

Comparative morphology of the larvae of the palm weevils *Dynamis borassi* (Fabricius) and *Rhynchophorus palmarum* (Linnaeus) (Curculionidae: Dryophthorinae): Two major pests of peach palms in the Neotropics

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Abstract. The morphology of the larvae of *Dynamis borassi* (Fabricius) and *Rhynchophorus palmarum* (Linnaeus) was compared, described and illustrated. A complete definition of subtribe Rhynchophorina at the larval stage was elaborated, based on mature and submature larvae, and characters of the first instar larvae are provided for the first time. Diagnostic characters to distinguish the larvae of *D. borassi* and *R. palmarum* are mainly from the epipharynx and maxillae, but the abdominal terminal plate also provides differential features that can aid in the identification. The characterization of both species at the larval stage is expected to be useful in the implementation of new control strategies in palm plantations in South America. For practical reasons, a comparative table is appended in Spanish to serve as a quick diagnostic guide for species identification.

Key-Words. Coleoptera; Palm weevils; Larval morphology; *Bactris gasipaes*; Neotropical Region.

INTRODUCTION

The weevils *Dynamis borassi* (Fabricius, 1801) and *Rhynchophorus palmarum* (Linnaeus, 1758) attack native, ornamental and commercially cultivated palms in tropical America (Couturier *et al.*, 2000; Löhr *et al.*, 2015), with significant economic impacts. *Dynamis borassi* has generated losses of up to 57% in experimental cultures of the palm *Oenocarpus mapora* Karst (Couturier *et al.*, 2000). Meanwhile, for *R. palmarum*, its effect as a vector of the nematode *Bursaphelenchus cocophilus* (Cobb, 1919) on oil and coconut palms has been widely documented, having caused the elimination of large-scale production areas such as Tumaco Bay in Colombia (Löhr *et al.*, 2015).

A similar situation has developed over the last decade in the production areas of peach palm, *Bactris gasipaes* Kunth (locally known as “chontaduro”), in Colombia. There has been a production loss of 48% (Agronet, 2016), attributable to the attacks of both *D. borassi* and *R. palmarum*

(ICA, 2015; Pardo-Locarno *et al.*, 2016). Although the presence of *D. borassi* has been documented, current management plans are designed exclusively to control *R. palmarum* (ICA, 2015). Consequently, peach palm production in most of the Pacific lowlands of Colombia has come to a stand-still (A.A. Vásquez-Ordóñez, unpublished). There is ample evidence now that the attack on the peach palm is initiated by *D. borassi*, and *R. palmarum* only comes in as an opportunist pest (A.A. Vásquez-Ordóñez, unpublished). This may be due to the difficulty to distinguish the larvae of both species, indispensable to determine the role of each species.

A key step in palm weevil research is to develop identification tools that allow field researchers to distinguish the larvae of these species since it is at this stage that major damage is caused. Morphological descriptions of the larvae of *D. borassi* and *R. palmarum* were made and illustrated by Wattanapongsiri (1966), in addition to those by Cotton (1924) and Anderson (1948). These authors

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recognize the high structural similarity of both species at the larval stage, highlighting the value of some mouthpart structures for differentiation. However, these larval descriptions differ in the terminology used and problems often arise when doing the identifications. Furthermore, details of body chaetotaxy and other taxonomic characters, widely documented in other weevils, are missing or poorly documented. Recently, Chamorro (2019) provided a synoptic key to larvae of genera of Dryophthorinae, based mainly on characters of the mouthparts. The key includes both genera, but information on *Dynamis* is rather incomplete as no material was available for examination, with only a few characters extracted from existing literature. Therefore, a comparative morphological study of the larvae of *D. borassi* and *R. palmarum*, using standardized terminology is urgently needed to facilitate accurate identification of both species at the larval stage. This is fundamental to document the occurrence and role of *D. borassi* in the recent wide-spread mortality of peach palms in Colombia. It is expected that the new morphological tools will facilitate rapid phytosanitary diagnoses in the field, since rearing larvae to the adult stage can take up to six months (Wattanapongsiri, 1966; Cuellar Palacios, 2019), making the monitoring and control processes too lengthy.

MATERIAL AND METHODS

We studied 23 larvae, 12 belonging to *D. borassi* and 11 to *R. palmarum*. All larvae of *D. borassi* were obtained from adults collected in pheromone traps (ferugineol) from peach palm plantations in Colombia. The progenitors of five mature and four submature larvae were collected at Tadó, Chocó (05°17'08.82"N, 76°29'16.34"W) in March 2016. Two first instar and one second instar larvae were produced by females collected in Zabaletas and Bajo Calima, Buenaventura, Valle del Cauca (03°59'00.05"N, 76°58'49.77"W; 03°45'47.69"N, 76°57'49.69"W, respectively) in September 2017. The larvae were reared on artificial diet following the protocol described by Löhr (2016), in the entomology laboratory of the Colombian Corporation of Agricultural Research (AGROSAVIA), Palmira Research Center, Valle del Cauca, Colombia. On the other hand, a mature larva of *R. palmarum* was collected inside the stem of a peach palm at Pueblo Rico, Santa Cecilia (05°20'10.72"N, 76°08'23.06"W), in November 28, 2017. One first instar, four submature and five mature larvae of *R. palmarum* were reared from adults collected in pheromone traps at Palmira Research Center.

The taxonomic identity of the larval specimens and of their associated adults was corroborated with the keys of Wattanapongsiri (1966), Giblin-Davis *et al.* (2013) and Chamorro (2019).

The observations, photographs and illustrations for the morphological descriptions were done using the following equipment: Canon EOS 6D Mk ii camera with EF100 mm f/2.8 lens associated with a light box; Nikon DS-Ri1 U3 and JVC KY-F75U cameras, associated with a

Nikon SMZ-1500 and a Leica MZ16f stereo microscopes, respectively. Subsequently, the larvae were dissected and prepared on microscopic slides as in May (1994) and Marvaldi (1999). Finally, the structural characters were documented and illustrated with a Leitz Laborlux S compound microscope and a Nikon SMZ800 stereomicroscope, using their attached drawing tubes. The terminology followed for body parts and setae of the larva of Curculionidae is explained in Marvaldi (1999), May (1994) and Oberprieler *et al.* (2014). Most larval specimens studied were deposited in the Entomology collection of Museum of La Plata, Buenos Aires, Argentina (MLP). The mature larvae of *D. borassi*, one first instar larva of *R. palmarum*, and adult specimens of both species were deposited in the Entomology Museum of the Universidad del Valle (MUSENUV), Cali, Valle del Cauca, Colombia.

RESULTS

The morphology of the larvae of *Dynamis borassi* and *Rhynchophorus palmarum* was compared, described and illustrated. A complete larval re-description was elaborated, based on mature and submature larvae, and a characterization of the first instar larva is newly provided. For *D. borassi* and *R. palmarum*, the diagnostic larval characters that distinguish them are given.

Subtribe Rhynchophorina (Figs. 1-9)

The following description applies to mature (and submature) larvae of both *Dynamis borassi* and *Rhynchophorus palmarum*, which are, respectively, the type species of the genera *Dynamis* and *Rhynchophorus*. It is descriptive of the larval stage of the subtribe Rhynchophorina of the current classification of dryophthorines (see Anderson & Marvaldi, 2014).

Mature larva (Figs. 1-7)

Body (Figs. 1A-F) very robust, expanded at middle of abdomen between segments III and VI, narrowing posteriad, with abdominal segments VIII and IX forming a depressed terminal disc (Figs. 6B, 7A-B). Thoracic and abdominal segments with sternellum present (Figs. 1B, E, 6A). Cuticle (Fig. 6) sclerotized around setal groups, elsewhere with coarsely distributed asperities like small spicules; vestiture consisting of sparsely-distributed red-brown setae, mostly short or minute, except longer on terminal disc.

