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PASSALIDAE: STATE OF LARVAL TAXONOMY WITH DESCRIPTION OF NEW WORLD SPECIES

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ABSTRACT

Larvae of 12 New World species of Passalidae are described and 7 species redescribed, bringing the total number of species described to 134 worldwide. A key is provided for all New World genera. Basic setal pattern differences differentiate New World Passalini from Proculini, with the latter tribe showing 2 basic groups of genera. Some exceptions to these basic patterns suggest possible nomenclatural changes.

RESUMEN

Se describen larvas de 12 especies de Passalidae del Nuevo Mundo y se redescriben 7 más, dando un total de 134 especies descritas mundialmente. Se presenta una clave para todos los géneros del Nuevo Mundo. Diferencias básicas en el patrón de setas diferencian Passalini del Nuevo Mundo y Proculini, con la última tribu mostrando 2 grupos principales de géneros. Algunas excepciones a estos patrones básicos sugieren posibles cambios nomenclatoriales.

Passalid larvae have been described for 123 species, summarized in Schuster & Reyes-Castillo (1990), with additional species in Castillo et al. (1988) and Schuster (1991). Recent works treating previously described species include those of Costa et al. (1988) and da Fonseca (1990). The majority of these are New World species. Schuster & Reyes-Castillo (1981) presented a key to genera and provided nomenclature for primary setae and setal diagrams, which are the basic characters for separating many groups.

In this work I describe 12 more New World species, redescribe 7 species and discuss the state of passalid larval taxonomy.

METHODS

Collecting methods and larval characters are the same as those described in Schuster & Reyes-Castillo (1981), except where noted. Setal nomenclature is given in Fig. 1 and, more completely, in Schuster & Reyes-Castillo (1981). The numbers following the collector's name in the descriptions refer to the number of individuals collected, instar (roman numeral) and head width or range of head widths in mm. Sometimes a collection number will follow this.

DESCRIPTIONS

Tribe PROCULINI

Petrejoides laticornis Truqui. MEXICO, Veracruz, Pto. del Aire 2400 m alt. 17 VII 80, C. Castillo, 1 III 4.1

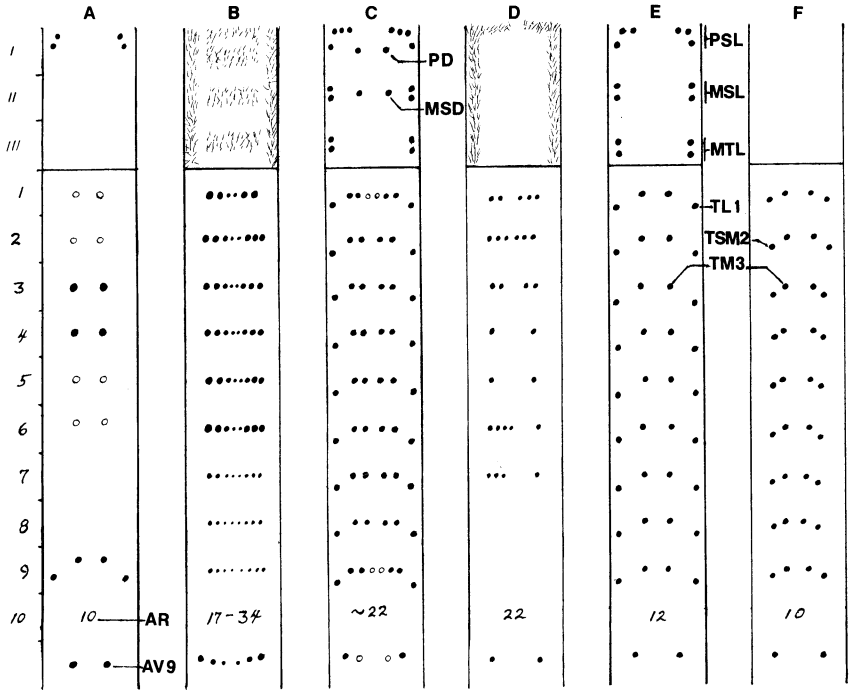

Fig. 1. Various third instar dorsal primary setal patterns in Passalidae. A, *Popilius lenzi*; B, basic *Oileus* pattern; C, *Verres furcilabris*; D, *Xylopassaloides schusteri*; E, *Pseudoarrox karreni* (≒ basic "Chondrocephalus" group pattern); F, basic "Neleus" pattern. Black dots represent setae almost always present, open circles are setae that are sometimes present. AV9 = ventral abdominal setae on sternite 9, PD = dorsal pronotal setae, MSD = dorsal metanotal setae, PSL = lateral pronotal shield setae, MSL = lateral mesonotal setae, MTL = lateral mesonotal setae, TM = medial tergal setae, TL = lateral tergal setae, TSM = submedial tergal setae, AR = anal ring setae. Numbers refer to thoracic (I-III) and abdominal (1-10) segments.

This species conforms to the genus description of Schuster & Reyes-Castillo (1981). The dorsal setal pattern is typical of the genus, except for the lack of TM-8 setae; 6 of the 8 species for which larvae are known possess this basic pattern. The 2 exceptional species (*P. orizabae* Kuwert and *P. recticornis* (Burmeister)) lack TL setae on most segments. The anal ring has 14 setae, thus differing from all other except *P. guatemalae* Reyes-Castillo & Schuster (1983) and *P. panamae* Schuster (in press). The head width is smaller than that of *P. guatemalae* (4.4-4.9 mm) and it possesses 2-3 internal coxal setae, as opposed to >5 in *P. panamae*. One or 2 HPA hairs extend beyond the antennal tip. Prosternal hairs are few, 2 or 3 to 0.3 mm. The raster has setae; most of the ventral abdomen is bare. The metathoracic leg has 4 subapical teeth.

