval spiracles.

Notes. The identification of a single pupa, collected in inflorescences of *Ballota nigra* L. (Lamiaceae) and undoubtedly belonging to *Meligethes (Clypeogethes)*, was made in accordance with all hitherto known records on host plants of the species represented in Samara Prov. Audisio (1993), who summarized the data on host plants for the West-Palaearctic species of the genus *Meligethes*, listed only 4 species of this genus as associated with species of *Ballota*, and only one of them registered as developing on *B. nigra* L.

[namely *M. (Clypeogethes) ruficornis*]. Of three other species of *Meligethes*, *M. (C.) nanus* Erichson, 1845 usually develops on flowers of *Marrubium vulgare* L. (Lamiaceae); imagines of *M. nanus* were collected on flowers of *Ballota* and other Lamiaceae. *M. (C.) scholtzi* Easton, 1960 and *M. (C.) syriacus* Brisout, 1872 are not recorded from Samara Prov., and only adults of these species have been collected in flowers of *B. saxatilis* Sieber and *B. rupestris* (Biv.) Vis.

In contrast to many records on pupation of species of *Meligethes*, the pupa of *M. (C.) ?ruficornis* examined was found not in soil, but in remains of an ovary of *Ballota nigra*.

From the pupa of *M. (C.) aeneus* (F.) described by Osborne (1965), the examined specimen differs in the heavily pigmented pronotum, greater number of setae on the head, number and arrangement of setae on the pronotum and other sclerites of the dorsum, and shape of the urogomphi. Moreover, the general coloration of the pupa examined, in contrast to that in formerly described pupae of the genus, is light green.

As to general character of chaetotaxy, it should be noted that each of the larger setae on the dorsum is located on more or less developed tubercle (setibearing one) and all of them look like homologous to elongate tubercles of pupae of other groups of sap beetles. A part of larger pronotal setae seem to be broken and can be traced only because of presence of these setibearing tubercles. All known pupae of the subfamily Meligethinae are characterized by a smaller number of tergites, which are completely developed; in all these, tergites VIII and IX are strongly reduced, although the urogomphi remain well developed.

Discussion

Hinton (1945) indicated the external sexual differences between pupae of some sap beetles species. According to him, the female of *Carpophilus (Carpophilus) hemipterus* (Linnaeus, 1758) "differs from male in having two prominent mammiform processes behind sixth sternite", while that of *C. (Myothorax) dimidiatus* (Fabricius, 1792) "differs from male in having the apex of the fifth sternite rounded instead of deeply emarginated and the sixth abdominal sternite entirely concealed instead of externally visible". The rearing of *Epuraea (Dadopora) guttata* and other sap beetles showed that such mammiform processes are possessed also by female pupae of Epuraeinae.

The examination of pupae of *Epuraea (Dadopora) guttata* and *Meligethes (Clypeogethes) ?ruficornis* allowed us to determine some characters which can be used for distinguishing pupae

of the subfamilies of Nitidulidae. Pupae of Epuraeinae have the head concealed from above by the pronotum, deflected ventrally and sometimes bearing supraorbital longitudinal tubercles, all abdominal segments well developed, posterior edge of the pygidium more or less transverse, the pronotum and abdomen with a number of elongate setiferous tubercles of various size and arrangement, bearing 1 or 2 short setae, the elytra and wings without setae, apices of femorotibial articulations with tubercles, posterior femorotibial articulations visible from above, urogomphi simple.

Pupae of Meligethinae also have the head concealed from above by the pronotum and deflected ventrally, but the pronotum covered with a number of elongate comparatively large setae arranged on setibearing tubercles, the head and dorsum with numerous smaller setae, the elytra and wings without setae, posterior femorotibial articulations invisible from above and covered by elytra, tergites VIII and IX significantly reduced, urogomphi simple.

Pupae of Carpophilinae, in contrast to those of Epuraeinae and Meligethinae, have the head not always concealed and dorsal sclerites, including elytra, with scattered short fine setae (Hinton, 1945; Rozen, 1963); in all known pupae of Carpophilinae the pygidium (tergite VII) of all known pupae and abdominal tergite VIII are transverse and with truncate posterior edge; in contrast to Meligethinae, the femorotibial articulations bear clear longitudinal tubercles.

Pupae of some representatives of Nitidulinae bear short fine setae dispersed diffusely on the dorsal sclerites, including elytra [*Omosita colon* (Linnaeus, 1758), see Hinton, 1945]; pupae of other genera have no such setae [*Lobiopa*, *Phenolia*, *Cyllodes* and *Pallodes*, see Rozen, 1963; *Aethina*, see Kirejtshuk, 1996]. In addition, pupae of Nitidulinae have the longitudinal tubercles, although in some genera they are probably substituted by large setae; the pygidium (tergite VII) may be somewhat similar to that in adults [*Nitidula*, see Mjöberg, 1905 and *Aethina*, see Kirejtshuk, 1996] or to that in larvae of Epuraeinae and Carpophilinae (in the last cases tergite VIII is well developed and transverse) [*Pocadius*, see Letzner & Kraatz, 1859; *Omosita*, see Hinton, 1945], but their femorotibial articulations are without evident longitudinal tubercles.

Pupae of some Cillaeinae have a well-developed fine pubescence on the dorsum, including elytra [species of *Conotelus*, see Rozen, 1963], while pupae of other taxa have a reduced pubescence and completely glabrous elytra [*Brachypeplus* and *Macrostola*, see Rozen, 1963]. In Cillaeinae, the abdominal apex (segments 7-11) may be resembling that in Epuraeinae, Carpo-

philinae and *Omosita*, while the pygidium of *Brachypeplus ponapeus* Gillogly, 1962 is imagoform; femorotibial articulations in these taxa are without evident longitudinal tubercles.

The pupae of Cryptarchinae are characterized by the head with supraocular tubercles, each femorotibial articulation with a tubercle, the pronotum with 4-6 longitudinal tubercles (in most sap beetles, the pronotum is at least with 8 longitudinal tubercles; in Meligethinae these are probably substituted by setiferous tubercles), triangular shape of the pygidium, and well-developed urogomphi with a narrow interspace between the bases.

Unfortunately, the pupa of Cybocephalinae still remains insufficiently described for more or less comprehensive interpretation of its characters, although the published drawings of this pupa (Silvestri, 1911) may be used to formalize some diagnostic characters, such as the presence of long setae on the dorsum (instead of longitudinal tubercles), transverse pygidium with subtruncate posterior edge, well-developed abdominal tergite VIII, short abdominal segment 9 with small urogomphi scarcely visible from above, and the lack of longitudinal tubercles at femorotibial articulations.

As to diagnostic characters of the family, pupae of Nitidulidae, as adults, are characterized by developed and functioning spiracles only on abdominal segments 1-6. In all studied pupae of sap beetles, the frons and labrum are fused, while only adults of the subfamily Cryptarchinae, including the tribes Arhinini, Eucalospherini and Platyarchini (Kirejtshuk, 1998a, 1998b), retain this "pupal" feature. Pupae of most taxa have longitudinal pointed tubercles bearing 1-2 setae; in several subfamilies these setae have been substituted by short setibearing tubercles. Pupae of most studied taxa bear a longitudinal tubercle at each femorotibial articulation. However, in some cases these tubercles have been substituted by a seta or reduced. The pupal urogomphi are more or less developed (even in cases when larvae have strongly reduced urogomphi), but the pupa of *Brachypeplus ponapeus* Gillogly, 1962 seem to have no urogomphi.

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