Head (Figs. 2A-B) exposed, longer than wide, strongly sclerotized and deeply pigmented, with paler paramedian stripes. Cervix without typical postoccipital condyles, its dorsal side often thickened and with a pair of cervical sclerites on the membrane at joint of head and prothorax (Fig. 2C). Frontal lines distinct, reaching antennae; frons with two medial longitudinal grooves. Endocarina absent. Antennae in oblique position on anterior margin

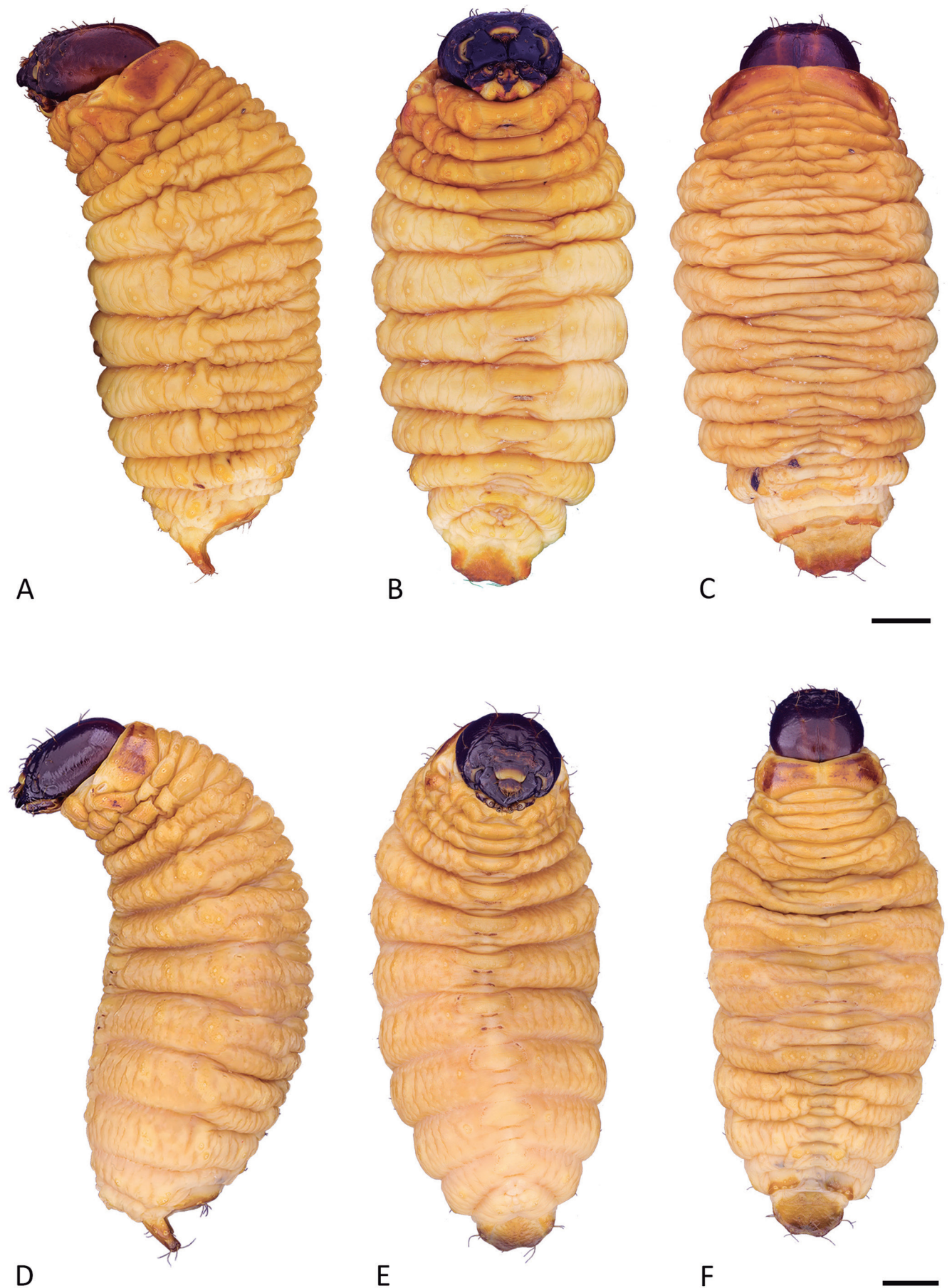


Figure 1. Habitus of mature larva (lateral, ventral, dorsal). (A-C) *Dynamis borassi* (Fabricius); (D-F) *Rhynchophorus palmarum* (Linnaeus). Scale bars: 5 mm.

of head; sensorium longer than wide, subconical, circular in apical view (Fig. 2D). Stemmata present, anterior one distinct, near antenna, posterior one faint in older larvae. Five dorsal epicranial setae (*des*) present; *des1*, *des3* and *des5* longest, *des2* short and *des4* minute; *des3* on epicranium, close to frontal line; five frontal setae (*fs*), *fs3* and *fs5* longest, *fs4* short to well developed, *fs1* and *fs2* minute; four minute posterior epicranial setae (*pes*); two lateral epicranial setae (*les*) unequal in size, *les1* much smaller; ventral cranial setae (*vcs*) un conspicuous. Hypopharyngeal bracon clear. Clypeus (Fig. 3A) with two setae, unequal in size (*cls1* much larger than *cls2*), and one sensillum between *cls* on each side. Labrum (Fig. 3A) pigmented, with anterior margin truncate or slightly produced at middle; labrum with three pairs of setae (*lms*), with a pair of basal sensilla, and a pair of anterior sensilla, the latter situated near *lms2*. Epipharynx (Figs. 3B-C, 4A-B) with simple setae, with five to more anterolateral setae (*als*); bearing patches of dense pubescence medially and laterally; epipharyngeal sensillum clusters present, a distal pair of three sensillae each, between labral rods, and a proximal pair

of two sensillae each; labrum-epipharynx with labral rods elongate, slightly sinuate, joined posteriorly. Mandibles (Figs. 4C-J) robust, dark, often bidentate at apex, with median tooth and a molar area on inner side; with basal sensillum and two short setae on outer surface (*mds1*, *2*) placed in pits, aligned longitudinally. Maxillae (Figs. 5A-I) with mala truncate and slightly excised apically, bearing several dorsal setae (*dms*) aligned in a row medially and irregularly placed proximally (Figs. 5E-F); some *dms* branched, mostly bifid; ventral malar setae (*vms*) simple (Fig. 5H); maxillary palpi 2-segmented, basal palpomere with two sensilla and one minute seta (Fig. 5I). Labium (Figs. 5A-D) with palpi 2-segmented; premental sclerite trident shaped; postmentum sclerotized and pigmented in mesal and lateral areas, with a lighter stripe between them; three postmental setae (*pms*), proximal pair (*pms1*) closer together than *pms2* and *pms3*, median pair (*pms2*) the longest; hypopharynx (Figs. 5C-D) densely setose in lateral areas, medially smooth with a longitudinal furrow.

Thorax (Fig. 6A). Pronotum (Figs. 6A, 1C, F) well pigmented, consisting of two sclerotized halves separated