Pseudoarrox karreni Reyes-Castillo. COSTA RICA, Cartago, E. of Empalme, La Chonta (TOPOTYPE) 2310 m 16 I 88, JCS, 4 III 3.8-4.2, 2 II 2.9-3.0

This is the only New World genus lacking larval description. It is monotypic, keying directly to *Chondrocephalus* in Schuster & Reyes-Castillo (1981). It differs from most *Chondrocephalus* in having 6-8 internal coxal setae. This is similar to *Ch. granulifrons*

(Bates); however, the head width of the latter is larger (4.2-4.7 mm). Also, the prosternum bears very long hairs between the prothoracic legs (to 0.8 mm). Of 5 specimens, 3 had a single long (0.2-0.4 mm) seta in the middle of the frons. The metathoracic leg has 4 subapical teeth; the raster has hairs. The dorsal primary setae form a perfect "Chondrocephalus" group pattern (Fig. 1e), suggesting a close relationship to that evolutionary line, which includes *Chondrocephalus*, *Petrejoides*, *Coniger*, *Popilius*, and *Spurius* (see Schuster & Reyes-Castillo 1981).

Popilius lenzi Kuwert. COSTA RICA, Cocos Is., Wafer Bay 17-22 IV 75, C. L. Hogue, 1 II 2.9, 1 I 2.1

Popilius is a large genus in need of revision. We recognize 2 basic larval types: those with 1 pair of TM setae per segment and those with more than 1 pair per segment (Schuster & Reyes-Castillo 1981). This species falls in the former category (Fig. 1a). It differs from all other Proculini in instar II having only 10 AR setae (instar I has 11). The raster has setae, coxae have 2 internal setae, HPA setae are longer than the antennae, and the prosternal hairs reach 0.5 mm in length.

Oileus Kaup

Quintero and Reyes-Castillo (1983) described larvae of all species of *Oileus*, except for a new species from Mexico. They provided a key and setal maps. On examining some of the same specimens they used, I noticed certain discrepancies with their descriptions. For this reason, and to add characters not previously mentioned, I here redescribe 2 species. The basic larval setal pattern for the genus is given in Fig. 1b. The species may be separated with the following key:

1 Internal coxae with >8 setae; abdominal sternites 2-8 with transverse bands of hairs (0.3-0.6 mm long); only 1 pair of TM setae per segment; raster completely covered with setae; anal ring with 18-22 setae; third instar head width 6.5-7.1 mm ..... *O. heros*

1' Internal coxae with 8 or less setae; abdominal sternites 2-8 bare or with few short setae (0.2 mm); >1 pair of TM setae per segment; raster usually with setae except for a bare central area 1-3 mm wide; anal ring with 20-34 setae; third instar head width 4.6-6.8 mm 2

2(1') Internal coxae with 1-4 setae, AV9 with 3-4 pairs of setae, prosternum with 0-4 hairs <0.8 mm long; anal ring with 20-26 setae, third instar head width 4.6-5.1 mm ..... *O. sargi*

2' Internal coxae with 4-8 setae, AV9 with 3 pairs of setae, prosternal hairs variable, anal ring with 22-34 setae, third instar head width >5.8 mm 3

3(2') Prosternum with many hairs >0.5 mm, third instar head width >6.4 mm .. 4

3' Prosternum with at most 1 hair longer than 0.1 mm, third instar head width 5.8-6.1 mm ..... *O. rimator*

4(3) AV1 bare; bare area of raster approximately 0.1 mm wide, anal ring with approximately 34 setae ..... *O. nonstriatus*

4' AV1 with several long (to 1.0 mm) hairs, bare area of raster >3 mm wide, anal ring with 23-24 setae ..... *O. bifidus*

O. nonstriatus (Dibb). MEXICO, Hidalgo, rd. to Xochicoatlán 18 III 79, M. A. Morón, A. Morón, F. Cervantes, 1 II 5.6

Characteristics not mentioned in the key above include: metathoracic leg with 4 subapical teeth; many HPA setae not reaching antennal tip, to 0.6 mm long; many prosternal hairs to 0.6 mm; TM setae are strong only on abdominal tergites 2-6, which have 3-5 pairs. I suspect that some of the differences between our descriptions reflect the fact that at least one of their larvae is a third instar.

O. bifidus (Zang) MEXICO, Oaxaca, 4 km from La Esperanza 1800 m 17 V 80, G. Quintero, M. L. & C. Castillo, E. Rivera, 2 III 6.5-6.8

Characteristics not mentioned in the key include: metathoracic leg with 2-5 subapical teeth, many HPA setae not reaching antennal tip, to 0.7 mm long; prosternum with 30-40 hairs to 1.2 mm; abdominal sternites 2-8 bare or with few short (0.2 mm) setae, longer laterally; frons with many hairs to 0.7 mm; TM setae strong on abdominal tergites 1-7 which have 2-4 pairs.