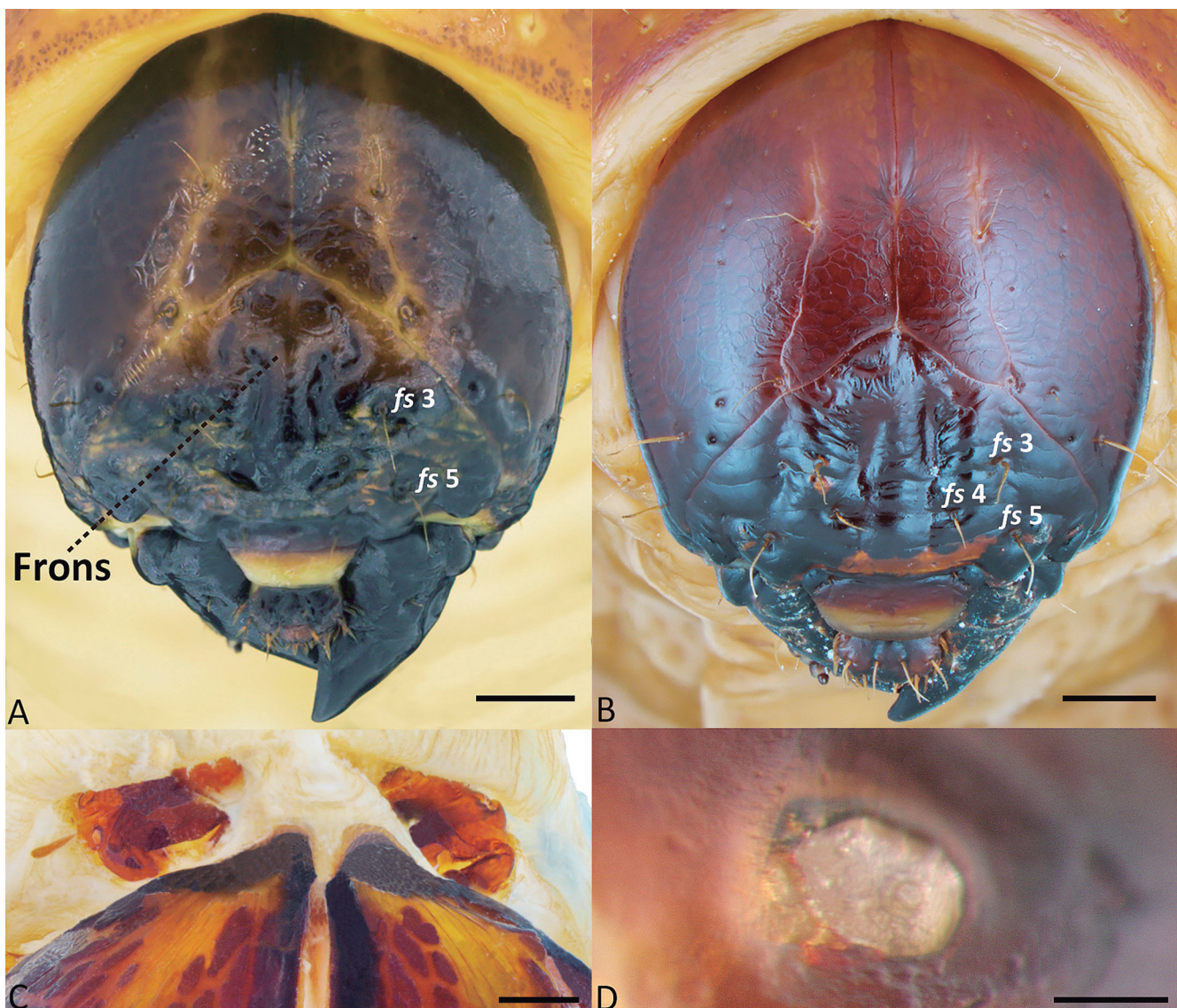


Figure 2. Head of larva, anterodorsal: (A) *Dynamis borassi* (Fabricius); (B) *Rhynchophorus palmarum* (Linnaeus). (C) *D. borassi*, postoccipital membrane showing cervical sclerites; (D) *R. palmarum*, antenna, apical. Scale bars: A and B = 2 mm, C = 0.4 mm, D = 0.1 mm.

dorsally by a lighter band, bearing few pronotal setae (five to seven). Prothoracic sternum with a median depression (Figs. 1B, E). Meso- and metathorax (Fig. 6A) with one seta on alar area and several very short spiracular setae (*ss*); epi- and pleural areas subdivided into two lobes. Pedal areas with six setae, one of them minute, close to the longest one. Thoracic spiracles (Figs. 6A, 7C, F-G) placed on prothorax, narrow-ovate, without airtubes.

Abdomen (Fig. 6). Typical abdominal segments (Figs. 1, 6A) with four dorsal folds, bearing five postdorsal setae (*pds*). Segments VIII and IX (Figs. 1, 6B) with fewer

but longer dorsal setae, forming a sclerotized dorsal disc, with posterior margin extended into two pairs of broadly defined, seta-bearing lobes (Figs. 6B, 7A-B). Epi- and pleural areas subdivided into three lobes (Figs. 1, 6A). Anal region (Fig. 6B) ventral, anus transverse, four anal lobes, the lateral ones bearing one or two small setae. Spiracles narrow-ovate, without airtubes (Figs. 6A-B, 7D-E, I-J); abdominal spiracles I to VII (Figs. 6A, 7D-E) placed laterally near anterior margin of segments, much smaller than the VIII, but functional; spiracles of segment VIII (Figs. 6B, 7I-J) well developed and placed on dorsum, aligned longitudinally.

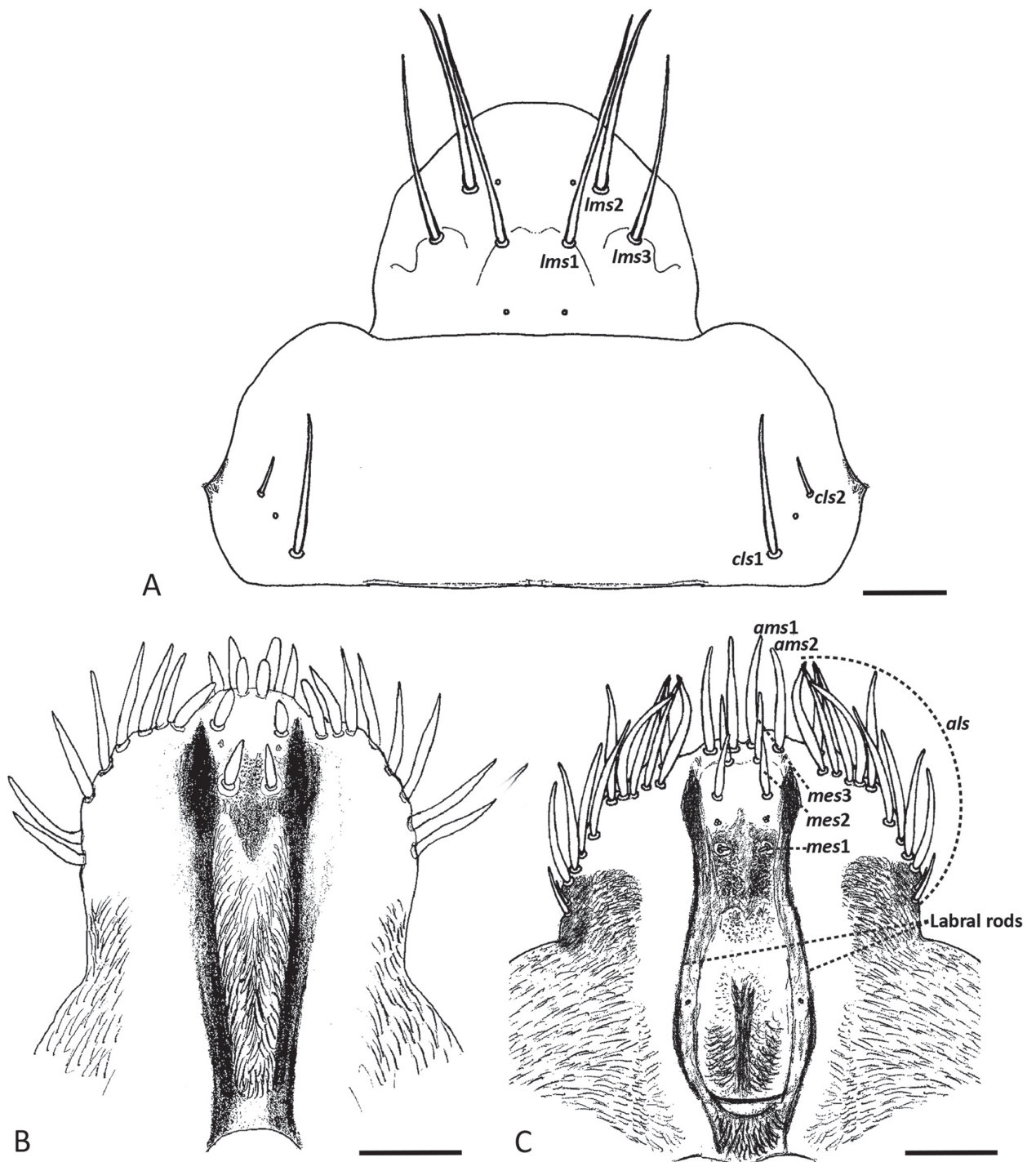


Figure 3. Larval mouthparts. (A) *Rhynchophorus palmarum* (Linnaeus), clypeus and labrum; (B) *Dynamis borassi* (Fabricius), epipharynx; (C) *R. palmarum*, epipharynx. Scale bars: 0.5 mm.