Publius granulipennis (Zang) *nov. comb.* MEXICO, Chiapas, Km 59.5 rd. to Villa Hermosa, 1515 m alt., 9 VII 83, JCS, 1 III 5.5 #QB-1-6

This species conforms well to the description of the genus given in Schuster & Reyes-Castillo (1981). It differs from other *Publius* in having 18 AR setae and the prosternum lacking any setae. Two pairs of HPA setae extend past the antennae. It has an almost complete "Chondrocephalus" dorsal primary setal pattern, lacking only 1 pair of MSL & MTL setae, as well as having >12 AR setae.

This species was orginally described by Zang (1905) as *Proculejoides*, a genus that Reyes-Castillo (1970) synonimized with *Ogyges*. Nevertheless, in a recent study of this genus (Schuster and Reyes-Castillo, in press), we excluded *granulipennis* from it without assigning it a definite nomenclatorial position. According to the description of the larvae and examination of the adult, we assigned this species to the genus *Publius*.

Publius n. sp. (sp. A of Schuster & Reyes-Castillo, 1981). PANAMA, Chiriquí, Respingo 2400 m alt., 7 XII 85, JCS, 1 II 4.9, 7 III 3.3-3.5 #PAN-2d

Schuster & Reyes-Castillo (1981) described the third instar larva. First and second instars have essentially the same setal pattern, differing only in number of AR setae: instar II with 23, instar I with 22-24 versus 20-21 in instar III. Prosternal hairs are lacking in instars I and II; raster hairs are lacking in instar I. All instars have 4 subapical teeth on the metathoracic leg and 2 internal coxal setae.

Verres Kaup

The following 2 species conform to the genus description given in Schuster & Reyes-Castillo (1981). The genus is characterized by a fine golden hair pile over the whole body.

V. furcilabris (Eschscholtz). TOBAGO, Forest Preserve, Bloody Bay Rd., 4.4 km from eastern terminus, 470 m alt., 11 XII 82, JCS, 6 I 2.7-3.0 palm log #TT82-2.5; 13 XII 81, JCS, 1 II 4.1 #TT-13.5; TRINIDAD, Arima Valley, 580 m alt., 19 XII 81 JCS 1 I 2.7 #TT-17c

The anal ring has approximately 22 setae in instars I and II; instar III has 6 pairs above raster, others blend into raster setae. The coxae have 2-3 internal setae. The metathoracic leg has 4 subapical teeth. Instar I has 2 or more HPA setae longer than antenna when extended forward; these setae do not pass the antenna in later instars. Instar I has secondary setae longer than 1 mm on the frons. The raster has long setae. Only instars II and III have hair pile on body. The basic setal pattern is the same for all instars (Fig. 1c). A brown egg measured 4.6 × 3.1 mm. In the tunnel with the instar III were a teneral adult, a mature adult, and 11 red, brown, and green eggs in a nest 4.5 cm diameter.

The setal pattern may distinguish *Verres furcilabris* from other *Verres* spp. (Schuster & Reyes-Castillo 1981). It is most similar to that of *V. hageni*, but has 3TM setae on most abdominal segments.

V. corticicola (Truqui). COSTA RICA, Cartago Prov., Turrialba, CATIE 600 m alt., 8 X 84, JCS, 1 III 4.7

The previous description of this species was based on instars I and II only. This third instar lacks the extra pair of TM8-9 setae of earlier instars and has only 1 pair of

AV9 setae. The dorsal primary setal pattern is identical to that of the basic "Chondrocephalus" group type, with 18AR setae.

Proculus Kaup

The following 2 species conform to the description of the genus given in Schuster & Reyes-Castillo (1981).

P. burmeisteri Kuwert. HONDURAS, Ocotepeque Dept., El Portillo Mtn. 1900 m alt., 13-14 IV 81, JCS, 8 III 10.3-11.7, 1 I 5.0 #NJ

Instar III has 28-36 AR setae, instar I has 23. The metathoracic leg has 6 subapical teeth. The coxa has 2-5 internal setae; the prosternum between the legs has few hairs, to 0.3 mm. Center frons has many hairs to 0.6 mm. As in *P. goryi* (Melly) and *P. mniszechi* Kaup, the dorsal surface totally lacks primary setae. It differs from *P. goryi* in having many long (to 0.6 mm) hairs on the central frons (versus 3-5 in *P. goryi*) and lacking many long hairs below spiracle line on each abdominal segment. It differs from all other described *Proculus* in having the T9 without any long hairs. Both instars have a band of hairs crossing the pronotum.

The first instar differs in having 3-4 TM setae on tergites 1-6 as well as the whole dorsal surface of the body covered by a hair pile 0.2-0.3 mm thick. This reminds one of *Verres*, yet the ventral surface is totally bare, except for raster setae. Metanotal bars are lacking, a rare occurrence for a first instar.

P. mniszechi Kaup. GUATEMALA, Baja Verapaz, approximately 3 km E. of Chilasco 1930 m alt., 12-15 IX 81, JCS, 1 II 6.4, 1 I 4.4 egg: 6.3 × 7.0 mm.

Anal ring has 24-26 setae. The metathoracic leg has 4-5 subapical teeth. The coxae have 1-3 internal setae; the prosternum is bare. The center frons has many hairs to 0.6 mm. No hair pile is present on either instar, but a distinct row of long hairs crosses the pronotum. T9 also has many long hairs (to 0.3 mm) and, in instar I, 8 pairs of primary setae decreasing in size mesally. No other dorsal setae are present. Both instars show metanotal bars. It differs from *P. goryi* in having many central frons hairs and lacking many long (to 0.5 mm) hairs below the spiracle line on each abdominal segment.