First instar larva (Figs. 8A-F, 9A-C)

Both anterior and posterior stemmata distinct, as dark pigmented spots, anterior larger than posterior (Fig. 8C). Egg-bursters (Fig. 8D) present on abdominal segments IV

to VII, on either side in the dorso-lateral region of each segment, the posterior pair smaller than those in AIV-AVI; each egg burster (Fig. 8E) arising on a convex tubercle and consisting of a sub-conical, forwardly directed spine, situated anterior to a blunt seta. Only the spiracles of

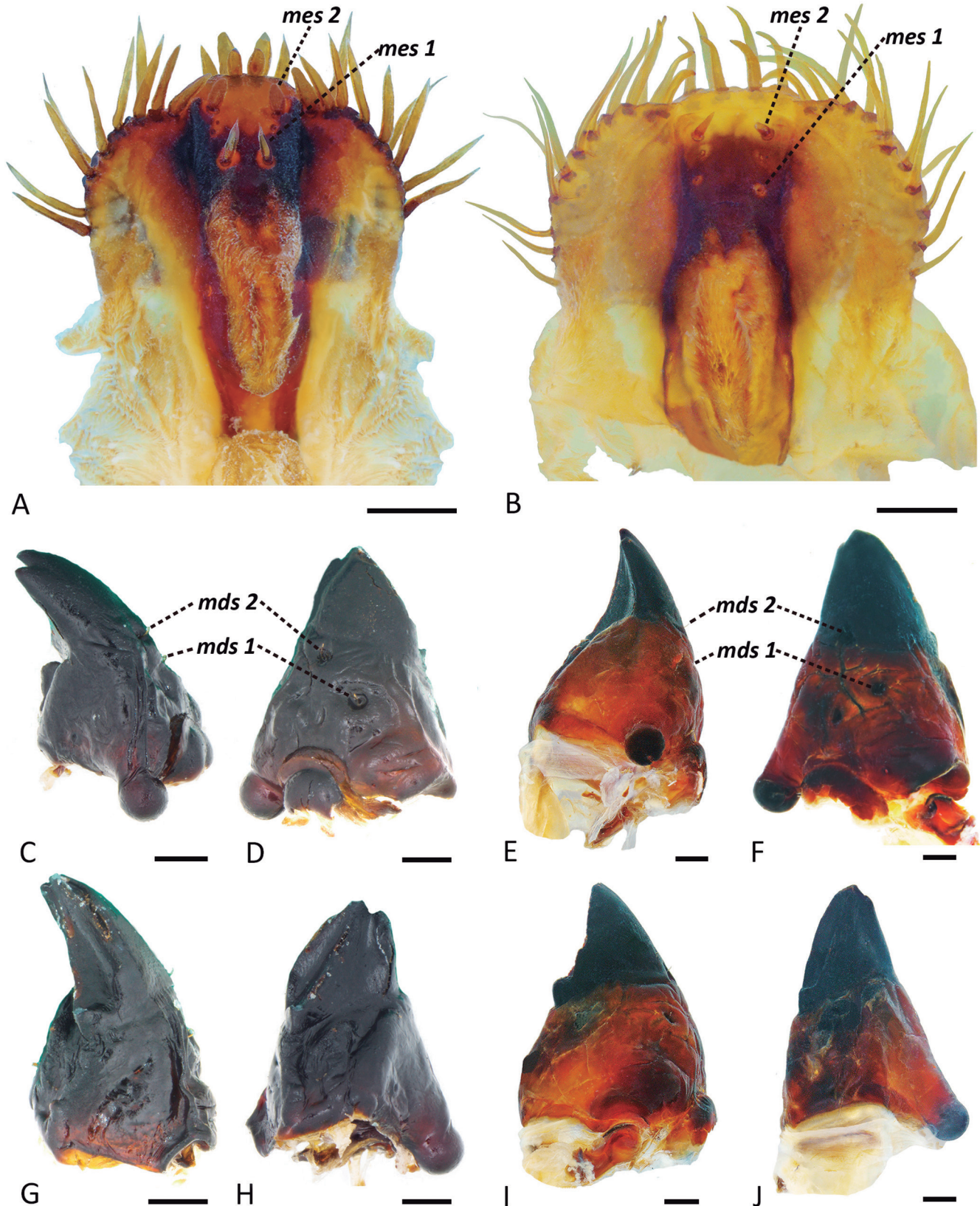


Figure 4. Larval mouthparts. *Dynamis borassi* (Fabricius): (A) epipharynx; (C-D, G-H) mandible in dorsal, outer, ventral and inner views. *Rhynchophorus palmarum* (Linnaeus): (B) epipharynx; (E-F, I-J) mandible in dorsal, outer, ventral and inner views. Scale bars: 0.5 mm.

thorax and abdominal segment VIII (Fig. 8F) are distinct, abdominal spiracles I to VII absent. Abdominal terminal plate (Fig. 8F) with margins only weakly sinuated.

Comments: The characters mentioned above are exclusive of the first instar. Additional differences between early and older instar larvae involve relative dimension of structures, like the antennae, which are relatively much larger in the first instar; the pigmentation and level of sclerotization of body areas tend to increase in successive instars; the differences in length between se-

tae of body areas are higher in early instars; when setae are supernumerary (compared to modal numbers), such as those placed laterally in the epipharynx or dorsally in the maxillary mala, their amount is higher in later instars.

***Dynamis borassi* (Fabricius, 1801)**

Mature larva: Figs. 1A-C, 2A, C, 3B, 4A, C-D, G-H, 5A, C, E, 7A, 7C-E, G-I.

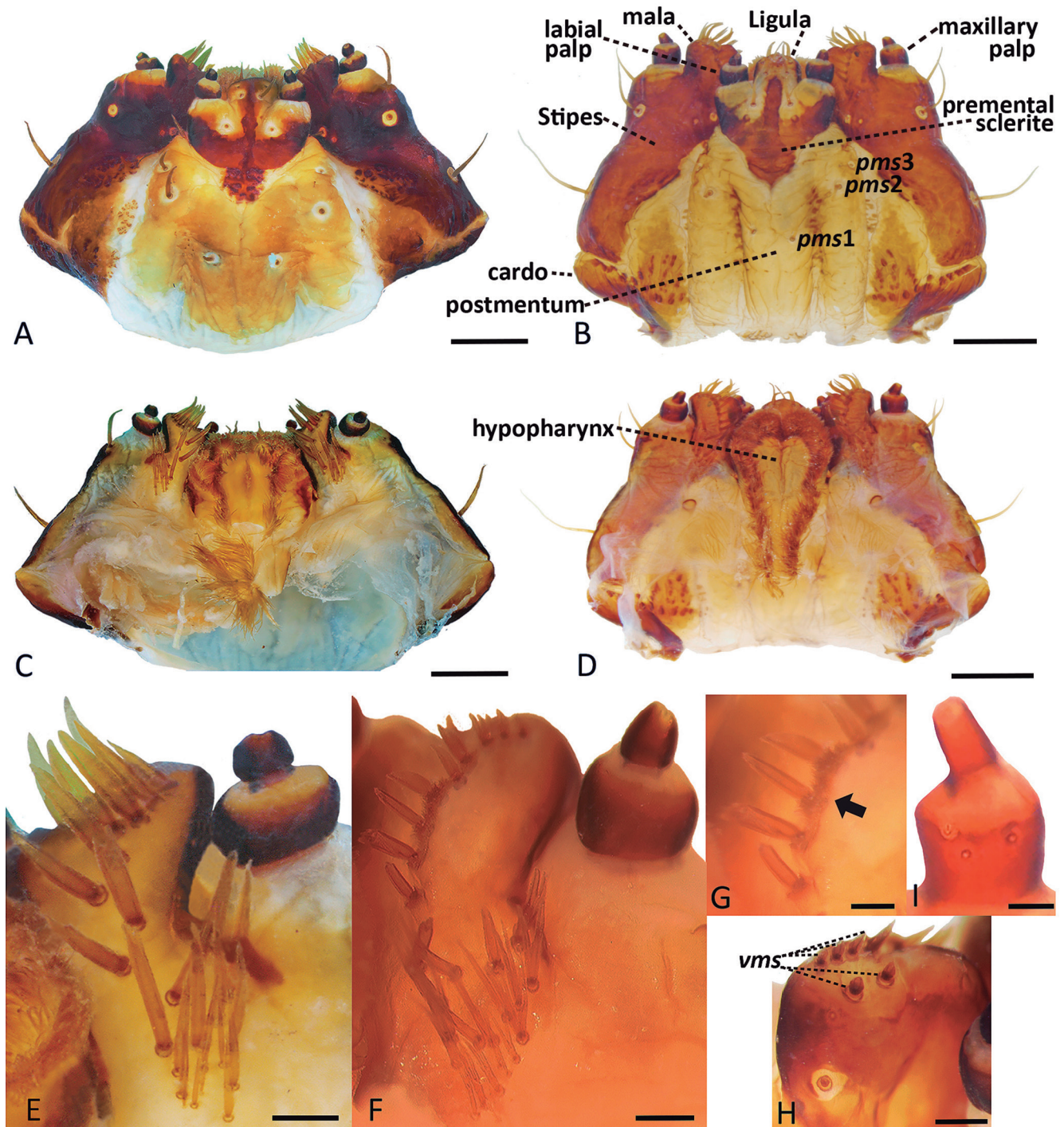


Figure 5. Maxillae and labium of larva. *Dynamis borassi* (Fabricius): (A) ventral; (C) dorsal; (E) detail of mala, dorsal. *Rhynchophorus palmarum* (Linnaeus): (B) ventral; (D) dorsal; (F) detail of mala, dorsal; (G) detail of dorsal malar setae; (H) detail of ventral malar setae; (I) detail of maxillary palp. Scale bars: A-D = 1 mm, E and F = 0.2 mm, G and I = 0.1 mm, H = 0.2 mm.

First instar larva: Figs. 8A, C-F, 9A-C.

Maximum dimensions: 52.9 × 23.6 mm, head width 10.5 mm. Chaetotaxy (see Table 1).

Frons (Figs. 2A, 8C, 9A) with two setae well developed (*fs3* and *fs5*), *fs4* minute (earlier instars) or short. Epipharynx (Figs. 3B, 4A): five (earlier instars) to eight anterolateral setae (*als*) on each side, none placed proximally near the limit with clypeus; median epipharyngeal setae 2 (*mes2*) thick, more widely separated than *mes1*, the latter smaller but well developed, distinct; mesal area of epipharynx (between labral rods) with asperities evenly distributed, not leaving a glabrous area; labral rods V-shaped, less widely separated towards their proximal junction than between their distal tips. Maxillae (Figs. 5A, C, E): with dorsal malar setae (*dms*) without pubescence at their bases; number of *dms* about 20 (earlier

Table 1. Larvae of *Dynamis borassi* (Db) and *Rhynchophorus palmarum* (Rp): Body areas and chaetotaxy; modal numbers of setae of Curculionidae, *D. borassi* and *R. palmarum* (V = variable). Terms and abbreviations follow Marvaldi (1999) (see also May, 1994; Oberprieler et al., 2014).

Body area	Setal numbers			Abbreviations	Meanings	
	Modal	Db	Rp			
Head						
frontal	5	5	5	<i>fs</i>	Frontal setae	
dorsal	5	5	5	<i>des</i>	Dorsal epicranial setae	
posterior	4	4	4	<i>pes</i>	Posterior epicranial setae	
lateral	2	2	2	<i>les</i>	Lateral epicranial setae	
ventral	2	1	0	<i>vcs</i>	Ventral cranial setae	
Clypeus	2	2	2	<i>cls</i>	Clypeal setae	
Labrum	3	3	3	<i>lms</i>	Labral setae	
Epipharynx						
anterolateral	3	5-8	10-14	<i>als</i>	Anterolateral setae	
anteromedian	2	2	2	<i>ams</i>	Anteromedian setae	
median	3	3	3	<i>mes</i>	Median epipharyngeal setae	
Mandible	2	2	2	<i>mds</i>	Mandibular setae	
Maxillae						
dorsal mala	V	~20	~30	<i>dms</i>	Dorsal malar setae	
ventral mala	4-5	5	5	<i>vms</i>	Ventral malar setae	
palp	1	1	1			
stipes	4	4	4	<i>stps</i>	Stipital setae	
Labium						
prementum	1	1	1	<i>prms</i>	Premental setae	
ligula	2	2	2	<i>lgs</i>	Ligular setae	
postmentum	3	3	3	<i>pms</i>	Postmental setae	
Prothorax						
pronotum	V	6	5+2	<i>prms</i>	Pronotal setae	
epipleuron	0-3	2	2	<i>epls</i>	Epipleural setae	
pleuron	2	2	2	<i>pls</i>	Pleural setae	
pedal area	V	6	6	<i>pds</i>	Pedal setae	
sternum	1	1	1	<i>sts</i>	Sternal setae	
Meso-, Metathorax						
prodorsum	1	1+1	1+1	<i>prs</i>	Prodorsal setae	
postdorsum	4	4	4	<i>pds</i>	Postdorsal setae	
alar area	1-2	1	1	<i>as</i>	Alar setae	
spiracular area	1-3	3-9	3-8	<i>ss</i>	Spiracular setae	
epipleuron	1	1	1	<i>epls</i>	Epipleural setae	
pleuron	1	1	1+2	<i>pls</i>	Pleural setae	
pedal	V	6	6	<i>pds</i>	Pedal setae	
sternum	1	1	1	<i>sts</i>	Sternal setae	
Abdomen, I-VIII segments						
prodorsum	1	1	1	<i>prs</i>	Prodorsal setae	
postdorsum	I-VII	5	5	<i>pds</i>	Postdorsal setae	
	VIII	V	2			
spiracular	I-VII	2	1			
	VIII	1	5-6	7	<i>ss</i>	Spiracular setae
epipleuron		2	2	2	<i>epls</i>	Epipleural setae
pleuron	I-VII	2	2	2	<i>pls</i>	Pleural setae
	VIII	2	1	1		
laterosternal	I-VII	1	1	1	<i>lts</i>	Laterosternal setae
	VIII	1	0	0		
sternum		2	2	2	<i>sts</i>	Sternal setae
Abdomen, IX segment						
disc/dorsum	V	4/0	4/1	<i>ds</i>	Dorsal setae	
lateral	2	0	1	<i>ls</i>	Lateral setae	
sternum	2	2	2	<i>sts</i>	Sternal setae	
Abdomen, X segment						
anal lateral	1-3	1	2	<i>as</i>	Anal setae	

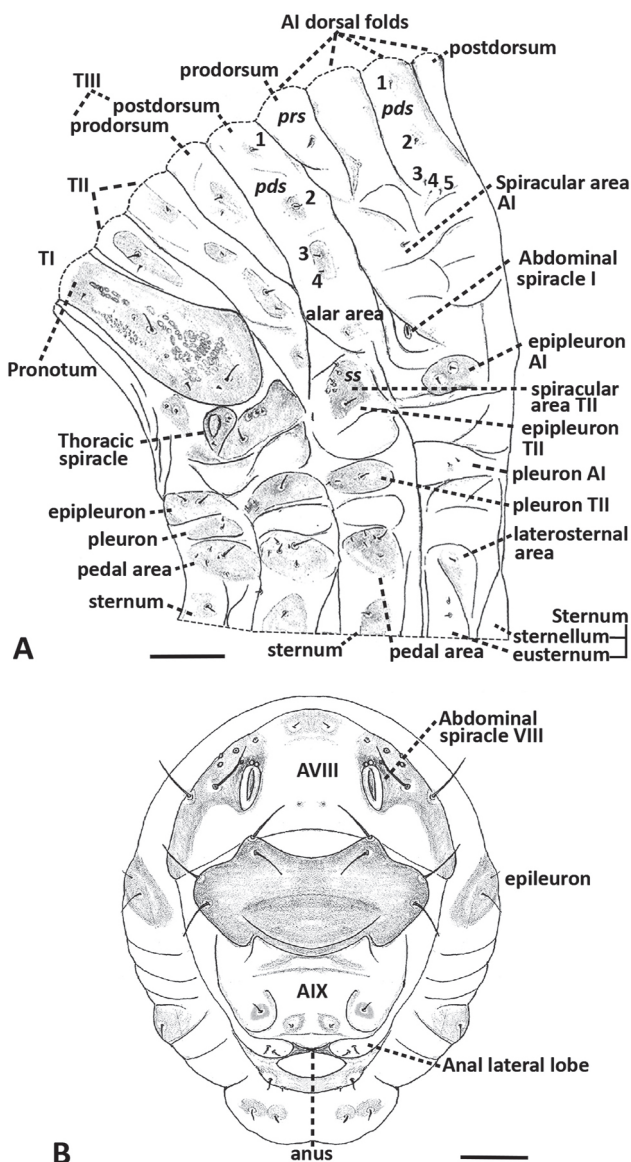


Figure 6. Chaetotaxy of thorax and abdomen, mature larva, *Rhynchophorus palmarum* (Linnaeus). (A) Prothorax, mesothorax, metathorax and abdominal segment I. (B) Abdominal apex, segments VIII to X, caudal. Scale bars: A = 3 mm, B = 2 mm.