Ogyges Kaup

This genus has been revised recently (Schuster & Reyes-Castillo, in press). Schuster & Reyes-Castillo (1981) described larvae of 2 species, *O. laevior* (Kaup) and *O. laevissimus* (Kaup). They included, however, members of a new species in their description of *O. laevior*. In reality, only the specimen cited from Baja Verapaz is *O. laevior*; the others belong to *O. cakchiqueli* Schuster & Reyes-Castillo.

Ogyges is difficult to separate from *Vindex* and *Xylopassaloides*. With known species, it can be done on instar III head width, but it remains to be seen how the unknown larvae of smaller species of *Ogyges* will compare. All species conform to the basic "Vindex" setal pattern.

O. furcillatus Schuster & Reyes-Castillo. GUATEMALA, El Progreso Dept., Cerro Pinalón above Los Albores 2700 m alt., 1 VII 89, JCS, 3 III 5.0-5.2, 1 II 3.3, #WGi-3-6; 2710 m alt., 2 III 4.9-5.0, #WGh

This species, on the basis of both adults and larvae, seems to be related to *O. laevior* and *O. cakchiqueli*. It has 16-18AR setae, a bare raster, 2 internal coxal setae, 2 pairs of AV9 setae, 4 subapical teeth on the metathoracic leg, many prosternal hairs to 0.8 mm long, and no long hairs on the center of T8. Though usually bare, each abdominal sternite may have up to 4 hairs to 0.8 mm long. Many HPA hairs are present, though 1-4 may be thicker and longer (to 1.0 mm). Central frons has many hairs (to 0.4 mm). Above the spiracle line on abdominal tergites 4-6 are many hairs (to 0.6 mm).

O. hondurensis Schuster & Reyes-Castillo. HONDURAS, Ocotepeque Dept., Cerro el Portillo 1900 m, 13 IV 81, JCS, 7 III 5.7-6.6, #NJ

This species, on the basis of both adults and larvae, is closely related to *O. laevissimus*. The anal ring has 22-28 setae. The raster is bare. The coxae have 2-3 internal setae. There are 2-3 pairs of AV9 setae (usually 2), 4-5 subapical teeth on the metathoracic leg, many prosternal hairs (to 0.5 mm), many HPA hairs (to 1.0 mm), many central frons hairs (to 0.5 mm), and many hairs (to 0.8 mm) above spiracle line on T4-6. It differs from other species of *Ogyges* in having 10-18 long (to 0.6 mm) hairs on each side of each abdominal sternite and having long hairs (to 0.7 mm) in the center of T8.

O. laevior (Kaup). GUATEMALA, Alta Verapaz, approximately 16 km N. of San Cristobal 1570 m alt., 14 IV 79, JCS, 2 III 4.9-5.0, #KJ-1,2

The anal ring has 16 setae. The raster is bare, the coxae have 2 internal setae. There are 2 pairs of AV9 setae, 4-5 subapical teeth on the metathoracic leg, >20 prosternal hairs (to 0.8 mm), and the center of T8 is bare or with at most 2 long (to 0.4 mm) hairs. Abdominal sternites have 1-7 long (to 1.0 mm) hairs each, the number increasing anteriorly. The HPA area has many long hairs, 1 or 2 of which are thicker and longer (to 1.0 mm) than the others. The frons has many hairs (to 0.6 mm) and there are many long hairs (0.6 mm) above the spiracle line on T4-6. This is the only species of *Ogyges* examined in which the majority of T1-6 show only 2 pairs of setae, though *O. furcillatus* approaches this condition. *O. furcillatus* is also very similar to *O. laevior* in all other characteristics mentioned. I suspect these species have a fairly recent common ancestor, *O. furcillatus* evolving from *O. laevior*, since *O. laevior* is distributed from Chiapas to the Sierra de las Minas of Guatemala, whereas *O. furcillatus* apparently occurs only in the Sierra de las Minas. In the Sierra de las Minas, *O. laevior* occurs from 1640 m to 2420 m; *O. furcillatus* occurs from 2140 m to 2710 m. They were found sympatric only at 2140 m above San Lorenzo, Zacapa, and apparently don't overlap above los Albores, El Progreso, where *O. laevior* reaches 2420 m and *O. furcillatus* starts at 2475 m. Both are cloud forest species. I suspect a similar relationship between *O. laevior* and *O. cakchiqueli* in the Cuchumatan Mtns. of western Guatemala. J. Campbell has brought me a specimen of *O. laevior* from 1300 m near Barillas; I have collected *O. cakchiqueli* above 2800 m where it is endemic to the Cuchumatan Mtns.

Xylopassaloides Reyes-Castillo et al.

Reyes-Castillo et al. (1987) describe adults and larvae of 2 species in this genus: *X. pterocavis* and *X. pereirai*. These descriptions, though quite detailed for instar I of *X. pterocavis*, are not sufficient to separate them from other larvae of the "Vindex" species group, since some key characters were not mentioned. Actually, it may be difficult to separate the 2 species from each other on the basis of the descriptions, since they only include instar I for *X. pterocavis*, and instar III for *X. pereirai*. The only differences mentioned were: 8 to 9 pairs of AR setae and the lack of primary thoracic setae as well as inconspicuous primary setae on tergite 7. All except the first character mentioned are typical differences between instars!

The adult of a third species, *X. schusteri*, was also described. The larva of this species was originally described in Schuster & Reyes-Castillo (1981) as *Vindex* sp. A. It may be separated from *Vindex* by the presence of only 1 short (0.2 mm) prosternal hair between the legs (versus 5 or more greater than 0.4 mm) and the lack of long (>0.2 mm) hairs in the center of tergite 8. It, as well as the other described *Xylopassaloides* (Reyes-Castillo et al. 1987), lack transverse notal bands of long hairs, except near the anterior border of the pronotum (Fig. 1d). Complete or partial bands are found in all described *Vindex* species, similar to those of *Oileus* (Fig. 1b). It differs from other

Xylopassaloides in possessing 22 AR setae. The raster is bare and the metathoracic leg has 4-5 subapical teeth.

Spasalus robustus (Percheron). TOBAGO, Forest Preserve, Bloody Bay Rd., 470 m alt., 13 XII 81, JCS, 1 III 2.7, #TT-12

This larva keys to the couplet with *Spasalus* in Schuster & Reyes-Castillo (1981). It is still impossible to differentiate between larvae of *Spasalus*, *Passalus* (*Pertinax*) and (*Mitrorhinus*). *S. robustus* differs from most larvae in these groups by having 2 pairs of PSL setae. The dorsal primary setal pattern (Fig. 1e) is the same as that of *P.* (*Pertinax*) *incertus* Perch. and basically the same as that of *Popilius lenzi* (fig. 1a) with the addition of TM setae on all abdominal segments. The extremely short HPA setae (0.03 mm) differ from those of *P. incertus* (0.2 mm). It has 5 subapical teeth on the metathoracic leg.

This species is described in Costa & da Fonseca (1986). Differences in size and setal pattern suggest that 1 of us is dealing with a different species.

Passalus (*Pertinax*) *latifrons* Perch. TOBAGO, Forest Preserve, Bloody Bay Rd., 470 m alt., 13 XII 81, JCS, 1 III 4.9, 1 I 2.5

Da Fonseca (1990) recently published a study of head widths for specimens of this species collected in Brazil. His data, in the notation style used here, are: 20I2.07-2.69, 17II2.84-3.85, 21III4.15-4.54. My third instar from Tobago is larger than his Brazilian specimens; however, my first instar falls within his range.

This species is unusual for *Passalus* (*Pertinax*) in that it has TL setae on each abdominal segment. These are quite marked in instar I, but only remnants in instar III. Instar III TM8 & 9 setae are also only remnants and it has lost all thoracic dorsal primary setae. The instar I pattern is quite similar to the basic Proculini pattern of the "Chondrocephalus" group, suggesting that this or a similar pattern might be the ancestral pattern of New World passalids.

HPA setae are few, to 0.15 mm; raster setae are few, to 0.1 mm; prosternum is bare; coxae have 2 internal setae; metathoracic leg has 4 subapical teeth.

Costa & da Fonseca (1986) describe *P. latifrons*. Though they do not mention which instar they describe, the length they mention suggests instar III. Their description, apparently confusing TSM with TM setae, coincides with our instar I with addition of a pair of PSL, MSL and MTL setae. This confusion occurs easily. Schuster & Reyes-Castillo (1981) do not precisely define TSM setae. Basically, TM setae are at least twice as far from the spiracles as from the dorsal midline. TL setae are twice as far from the dorsal midline as from the spiracles. TSM setae are any that fall between these points. Thus, whereas Schuster & Reyes-Castillo (1981) mention 2 pair of TM setae as caracterizing the general "Neleus" setal pattern, in reality the outer setae are TSM setae (Fig. 1f).

Passalus (*Pertinax*) *spiniger* Bates. GUATEMALA, Izabal, E. of Morales 370 m, 6 VI 85, JCS, 2 III 4.0, #SW 1-4

Larvae have the typical "Pertinax" pattern, abdominal tergites 2-6 with a pair of TM setae each, 10 AR and 2 AV setae. The raster is bare. Coxae each have 1-2 internal setae. Metathoracic leg has 5 subapical teeth. Prosternum is bare anteriorly, with a few hairs to 0.2 mm long posteriorly.

Passalus (*Passalus*) section "Neleus" *unicornis* Lepeletier & Serville. TRINIDAD, Arima Valley 580 m alt., 19 XII 81, JCS, 1 III 6.3, #TT-18; GUADELOUPE, Saint Anne, Grands Fond 40 m alt., 4 XII 82, JCS, 1 II 4.1

The third instar shows the complete basic "Neleus" setal pattern (Fig. 1f). The instar II lacks TSM 6-9 setae. HPA setae are few, to 0.15 mm. Only 1 internal coxal

seta is present. The uncus of lacinia is entire. Metathoracic leg has 4-5 subapical teeth (on same individual in Trinidad larva). Eleven red, brown, and green eggs measured 3.8-4.3 × 2.8-3.3 mm.