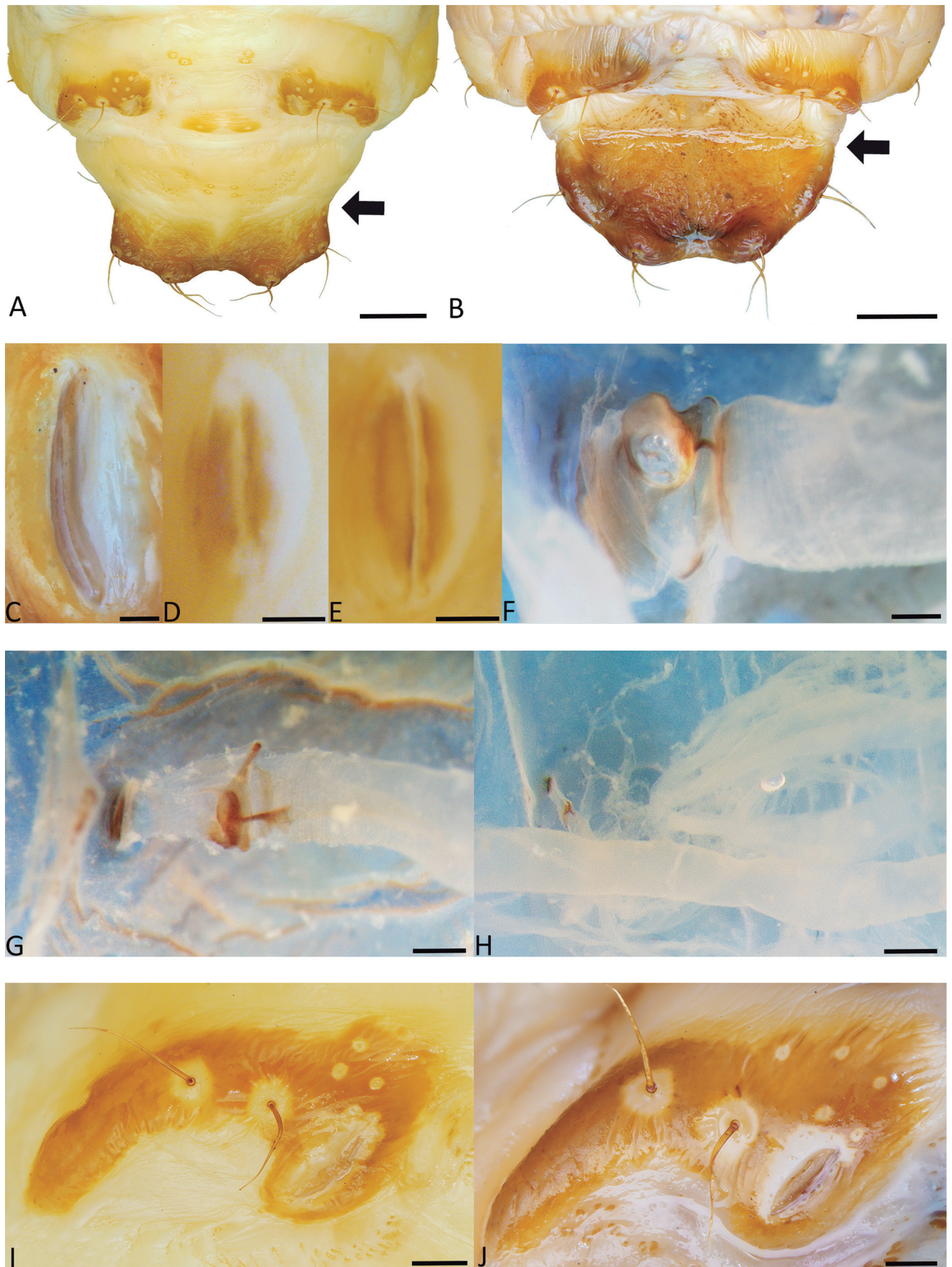


Figure 7. Larval abdominal apex showing posterior disc, dorsal: (A) *Dynamis borassi* (Fabricius); (B) *Rhynchophorus palmarum* (Linnaeus). Spiracles of *D. borassi* (external view, not at same scale): (C) thoracic; (D) abdominal I; (E) abdominal IV. (F) Thoracic spiracle and trachea of *R. palmarum*, seen from inside of body. (G, H) Spiracles and tracheal system of *D. borassi*, seen from inside of body: thoracic, abdominal IV. Abdominal spiracle VIII: (I) *D. borassi*; (J) *R. palmarum*. Scale bars: A and B = 2 mm, C and F-H = 0.2 mm, D and E = 0.1 mm, I and J = 0.5 mm.

instars with fewer setae). Hypopharynx (Fig. 5C) more densely setose laterally than anteriorly. Abdominal posterior disc (Fig. 7A) with lateral margins inwardly curved, with seta-bearing lobes defined by sinuate posterior margin (weakly so in first instar).

Rhynchophorus palmarum (Linnaeus, 1758)

Mature larva: Figs. 1D-F, 2B, D, 3A, C, 4B, E-F, I-J, 5B, D, F-I, 6A-B, 7B, F, J.

First instar larva: Fig. 8B.

Maximum dimensions: 51.2 × 23.8 mm, head width 11.5 mm. Chaetotaxy (see Table 1).

Frons (Fig. 2B) with three setae well developed (*fs3*, *fs4* and *fs5*). Epipharynx (Figs. 3C, 4B): ten (earlier instars) to fourteen anterolateral setae (*als*) on each side, posterior ones can arise near the limit with clypeus; median

epipharyngeal setae 2 (*mes2*) slender, about as widely separated than *mes1*, the latter weak, inconspicuous; mesal area of epipharynx (between labral rods) with an elongate glabrous area coarsely defined by surrounding asperities; labral rods U-shaped, about as widely separated towards their proximal junction than between their distal tips. Maxillae (Figs. 5B, D, F-I): with dorsal malar setae (*dms*) (Figs. 5F, G) with pubescence at their bases; number of *dms* about 30 (earlier instars with fewer setae). Hypopharynx (Fig. 5D) densely setose in both anterior and lateral margins. Abdominal posterior disc (Fig. 7B) with lateral margins outwardly curved, with seta-bearing lobes broadly defined by slightly sinuate posterior margin.

Comparative notes

A selection of characters useful to distinguish *D. borassi* and *R. palmarum*, at larval and adult stages, is provided below (see Appendix 1 for a comparison in Spanish):