On the basis of these and other (e.g. Costa & da Fonseca 1986) recent descriptions, the key given by Schuster & Reyes-Castillo (1981) needs to be revised in the following form:

LARVAL KEY TO GENERA OF NEW WORLD PASSALIDAE

1 Maxilla with uncus of lacinia entire (except *Passalus interruptus* & occasionally *P. punctiger*); ninth abdominal sternite with 0-1 pair of primary setae, if more, then primary setae also on other sternites; anal ring with 8-18 setae; post-antennal setae usually short (0.1-0.5 mm), never reaching antennal tip when extended forward; pronotum usually without PSL setae or hair ..... PASSALINI 2

1' Maxilla with uncus of lacinia bifid; ninth abdominal sternite with 0-5 pairs of primary setae; anal ring with 12-34 setae; post-antennal setae variable in size, often passing antennal tip when extended forward; pronotum usually with PSL setae or abundant hair (see table 1) ..... PROCULINI 7

2(1) Pronotum with 3 or more pairs of long primary setae as well as many long hairs; mandibles with dorsal terminal tooth subapical; anal ring of 14-18 setae ..... *Ptichopus* & *Passalus inops*

2' Pronotum without setae or at most with 2 pairs; if 3 pairs, then no long pronotal hairs present; mandibles with dorsal terminal tooth apical 3

3(2') Fine hair pile on body, anal ring with 10-18 setae 4

3' Fine hair pile absent, anal ring with 8-12 setae 5

4(3) Tergites 1-6 mostly with 2-4 setae each; anal ring with 10-12 setae .... *Passalus* (*P.*) sec. "Petrejus"

4' Tergites 1-6 mostly with either 6-12 setae each or 2 setae each; anal ring with 10 or 14-18 setae ..... *Passalus* (*P.*) sec. "Phoroneus"

5(3') Tergites 1-6 mostly with 1 pair each of TM & TSM setae .... *Passalus* (*P.*) sec. "Neleus"

5' Tergites 1-6 mostly with only 1 pair of setae well developed (usually TM, except in *P. latifrons* is TL) 6

6(5') Sternal hairs between prothoracic legs mostly 0.05 mm long or absent, if longer then head width greater than 4.2 mm; raster bare or with hairs; third instar head width exceeds 4.2 mm in some species .... *Spasalus*, *Passalus* (*Pertinax* & *Mitrorhinus*)

6' Sternal hairs between prothoracic legs mostly 0.1 mm long; raster with scattered short (0.05-0.15 mm hairs; third instar head width less than 4.2 mm ..... *Paxillus**

7(1') Pronotum with many long hairs no primary setae; raster with or without hair or setae; anal ring of 15-28 setae 8

7' Pronotum bare or usually with long primary setae, if with long hairs and no setae then primary tergal setae absent or indistinct *and* third instar head width approximately 5.0 mm, *or* anal ring with only 12 setae; raster has hair or setae; anal ring of 12-33 long setae 15

8(7) Mid-ventral tenth abdominal segment entirely bare, without hairs or setae except anal ring 9

*Costa and da Fonseca (1986) describe *Paxillus anguliferoides* with 2 pairs of PSL setae as well as TL, TM and TSM setae. This description, however, is not in accordance with their drawing of the same species, which appears as a normal *Paxillus* larva.

8' Mid-ventral tenth abdominal segment with hair or setae other than anal ring, maximum extent of bare area being a narrow band well within the raster area 13

9(8) Ventral abdomen with numerous hairs or setae crossing in transverse bands in middle of each segment; ninth abdominal sternite with 2-5 primary setae ..... *Undulifer*

9' Ventral abdomen bare, or with a few setae (2-10) on each side of each segment, just lateral to mid-venter; ninth abdominal sternite with 1-2 pairs of primary setae 10

10(9') Tergites 4-6 with few (less than 5) or no hairs longer than 0.3 mm above the spiracle level; central frons with many long (0.4 mm) hairs; anal ring with 16-22 setae; primary post-antennal setae absent; ninth abdominal sternite with 2 pairs of primary setae ..... *Pseudacanthus*

10' Tergites 4-6 with many long (0.3-0.6 mm) hairs above the spiracle level, if few long hairs above the spiracle level, then a single primary seta present among post-antennal hairs; central frons with or without long hairs; anal ring with 16-28 setae; ninth abdominal sternite with 1-2 pairs of primary setae 11

11(10') Center frons usually with few hairs, most less than 0.33 mm long; if with many long (0.4 mm) hairs, then a single primary post-antennal seta present; third instar head width greater than 5.5 mm; anal ring with 16-24 setae; ninth abdominal sternite with 2 pairs of primary setae; third instar head width >4.9 mm, from south of Isthmus of Tehuantepec ..... *Ogyges*

11' Center frons with many hairs longer than 0.3 mm, if with few hairs all less than 0.1 mm then anal ring with 28 setae; third instar head width less than 5.3 mm; anal ring with 16-28 setae; ninth abdominal sternite with 1-2 pairs of primary setae; third instar head width <4.3 mm, if 5.0 mm then from north of the Isthmus of Tehuantepec 12

12(11') Prosternum with only 1 short (0.2 mm) hair between legs, long (>0.2 mm) hairs absent in center of abdominal tergite 8, meso- and metanota . *Xylopassaloides*

12' Prosternum with 5 or more hairs >0.4 mm between legs, long hairs present in center of abdominal tergite 8, meso- and metanota ..... *Vindex*

13(8') Raster with many long (approx. 0.5 mm), stout setae; mid-ventral abdomen with many short (0.1 mm) stout setae ..... *Proculus*

13' Raster with short (0.3 mm or less) setae or bare; mid-ventral abdomen with hair or bare 14

14(13') Abdominal sternites 1-8 bare, if hair present then tergites each with only 1 pair of medial setae; ninth abdominal sternite usually with 3 or more pairs of primary setae ..... *Oileus*

14' Abdominal sternites 1-8 with hairs; tergites each with 3 or more pairs of medial setae; ninth abdominal sternite with at most 2 pairs of primary setae ..... *Proculejus*

15(7') Anal ring with 16 or more setae, if 14 then prosternum with few hairs, all 0.1 mm or shorter, *or* coxae each with 5 or more internal setae *and* pronotum with 4-8 primary setae 16

15' Anal ring with 12-14 setae, if 16 then tergites 1-5 with 3 pairs of medial setae 20

16(15) Body with uniform pile of short golden hairs; anal ring with 16-26 setae ... 17

16' Body with bare areas and hair patches or tiny stout setae, if whole body covered with hairs then they are notably longer on head than on rest of body; anal ring with 14-20 setae 18

17(16) Longest post-antennal seta usually can be extended past antennal tip; head with 2-6 pairs of primary post-antennal setae; anal ring with 16-20 setae ..... *Veturius*

17' Longest post-antennal seta cannot be extended as far as antennal tip; head with 2-3 post-antennal setae, if more then post-antennal setae are only twice the length of hair pile; anal ring with 16-26 setae ..... *Verres*

18(16') Coxae each with 2-3 long internal setae; ventral labial palpigers with 1-4 setae each; anal ring of 16-20 (rarely 14) setae; head width 4.6-6.9 mm ..... *Publius*

18' Coxae each with more than 4 long internal setae or many long hairs, if less then post-antennal setae do not reach antennal tip when extended forward *and* from eastern United States; ventral labial palpigers with 4 or more setae each; anal ring of 14-18 setae; third instar head width 3.8-6.0 mm 19

19(18') Ninth abdominal sternite with only 1 pair of long primary setae; coxae each with 5 or more long internal setae; post-antennal setae pass the antennal tip when extended forward; third instar head width less than 5.0 mm* . *Heliscus*

19' Ninth abdominal sternite with 2 or more pairs of primary setae, the inner ones 1/2 or more the length of the outer ones; coxae each with 2 or more long internal setae; post-antennal setae do not reach, or just barely reach, antennal tip when extended forward third instar head width 3.1-6.0 mm ..... *Odontotaenius*

20(15') Prothoracic spiracle with more than 50 striations; ninth tergite with medial setae, if absent then coxae with more than 5 internal setae *and* pronotum with primary setae; anal ring of 12-16 setae 21

20' Prothoracic spiracle with less than 50 striations, if more, then sternites with many hairs *or* ninth tergite with medial setae *and* coxae each with 5 or more internal setae; anal ring of 12-14 setae 23

21(20) Metanotum either lacking long primary setae or more than 6 pairs of long thin setae present; anal ring with 12-16 setae ..... *Popilius*

21' Metanotum with 1-3 pairs of long lateral setae, if none then tergites 1-6 with only 1 pair of setae *and* coxae each with more than 5 internal setae; anal ring usually with 12 setae, if 14 then ninth abdominal sternite without primary setae 22

22(21') Third instar head width 4.6 mm; lateral tergal setae 1-7 absent; anal ring with 12 setae ..... *Pseudacanthus mexicanus*

22' Third instar head width less than 4.3 mm, if wider (4.4-4.9 mm), then most lateral tergal setae present *and* anal ring often with 14 setae ..... *Petrejoides*

23(20') Ninth tergite either without setae or with 2 pairs of medial setae; tergites 1-6 without lateral setae, if present, then tergites 7-9 each with 2 pairs of medial setae ..... *Spurius*

23' Ninth tergite with dorsal setae; tergites 1-6 with or without lateral setae . 24

24(23') Seventh and eighth tergites with medial and/or lateral setae; coxae each with 2 to more than 15 internal setae 25

24' Seventh and eighth tergites without medial and lateral setae; coxae each with more than 10 internal setae ..... *Coniger*

25(24) Coxae with 6-8 internal setae, third instar head width 3.8-4.2 mm, ninth ventral abdominal sternite with a pair of primary setae ..... *Pseudoarrox*

25' Coxae with 2-15 internal setae, if 6-8, then head width 4.2-4.7 mm and ninth ventral abdominal sternite without primary setae ..... *Chondrocephalus*

Discussion

Costa & da Fonseca (1986) suggested that it is premature to provide diagnostic characters to separate passalid larvae at tribal level. I agree that the couplet in our key

**Odontotaenius zodiacus* falls on this side of the couplet, but its body is covered with many long hairs, primary tergal setae are indistinct or absent, and the third instar head width is approximately 5.0 mm.