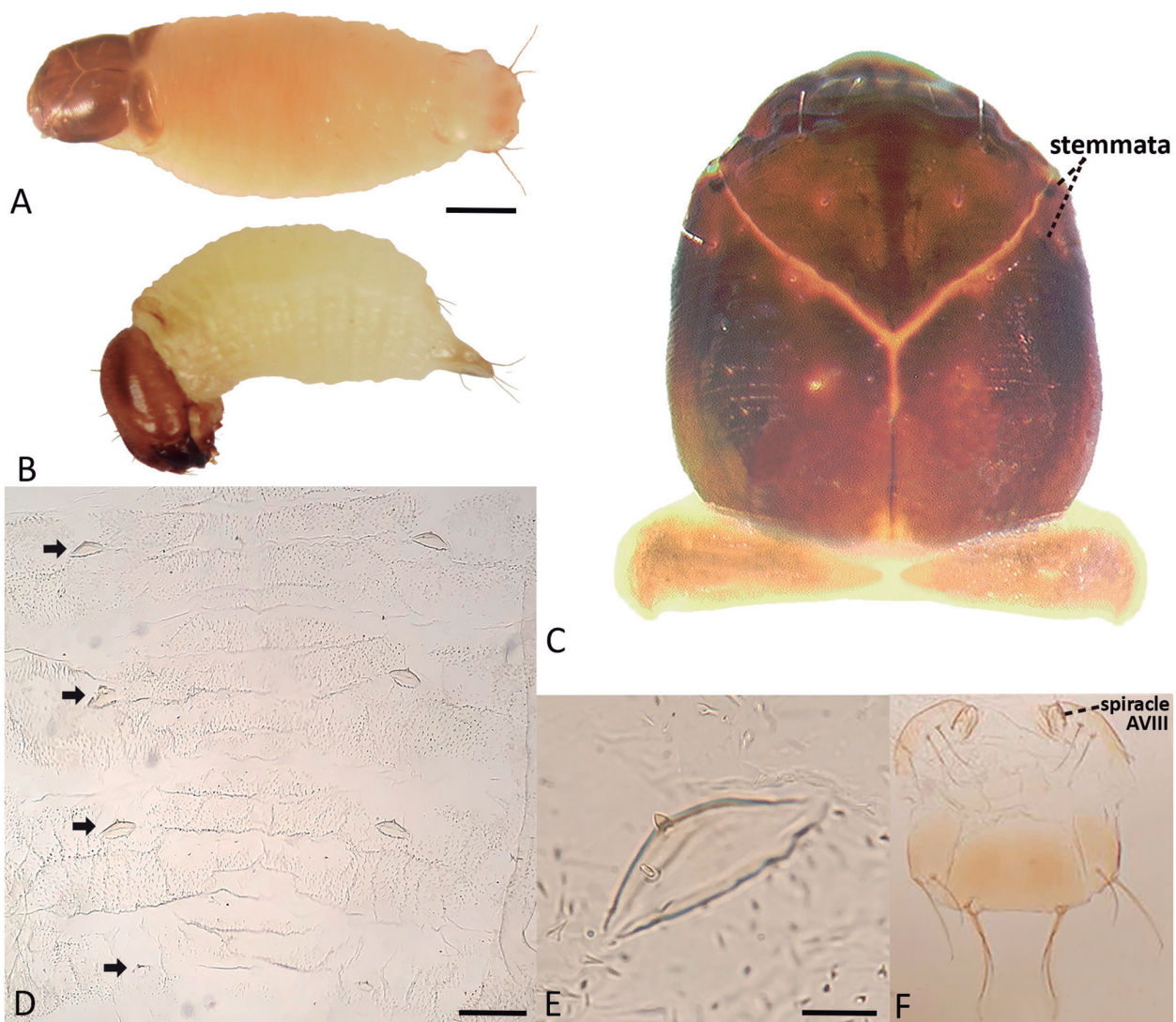


Figure 8. First instar larva. (A) *Dynamis borassi* (Fabricius), habitus dorsolateral; (B) *Rhynchophorus palmarum* (Linnaeus), habitus lateral. *D. borassi*: (C) head and pronotum, dorsal; (D) abdominal segments IV to VII, dorsal, showing egg bursters; (E) detail of egg burster; (F) terminal dorsal disc (abdominal tergites VIII and IX). Scale bars: A and B = 0.5 mm, D = 0.2 mm, E = 0.03 mm.

***Dynamis borassi*:** LARVAE: Frons (Fig. 2A) with two (pairs of) frontal setae well developed (*fs3* and *fs5*). Epipharynx (Figs. 3B, 4A) with *mes1* well developed and distinctly less widely separated than *mes2*, *mes2* thick; laterally with five (earlier instars) to eight *als*; labral rods V-shaped, less widely separated towards their proximal junction than between their distal tips. Maxillae with *dms* without pubescence at their bases (Fig. 5E). Abdominal terminal disc (Fig. 7A) with lateral margin inwardly curved. ADULTS (Figs. 10A-B, E-F, I-J): Pronotum strongly produced posteriorly and scutellum very small, about 1/10 elytral length (Figs. 10E-F). Male with profemora bearing dense, erect setae on ventral side (Figs. 10A, I).

***Rhynchophorus palmarum*:** LARVAE: Frons (Fig. 2B) with three (pairs of) frontal setae well developed (*fs3*, *fs4* and *fs5*). Epipharynx (Figs. 3C, 4B) with *mes1* very small and about as widely separated than *mes2*, *mes2* slender; laterally with 10 (earlier instars) to 14 *als*; labral rods U-shaped, about as widely separated towards their proximal junction than between their distal tips. Maxillae with *dms* with pubescence at their bases (Figs. 5F-G). Abdominal terminal disc (Fig. 7B) with lateral margin outwardly curved. ADULTS (Figs. 10C-D, G-H, K-L): Pronotum slightly produced posteriorly and scutellum very large,

about ¼ elytral length (Figs. 10G-H). Male with rostrum bearing dense, erect setae on dorsal side (Figs. 10C, G).

Comments: The following additional adult characters (Wattanapongsiri, 1966; Löhr et al., 2015), in combination with those given above, distinguish *R. palmarum* from other species of *Rhynchophorus*: body entirely black, exceptionally reddish, interocular distance (dorsal view) ½ or less than ½ than the width of rostrum at base (Figs. 10G-H), rostral ventral area between the antennal scrobes rugose and with setae (Figs. 10K-L).

DISCUSSION

The larvae of *Dynamis borassi* and *Rhynchophorus palmarum* were redescribed in detail in this contribution, using modern terminology to allow comparisons with other larvae in Dryophthorinae and across Curculionidae. Few structural characters, including chaetotaxy, show clear differences between both species. In agreement with Anderson (1948) and Wattanapongsiri (1966), the most useful characters to distinguish *D. borassi* and *R. palmarum* are found in the mouthparts, particularly the epipharynx and maxillae. The observation of these features requires at least partial dissection of the head and examination under magnification, but the shape of the abdominal posterior plate, which also shows differences in both species, can be observed directly. This is advantageous to facilitate a rapid identification in the field, as required in most applied studies related to pest control. However, because differences in the abdominal plate of both species are only obvious and more distinct in older or mature larvae, it is worth to complement with other (e.g., from mouthparts) diagnostic features.

The terminology used by Wattanapongsiri (1966), to describe larval structures and chaetotaxy of *Rhynchophorus* and *Dynamis*, differs in some important aspects with the one adopted in the present work and other comparative studies (e.g., see Marvaldi, 1999; May, 1994; Chamorro & Huang, 2019). Among the differences worth to note are those involving the “anterolateral setae of epipharynx (*als*)”, which in Wattanapongsiri (1966) are named “lateral setae of labrum” and, as additional source of confusion, their counting is given in full and not for one side, as it is standard for description of bilateral structures. Other discrepancies with Wattanapongsiri (1966) may arise because sometimes (e.g., in mandibles, stipes) he considers and counts as setae other sensilla that are not true setae (i.e., basal socket plus “hair”). In our study, we also provided labeled figures to facilitate the determination of homology when compared with works using different terminology.

From a phylogenetic perspective, the larval characters described for both species studied are in agreement with those diagnostic and synapomorphic of subfamily Dryophthorinae, such as maxillary malae with some dorsal setae branched, the pleura subdivided, the spiracles of AVIII placed on dorsum and oriented caudally, among others (May, 1994; Marvaldi, 1999; Anderson & Marvaldi,

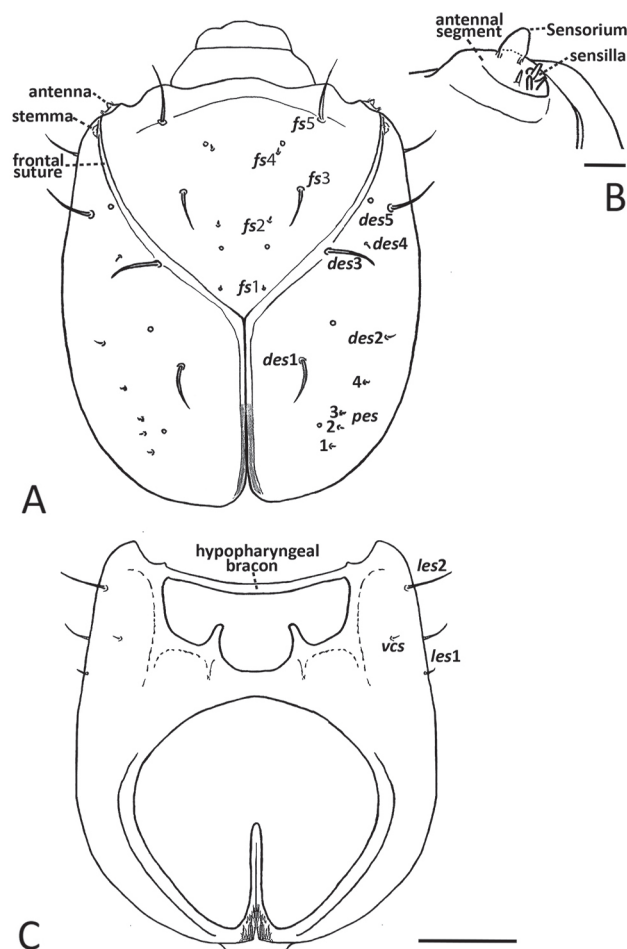


Figure 9. First instar larva of *Dynamis borassi* (Fabricius): (A) head capsule, dorsal; (B) detail of right antenna; (C) head capsule, ventral. Scale bars: A and C = 0.2 mm, B = 0.02 mm.

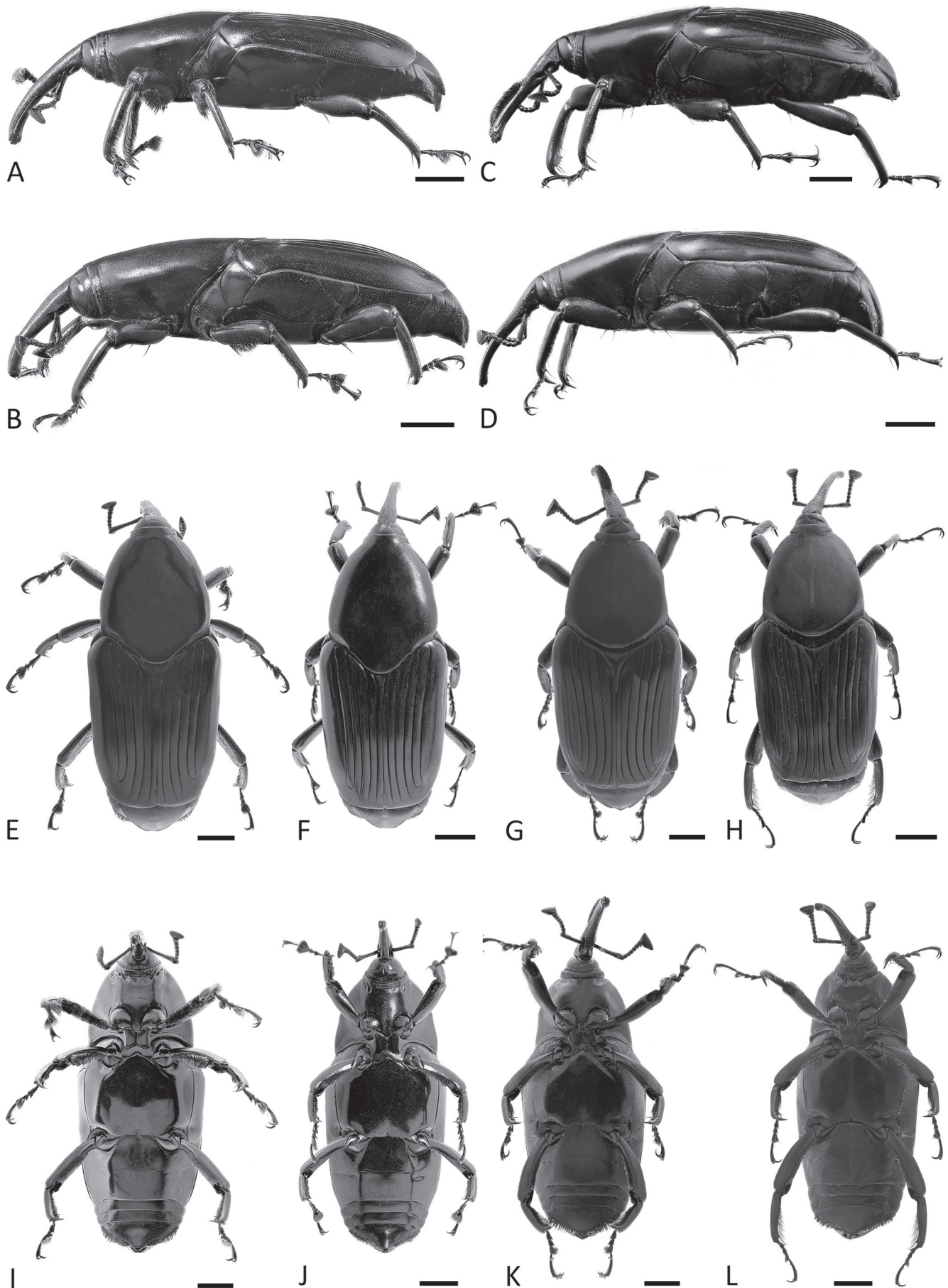


Figure 10. Adult, habitus. *Dynamis borassi* (Fabricius): (A) male, lateral, note sexually dimorphic ventrally setose profemora; (B) female, lateral; (E) male, dorsal; (F) female, dorsal; (I) male, ventral; (J) female, ventral. *Rhynchophorus palmarum* (Linnaeus): (C) male, lateral, note sexually dimorphic dorsally setose rostrum; (D) female, lateral; (G) male, dorsal; (H) female, dorsal; (K) male, ventral; (L) female, ventral. Scale bars: 5 mm.

2014). We also corroborate, as diagnostic of dryophthorines, that the first instar larva lacks the spiracles of abdominal segments I-VII, having only the thoracic and AVIII spiracles developed. The larvae of later instars of *Dynamis* and *Rhynchophorus* have the complete set of abdominal spiracles, and although those of AI to AVII are small, they are clearly functional (i.e., connected to tracheal system, see Fig. 7H); therefore, they are not absent as interpreted in the identification key by Chamorro (2019). The occurrence of egg-bursters in first instar larvae of Curculionoidea is less common, but also more poorly documented, than in their sister group Chrysomeloidea, where egg burster's features (e.g., position, shape) were found to be phylogenetic informative at both higher and lower taxonomic levels (Cox, 1988). In Dryophthorinae, egg bursters were known to occur in first instar larvae of genus *Sitophilus* of subtribe Litosomina, and in the present contribution, we report their occurrence in representatives of Rhynchophorina.

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APPENDIX 1

Caracteres diagnósticos para la identificación morfológica de larvas y adultos de *Dynamis borassi* y *Rhynchophorus palmarum*.

	<i>Dynamis borassi</i>	<i>Rhynchophorus palmarum</i>
LARVAS		
Cabeza: Cantidad de setas frontales (a cada lado) bien desarrolladas	Dos (Fig. 2A)	Tres (Fig. 2B)
Epifaringe: Setas epifaringeales medias (<i>mes</i>)	Setas del primer par (<i>mes1</i>) bien distinguibles, separadas entre sí por menor distancia que entre las del segundo par (<i>mes2</i>), éstas robustas (Figs. 3B, 4A)	Setas del primer par (<i>mes1</i>) muy débiles, pequeñas, separadas entre sí por igual distancia que las del segundo par (<i>mes2</i>), éstas delgadas (Figs. 3C, 4B)
Epifaringe: Cantidad de setas anterodorsales (<i>als</i>) a cada lado	Cinco a ocho (Figs. 3B, 4A)	10 a 14 (Figs. 3C, 4B)
Epifaringe: Forma de las varillas labrales	Parecida a una "V", las varillas más separadas hacia el ápice que cerca de su base (Figs. 3B, 4A)	Parecida a una "U", las varillas aproximadamente tan separadas cerca de su base como distalmente (Figs. 3C, 4B)
Maxilas: Setas dorsales de la mala (<i>mds</i>)	Sin pubescencia en su base (Fig. 5E)	Con pubescencia en su base (Figs. 5F-G)
Abdomen: Margen lateral del disco terminal	Curvado hacia adentro (Fig. 7A)	Curvado hacia afuera (Fig. 7B)
ADULTOS		
Base del pronoto	Marcadamente extendida hacia atrás (Figs. 10E-F)	Suavemente extendida hacia atrás (Figs. 10G-H)
Escutelo	Muy pequeño, alrededor de 1/10 el largo de los élitros (Figs. 10E-F)	Muy grande, alrededor de ¼ el largo de los élitros (Figs. 10G-H)
Dimorfismo sexual	Macho con fémures anteriores densamente setosos en su cara ventral (Figs. 10A, I)	Macho con rostro provisto de setas densas, erectas, en su cara dorsal (Figs. 10C, G)

Nota: Los siguientes caracteres adicionales del adulto (Wattanapongsiri, 1966; Löhr et al., 2015), en combinación con los anteriores, distinguen a *R. palmarum* de otras especies de *Rhynchophorus*: cuerpo completamente negro, excepcionalmente rojizo, distancia entre los ojos (vista dorsal) $\frac{1}{2}$ o menos de $\frac{1}{2}$ que el ancho del rostro en la base (Figs. 10G-H), área ventral del rostro entre las escrobas antenales rugosa y con setas (Figs. 10K-L).