separating tribes (Schuster & Reyes-Castillo 1981) is quite artificial and extensive, in order to cover all contingencies. We do mention basic Proculini and Passalini setal patterns, but as a basis from which other patterns have evolved within each tribe—not as patterns to distinguish each tribe. Yet, there do appear to be some basic differences between larvae of both tribes. According to Costa & da Fonseca (1986) "When setal patterns are compared (Table 1) the distinction between Proculini & Passalini becomes very difficult." On the contrary, their Table 1, instead of emphasizing similarities between tribes, shows some obvious differences (e.g., number of AR, HPA, and PSL setae). Their table, however, lists only 3 species of Proculini in 1 genus (*Veturius*) versus 18 species of Passalini. Do these differences really exist? I compare *all* 23 New World passalid genera (including 19 genera of Proculini) in my Table 1 (having seen over 100 spp.), using only those setal characters which are least variable and emphasize differences. One can see that most Passalini differ from most Proculini in the lack of PSL setae or hairs. (MSL and MTL setae are lacking as well; however, I suspect that they may be controlled by the same genes that control PSL setae, being expressed metamerically. Usually, there are fewer MSL and MTL setae than PSL setae.) Many

TABLE 1. CHARACTERISTICS OF LARVAE OF NEW WORLD PASSALID GENERA. NUMBERS IN PARENTHESIS REFER TO CHARACTER STATES RARELY PRESENT. + = PASS ANTENNAE WHEN STRETCHED FORWARD.

		SETAL GROUPS				
GENUS	HPA	PSL	TM	TL	AV9	AR
Chondrocephalus	+	2–5	1	1	0–1	12
Petrejoides	+	3–5	1	1(0)	1(0,2)	12(14)
Spurius	+	0–6	1	0–1	1	12–14
Coniger	+	3–4	1	0	1–2	12–13
Pseudoarrox	+	3	1	1	1	12
Popilius	+	2	1(3)	0(1)	1(2,3–4)	12(14–16)
Heliscus	+	3–4	1–2	0–1	1	14–16
Publius	+	3–4	1	1	1	14–21
Veturius	+	3–4	1–2	1	1	14–21
Verres	<ant	3–5	1–4	1(2)	1–2	16–26
Proculus	<ant	0	0(3)	0	3–4	19–33
Pseudacanthus						
mexicanus	+	6	1	0	1	12
violetae	<ant	0hair	3	0	2	16–21
subopacus	<ant	0hair	2–4?	0	2	20–22
Oileus	<ant	0hair	2–5(1)	0(1)	3–4(2)	17–28
Proculejus	<ant	0hair	4–5	0	2	20–28
Ogyges	<ant	0hair	2–5	0	2(3)	15–28
Undulifer	many<ant–0.7	0hair	3–4	0	3–5	22–24
Vindex	<ant	0hair	3–4	0	1	16–22
Xylopassaloides	<ant	0hair	3–4	0	1–2	20–25
Odontotaenius	3+<ant1.2–1.7	0–5(h)	1(2–4)	1(0)	1–3	14–18(7)
Ptichopus	<ant1.0	3–5	2	1	1–3	14–19
P. inops	<ant>1	3+	2	0–1	?	18
P. (Pertinax)	<ant0.5	0–(2)	1	0	1	10(8,12)
P. (Mitro.)	few<ant0.05	0	1	0	1	10
P. [Petrejus]	many<ant0.3	0	1	0	1	10–12
P. [Phoroneus]	many<ant0.3	0	3	2	0–1	10(14–18)
P. [Neleus]	<ant0.3	0	2	0	1	10(12)
Spasalus	<ant0.3	0	1	0	1	10–12
Paxillus	<ant0.1	0	1	0	1	12(10)

Passalini have only 10 AR setae; no Proculini possess only 10 AR setae in the third instar, having 12 or more. All Passalini HPA setae cannot be extended beyond the antennal tip; most are short (0.05-0.5 mm). Proculini hairs or setae are usually longer, in many cases extending beyond the antennal tip. Usually only 1 pair of AV9 setae are present in Passalini; Proculini may have 1 or 2 pairs. The basic exceptions to these characteristics are in *Ptichopus* and *Passalus inops*, where setal patterns are radically different from those of all other New World species (Schuster & Reyes-Castillo 1981). Perhaps this is due to unique enviromental factors; both are known to live in detritus chambers of *Atta* leaf-cutter ants (Schuster & Reyes-Castillo 1981, Hendrichs & Reyes-Castillo 1963, Schuster 1984). Much redefining of genera needs to be done in this tribe.

The Proculini can be divided into 2 major groups: those usually with PSL, MSL and MTL setae, the "Chondrocephalus" group, versus those with abundant hairs at these locations, the "Vindex" group. In most cases, the former group has HPA setae which can be extended past the antennae, 1 pair of TM and 1 pair of AV9 setae and usually 12-14 AR setae. The latter group has usually 2 or more pairs of TM and AV9 setae, 15 or more AR setae and HPA setae which, though long, don't reach the antennal tip.

On the bases of the larvae, it is obvious that *Pseudacanthus mexicanus* belongs in the "Chondrocephalus" group, whereas the other 2 species belong in the "Vindex" group. This suggests further study to determine the correct classification changes here.

Odontotaenius, at present, is an enigma, with species characteristic of each group and even intraspecific differences. It probably belongs in the "Chondrocephalus" group.

Verres is exceptional with respect to HPA & AR setae (table 1), but appears to be closely related to *Veturius*. *Proculus* differs from most other Proculini in lacking PSL, MSL and MTL setae. Its exceptionally large size may account for the greater number of AV9 and AR setae.

Despite the exceptions mentioned, a clear pattern emerges separating the New World Passalini from the Proculini and distinguishing 2 basic lineages within the Proculini. Much work needs to be done, however, in defining taxa below tribal level, especially in the Passalini.

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